Small Project Stormwater Management Control Guidance

Increases in impervious surface (an area that does not infiltrate stormwater into the ground, such as roof area, driveways, patios or pools) create additional runoff. The increases in runoff volume are required to be controlled at their source. This handout details a brief explanation of some of the methods available to property owners to control the increased runoff.

Stormwater runoff from residential areas can be handled by simple, cost-effective and aesthetically pleasing methods. Every time it rains, or when snow melts, water flows over impervious surfaces such as roofs, driveways, roads, parking lots and turf grasses, and does not infiltrate the ground. This runoff collects fertilizers, dirt and debris, pesticides, oil, grease, and many other pollutants that are discharged into out lakes, streams and rivers. This untreated discharge is detrimental to our water quality and environment.

Federal and state regulations require Northampton Township to implement a program of stormwater controls. Northampton Township is required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES). The implementation of stormwater controls and water quality measures is necessary to maintain compliance with the NPDES Permit.

To minimize the adverse effects of the increase in impervious surface, the first 2 inches of rain must be controlled as part of statewide requirements. This can be done through Best Management Practices (BMPs). BMPs can be structural or nonstructural and a combination of the two can be used on the site to achieve the required storage volume.

The following steps will assist you in choosing and sizing the appropriate Best Management Practices (BMPs) for your project. For more information, please visit the Stormwater page on the Township Website.

STEP 1: Determine Total Impervious Area

Determine the AREA (in square feet) of impervious surface that will be created. For example, if you have a garage addition that is 12' x 12' your total impervious area is 12' x 12' = 144 sq. ft.

STEP 2: Determine Required Volume Control

The volume of stormwater runoff you need to control can be calculated using the following equation:

(AREA (sf) x 2 in. runoff)/ 12 in = Required VOLUME (in cubic feet (cf))

Example: (144 sq. ft x 2 in)/ 12 in = 24 cf; this is the minimum volume required to be controlled

STEP 3: Sizing the Selected Volume Control BMP

Several Best Management Practices (BMPs), as described below, are suitable for small stormwater projects. Their application depends on the volume required to be controlled, how much land is available, and site constraints. Choose one that will work best for your property and volume that needs to be controlled. Also, take careful consideration in the location and any additional runoff the BMP may receive. It is possible to use several types of BMPs on each site if desired. Worksheets are provided to assist in totaling the volume required and provided.

The Nonstructural BMP's provide a volume "credit" toward the required storage volume to be provided onsite. Dependent on the site, proposed improvements, and proposed structural BMPs, the nonstructural methods may reduce the size of structural BMPs needed.

It is recommended that the following steps be followed:

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1. Subtract Nonstructural BMP volume from the required volume (from Step 2, above) to determine the necessary structural BMPs. The worksheet found at the end of this narrative can be utilized.

Required Volume (cf)	-	Nonstructural Volume (cf)	=	Structural Volume needed (cf)

2. Calculate the volume controls provided through structural BMPs. The worksheet found below can be utilized.

STEP 4: Calculate the total volume controls provided

Nonstructural Volume (cf)	+	Structural Volume Volume (cf)	=	Volume Provided (cf)

When the volume provided is greater than or equal to the Required Volume, the design will meet the requirements.

NONSTRUCTURAL BMP WORKSHEET

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Type of Nonstructural BMP

(note that each type of nonstructural BMP receives varying runoff volume reduction)

Use of Natural Drainage Features

Utilize natural flow pathways _____sf x ¼" x 1/12 = _____ cf volume credit

Minimum Soil Compaction

Lawn _____ sf x 1/3" x 1/12 = _____ cf volume credit
Meadow _____ sf x 1/3" x 1/12 = _____ cf volume credit

Protect existing trees

Trees within 20 ft. of proposed impervious surface:
Tree Canopy _____ sf x 1" x 1/12 = _____ cf volume credit

Trees within 20 - 100 ft. of proposed impervious surface:
Tree Canopy _____ sf x 1/2" x 1/12 = _____ cf volume credit

Rooftop/Impervious Surface Disconnection

Roof Area _____ sf x 1/4" x 1/12 = _____ cf volume credit

(Note: the rooftop area disconnection is subject to length of overland flow available. See the example in the following pages.)

