RUTGERS UNIVERSITY
Water Resources Program
New Jersey Agricultural Experiment Station

# *Rutgers Cooperative Extension Water Resources Program*

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# Rutgers Cooperative Extension

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.

# Water Resources Program


***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.***

# New Jersey

- Most densely populated state
- 21 counties, 565 municipalities
- 95% of our waterways are impaired
- Harmful Algal Blooms (HABS) in many of our lakes
- Hammered by Ida, Henri, Sandy, and a bunch of nor’easters
- Climate change is real – more severe storms and sea level rise


# New Jersey Regulations

- N.J.A.C. 7:8 Stormwater Management Regulations (major development)
- Municipal Separate Storm Sewer System (MS4) NJPDES General Permit (564 municipalities)
- Combined Sewer Overflow NJPDES Individual Permits (21 cities)

# N.J.A.C. 7:8 - Stormwater Management Regulations

- Use nonstructural management strategies
- Protect communities from increases in stormwater volume and peak flows as a result of new development
- Maintain groundwater recharge
- Protect waterways from pollution carried in stormwater runoff

# New Jersey Stormwater Management Rules

- Rules apply to any “Major Development” defined as a project disturbing more than 1 acre or increasing impervious surfaces by ¼ acre or more
- Design and Performance Standards established in NJAC 7:8-5, for:
  - Nonstructural Stormwater Management Strategies
  - Stormwater Quantity
  - Groundwater Recharge
  - Stormwater Quality
  - Stormwater Maintenance Plan

# Nonstructural Strategies

- Plan the project using Low Impact Development (LID) Principles
- Collect, infiltrate, and where possible reuse stormwater near its source
- Capture runoff from small storm events in vegetated systems to protect water quality and promote recharge
- Minimize and disconnect impervious surfaces

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces
3. Maximize the protection of natural drainage features and vegetation
4. Minimize the decrease in the "time of concentration" from pre-construction to postconstruction
5. Minimize land disturbance including clearing and grading
6. Minimize soil compaction
7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides
8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas
9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff

# 2019 Revisions

1. The current requirement that major developments incorporate ***nonstructural stormwater management strategies*** to the "maximum extent practical" to meet groundwater recharge standards, stormwater runoff quantity standards, and stormwater runoff quality standards, with a requirement that ***green infrastructure*** be utilized to meet these same standards.
2. Total suspended solids (TSS) removal only applies to runoff from motor vehicle surfaces

# NJDEP Green Infrastructure Definition

A stormwater management measure that manages stormwater close to its source by:

1. Treating stormwater runoff through infiltration into subsoil
2. Treating stormwater runoff through filtration by vegetation or soil
3. Storing stormwater runoff for reuse

| Best Management Practice | Quality TSS removal rate (%) | Quantity | Recharge | Minimum separation from seasonal high-water table (ft) |
|---|---|---|---|---|
| **Bioretention Systems** | 80 or 90 | Yes | Yes<br>No | 2<br>1 |
| **Cisterns** | 0 | Yes | No | - |
| **Dry Wells** | 0 | No | Yes | 2 |
| **Grass Swales** | 50 or less | No | No | 2 |
| **Green Roofs** | 0 | Yes | No | - |
| **Infiltration Basins** | 80 | Yes | Yes | 2 |
| **Manufactured Treatment Device** | 50 or 80 | No | No | Dependent upon the device |
| **Pervious Paving Systems** | 80 | Yes | Yes<br>No | 2<br>1 |
| **Sand Filters** | 80 | Yes | Yes | 2 |
| **Vegetative Filter Strips** | 60-80 | No | No | - |

