SIMPLIFIED APPROACH TO STORMWATER MANAGEMENT FOR SMALL PROJECTS

Introduction

As required by federal and state law, the Borough of Swarthmore has adopted regulations that affect stormwater runoff and surface and groundwater quantity and quality. The purpose of the regulations is to help reduce stormwater runoff in the community, maintain groundwater recharge, prevent degradation of surface and groundwater quality, and otherwise protect water resources and public safety.

Every project constructing, reconstructing or adding over 499 square feet of impervious cover (see definition below) is required to comply with the Borough's stormwater management regulations. However, projects on single-family lots that involve construction or reconstruction of less than 1,000 of impervious area may follow a simplified approach, as outlined in this document. This approach includes sizing, designing, locating and installing structures, referred to as Best Management Practices, or BMPs, that will capture the first 1" of rainfall runoff from the new or reconstructed impervious surface. BMPs may include rain gardens, rain barrels or cisterns, dry wells, or infiltration trenches.

This document describes requirements and a simplified method for designing a suitable BMP, or multiple BMPs, if desired, and a description of what needs to be included on the site plan. Detailed descriptions of each BMP option that may be considered for on-lot stormwater management are included, as are requirements for on-going operation and maintenance of the installed BMPs.

Upon completion, the Simplified Method Worksheet and Simplified Method Site Plan should be submitted to the Borough, along with the Stormwater Management Plan application and any applicable fees.

Definitions

Best Management Practice (BMP) - Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, dry wells, bioretention, rain gardens, permeable paving, rain barrels, and cisterns.

Capture - Collecting runoff to be stored for reuse or allowed to slowly infiltrate into the ground.

Geotextile - A fabric manufactured from synthetic fiber that is used to achieve specific objectives, including infiltration, separation between different types of media (i.e., between soil and stone), or filtration.

Hotspot - Areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants that are higher than those that are typically found in stormwater (e.g., vehicle salvage yards and recycling facilities, vehicle fueling stations, fleet storage areas, vehicle equipment and cleaning facilities, and vehicle service and maintenance facilities).

Impervious Surface - A surface that prevents the infiltration of water into the ground. Impervious surfaces include, but are not limited to, streets, sidewalks, pavements, driveway areas or roofs. Any surface area designed to be gravel or crushed stone is considered an impervious surface. Swimming pools and other water features are regarded as impervious surfaces, whether they are above or below ground. Porous asphalt or concrete, grid/lattice systems, paving blocks and similar materials deemed to be less than 100% impervious may be given partial consideration as pervious surfaces if installed and maintained in accordance with Borough specifications and approved by the Borough Engineer.

Infiltration - Movement of surface water into the soil, where it is absorbed by plant roots, evaporated into the atmosphere, or percolated downward to recharge groundwater.

Low Impact Development - A land development and construction approach that uses various land planning, design practices, and technologies to simultaneously conserve and protect natural resource systems, and reduce infrastructure costs.

Pervious Surface - Any surface that is not impervious.

Runoff - Any part of precipitation that flows over the land surface.

Stormwater - Drainage runoff from the surface of the land resulting from precipitation or snow or ice melt.

Void Ratio - The ratio of the volume of void space to the volume of solid substance in any material.

Description of BMPs

The following is a description of several types of BMPs that may be implemented in the simplified stormwater management plan. The requirements of each BMP as described below are taken from the PA BMP Manual, which can be found on the PA Department of Environmental Protection's website.