Tree Plantings

Deciduous Trees: 6 cf per tree

____ trees x 6 cf/tree = _____ cf volume credit

Coniferous Trees: 10 cf per tree

____ trees x 10 cf/tree = _____ cf volume credit

Note that a combination of deciduous and coniferous trees can be used.

For example, 24 cf / 6 cf (deciduous trees) = 4 trees required.

STRUCTURAL BMP WORSKSHEET

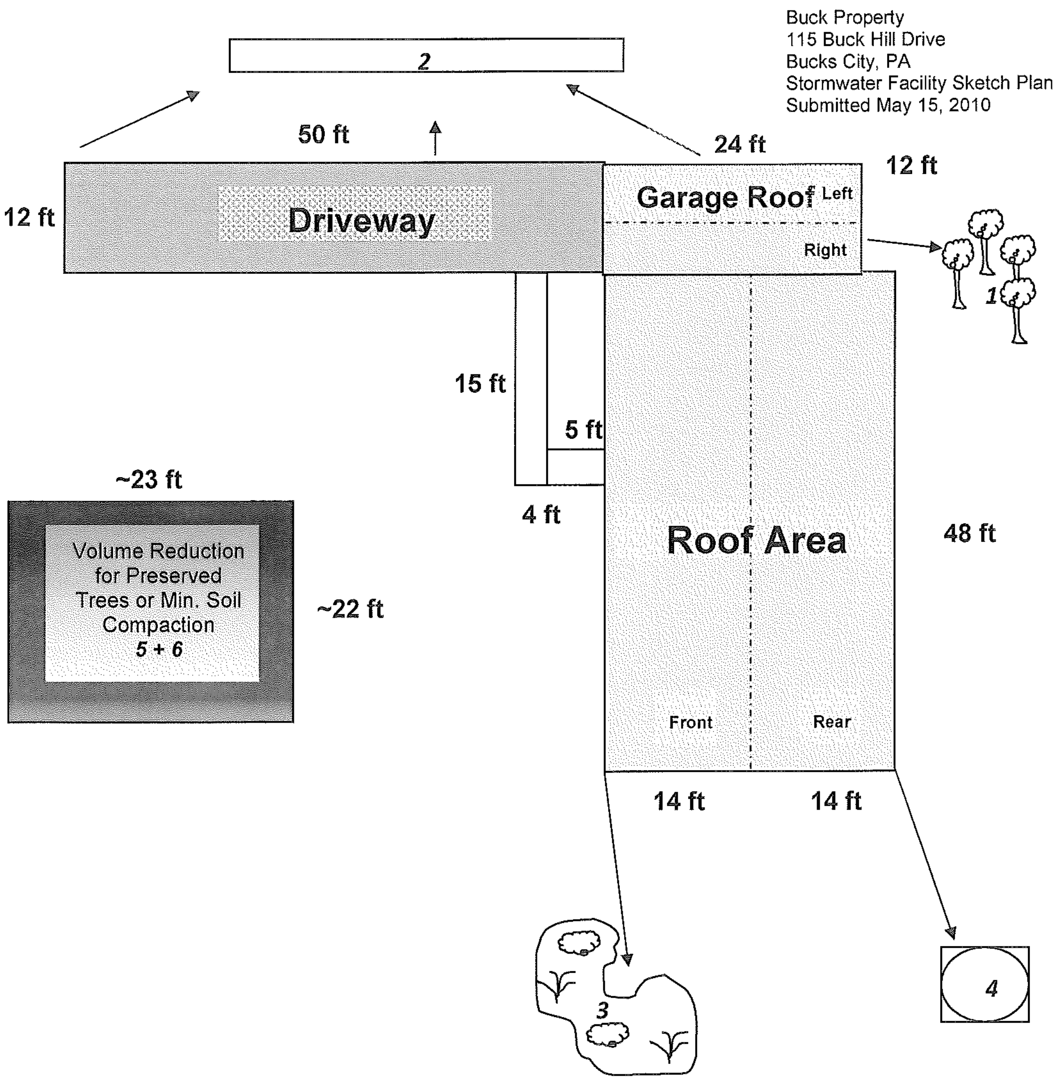
Required Volume Control (cf) – Nonstructural Volume Control (cf) = Structural Volume Requirement (cf)

