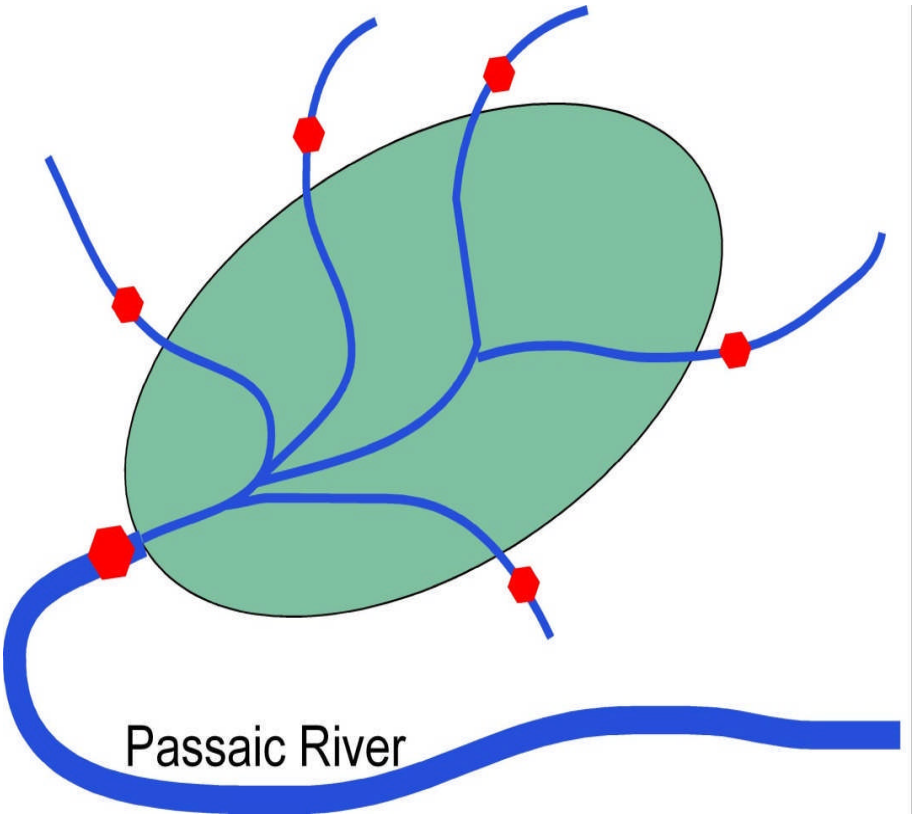
Long Hill Township

Sample Stormwater Management Practices

Long Hill Township Planning Board
September 2013



I. OVERVIEW

This Sample Stormwater Management Practices handout has been designed as a starting point for property owners with smaller scale projects that want to and/or are required to implement stormwater management facilities. While the first solution that comes to mind for many in addressing stormwater is the use of an underground stormwater detention facility, such as a dry well, there are a number of stormwater control systems that have been used in Long Hill Township. They include rain gardens, infiltration trenches, pervious paving systems and green roofs.

This handout provides an overview of these control process. This handout is not all encompassing and should be viewed as a supplemental resource. The stormwater management facilities that are best for your property will be dependent on a number of factors including project size, soil composition and lot contour. We would encourage you to review the township's ordinances which can be found on the township's web site (www.longhillnj.org), and the Environmental Protection Regulations and Stormwater Regulations, as you begin your planning process. Given Long Hill Township's relationship with the Passaic River and the known benefits of stormwater management, the township encourages the use of stormwater facilities regardless of any requirements.

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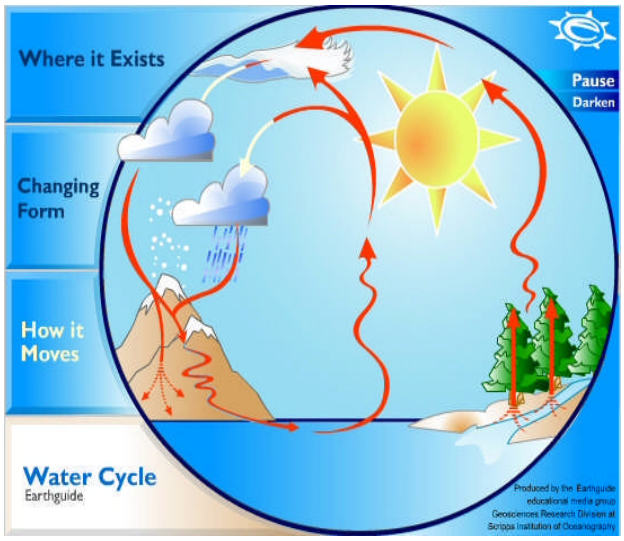
II. INTRODUCTION