Rain Barrels/Cisterns

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. The stored water can also be used as a non-potable water supply. Cisterns are larger than rain barrels, having volumes of 200 gallons or more, and can be placed on the surface or underground. Examples of rain barrels and cisterns, respectively, are shown below. Rain barrels and cisterns are manufactured in a variety of shapes and sizes. All of these facilities must make provisions for the following items:

- There must be a means to release the water stored between storm events in order for the necessary storage volume to be available for the next storm.
- Stormwater must be kept from entering other potable systems, and pipes and storage units must be clearly marked “Do Not Drink.”
- An overflow outlet should be placed a few inches below the top with an overflow pipe to divert flow away from structures.
- Use screens to filter debris, and covers (lids) to prevent mosquitoes.
- Make sure cisterns are watertight and do not leak.
- Rain barrels are typically assumed to be 25% full to calculate volume since they are not always emptied before each storm.*

Rain Barrels


Source (picture on left): http://www.rfcity.org/Eng/Stormwater/YourProperty/YourProperty.htm
Source (picture on right): :http://www.floridata.com/tracks/transplantedgardener/Rainbarrels.cfm

Cisterns

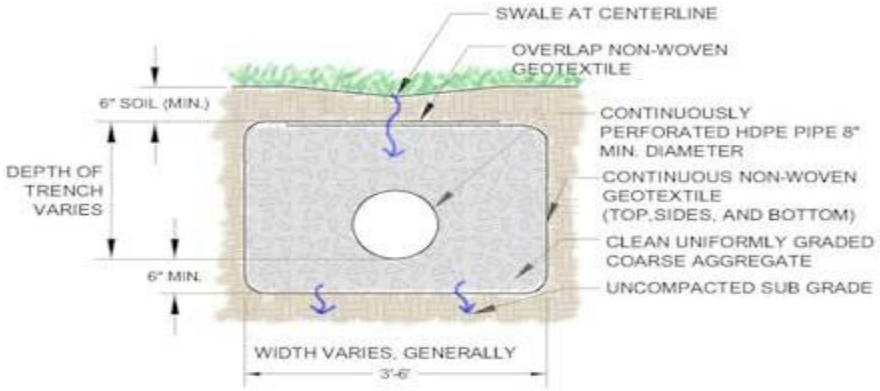

Source (for both pictures): Pennsylvania Stormwater BMP Manual (2006)

Infiltration Trench

An infiltration trench is a long, narrow, rock-filled trench with or without a perforated pipe that receives stormwater runoff and has no outlet. Runoff is stored in the void space between the stones and in the pipe and infiltrates through the bottom and into the underlying soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. A typical infiltration trench configuration is shown below. Infiltration trenches should incorporate or make provisions for the following elements:

- Perforated pipe is to be set level.
- The width should be between **3 and 8 feet** with a depth range from **2 to 5 feet**.
- Trench should be wrapped in nonwoven geotextile (see definition above) on the top, sides, and bottom.
- There should be a positive overflow that allows stormwater that cannot be stored or infiltrated to be discharged into a nearby vegetated area.
- Roof downspouts may be connected to infiltration trenches, but should contain a cleanout to collect sediment and debris before entering the infiltration area.
- Infiltration testing is recommended to ensure that the soil is capable of infiltrating stormwater. A description of how an infiltration test is performed is found in Appendix C of the PA BMP Manual.
- It is recommended that there be a 2-foot clearance above the regularly occurring seasonal high water table and a minimum depth to bedrock of 2 feet.
- The infiltration trench should be at least 50 feet from individual water supply wells, 100 feet from community or municipal water supply wells, and 50 feet from any septic system component. It should not be located near hotspots (see definition above).
- The infiltration trench should be located so that it presents no threat to sub-surface structures such as building foundations and basements.
- Infiltration areas should be protected from compaction.
- The ratio of the collected area to the footprint of the facility should be as small as possible with a ratio of less than 5:1 preferred.

Typical Infiltration Trench



Source: Pennsylvania Stormwater BMP Manual (2006)

Rain Garden/Bioretention Area

A rain garden (bioretention area) is an excavated depression area on the surface of the land in which native vegetation is planted to filter and use stormwater runoff. Runoff ponds on top of the surface of the rain garden and then infiltrates into an enhanced soil below the surface where plants can use the water to grow. Bioretention also improves water quality, vegetation filters the water, and the root systems encourage or promote infiltration. A typical rain garden is shown below. Key elements of a rain garden include:

- Ponding depths of **1 foot** or less (recommended).
- Native vegetation that can tolerate dry and wet weather.