Type	Proposed Structural BMP	Section in BMP Manual*	Area (sq ft)	Storage Volume (cu ft)
Infiltration and / or Evapotranspiration	Porous Pavement	6.4.1		
	Infiltration Basin	6.4.2		
	Infiltration Bed	6.4.3		
	Infiltration Trench	6.4.4		
	Rain Garden/Bioretention	6.4.5		
	Dry Well/Seepage Pit	6.4.6		
	Constructed Filter	6.4.7		
	Vegetative Swale	6.4.8		
	Vegetative Filter Strip	6.4.9		
	Infiltration Berm	6.4.10		
Evaporation and / or Reuse	Vegetative Roof	6.5.1		
	Capture and Re-use	6.5.2		
Runoff Quality	Constructed Wetlands	6.6.1		
	Wet Pond / Retention Basin	6.6.2		
	Dry Extended Detention Basin	6.6.3		
	Water Quality Filters	6.6.4		
Restoration	Riparian Buffer Restoration	6.7.1		
	Landscape Restoration / Reforestation	6.7.2		
	Soil Amendment	6.7.3		
Other	Level Spreader	6.8.1		
	Special Storage Areas	6.8.2		
	other			

Total Volume Control from Structural BMPs: ____________________

***BMP Manual** is the "Pennsylvania Stormwater Best Management Practices Manual" dated December 30, 2006, as amended.

Figure 1: Sample Site Sketch Plan (Note: Figure 1 is an example of how various BMPs can be utilized in conjunction to control the total required volume on one site.)



Stormwater BMPs

1. Four tree plantings; controls 24 cu. ft. of runoff.
2. Infiltration Trench; 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)
3. Rain Garden; 225 sq. ft.
4. Dry Well; 3.5 ft. (D) x 9 ft. (L) x 9 ft. (W)
5. Protect existing trees; reduces required volume control by 21 cu. ft.
6. Minimize soil compaction; reduces required volume control by 13.8 cu. ft. if planted with meadow, and 10. 4 cu. ft. if planted with lawn.

The examples given are commonly used, but other BMP measures may be acceptable.

Structural BMPs

1. Infiltration Trench

An Infiltration Trench is a linear stormwater BMP consisting of a continuously perforated pipe at a minimum slope in a stone-filled trench. During small storm events, infiltration trenches can significantly reduce volume and serve in the removal of fine sediments and pollutants. Runoff is stored between the stones and infiltrates through the bottom of the facility and into the soil matrix. Runoff should be pretreated using vegetative buffer strips or swales to limit the amount of coarse sediment entering the trench which can clog and render the trench ineffective. In all cases, an infiltration trench should be designed with a positive overflow.

Design Considerations:

- Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6) feet of stone.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Trench needs to be placed on uncompacted soils.
- Slope of the Trench bottom should be level or with a slope no greater than 1%.
- A minimum of 6" of topsoil is placed over trench and vegetated.
- The discharge or overflow from the Infiltration Trench should be properly designed for anticipated flows.
- Cleanouts or inlets should be installed at both ends of the Infiltration Trench and at appropriate intervals to allow access to the perforated pipe.
- Volume of facility = Depth x Width x Length x Void Space of the gravel bed (assume 40%).