The New Jersey Department of Environmental Protection Stormwater Management Rules (SMR), under N.J.A.C. 7:8, provide regulations to protect from the impacts of poorly controlled stormwater. The SMR required the use of Best Management Practices (BMP's) to achieve stormwater controls. The New Jersey Stormwater Best Management Practices Manual (NJBMP Manual) was created to provide technical support to the designer of stormwater management facilities to meet the SMR. For large projects categorized as Major Development, the methods in the NJBMP Manual can be technically complicated and may involve expensive engineering studies to design systems that can control the stormwater runoff from larger projects such as parking lots, commercial buildings, multi-family buildings, residential subdivisions, etc. Thus The Long Hill Township Sample Stormwater Management Practices handout (LHSSMP) is designed to assist those who want to and/or are required to incorporate environmental Best Management Practices (BMPs) into their project. This includes smaller projects where the methods in the NJBMP Manual may not apply.

A requirement for higher levels of engineering may be inappropriate for smaller projects such as minor site plans, single family dwellings, residential additions, patios, etc. However, the *principles* of BMPs are relatively simple and beneficial gains in stormwater management and can be attained with little or no additional costs for small projects.

III. WHY ARE BMP's IMPORTANT?

When rain falls in a natural environment that is covered with trees, shrubs, grasses, and other plants, the vegetation disperses the rain so by the time it reaches the soil, there is not enough energy left to cause erosion. The water is trapped to a large extent by the vegetation so it can slowly infiltrate into the ground where much of it is used by the plants in the normal growth process. With heavy rainfalls, the soil will become saturated and some of the stormwater stormwater will gradually flow into nearby streams. Evaporation of water and evapotranspiration (water released by plants) allows runoff to enter the atmosphere slowly where it enters the cycle for the next rain event.



In developed areas, a different process occurs. When rain falls on impervious surfaces such as streets, sidewalks, and rooftops, there is no infiltration. All of the stormwater flows into the nearest storm drain, then directly into local streams. As such, stream levels rise rapidly from the surge of water and can cause flooding and erosion of the stream bank. Then the stream recedes to artificially low levels because the rainfall is not followed by the gradual release of water from the soil. The surge of stormwater can carry a variety of pollutants such as fertilizers, pesticides, silt, and even thermal shock from hot surfaces in summertime. Plant and animal life in affected streams can be negatively affected.

Applying stormwater BMPs during the project's planning stage can mitigate most of these problems. The idea is to match the impervious cover with landscaping or other measures that work more like the natural forest and less like a storm drain.

IV. BMP DESIGN ALTERATIVES

A. RAIN GARDENS

1. Definition

A Rain Garden is a shallow, landscaped, depression that allows rain and snowmelt to be collected and seep naturally into the ground. This helps recharge groundwater supply and prevents a water quality problem called nonpoint source pollution. Rain gardens are an important way to make our cities and neighborhoods more attractive places to live while enhancing ecological health.

2. Condition Where Practice Applies

Rain Gardens can be used to filter the runoff from both residential and nonresidential developments. Concentrated inflow from a drainage pipe or swale must include adequate erosion protection and energy dissipation measures.

Rain Gardens are most effective when they receive runoff as close to its source as possible. They can vary in size and can receive and treat runoff from a variety of drainage areas within a land development site. They can be installed in lawns, median strips, parking lot islands, and unused lot areas. They are intended to receive and filter storm runoff from both impervious areas and lawns.

Rain Gardens must not be placed into operation until the contributing drainage area is completely stabilized. Therefore, system construction must either be delayed or upstream runoff diverted around the system until such stabilization is achieved. Such diversions must continue until stabilization is achieved. Further suggestions are provided in the section on Additional Information.