- An overflow area where, if the bioretention area were to overflow, the water would flow over pervious area (i.e., grass, meadow), and would not cause harm to property, or;
- An overflow such as a domed riser to allow excess flow from large storms to travel to other substantial infiltration areas or pervious areas.
- Typical side slopes of 3:1 are recommended, with 2:1 being the maximum.
- The soil/planting mix depth should be between 2 feet and 6 feet deep.

Typical Rain Garden/Bioretention Area

Source: Pennsylvania Stormwater BMP Manual (2006)

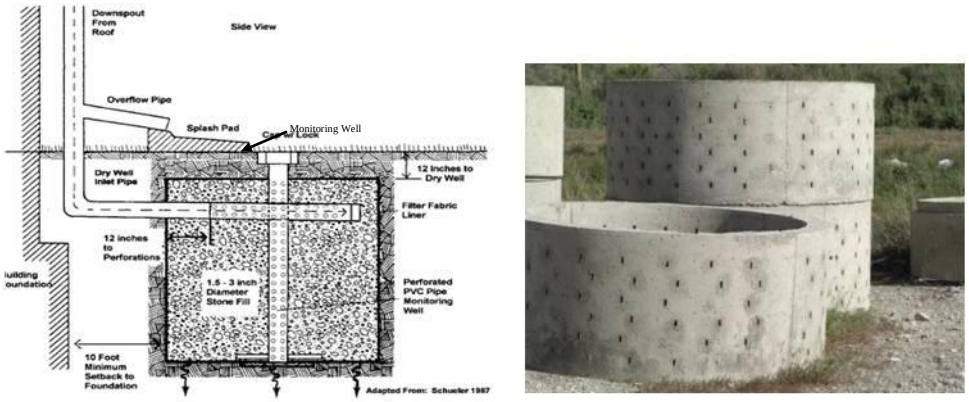
Dry Wells

A dry well, also referred to as a seepage pit, is a subsurface storage facility that temporarily stores and infiltrates runoff from the roofs of buildings or other impervious surfaces. A dry well can be either an excavated pit filled with stone fill (Dry Well #1) or a structural prefabricated chamber with no stone bed (Dry Well #2). Dry wells discharge the stored runoff via infiltration into the surrounding or underlying soils. A typical dry well configuration with stone fill and a typical prefabricated dry well are shown below. The following elements shall be incorporated into all dry well designs:

- Facilities should be located a minimum of ten (10) feet from the building foundation to avoid foundation seepage problems and are not recommended if their installation would create a risk for basement flooding.
- Construction of a dry well should be performed after surface soils in all other areas of the site are stabilized to avoid clogging.
- During construction, compaction of the subgrade soil in the bottom of the dry well should be avoided, and construction should be performed only with light machinery.
- Depth of a dry well should be between **1.5 feet and 4 feet**. Gravel fill should consist of stone of an average of one and one half to three (1.5 - 3.0) inches in diameter with the gravel fill wrapped in a nonwoven geotextile that separates the stone fill from the surrounding soil.
- At least 1 foot of soil needs to be placed over the top of the dry well.
- Dry wells should be inspected at least four (4) times annually as well as after large storm events.

- Dry wells should have overflow pipes to allow high volumes of runoff to connect to other on-site substantial infiltration areas or pervious areas.
- Every dry well needs to have at least one monitoring well.
- Infiltration testing is recommended to ensure that the underlying soil is capable of infiltrating the needed volume of stormwater.