Maintenance:

- Catch basins and inlets should be inspected and cleaned at least two times a year.
- The vegetation along the surface of the infiltration trench should be maintained in good condition and any bare spots should be re-vegetated as soon as possible.
- Vehicles should not be parked or driven on the trench and care should be taken to avoid soil compaction by lawn mowers.

Sizing Example for Infiltration Trench

1. Determine Total Impervious Surface to drain to Infiltration Trench:

Garage Roof (Left)	6 ft. x 24 ft.	=	144 sq ft
Driveway	12 ft. x 50 ft.	=	1000 sq ft
Walkway	4 ft. x 20 ft.	=	80 sq ft

2. Determine the required infiltration volume:

(1224 sq. ft. x 2 inches of runoff)/12 ft. = 204 cu. ft. / 0.4* = 510 cu. ft.
(*0.4 assumes 40% void ratio in gravel bed)

3. Sizing the infiltration trench facility:

Volume of Facility = Depth x Width x Length

Set Depth to 3 feet and determine required surface area of trench.

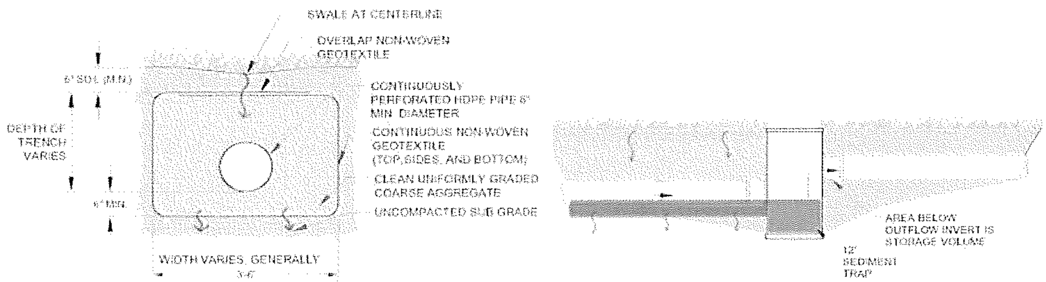
510 cu. ft / 3 ft = 170 sq ft.

The width of the trench should be greater than 2 times its depth (2 x D), therefore in this example the trench width of 6 feet selected.

Determine trench length: L = 170 sq. ft. / 6 ft. = 28.3 ft.

Final infiltration trench dimensions: 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)

Figure 3: Infiltration Trench Diagram



Source: PA BMP Guidance Manual, Chapter 6, page 42.

Figure 4: Example of Infiltration Trench Installation

Source: PA BMP Guidance Manual, Chapter 6, Page 46.

2. Rain Garden

A Rain Garden is a planted shallow depression designed to catch and filter rainfall runoff. The garden captures rain from a downspout or a paved surface. The water sinks into the ground, aided by deep rooted plants that like both wet and dry conditions. The ideal location for a rain garden is between the source of runoff (roofs and driveways) and the runoff destination (drains, stream, low spots, etc).

Design Considerations:

- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches. Ponded water should not exceed 6 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 10-20 feet from a building's foundation and 25 feet from septic system drainfields and wellheads.
- If the site has clay soils, soil should be amended with compost or organic material.
- Choose native plants. See http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf for a native plant list. To find native plant sources go to www.pawildflower.org.
- At the rain garden location, the water table should be at least 2' below the soil level. If water stands in an area for more than one day after a heavy rain you can assume it has a higher water table and is not a good choice for a rain garden.

Maintenance:

- Water plants regularly until they become established.
- Inspect twice a year for sediment buildup, erosion and vegetative conditions.
- Mulch with hardwood when erosion is evident and replenish annually.
- Prune and remove dead vegetation in the spring season.
- Weed as you would any garden.
- Move plants around if some plants would grow better in the drier or wetter parts of the garden.

