Green Stormwater Infrastructure for the 2nd Northwest New Jersey Rivers Conference

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on November 12, 2020

Rutgers
New Jersey Agricultural Experiment Station
Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.
Our Mission is to identify and address water resources issues by engaging and empowering communities to employ practical science-based solutions to help create a more equitable and sustainable New Jersey.
Water Resources Problems of NJ

• Localized flooding
• Major flooding (hurricanes, Northeasters, etc)
• Poor stream health (chemical, physical, biological)
• Harmful Algal Blooms (HABs)
• Erosion and sedimentation
Causes of Water Resources Problems

• Existing Development
• New Development (Major and Minor)
• Agriculture Land Uses
• Natural Lands
Agriculture
High Density Development
Single Family Homes
Development with and without stormwater management in NJ

- 1986 Urban: 1,252,139 acres
- 2015 Urban: 1,569,210 acres
- Difference: 317,071 acres (28% ↑)

- 79.8% of all urban land existed in 1986
Green Infrastructure (GI or GSI)

...an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:
- capture,
- filter,
- absorb, and
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource.
The Natural Water Cycle
Impervious Surfaces

More development ➔ More impervious surfaces ➔ More stormwater runoff

10% 20% 30% 55%
The Urban Water Cycle

- Sublimination
- Condensation
- Limited Transpiration
- Precipitation
- Stormwater Runoff
- Roof Runoff
- Limited Infiltration
- Road Runoff
- Unfiltered Storm Sewer Discharge
- Increased Stream Volumes & Erosion
- Evaporation
Green Infrastructure

Stormwater management practices that protect, restore, and mimic the native hydrologic condition by providing the following functions:

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration
Green Infrastructure Practices

**Bioretention Systems**
- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

**Permeable Pavements**

**Rainwater Harvesting**
- Rain barrels
- Cisterns

**Dry Wells**

**Rooftop Systems**
- Green Roofs
- Blue Roofs
TYPES OF BIORETENTION

Bioretention Cells
- Single-family lots
- Commercial areas
- Parking lots

Rain Gardens
- Single-family lots
- Small commercial areas

Bioretention Swales/Bioswales/Vegetated Swales
- Typically in right-of-way

Planters & Planter Boxes
- Highly urban areas
- Right-of-way and adjacent to buildings

Vegetated Curb Extensions
- Bioretention incorporated into right-of-way in urban and suburban areas
Rain Garden Cross-Section
Lots of Rain Gardens
Bioswale

NATIVE PLANTS
A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.

CONVEYANCE
Unlike other systems, the bioswale is designed to move water through a vegetative channel as it slowly infiltrates into the ground.

SLOPE
The slope is designed at a maximum of 3:1. These slopes often require erosion control materials for stabilization.

INFLOW
This is the area where stormwater enters.
Stormwater Planters

Native Plants
A stormwater planter is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions.

Curb Cut
This curb cut and concrete flow pad are designed to help redirect stormwater runoff to the rain garden system and out of the storm drain.

Concrete Wall
Concrete walls are installed to match the existing curb. These walls create the frame for the stormwater planter and continue to function as a curb.

Inlet
This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

Subgrade
Stormwater planter systems are unique because of their subgrade structure. This structure is layered with bioretention media, choker course, compact aggregate, and soil separation fabric.
Stormwater Planter Cross-section
Curb Extensions
Permeable Pavement

POROUS ASPHALT
It is common to design porous asphalt in the parking stalls of a parking lot. This saves money and reduces wear.

DRAINAGE AREA
The drainage area of the porous asphalt system is the conventional asphalt cartway and the porous asphalt in the parking spaces. Runoff from the conventional asphalt flows into the porous asphalt parking spaces.

SUBGRADE
Porous pavements are unique because of their subgrade structure. This structure includes a layer of choker course, filter course, and soil.

UNDERDRAIN
Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.

ASPHALT
This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.
Permeable Pavements

• Underlying stone reservoir
• Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
• Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
• Permeable pavers systems are concrete pavers with infiltration between the spaces of the pavers
• Ideal application for porous pavement is to treat a low traffic or overflow parking area
ADVANTAGES

• Manage stormwater runoff
• Minimize site disturbance
• Promote groundwater recharge
• Low life cycle costs, alternative to costly traditional stormwater management methods
• Mitigation of urban heat island effect
• Contaminant removal as water moves through layers of system

COMPONENTS
Porous Asphalt
Pervious Concrete
Grass Pavers
Rainwater Harvesting Systems

**DRAINAGE AREA**
This is the area of impervious surface that is captured in the rainwater harvesting system. In this case, it is a structure rooftop.

