PUTNAM VALLEY
CENTRAL SCHOOL DISTRICT
146 PEEKSKILL HOLLOW ROAD
PUTNAM VALLEY, NY 10579

MS4PY10 STORMWATER PROGRAM

FACT SHEET #3
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BIORETENTION SYTEMS FOR STORMWATER MANAGEMENT

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1. WHAT IS A BIORETENTION SYSTEM?

Just like rain gardens, a bioretention system is a stormwater retention system that stores and treats stormwater runoff. Bioretention systems are modelled after the biological and physical characteristics of an upland terrestrial forest or meadow ecosystem. These systems utilize vegetation, such as trees, shrubs and grasses to remove pollutants from stormwater. Stormwater entering a bioretention system is filtered through a planting soil bed before being either 1) conveyed downstream by an underdrain system or 2) infiltrated into the existing subsoil below the soil bed. A bioretention system can be configured as a basin or a longer, narrower bioretention swale.

2. BIORETENTION SYSTEM BENEFITS

Bioretention systems collect and slow stormwater, during heavy rainfalls. The bioretention system reduces runoff volume, peak flow and flow duration and increases infiltration into the ground. Some of the benefits of a bioretention system include:

- **Groundwater Infiltration:** A bioretention system allows more water to seep into the ground than a conventional lawn. This seepage increase helps sustain stream flow during dry spells through infiltration and groundwater recharge
- **Evapotranspiration and Photosynthesis:** Trees and shrubs improve the environment through:
  - Transpiration: Trees and shrubs increase the transpiration of water into the atmosphere which impacts the atmospheric precipitation cycling
  - Photosynthesis: Trees and shrubs increase absorption of carbon dioxide from air pollution and release oxygen into our atmosphere

- **Habitat for Birds and Wildlife:** Bioretention systems provide a habitat for birds and other wildlife
- **Reduction of Flooding:** Bioretention systems protect communities from flooding and drainage problems
- **Reduction of Stormwater Structures:** Bioretention systems reduce the need for costly municipal stormwater treatment structures

3. SITE SUITABILITY CRITERIA

Step 1. Picking a Site: Picking a site is a critical first step.

- **Required Space:** The surface area of the bioretention system should be at least 3% to 6% of the contributing drainage area, depending on the imperviousness of the contributing drainage area
- **Site Slope:** The site most suitable for a bioretention system is when the grade of the area is greater than 1% and less than 5%
- **Building Foundation**: Select a site that is at least 10 feet away from your building foundation. Infiltrating water close to your foundation can lead to water problems in your basement
- **Property Lines**: Select a site that is at least 10 feet away from the property line
- **Private Water Supply Lines**: Select a site that is at least 75 feet away and downstream from a private water supply line
- **Septic System:** Select a site that is at least 75 feet away and downstream from septic systems
- **Proximity to Utilities:** Ensure that future tree canopy growth will not interfere with existing overhead utility lines. Interference with underground utilities should be avoided
- **Seasonal High Groundwater Table:** Bioretention systems with an underdrain should be located where the seasonal high groundwater table is 1 foot minimum from the bottom of the proposed bioretention system. Bioretention systems without an underdrain should be located where the seasonal high groundwater table is 2 foot minimum from the bottom of the proposed bioretention system.
- **Location of the Nearest Storm Drain:** Bioretention system with an underdrain system should be located such that the nearest existing storm drain is at least 4-5 ft. below the invert of the underdrain system or nearest discharge point

Step 2. Checking the Soil Infiltration: It is important to know how your soil infiltrates water into the ground. The "infiltration rate" refers to the speed at which water enters the soil. The soil infiltration rate should be sufficient to drain the storm runoff volume within 72 hours.

- **Test Hole:** Dig a hole 6-8" deep in the area of the selected for the bioretention system site
- **Pre-Soaking and Testing:** After the hole is completed, fill the hole with water to the top of hole and check the level of the water after 6 hours
- **Soil Infiltration Results:**
  - **Less Than 6 Hours:** If the water is gone after 6 hours, the site is suitable for a bioretention system

- **Greater than 6 Hours**: If the water takes 6-24 hours to disappear, the site is probably acceptable, but you may have to install an underdrain system to direct excess water to a nearby waterway or storm drain
- **After 24 Hours**: If the water has not disappeared after 24 hours, the site is not suitable for the bioretention system

4. DESIGN CRITERIA

The basic design parameters for bioretention systems are typically as noted below:

- **Storage Volume:** The storage volume for a flat-bottomed bioretention system is commonly 12 inches and 18 inches at the deepest end of a slope-bottomed swale system. The volume should be designed to store runoff for a period of 72 hours
- **Inlet Design:** Incoming flow should be distributed as evenly as possible across the entire filter surface area
- **Side Slopes:** Sides slopes should be 3:1 or flatter
- **Planting Soil Bed:** The planting soil bed provides the environment for water and nutrients to be made available for the trees and shrubs planted in the bed
  - **Planting Soil Depth:** The planting soil bed should be between 1.5 ft. and 2.0 ft. to accommodate trees and shrubs
  - **Planting Soil Mixture:** The soil should contain 85 to 95% sand, 15% of silt and clay and amended with 3 to 7% organics
  - **Soil Bed Surface Cover:** The soil bed cover may include a 2-3inch layer of mulch, river stone or pea gravel
- **Gravel Layer and Underdrain Pipes:** The gravel layer (0.5 to 1.5inch pea gravel) serves as a bedding material for the underdrain pipes, located below the planting soil bed. It is typically a minimum depth of 3 inches, sufficient to cover the top and bottom of the underdrain pipes. The underdrain pipes are top-perforated to permit flow of water into pipes for collection and disposal to the nearest storm drain or discharge stream
- **Outlet Connection:** The outlet from the underdrain piping system shall be connected to downstream storm sewer manhole, catch basin or channel, at a location that is not subject to blockage, and that is readily accessible for inspection and cleanout
- **Emergency Overflow:** An overflow must be provided to pass storms that are greater than the design storage. The overflow should be located at a downstream storm sewer manhole, catch basin or channel. The top of the overflow should be designed to provide 3-6 inches of freeboard, to ensure that the basin is not flooded during heavy rainfall events.

SOURCES: The information in this fact sheet was extracted from various EPA publications and other guides to Stormwater Best Management Practices