Sizing Example for Rain Garden

1. Pick a site for the rain garden between the source of runoff and between a low lying area, a.k.a., a drainage area.

2. Perform an infiltration test to determine the depth of the rain garden:
   - Dig a hole 8″ x 8″
   - Fill with water and put a popsicle stick at the top of the water level.
   - Measure how far it drains down after a few hours (ideally 4).
   - Calculate the depth of water that will drain out over 24 hours.

3. Determine total impervious surface area to drain to rain garden:

House Roof (Front)	14 ft. x 48 ft.	=	672 sq ft

4. Sizing the rain garden:

   For this example the infiltration test determined 6″ of water drained out of a hole in 24 hours. The depth of the rain garden should be set to the results of the infiltration test so 6″ is the depth of the rain garden. The sizing calculation below is based on controlling 1″ of runoff. First divide the impervious surface by the depth of the rain garden.

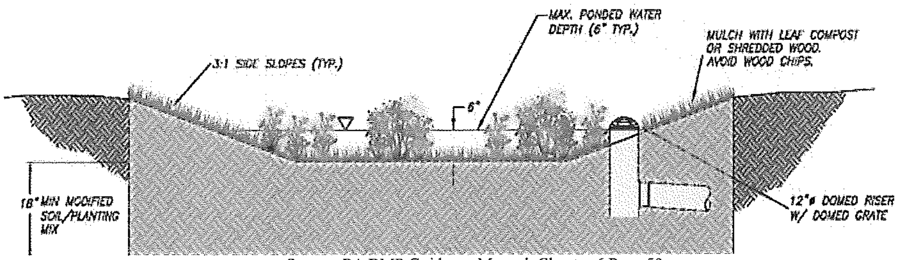
   (672 sq ft / 6 ft.) = 112 sq. ft.

In order to control 2″ of runoff volume, the rain garden area needs to be multiplied by 2.

112 sq. ft. * 2 = 224 sq. ft.

The rain garden should be about 225 sq. ft. in size and 6" deep.

Figure 5: Rain Garden Diagram



Source: PA BMP Guidance Manual, Chapter 6 Page 50

3. Dry Well (a.k.a., Seepage Pit)

A Dry Well, sometimes called a Seepage Pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of structures. By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Roof leaders connect directly into the Dry Well, which may be either an excavated pit filled with uniformly graded aggregate wrapped in geotextile, or a prefabricated storage chamber or pipe segment. Dry Wells discharge the stored runoff via infiltration into the surrounding soils. In the event that the Dry Well is overwhelmed in an intense storm event, an overflow mechanism (surcharge pipe, connection to a larger infiltration are, etc.) will ensure that additional runoff is safely conveyed downstream.

Design Considerations:

- Dry Wells typically consist of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar). "Clean" gravel fill should average one and one-half to three (1.5 – 3.0) inches in diameter.
- Dry Wells are not recommended when their installation would create a significant risk for basement seepage or flooding. In general, 10 - 20 feet of separation is recommended between Dry Wells and building foundations.
- The facility may be either a structural prefabricated chamber or an excavated pit filled with aggregate.
- Depth of dry wells in excess of three-and-a-half (3.5) feet should be avoided unless warranted by soil conditions.
- Stormwater dry wells must never be combined with existing, rehabilitated, or new septic system seepage pits. Discharge of sewage to stormwater dry wells is strictly prohibited.

Maintenance:

- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Remove sediment, debris/trash, and any other waste material from a dry well.

- Regularly clean out gutters and ensure proper connections to the dry well.
- Replace the filter screen that intercepts the roof runoff as necessary.

Sizing Example for Dry Wells:

1. Determine contributing impervious surface area:

House Roof (Rear)	14 ft. x 48 ft.	=	672 sq. ft.

2. Determine required volume control:

   (672 sq. ft. * 2 inches of runoff) / 12 inches = 112 cu. ft.