Typical Dry Well Configuration filled with Stone Fill (DRY WELL #1) (Left) and Structural Prefabricated Chamber with no Stone Fill (DRY WELL #2) (Right)



Source (for picture on left): http://www.seagrant.sunysb.edu/pages/BMPsForMarinas.htm
Source (for picture on right): http://www.copelandconcreteinc.net/1800652.html

Determining Volume Requirements for BMPs

All proposed new and reconstructed impervious areas must be included when calculating the volume requirements for proposed BMPs needed to control stormwater. Proposed impervious areas must be constructed so that runoff is conveyed to a BMP; no runoff can be directed to storm sewers, inlets, or other impervious areas (i.e., street). Additionally, the use of low impact development is recommended to further minimize the effect of the new construction on water, land, and air. Low impact development is a method of development that incorporates design techniques that include: minimizing the amount of land disturbance, reducing impervious cover, disconnecting gutters and directing runoff to vegetated areas to infiltrate, and redirecting the flow of runoff from impervious driveways to vegetated areas instead of to the street or gutter.

Listed below are the steps to be followed in order to meet the Borough's stormwater management requirements. Begin with Step 1, and then follow the other steps for each BMP to be used in the stormwater plan. The results obtained for each step should be included in the Simplified Method Worksheet (included) and shown on the Site Plan (example included).

STEP 1 – Establish the total area of all proposed impervious surfaces that need to drain to one or more BMPs. Determine locations where BMPs should to be placed so that runoff from all of the proposed impervious surfaces can be captured. Any arrangement of BMPs is allowed, as long as all impervious surfaces are infiltrated. It is permissible to install a BMP that collects water from a site other than where the new or reconstructed impervious cover is located, so long as the same amount of area is infiltrated.

Example: Joe Homeowner wants to build a 600 square foot addition to his home and increase his driveway by 350 square feet to reach the new addition. Because the total amount of impervious cover is less than 1,000 square feet, he is able to use the simplified method. He decides to infiltrate the front of the addition to a rain barrel, the rear to a rain garden, and the driveway to an infiltration trench.

Addition (Front) (10 ft. x 20 ft.)	200 sq. ft.	BMP 1	Rain Barrel
Addition (Rear) (20 ft. x 20 ft.)	400 sq. ft.	BMP 2	Rain Garden
Driveway (35 ft. x 10 ft.)	350 sq. ft.	BMP 3	Infiltration Trench
			----------
Total Proposed Impervious Surface	**950 sq. ft.**		

Next, calculate the required storage volume and surface area needed for each of the proposed BMPs from the appropriate heading below. Results should be included on the Simplified Method Worksheet.

For Rain Barrel/Cistern

STEP 2 –Select the proposed impervious area value in Column 1 of Table 1 that is closest to, but not less than, the determined value.

Example: The front of Joe Homeowner's garage is 200 square feet. The value in Column 1 that is closest to but is not less than 200 is 200.

STEP 3 – Determine the volume that needs to be provided in cubic feet and gallons to satisfy the volume requirements using Columns 2 and 3 in Table 1.

Example: As shown in Table 1, 200 square feet of impervious area requires storage of 22 cubic feet, or 166 gallons, in a rain barrel or cistern. Joe could use several smaller rain barrels (the typical volume of a rain barrel is between 50 and 200 gallons), or a cistern.

STEP 4 - Fill in the "Rain Barrel or Cistern" section of the Simplified Method Worksheet and include it on the Simplified Site Plan.

Table 1: Calculating Rain Barrel/Cistern Storage Volume for 1" Rainfall[1]

Column 1	Column 2	Column 3	
Proposed Impervious Area (square feet)	**Volume of Rain Barrel/Cistern[2] (cubic feet)**	**Volume of Rain Barrel/Cistern (gallons)**	
I	V_{RBcf}	V_{RBgal}	
Sum of all Proposed Impervious Areas	$(1*(1/12)*I)/0.75=V_{RBcf}$	VRBcf * 7.48=VRBgal	
50	6	42	
100	11	83	
150	17	125	
200	22	166	Rain Barrel
250	28	208	
300	33	249	
350	39	291	
400	44	332	
450	50	374	
500	56	416	
550	61	457	
600	67	499	Cistern
650	72	540	
700	78	582	
750	83	623	
800	89	665	
850	94	706	
900	100	748	
950	106	790	
999	111	830	

[1]The typical volume of a rain barrel is between 50-200 gallons, so more than one rain barrel may be needed. Larger volumes may require a cistern.