# Let’s talk about the practicality of these new regulations

**(Maximum Drainage Area 2.5 acres for each practice)**

| Best Management Practice | Quality TSS removal rate (%) | Quantity | Recharge | Minimum separation from seasonal high-water table (ft) |
|---|---|---|---|---|
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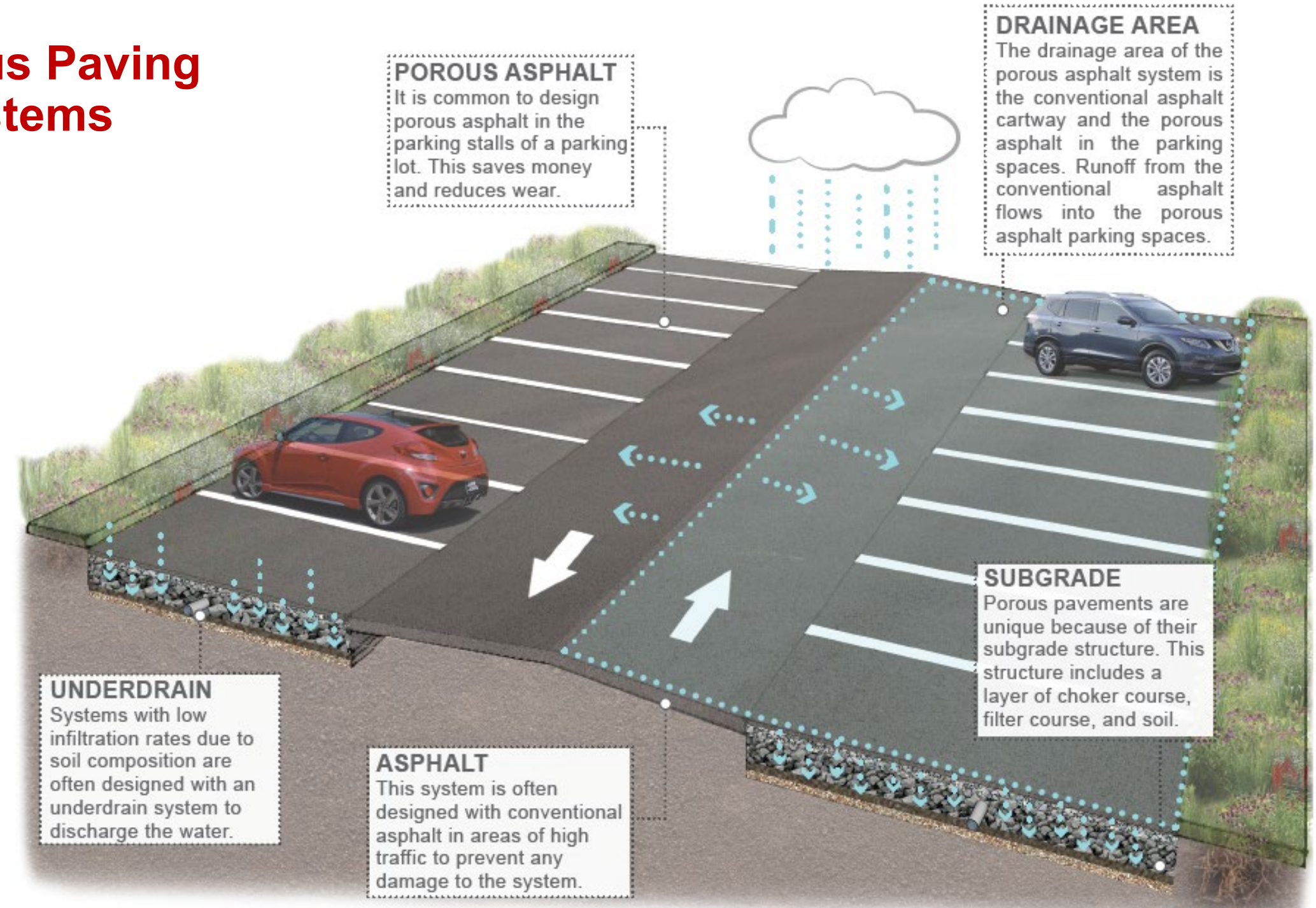
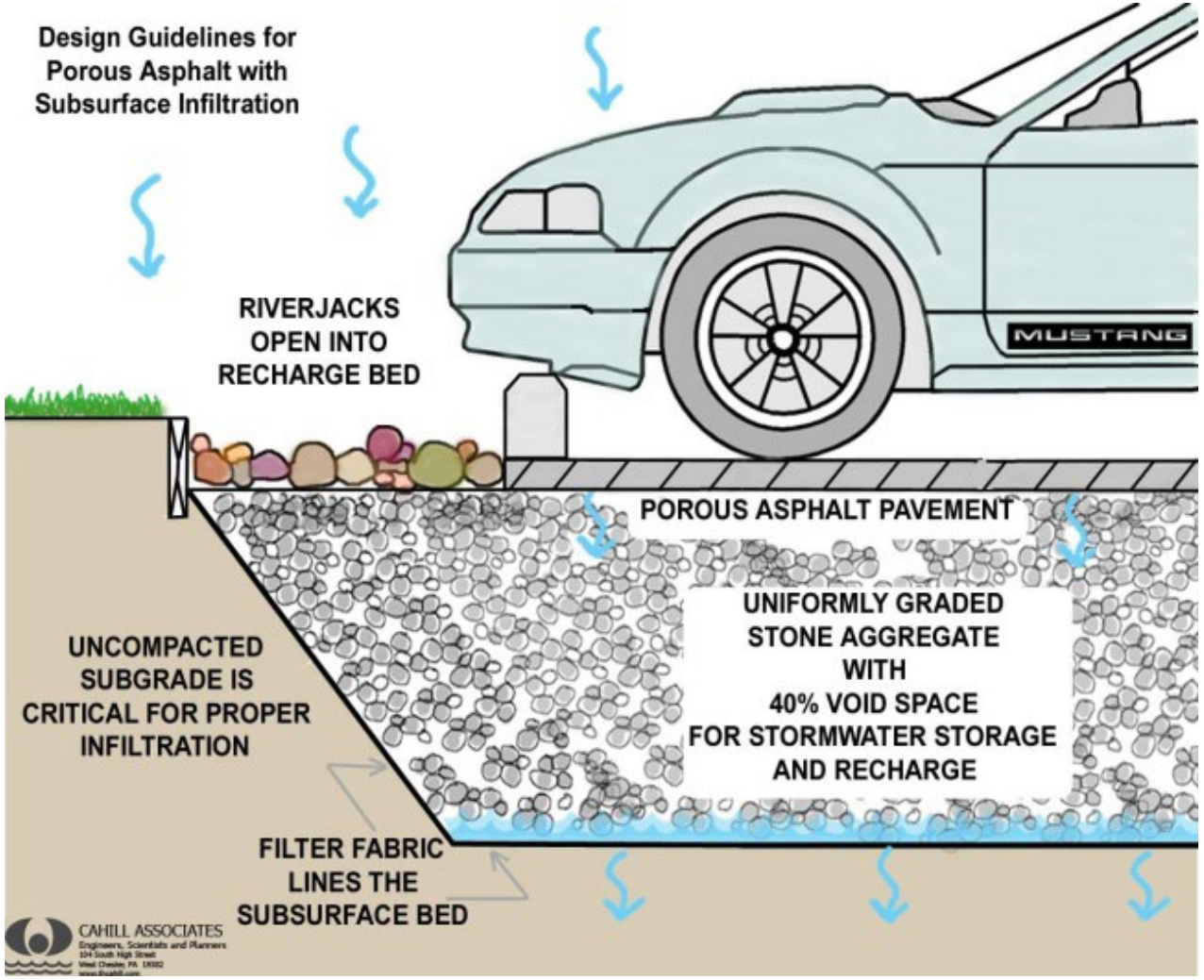
# Pervious Paving Systems