3. Design Criteria

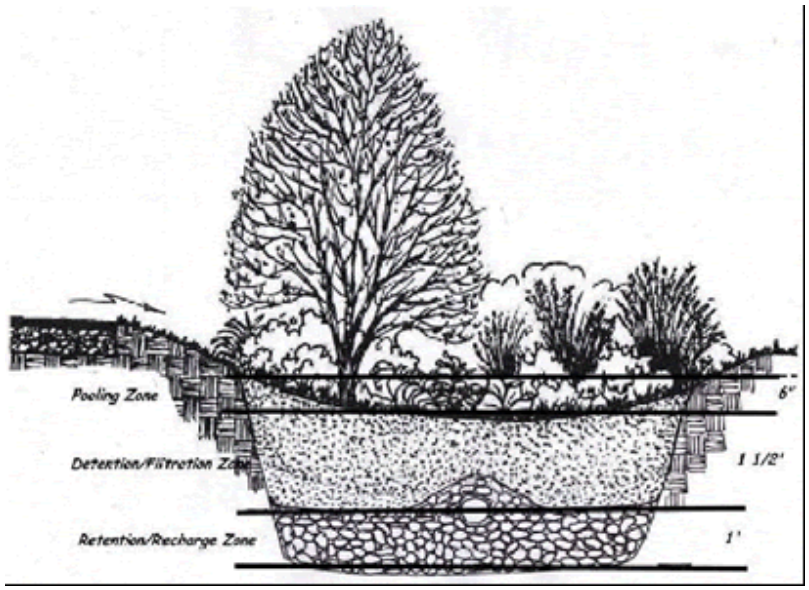


Figure III-1: Sample cross-section of a Rain Garden.

a. The required storage volume of the rain garden pooling zone is computed as 1.25 inches of runoff from the contributing area. In other words, the required rain garden volume for a 1,000 square foot roof is as follows:

   (1,000 s.f.) x (1.25 inches) x (1 foot/12 inches) = 104 cubic feet

   Given the requirement of 104 cubic feet, a 12 inch deep Rain Garden would need to have a surface area of 104 square feet, or about 10 feet by 10.5 feet. A 6 inch deep Rain Garden would need to have a surface area of 208 square feet, or about 10 feet by 21 feet.

b. The soils at the location of the rain garden must be checked for their infiltration potential. Dig a hole at least 12 inch deep and fill with water to saturate soil. Once water has drained, refill with water. If the hole completely drains within two (2) hours, you are reasonably assured the soil is suitable. If the soils are found to be suitably permeable, the underdrain pipe in Figure III-1 may be omitted.

   If seasonal high groundwater is detected less than two feet below the bottom of the gravel layer, the location is unacceptable. A sign of shallow groundwater includes water infiltrating into the excavation, and/or a blotchy appearance (mottling) in the soil.

c. In considering the location of a Rain Garden, the following considerations are recommended:

   (1) The Rain Garden should be at least 10 feet from a building with a slab-on-grade and 25 feet from a building with a basement.

   (2) Since Rain Gardens will overflow in moderate to large rain events, the path of the overflow, and the potential for erosion or damage to private property must be considered.

(3) Locating Rain Gardens in immediately adjacent to areas that may be subject to snow removal operations and materials should be carefully considered. Snow clearing operations and materials can be detrimental to the plantings in the Rain Garden and a buffer strip of lawn may be in order.

(4) In the case of Rain Gardens proposed in the vicinity of a subsurface sewage disposal system, the Infiltration trench is to be considered as a Dry Well in *Table 4.3 Minimum Required Separation Distances* in N.J.A.C. 7:9A-4.3 regarding the design of Individual Subsurface Sewage Disposal Systems.

d. Once a location is chosen, excavate for the Rain Garden bottom shown in Figure III-1. The gravel shall be ¾ inch diameter clean stone, wrapped in filter fabric. The soil layer above the gravel should be a sandy topsoil with a pH of 5.5 to 6.5.

e. The following table provides suggestion plant selections for the region:

Plant	**Common Name**	**Mature Size**	**Bloom Time**	**Exposure**
Perennials				
Asclepias incarnata	Swamp Milkweed-pink	5 ft.	May/June	Sun/Partial Shade
Chelone glabra	White Turtlehead	2-3 ft.	Aug/Oct	Sun/Partial Shade
Eupatorium maculatum	Joe-Pye Weed - pink	2-7 ft.	July/Sept.	Sun
Helenium autumnale	Sneezweed - gold to red	2.5-3 ft.	Aug./Sept.	Sun
Lobelia cardinalis	Cardinal flower - red	1-5 ft.	July/Sept.	Sun/Partial Shade
Lobelia siphilitica	Great Blue Lobelia - blue	1-3 ft.	Aug./Oct.	Sun/Shade
Ferns & Sedges				
Athyrium filix-femina	Lady Fern	2-3 ft.	N/A	Partial Sun/Shade
Osmunda regalis	Royal Fern	2-5 ft	N/A	Partial Sun/Shade
Osmunda cinnamomea	Cinnamon Fern	4 ft.	N/A	Partial Sun/Shade
Carex pendula	Drooping Sedge	2-3 ft.	May/June	Partial Shade
Carex stipata	Tussock Sedge	1-3 ft.	July/Aug.	Sun/Partial Shade
Shrubs				
Fothergilla gardenii	Dwarf Fothergilla - white	1.5-3 ft.	April/May	Sun/Partial Shade
Cephalanthus occidentalis	Buttonbush - white	3-10 ft.	Jul./Aug	Sun
Viburnum dentatum	Arrowwood - white	8-10 ft.	May/June	Sun/Partial Shade
Lindera benzoin	Spicebush - chartreuse	6-12 ft.	March/May	Sun/Shade