[2]Assume that the rain barrel/cistern is 25% full.

For Rain Garden/Bioretention Facility or Dry Well #2 (prefabricated, no stone fill)

STEP 2 – Determine Amount of Water to be Infiltrated (Infiltration Volume)

Example: Joe Homeowner is infiltrating 400 square feet from the rear of his addition to a rain garden.

$$\frac{1.0 \text{ inches} \times 400 \text{ sq. ft.}}{12} = 33 \text{ cu. ft.} = \text{infiltration volume}$$

STEP 3 – Size the Rain Garden/Bioretention Facility or Dry Well #2

Infiltration volume = Depth (D) x Width (W) x Length (L)

Example: Joe would like the rain garden to occupy an area 4 feet wide and 6 feet long. To determine how deep the base (soil/planting mix) of the rain garden needs to be, Joe does the following calculation:

33 cu. feet = D x 4 feet (W) x 6 feet (L)
D = 1.375 feet

Because the minimum depth for a rain garden is 2 feet, the final rain garden/bioretention facility measurements are: 2 ft (D) x 4 ft. (W) x 6 ft. (L)

STEP 4 - Fill in the "Rain Garden/Bioretention or Dry Well #2" section of the Simplified Method Worksheet and include it on the Simplified Site Plan.

For Infiltration Trench or Dry Well #1 (excavated pit filled with stone)

STEP 2 – Determine Amount of Water to be Infiltrated (Infiltration Volume)

Example: Joe Homeowner is infiltrating 350 square feet from his driveway addition.

$$\frac{1.0 \text{ inches} \times 350 \text{ sq. ft.}}{12} = 29 \text{ cu. ft.}$$

$$\frac{29 \text{ cu. ft.}}{.4^*} = 73 \text{ cu. ft.} = \text{infiltration volume}$$

(*to account for 40% void ratio in gravel used in the trench or dry well)

STEP 3 – Size the Infiltration Trench

Infiltration volume = Depth (D) x Width (W) x Length (L)

Example: Joe would like to place the infiltration trench along the edge of his driveway but doesn't know how long it has to be. He figures he'll dig down about 2 feet, and he knows the minimum width required for the trench is 3 feet. To determine the length of the trench, Joe does the following calculation:

73 cu. feet = 2 feet (D) x 3 feet (W) x (L)
Length = 12 feet

Final trench dimensions = 2 feet (D) x 3 feet (W) x 12 feet (L)

STEP 4 - Fill in the "Infiltration Trench" section of the Simplified Method Worksheet and include it on the Simplified Site Plan.

Completing the Site Plan

Sketch a simple site plan such as the sample shown in Figure 1. The Site Plan should include:

- Name and address of the owner of the property, and or name and address of the individual preparing the plan, along with the date of submission.

- Location of proposed structures, driveways, or other impervious areas with approximate size in square feet.

- Location, orientation, and dimensions of all proposed BMPs. For all rain gardens/bioretention, infiltration trenches, and dry wells, the length, width, and depth must be included on the plan. For rain barrels or cisterns the volume must be included.