## 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 the system

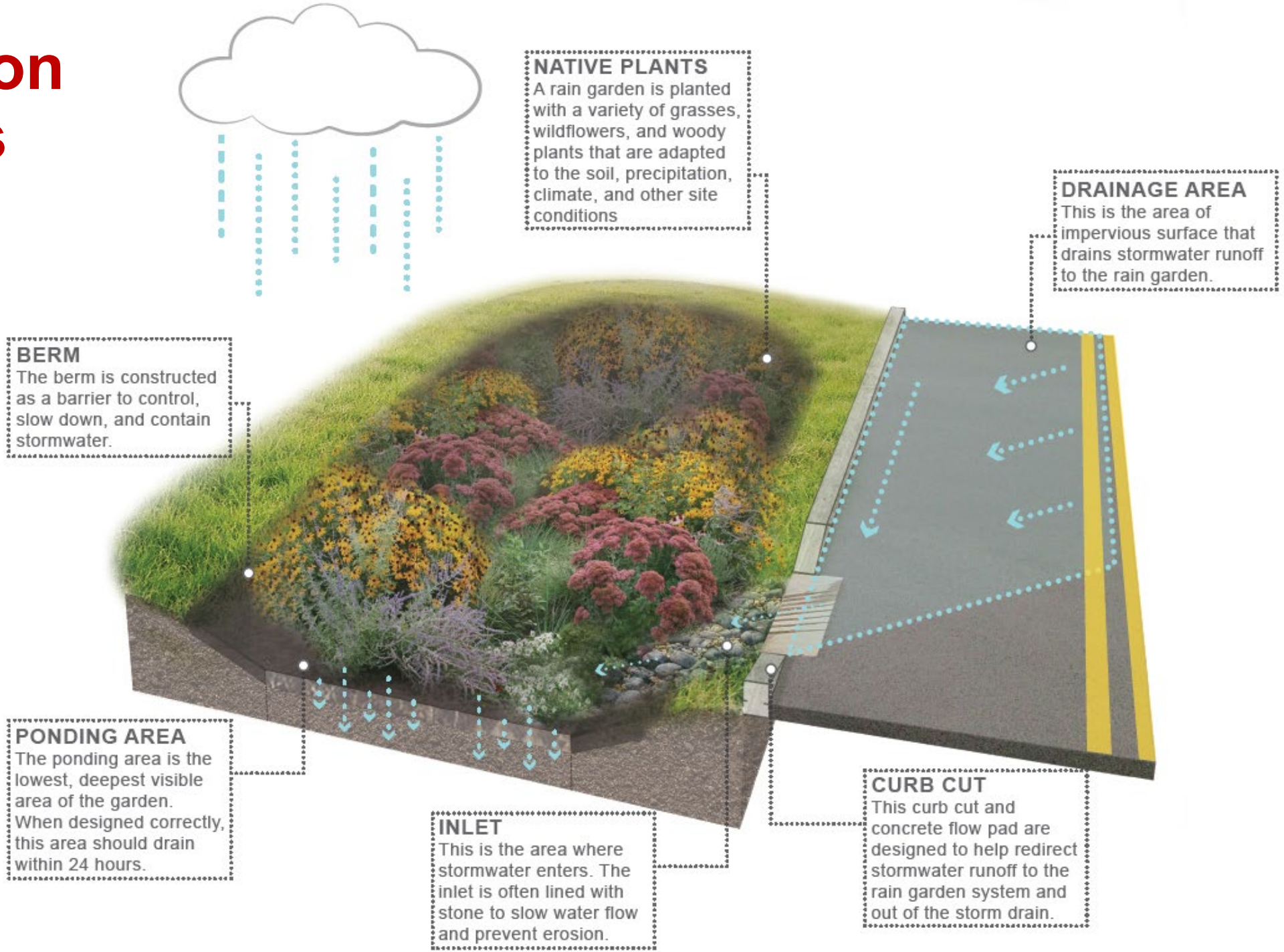
## COMPONENTS



# Porous