   112 cu ft / 0.4 = 280 cu. ft. (assuming the 40% void ratio in the gravel bed)

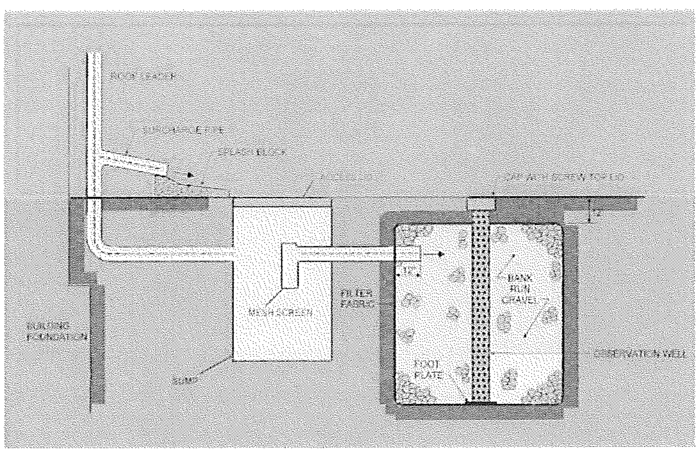
3. Sizing the dry well:

   Set depth to 3.5 ft; Set width equal to length for a square chamber.

   280 cu. ft. = 3.5 ft. x L x L; L = 9 ft.

   Dimensions = 3.5 ft. (D) x 9 ft. (L) x 9 ft. (W)

Figure 6: Dry Well Diagram



Source: PA BMP Guidance Manual, Chapter 6, Page 65.

Non-Structural BMPs

1. Tree Plantings and Preservation

Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. Tree roots and leaf litter also create soil conditions that promote the infiltration of rainwater into the soil. In addition, trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their root systems. A development site can reduce runoff volume by planting new trees or by preserving trees which existed on the site prior to development. The volume reduction calculations either determine the cubic feet to be directed to the area under the tree canopy for infiltration or determine a volume reduction credit which can be used to reduce the size of any one of the planned structural BMPs on the site.

Tree Considerations:

- Existing trees must have at least a 4″ trunk caliper or larger.
- Existing tree canopy must be within 100 ft. of impervious surfaces.
- A tree canopy is classified as the continuous cover of branches and foliage formed by a single tree or collectively by the crowns of adjacent trees.
- New tree plantings must be at least 6 ft. in height and have a 2″ trunk caliper.
- All existing and newly planted trees must be native to Pennsylvania. See http://www.dcnr.state.pa.us/forestry/commontr/commontrees.pdf for a guide book titled *Common Trees of Pennsylvania* for a native tree list.
- When using trees as volume control BMPs, runoff from impervious areas should be directed to drain under the tree canopy.

Determining the required number of planted trees to reduce the runoff volume:

1. Determine contributing impervious surface area:

Garage Roof (Right)	6 ft. x 24 ft.	=	144	ft

2. Calculate the required control volume:

   (144 sq. ft. x 2 inches of runoff) / 12 inches = 24 cu. ft.

3. Determine the number of tree plantings:

   - A newly planted deciduous tree can reduce runoff volume by 6 cu. ft.
   - A newly planted evergreen tree can reduce runoff volume by 10 cu. ft.

   24 cu. ft./ 6 cu. ft. = 4 Deciduous Trees

Determining the volume reduction for preserving existing trees:

1. Calculate approximate area of the existing tree canopy:

   ~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

2. Measure distance from impervious surface to tree canopy: 35 ft.

3. Calculate the volume reduction credit by preserving existing trees:

   - For Trees within 20 feet of impervious cover:
     Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 1 inch) / 12
   - For Trees beyond 20 feet but not farther than 100 feet from impervious cover:
     Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 0.5 inch) / 12

   (500 sq. ft. x 0.5 inches) / 12 = 21 cu. ft.

   This volume credit can be utilized in reducing the size of any one of the structural BMPs planned on the site. For example, the 21 cu. ft. could be subtracted from the required infiltration volume when sizing the infiltration trench;

   510 cu. ft – 21 cu. ft. = 489 cu. ft.