**FIRST FLUSH DIVERTER**
This mechanism is installed to by-pass the first several gallons of runoff which tend to be the dirtiest water before it enters the tank.

**GUTTER**
This captures runoff from the rooftop and carries it to the rainwater harvesting system.

**CISTERN TANK**
This tank is designed in different sizes to accommodate the runoff from a designated drainage area.

**SPIGOT**
A spigot is installed near the base of the cistern tank to allow water to be removed for use without an electronic pump system.

**OVERFLOW**
This mechanism is designed to act as a discharge for the water when the cistern is full or when it is winterized.

**SEDIMENT**
Sediment and other pollutants that enter the tank will settle to the bottom.
Rain Barrels
Cisterns
Dry Wells
Infiltration Trench

Water floods the trench then enters pipe and flows away

Perforated Pipe

Gravel Encase Pipe
Rooftop Practices – Green Roof
Types of Green Roofs

Extensive

Intensive
Types of Green Roofs

**Extensive**

- Soil depth up to 6 inches
- Lightweight
- Limited plant species options
- Lower maintenance, nutrient, and irrigation requirements

**Intensive**

- Soil depth typically 6 inches or greater
- Heavier weight load on roof
- Many more plant options, including trees and shrubs
- Requires irrigation, fertilization, and maintenance
Rooftop Practices – Blue Roof

- Gravel
  Optional alternative for securing roof
- Aluminum Tray
  Mobility and minimal maintenance
- Geotextile
  Moderate flow rate
- Corrugated Plastic
  Creates flat surface
- Roof Membrane
- Insulation
- Roof Deck
Stormwater Wetlands
Small-Scale Infiltration Systems

Surface Infiltration Basin – Plan View

- Conduit Outlet Protection for Non-erosive Inflow
- 3:1 Maximum Side Slope for Earthen Embankments
- Sand, Minimum Depth = 6 in., Min. Tested Permeability = 20 inches/hour
- Filter Fabric (Sides only)
- Optional Berm for Directing Overflow

NOTE: = Direction of Runoff

Not to Scale
Small-Scale Sand Filter

Profile View – Sand Filter Basics

- Inflow
- Pretreatment Zone
  - Optional Perforated Riser
- Treatment Zone
  - Optional Turf and Topsoil Layer
- Overflow
  - Outlet Control w/ Maintenance Access
- Stone Choker Course
- Sand Bed

SHWT

Underlying Soils

NOTE: ➔ = Direction of Runoff

Not to Scale
Plan View – Sand Filter Basics

**Inflow** | **Pretreatment Zone** | **Treatment Zone** | **Overflow**
---|---|---|---
Optional Perforated Riser w/ Grate | Sand Bed | Outlet Control w/ Maintenance Access
Riprap Apron

**NOTE:**
= Direction of Runoff

Not to Scale
Profile View – Sand Filter with Underdrain

- Inflow
- Pretreatment Zone
- Treatment Zone
- Overflow

- Stone Choker Course
- Sand Bed
- WQ Design Storm
- Perforated Underdrain
- Gravel Layer
- Filter Fabric
- Underlying Soils

NOTE:

↑ = Direction of Runoff

Not to Scale
Plan View – Sand Filter with Underdrain

Inflow → Pretreatment Zone → Treatment Zone → Overflow

- Gravel Layer
- Perforated Underdrain
- Filter Fabric

NOTE:

- Direction of Runoff
- Surface Vegetation, Topsoil, Sand Layer & Stone Choker Course Not Shown

Not to Scale
March 2021 – Major Development will mostly use these GI Practices

• Pervious Paving Systems
• Small-Scale Bioretention Systems
• Small-Scale Infiltration Basins
• Small-Scale Sand Filters

To satisfy groundwater recharge, stormwater quantity, and stormwater quality requirements.
50 Rain Gardens for 50th Anniversary of Earth Day
Where did the funding come from?