Asphalt

# Grass Pavers

# Bioretention Systems

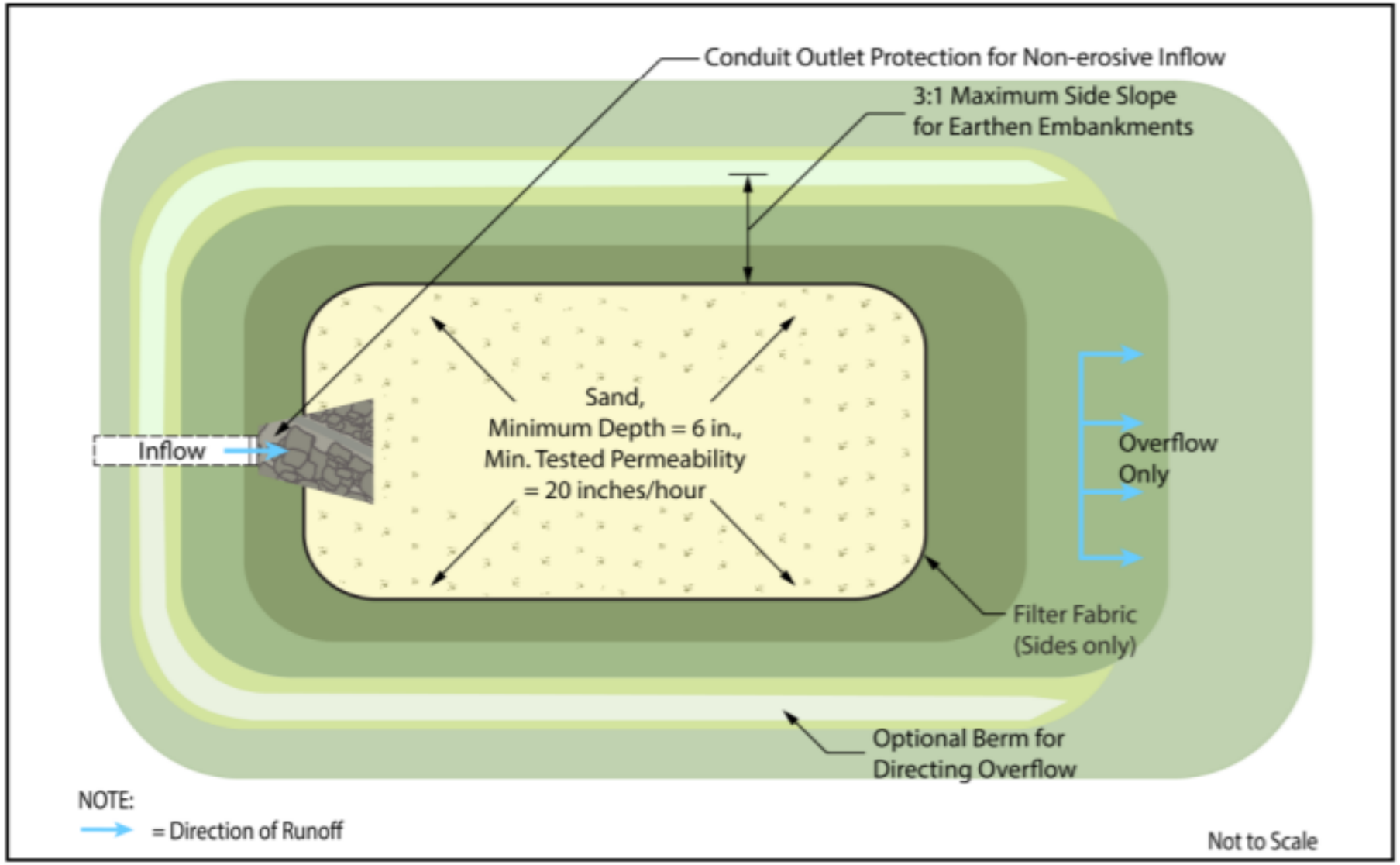



Rain Garden

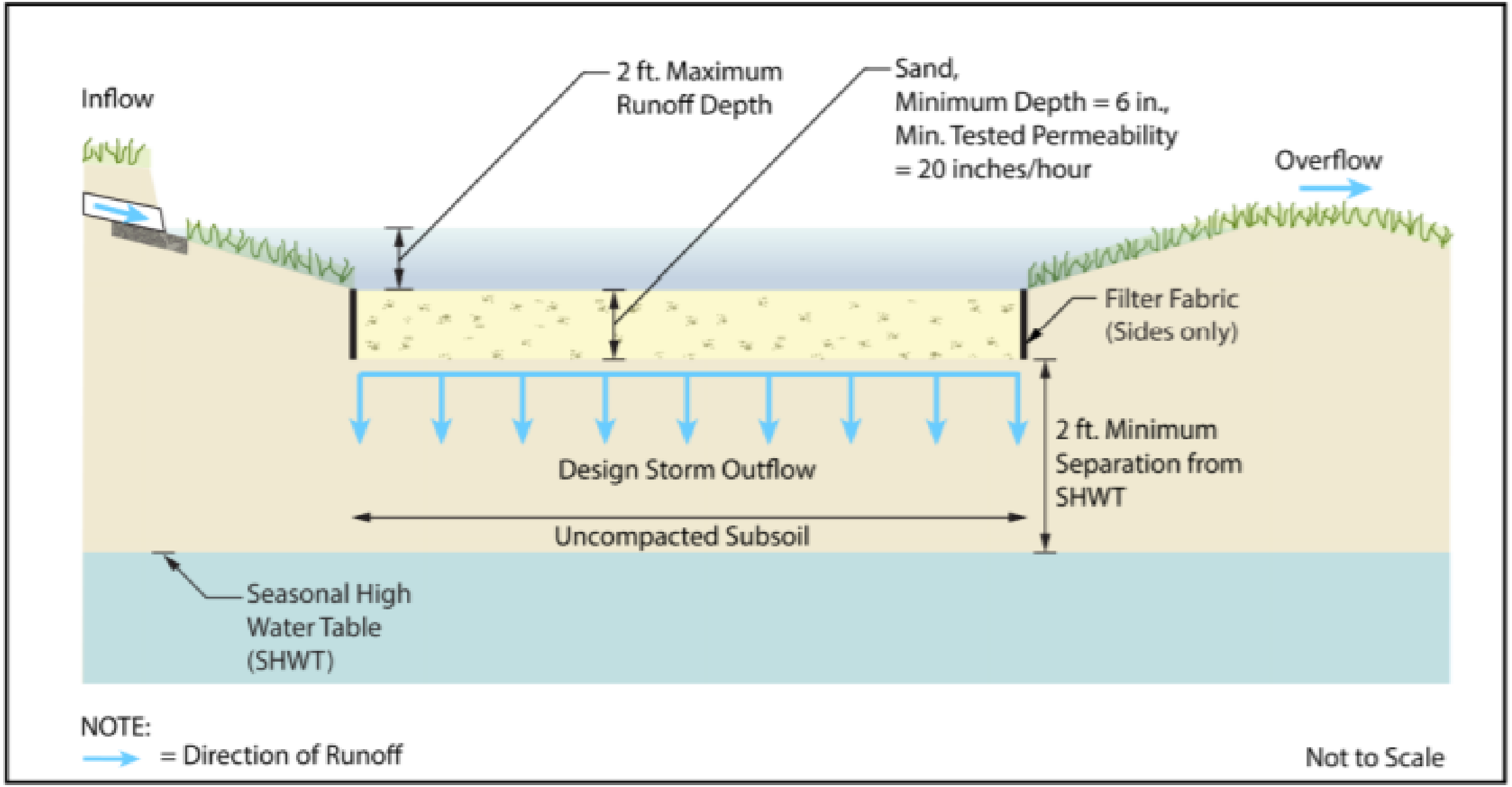