4. <u>Maintenance</u>

A rain garden will not require as much care as a lawn area but will need some maintenance to ensure long-term success. Measures include:

Weeding: Critical in the first few months after planting until maturing plants begin to grow and crowd the weeds out. Watch for invasive, overly-competitive weed species (RCRE NJ Weed Gallery for more info *http:// www.rce.rutgers.edu/weeds/default.asp* and NRCS Plants database *http://plants.usda.gov*). Mulch to prohibit weed seed germination and loss of soil through erosion.

Pruning: Dense shrub growth is encouraged to increase filtering capacity. Stems and seed heads can be left for winter interest, wildlife cover, and bird food. Tattered and discolored plants should be cut back after spring growth is 4–6 inches tall. Deadhead flowers for new growth.

Mowing: If mower can be raised to six inches, mow or use a string trimmer to cut the spent stems to 6–8 inches in early spring. Use hand clippers for thicker stems.

Re-vegetating: Remove and replace plant material that is not thriving.

Sediment: Sediment accumulating within the garden is a sign of success; however, occasionally use a flat shovel to remove any excess.

Leaf Litter Removal: If leaf litter is allowed to accumulate on the ground surface, it can form a mat that can inhibit water infiltration

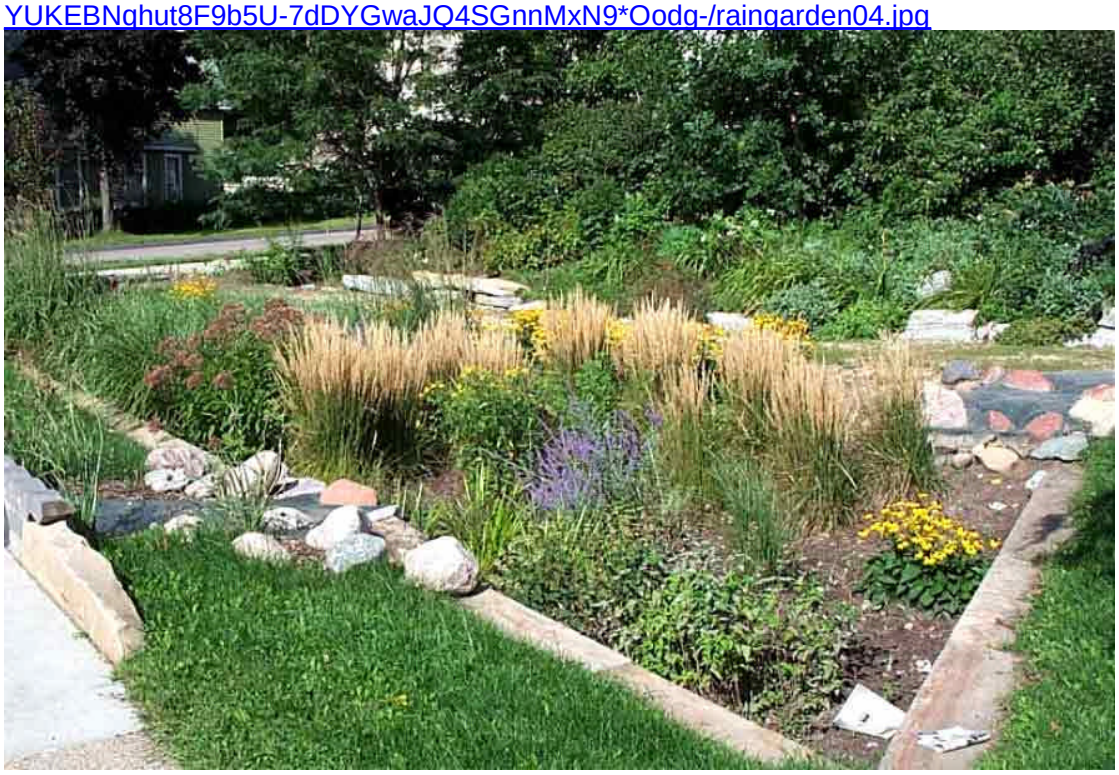
Soil Testing: Should precede planting to determine nutrient and pH (acidity) levels, and every 3 to 5 years. Follow the recommendations to maintain the soil pH in an acidic range. If pH is less than 5.2, apply limestone; if greater than 7.0 add iron sulfate and sulfur to reduce pH. Add amendments when no storms are expected to prevent runoff.