- New Jersey Agricultural Experiment Station (Rutgers Cooperative Extension Water Resources Program)
- National Fish and Wildlife Foundation (NFWF)
- William Penn Foundation
- NJ Department of Environmental Protection (NJDEP)
- Sustainable Jersey
- Individual Municipalities
- NJ Sea Grant Consortium
- Geraldine R. Dodge Foundation
- Deal Lake Watershed Alliance
Municipal/County Support

- Bernardsville
- Bridgewater
- Caldwell
- East Brunswick
- Edison
- Evesham
- Hamilton (Mercer Co)
- Hammonton
- Jamesburg
- Manville
- Metuchen
- Millville
- Monmouth Beach
- Monroe
- Perth Amboy
- Phillipsburg
- Pittsgrove
- Ocean Township
- Union County Parks Dept.
- Vineland
- Warren
- Watchung
- Westfield
- West Grove, PA
- Woodbridge
- Woodstown
The Rutgers Cooperative Extension (RCE) Water Resources Program was awarded a 319h grant from the New Jersey Department of Environmental Protection to implement green infrastructure projects in the city of Perth Amboy. With funding from the 319h grant two rain gardens were installed at Saint Peters Episcopal Church on April 6, 2020. Enviroscapes Inc. excavated the rain gardens, added bioretention media, added mulch and constructed curb cut inlets to allow stormwater runoff to enter the rain gardens. The RCE Water Resources Program staff designed the rain gardens and installed the plants. The managed drainage area for the two rain gardens is 4,802 square feet. The rain gardens are 142 square feet and 280 square feet in size, filled with native plants that will attract pollinators. The rain gardens will capture, treat, and infiltrate approximately 94,640 gallons of stormwater runoff per year.
The Rutgers Cooperative Extension (RCE) Water Resources Program was awarded a 319h grant from the New Jersey Department of Environmental Protection to implement green infrastructure projects in the city of Perth Amboy. With funding from the 319h grant two rain gardens were installed at American Legion on April 8, 2020. Enviroscape Inc. excavated the rain garden, added bioretention media, and added mulch to the rain garden. The RCE Water Resources Program staff designed the rain garden and installed the plants. The managed drainage area for the rain garden is 7,820 square feet. The rain garden is 390 square feet in size, filled with native plants that will attract pollinators. The rain garden will capture, treat, and infiltrate approximately 160,180 gallons of stormwater runoff per year.
The Rutgers Cooperative Extension (RCE) Water Resources Program partnered with West Grove Borough and to complete a green infrastructure master plan. The first demonstration project was a rain garden completed in May 2020 at the Avon Grove Library. The Borough Department of Public Works excavated the rain garden, and the RCE Water Resources Program staff worked with the White Clay Watershed Association to install the plants. The managed drainage area for the rain garden is 3,350 square feet. The rain garden is 625 square feet in size, filled with native plants that will attract pollinators. The rain garden will capture, treat, and infiltrate approximately 58,850 gallons of stormwater runoff per year.

Plants are looking good, October 2020.
On June 15, 2020 The Rutgers Cooperative Extension (RCE) Water Resources Program competed the installation of a rain garden at the Bernardsville Public Library by partnering with Borough Department of Public Works who assisted with the heavy lifting during the excavation. This rain garden opportunity was identified through funding provided by the New Jersey Highlands Council to complete an Impervious Cover Reduction Action Plan for Bernardsville Borough. The managed drainage area for the rain garden is 840 square feet. The rain garden is 215 square feet in size, and will serve as a demonstration project for residents that want to install rain gardens at their homes. The rain garden will capture, treat, and infiltrate approximately 13,380 gallons of stormwater runoff per year.
Green Infrastructure Champion Program

Green Infrastructure Champions are key players in implementing green infrastructure as a stormwater management approach in their community.

New on-line classes starting in January 2021.
To learn more about the program, go to: http://water.rutgers.edu/Projects/GreenInfrastructureChampions/GIC.html
About Us

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News

- CALENDAR OF UPCOMING EVENTS
- In the News - November 3, 2020
- SEBS/NJAES Newsroom
- Earth Day Every Day Webinar Series Returns!
  - Interactive one hour sessions on Monday evenings at 6:30 pm starting 9/21/2020
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www.water.rutgers.edu
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