Rain Garden

# Infiltration Systems

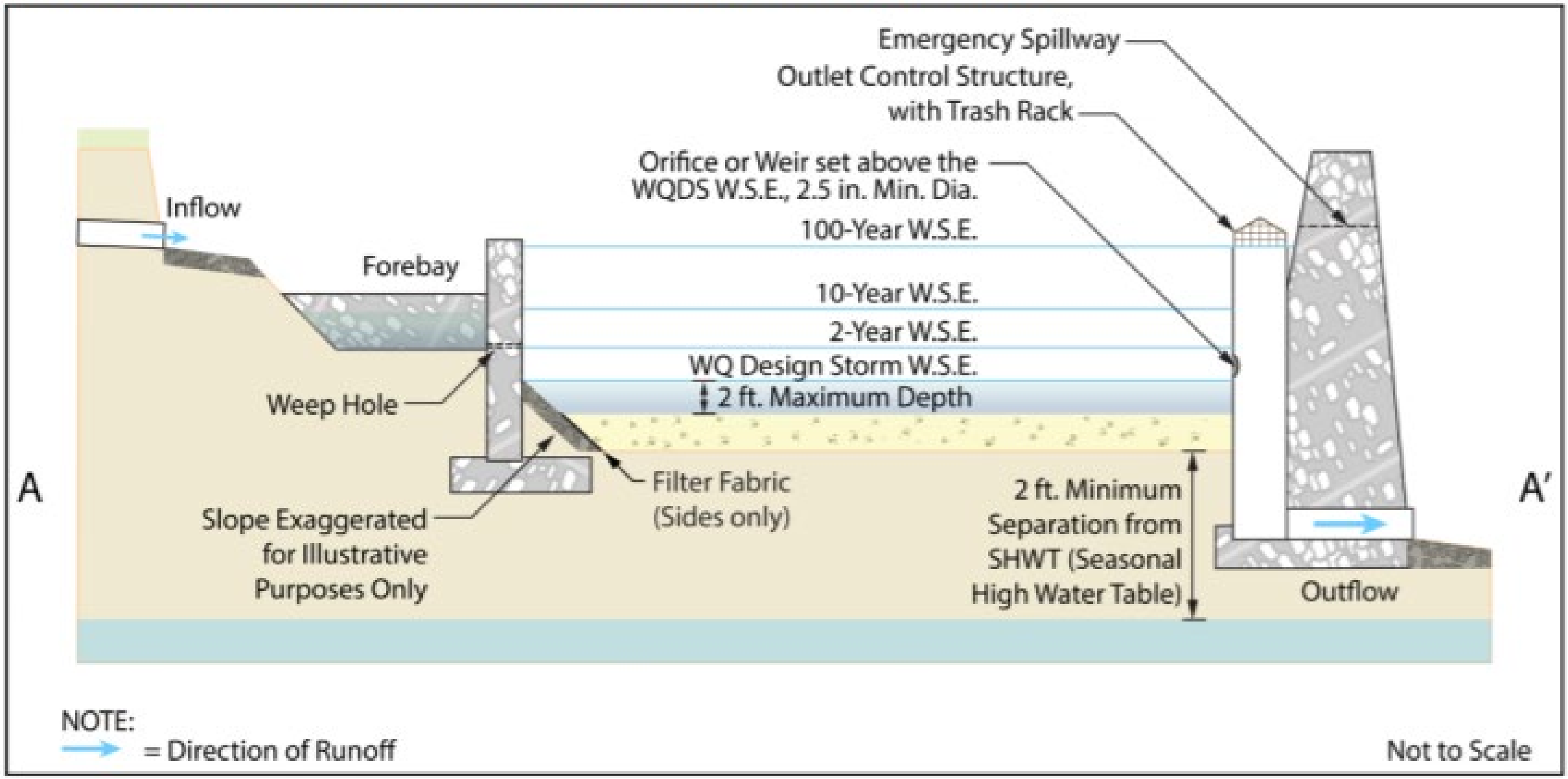
## Surface Infiltration Basin – Plan View