5. Additional Information

Following are diagrams, photographs, and links to internet web sites that may be helpful in designing rain gardens. It is important to note that each site is unique and certain aspects of the various references may not be appropriate in all conditions.

The photograph below shows an attractive rain garden alongside a sidewalk:
http://www.emmitsburg.net/gardens/articles/adams/2008/photo/rain%20garden.jpg

The photo below shows a larger rain garden that might be appropriate for a driveway or rooftop:
http://api.ning.com/files/J3HCpw15Y1NMyMmduK2XKh6TFjCqvYeLZYoER3PSYMM8FFXk7Eq1MrYUKEBNghut8F9b5U-7dDYGwaJQ4SGnnMxN9*Oodg-/raingarden04.jpg



Additional resources for design and plant selection:

Brooklyn Botanical Gardens recommended plant list:
http://www.bbg.org/gar2/topics/design/2004sp_raingardens.html

NJ Rain Garden Manual:
http://www.npsnj.org/rain_garden_home.htm

Native Species:
http://www.npsnj.org/lists_njplants.htm

B. INFILTRATION TRENCHES

1. Definition

An Infiltration Trench is a gravel filled trench that allows rain and snowmelt to be collected and seep naturally into the ground, or to be collected for conveyance to another stormwater facility. This helps recharge our groundwater supply and prevents a water quality problem called polluted runoff (nonpoint source pollution). Infiltration Trenches are an important way to make

our cities and neighborhoods more attractive places to live as the trenches can take the place of multiple stormwater inlets, but give the appearance of a decorative stone landscape feature.

2. Condition Where Practice Applies

Infiltration Trenches can be used to collect and infiltrate or convey the runoff from both residential and nonresidential developments. The Infiltration Trench is installed along the bottom of a sloped area to prevent the passage of surface runoff. Once in the Infiltration Trench, the runoff can be held for infiltration, or piped via a perforated drain within the Trench to another stormwater facility, such as a detention basin.

Infiltration Trenches are most effective when they are installed along the downhill Boundary of an area under development. Because they intercept surface water along their entire length, they are very effective in protecting areas that are downhill of a development. Because of their stone surface, Infiltration Trenches can also serve as energy dissipaters and a secondary infiltration method for drywell overflow pipes, and the like. They can vary in size and can be installed in lawns, median strips, parking lot islands, and unused lot areas. They are intended to receive and filter storm runoff from both impervious areas and lawns.

Infiltration Trenches must not be placed into operation until the contributing drainage area is completely stabilized. Therefore, system construction must either be delayed or upstream runoff diverted around the system until such stabilization is achieved. Such diversions must continue until stabilization is achieved. Further suggestions are provided in the section on Additional Information.

3. Design Criteria

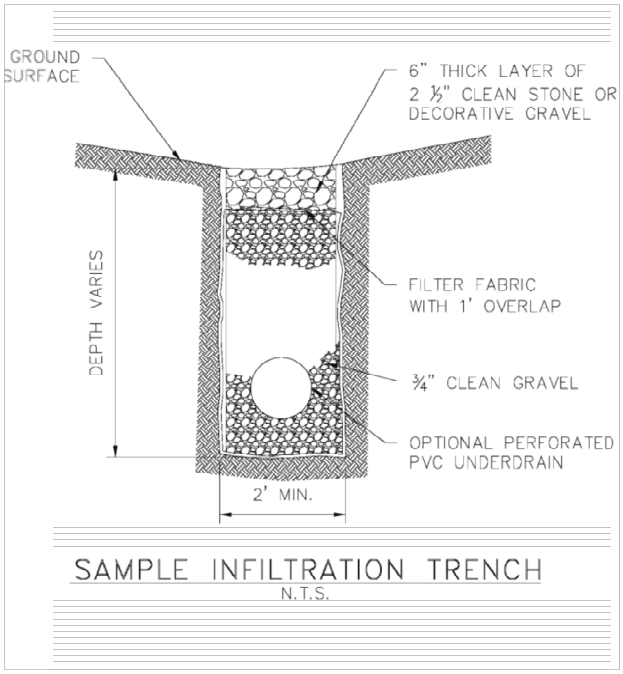


Figure III-2: Sample cross-section of an Infiltration Trench.

a. When used purely as an infiltration device (no underdrain) the required storage volume of the Infiltration Trench varies with the design. The design could call for the Infiltration Trench to represent the sole method of stormwater runoff and be designed to capture and infiltrate as much as all of the increase in runoff from the project. Regardless of the design standard chosen, the design standard for the storage capacity in the voids of the gravel is 40% of the volume of the gravel.