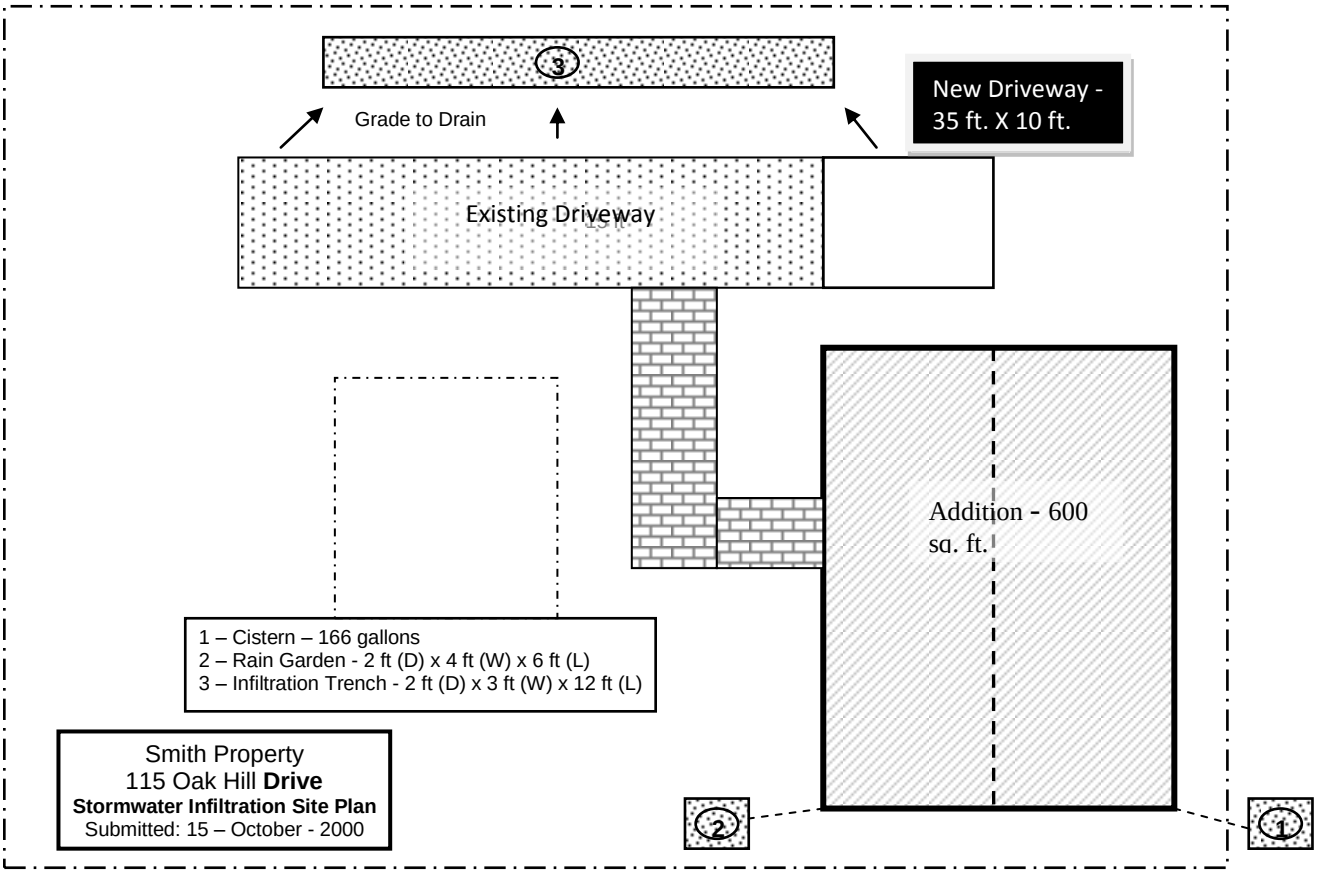
- Location of any existing waterbodies such as; streams, lakes, ponds, wetlands, or other waters of the Commonwealth within fifty (50) feet of the project site, and the distance to the project site and/or BMPs. The project or BMPs cannot be located less than fifty (50) feet away from a perennial or intermittent stream. If an existing buffer is legally prescribed (i.e., deed, convenant, easement, etc.) and it exceeds the requirements of this Ordinance, the existing buffer shall be maintained.