   489 cu. ft. / 3 ft (Depth) = 163 / 6 ft. (Width) = 27.1 ft (Length)

   Using the existing trees for a volume credit would decrease the length of the infiltration trench to 27.1 ft. instead of 28.3 ft.

2. Minimize Soil Compaction and Replant with Lawn or Meadow

When soil is overly compacted during construction it can cause a drastic reduction in the permeability of the soil and rarely is the soil profile completely restored. Runoff from vegetative areas with highly compacted soils similarly resembles runoff from an impervious surface. Minimizing soil compaction and re-planting with a vegetative cover like meadow or lawn, not only increases the infiltration on the site, but also creates a friendly habitat for a variety of wildlife species.

Design Considerations:

- Area shall not be stripped of topsoil.
- Vehicle movement, storage, or equipment/material lay down shall not be permitted in areas preserved for minimum soil compaction.
- The use of soil amendments and additional topsoil is permitted.
- Meadow should be planted with native grasses. Refer to *Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn* at http://pubs.cas.psu.edu/FreePubs/pdfs/UH128.pdf for reference on how to properly plant the meadow and for a list of native species.

Determining the volume reduction by minimizing soil compaction and planting a meadow:

1. Calculate approximate area of preserved meadow:

   ~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

2. Calculate the volume reduction credit by minimizing the soil compaction and planting a lawn/meadow:

- For Meadow Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/3 inch of runoff) / 12

  (500 sq. ft. x 1/3 inch of runoff) / 12 = 13.8 cu. ft.

- For Lawn Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/4 inch of runoff) / 12

  (500 sq. ft. x 1/4 inch of runoff) / 12 = 10.4 cu. ft.

This volume credit can be used to reduce the size of any one of the structural BMPs on the site. See explanation under the volume credit for preserving existing trees for details.

3. Rooftop Disconnection

When rooftop downspouts are directed to a pervious area that allows for infiltration, filtration, and increased time of concentration, the rooftop may qualify as completely or partially DIA and a portion of the impervious rooftop area may be excluded from the calculation of total impervious area at the discretion of the Township.

A rooftop is considered to be completely or partially disconnected if it meets the requirements listed below:

- The contributing area of a rooftop to each disconnected discharge is 500 square feet or less, and
- The overland flow path from roof water discharge area has a positive slope of 5% or less.

For designs that meet these requirements, the portion of the roof that may be considered disconnected depends on the length of the overland path as designated in Table F.1.

Table F.1: Partial Rooftop Disconnection

Length of Pervious Flow Path *	Roof Area Treated as Disconnected
(ft)	(% of contributing area)
0 – 14	0
15 – 29	20
30 – 44	40
45 – 59	60
60 – 74	80
75 or more	100

* Flow path cannot include impervious surfaces and must be at least 15 feet from any impervious surfaces.

If the discharge is concentrated at one or more discrete points, no more than 1,000 square feet may discharge to any one point. In addition, a gravel strip or other spreading device is required for concentrated discharges. For non-concentrated discharges along the edge of the pavement, this requirement is waived; however, there must be a provision for the establishment of vegetation along the pavement edge and temporary stabilization of the area until vegetation becomes stabilized.

REFERENCE

Philadelphia Water Department. 2006. *Stormwater Management Guidance Manual.* Section 4.2.2: Integrated Site Design. Philadelphia, PA.

MAINTENANCE RESPONSIBILITIES

- The owner of stormwater management facilities shall be responsible for their proper maintenance during and after development.

- No person shall modify, remove, fill, landscape, or alter any Stormwater Management (SWM) Best Management Practices (BMPs), facilities, areas, or structures unless it is part of an approved maintenance program without the written approval of the Township.

- No person shall place any structure, fill, landscaping, or vegetation into a stormwater facility or BMP or within a drainage easement which would limit or alter the functioning of the stormwater facility or BMP without the written approval of the municipality.