Therefore, in the case of the capturing of the 2 year storm event (1.25 inches) for a 1,000 square foot patio area around a pool, the required volume of gravel would be computed as follows:

(1,000 s.f.) x (1.25 inches) x (1 foot/12 inches) / 0.40 = 260 cubic feet

Given the requirement of 260 cubic feet, a 2 foot wide by 4 foot deep Infiltration Trench would need to have a length of nearly 33 feet to achieve the required volumetric capacity. It is important to note that the calculation of the volume of the Trench is that volume below a level line struck from the lowest point of the trench surface. Since water will find its own level, water will overflow at the lowest point of the Trench surface before it utilizes the volume above the lowest point.

b. When used for both conveyance device (via an underdrain) and as an infiltration device, the available storage in the Infiltration Trench is only that void volume below the lowest invert of the underdrain pipe. Other than this difference, the design characteristics are the same as in “a”, above.

c. The soils at the location of the rain garden must be checked for their infiltration potential. Due to the depth of the Trenches, a excavator will be required to dig a trench to the level of the proposed bottom of the Trench. Once at this level, dig a hole at least 12 inch deep and fill with water to saturate soil. Once water has drained, refill with water. If the hole completely drains within two (2) hours, you are reasonably assured the soil is suitable. If the soils are found to be unsuitable for infiltration, the underdrain pipe in Figure III-2 will be required, along with some other method of runoff rate control.

   If seasonal high groundwater is detected less than two feet below the bottom of the gravel layer, the location is unacceptable. A sign of shallow groundwater includes water infiltrating into the excavation, and/or a blotchy appearance (mottling) in the soil.
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d. In considering the location of a Infiltration Trench, the following considerations are recommended:

   (1) The Infiltration Trench should be at least 10 feet from a building with a slab-on-grade and 25 feet from a building with a basement.

   (2) Depending on the design, Infiltration Trench may overflow in large rain events. The path of the overflow, and the potential for erosion or damage to private property must be considered.

   (3) In the case of Infiltration Trenches proposed in the vicinity of a subsurface sewage disposal system, the Infiltration trench is to be considered as a Dry Well in *Table 4.3 Minimum Required Separation Distances* in N.J.A.C. 7:9A-4.3 regarding the design of Individual Subsurface Sewage Disposal Systems.

e. Once a location is chosen, excavate for the Infiltration Trench as shown in Figure III-2. The gravel fill shall be ¾ inch diameter clean stone, wrapped in filter fabric. The filter fabric may be folded over the ¾ inch stone slightly below the surrounding surface to allow a topping with decorative stone.

4. <u>Maintenance</u>

An Infiltration Trench will require minimal maintenance, but will need some attention to ensure long-term success. Measures include:

Surface Cleaning: As part of regular lawn maintenance, the surface of the Infiltration trench should be kept clear of leaves, lawn clippings and other debris that may impact the Trench's ability to accept surface flows.

Surface Refurbishment: Over time, the upper level of the stone in the Trench may become clogged with vegetative debris. If this occurs, the surface layer of gravel can be removed down to the filter fabric, the filter fabric can be cut away and replaced, and the surface layer of gravel replaced.

5. Additional Information

Following is a photograph of an Infiltration Trench along the edge of a driveway. Note that the outside edge of the gravel-filled trench is concrete, which would permit snowplowing in the New Jersey climate.