Post-Installation Operation and Maintenance Requirements

It is the property owner's responsibility to properly maintain BMPs in accordance with the following maintenance requirements. It is also the property owner's responsibility to inform any future buyers of the function, operation, and maintenance needed for any BMPs on the property prior to the purchase of the property.

- Vegetation along the surface of an infiltration trench should be maintained in good condition, and any bare spots should be revegetated as soon as possible.
- Vehicles shouldn't be parked or driven on an infiltration trench, and care should be taken to avoid excessive compaction by mowers.
- Any debris such as leaves blocking flow from reaching an infiltration trench or bioretention/rain garden should be routinely removed.
- While vegetation is being established, pruning and weeding may be required for a bioretention/rain garden.
- Mulch in a bioretention/rain garden needs to be re-spread when erosion is evident. Once every two to three years or after major storms the entire area may require mulch replacement.
- At least twice a year the landowner needs to inspect the bioretention/rain garden for sediment buildup and vegetative conditions.
- During periods of extended drought, the bioretention/rain garden requires watering.
- Trees and shrubs in a bioretention/rain garden need to be inspected at least twice per year by the landowner to evaluate their health. If they are in poor health, they need to be replaced.
- Dry wells need to be inspected by the landowner at least four times a year and after significant rainfalls, and debris/trash, sediment, and any other waste material need to be removed and disposed of at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.
- For dry wells, gutters need to be regularly cleaned out, and proper connections must be maintained to facilitate the effectiveness of the dry well.
- The filter screen for the dry well that intercepts roof runoff must be replaced as necessary.
- Dry wells that are damaged need to be fixed or replaced within two weeks of being damaged.
- If an intermediate sump box exists in conjunction with a dry well, it must be cleaned out at least once per year.
- Rain barrels and cisterns need to be cleared of debris routinely at least every three months and after significant storms to allow stormwater from gutters to enter them.
- Gutters that directly convey rain water to dry wells, rain barrels, and cisterns need to be routinely cleared of trash and debris at least every three months and after significant storms.
- Rain barrels and cisterns must be kept covered.

SAMPLE SITE PLAN



Simplified Method Worksheet

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	**Proposed Impervious Surface for BMP #2**	**Proposed Impervious Surface for BMP #3**		
BMPS				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table A-1	**Volume from Column 2 or 3 in Table A-1**			
Rain Garden/Bioretention or Dry Well #2				
Proposed Impervious Surface	**Volume of BMP**	**Area of BMP**	**Depth of BMP**	**Types of Material to Be Used**
Infiltration Trench or Dry Well #1				
Proposed Impervious Surface	**Volume of BMP**	**Area of BMP**	**Depth of BMP**	**Types of Material to Be Used**
Note: For additional BMPs, use additional sheets				

Simplified Method Worksheet (filled in from Example)

Simplified Method Worksheet				
STEP 1				
Proposed Impervious Surface for BMP #1	**Proposed Impervious Surface for BMP #2**	**Proposed Impervious Surface for BMP #3**		
200 sq. ft.	400 sq. ft.	350 sq. ft.		
BMPS				
Rain Barrel or Cistern				
Proposed Impervious Surface from Column 1 in Table A-1	**Volume from Column 2 or 3 in Table A-1**			
200 sq. ft.	166 gallons			
Rain Garden/Bioretention or Dry Well #2				
Proposed Impervious Surface	**Volume of BMP**	**Area of BMP**	**Depth of BMP**	**Types of Material to Be Used**
400 sq. ft.	33 cu. ft.	4 ft. x 6 ft.	2 ft.	Soil/planting mix full depth, native vegetation
Infiltration Trench or Dry Well #1				
Proposed Impervious Surface	**Volume of BMP**	**Area of BMP**	**Depth of BMP**	**Types of Material to Be Used**
350 sq. ft.	73 cu. ft.	3 ft. x 12 ft.	2 ft.	Infiltration trench, uniformly graded aggregate, HDPE 8" pipe, geotextile material, grass planted on top
Note: For additional BMPs, use additional sheets				