C. PERVIOUS PAVING SYSTEMS

Pervious Paving Systems are more fully described in the NJBMP Manual at:

http://www.nj.gov/dep/stormwater/bmp_manual/NJ_SWBMP_9.7.pdf

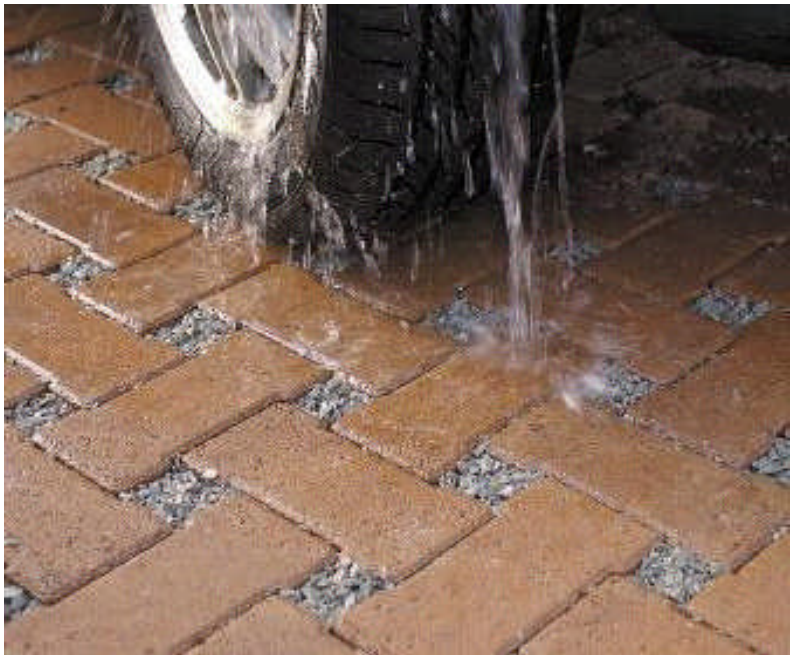
The document noted above is included by reference except as noted otherwise.

1. Definition

Pervious Paving Systems produce less stormwater runoff than areas surfaced with standard paving. Reductions are achieved primarily through the use of specialized design and/or installation methods that allow for the infiltration of a greater portion of the rain falling on the area than would occur with standard paving. This increased infiltration is achieved by either allowing the runoff to pass through the pavement material itself, or through voids between modular paving blocks.

For the purpose of this section, the following terms are defined:

- Pervious Pavement Systems include Permeable Pavement and Permeable Pavers.
- Permeable Pavement is a mechanically applied material, similar to the typical asphalt or concrete pavement overlay, developed to contain voids upon installation and curing. The voids allow the infiltration of runoff through the pavement itself.
- Permeable Pavers are blocks of concrete or similar material that are pre-manufactured and delivered to the site for installation. While the paver material is impervious, the paver shape and/or installation method causes there to be openings through which surface runoff can pass vertically through the system. A sample of a Permeable Paver is illustrated below:



SAMPLE PERMABLE PAVER BY
http://www.mytorontohomeimprovement.com/wp-content/uploads/2008/08/permeable-pavement-toronto.jpg

2. Condition Where Practice Applies

Pervious Paving Systems can be used in many areas where a standard, impervious surface treatment (such as concrete or asphaltic concrete) is used. These areas include walkways, sidewalks, patios, and courtyards. Pervious Paving Systems are not generally suitable in areas

where sand is used for snow control. Further, the use of Pervious Paving Systems is not recommended in areas where certain environmental threats are known to occur. These conditions are set forth in the NJBMP Manual at the following web site: http://www.nj.gov/dep/stormwater/bmp_manual/NJ_SWBMP_9.7.pdf

3. Design Criteria

The internet link provided at the beginning of this section leads to the section of the NJBMP Manual which contains a full explanation of the several design methods available for Pervious Paving Systems. While the direction in the NJBMP is considerable, the following additional design criteria are offered:

a. General Design Controls

(1) The Pervious Paving System shall be underlain by a clean gravel layer to facilitate the infiltration of runoff into the ground. The minimum depth of the stone layer shall be 6 inches, unless the system manufacturer recommends a greater depth, in which case the greater depth shall govern.

(2) The soils at the location of the Pervious Paving System must be checked for their infiltration potential, where infiltration is part of the design. Dig a hole at least 12 inch deep and fill with water to saturate soil. Once water has drained, refill with water. If the hole completely drains within two (2) hours, you are reasonably assured the soil is suitable.

If seasonal high groundwater is detected less than two feet below the bottom of the gravel layer, the location is unacceptable. A sign of shallow groundwater includes water infiltrating into the excavation, and/or a blotchy appearance (mottling) in the soil.

(3) The design must address the issue of a rainfall that is too great to be contained in the stone layer beneath the Pervious Paving System.

b. Permeable Pavement

(1) Permeable Pavement is an evolving method of stormwater control. The design of these pavements is subject to the recommendations of the manufacturer and the review by the municipal authority. If Permeable Pavements are proposed, substantial support documentation from the manufacturer must be provided to the local reviewing authority.

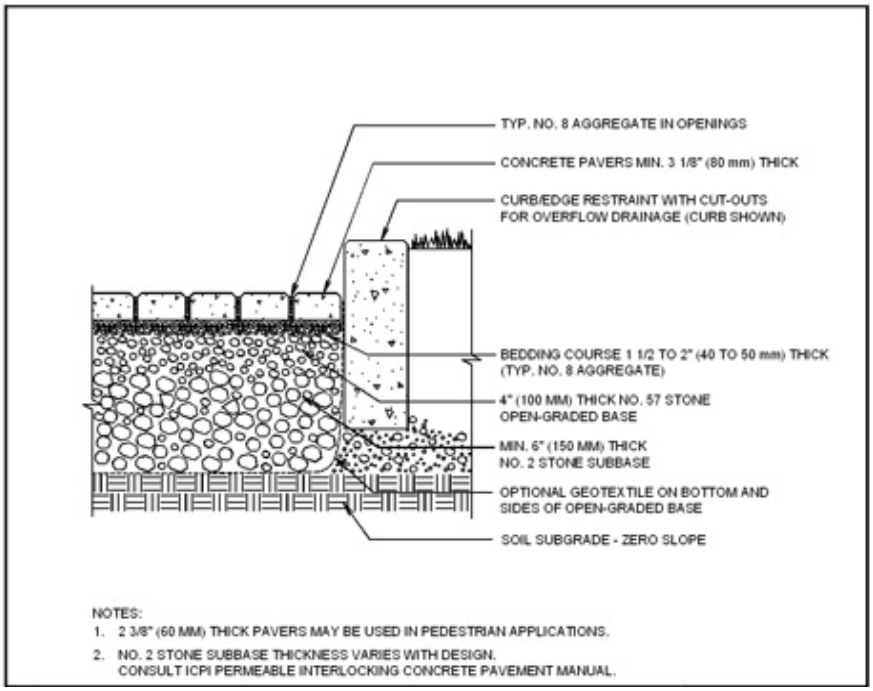
c. Permeable Pavers

(1) Permeable Pavers are not, in themselves, permeable. Rather, the paver design and/or layout incorporate void spaces that allow the infiltration of surface water. Over time, narrow openings, regardless of the fill material, can become less pervious, and eventually impervious. They can also be more difficult to clean. Therefore, in order to be acknowledged as a pervious area within a Permeable Paver system the subject opening must measure at least 5/8 inch in any direction. Openings that measure less than 5/8 inch in any direction shall be considered to be part of the impervious area of the system.

(2) The voids in Permeable Paver systems must be filled with a granular aggregate material that is no less than 3/8 inch diameter and contains no sand or other fine particles. Sand is generally not permitted as the sand can become overly compacted and less pervious over time. Sand, when placed in the larger gaps between or within the paver blocks, can

also be more susceptible to being dislodged by water and wind. The dislodging of the material in the paver voids can increase the required maintenance of the system.

(3) The following is a standard design detail for a Permeable Paver System:



http://www.pavestone.com/webmedia/cad/pavestone/pavers/PERMEABLE_PAVERS_FULL_EXFILTRATION.jpg

D. "GREEN ROOFS"

Rutgers University has produced a comprehensive guide to stormwater and energy BMPs for remodeling or building a new home (http://www.greenbuildingrutgers.us/).. This resource should be shared with your architect and engineer during the planning stages of your project. Since the design and installation of green roofs are a relatively new technology in Long Hill Township. Each proposal will be reviewed on an individual basis. However, a proposal for a green roof must, at the very least, address the following concerns:

1. What structural design considerations have been made to address the weight of the Green Roof. As a minimum, the structure should be able to support the green roof in a weather condition that starts as rain (saturating the system) that turns to snow. The snow load would then be added to the saturated green roof components. All designs must follow applicable building codes.

2. Access for maintenance should be discussed in a drainage report.

3. Data must be provided from a reputable source to discuss the anticipated runoff mitigation for review by the reviewing authority.

E. ALTERNATIVE CONSIDERATIONS

Each project has its unique aspects, as does each property. This handout, as well as the NJBMP, describes a number of stormwater management features. However, property owners are encouraged to find creative ways to work stormwater management features into their projects so that they do not detract from the property's appearance and function. However, if modified versions

of common stormwater management features are being considered, the property owner is encouraged to consult with the township professional responsible for reviewing the project before a significant design effort is invested.