# Surface Infiltration Basin – Profile View

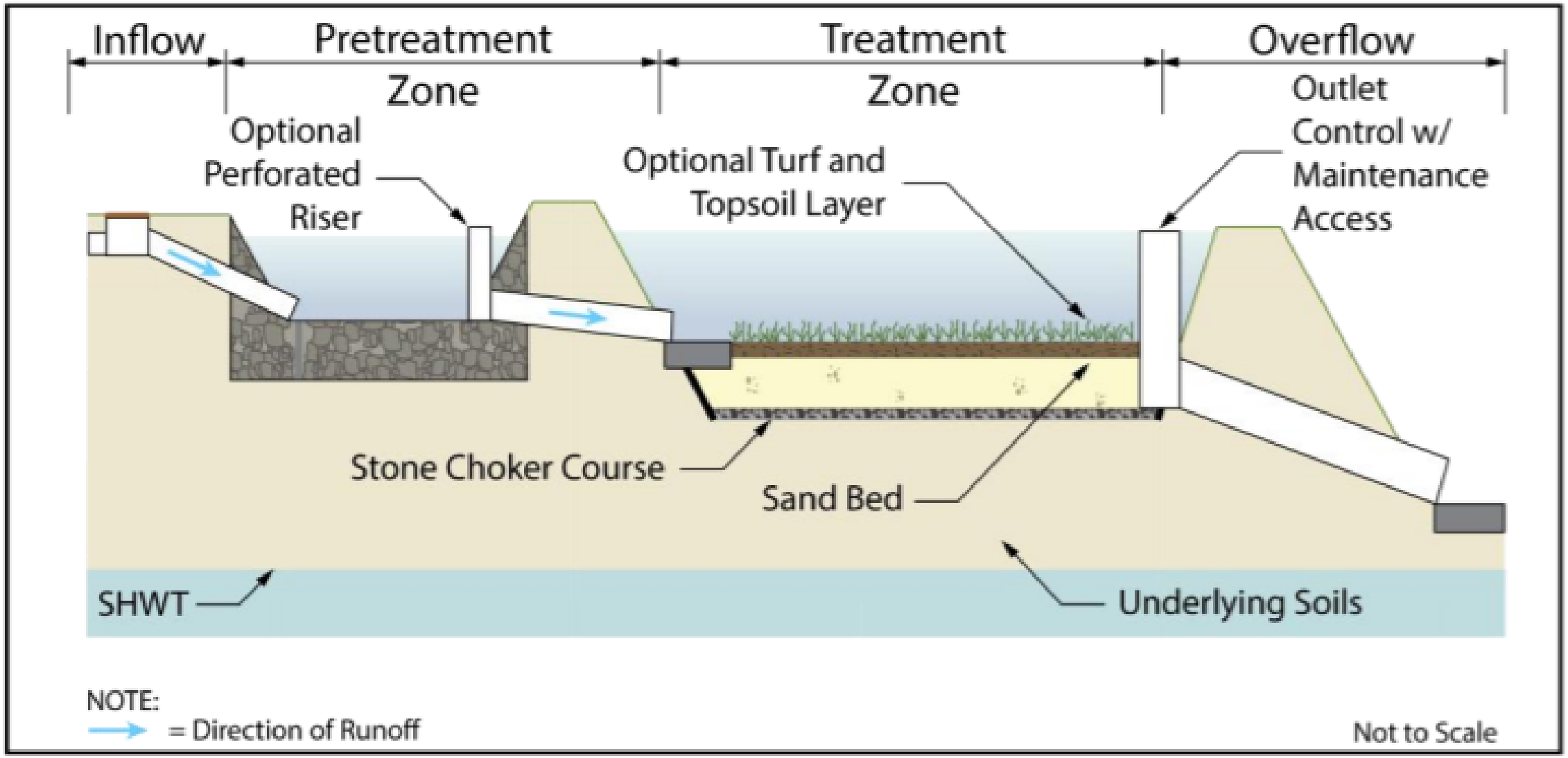


# Infiltration – Extended Detention Basin: Profile View

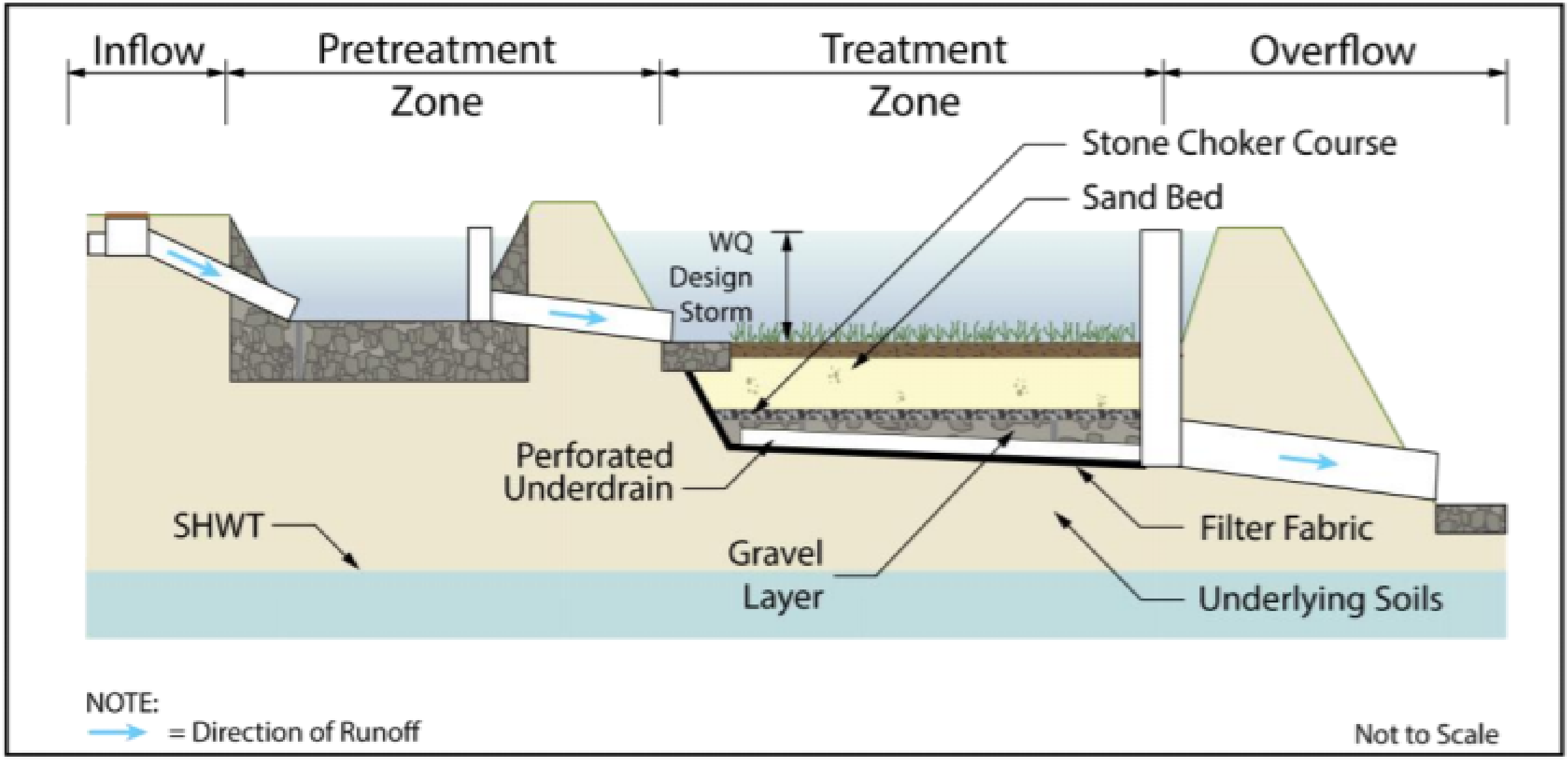


# Sand Filter

## Profile View – Sand Filter Basics



# Profile View – Sand Filter with Underdrain



# N.J.A.C. 7:14a - Municipal "Phase II" NJPDES Stormwater Regulations

- Regulates discharges to surface water and groundwater of stormwater from large, medium, and small municipal separate storm sewer systems
- Three general permits:
  1. Municipalities
  2. Public Complexes
  3. Highway Departments

# Summary of MS4 Requirements

1. Stormwater Management Program
2. Minimum Standards for Public Involvement
3. Minimum Standards for Local Public Education
4. Minimum Standards for Construction Site Stormwater Runoff
5. Minimum Standards for Post Construction Stormwater Management in New Development and Redevelopment
6. Minimum Standards for Pollution Prevention/ Good Housekeeping for Municipal Operators
7. Minimum Stands for MS4 Mapping, and Scouring, and Illicit Discharge Detection and Elimination
8. Watershed Improvement Plan
9. Additional Measures and Optional Measures

# Combined Sewer Overflow NJPDES Individual Permits

- 21 Cities with Combined Sewer Overflows (CSOs)
- NJDEP issuing individual permits to eliminate these CSOs
- Cities developing Long-Term Control Plans (LTCP)
- Community engagement important in developing LTCP
- Green Infrastructure a key component of LTCP
- Green Infrastructure required community engagement to be successful

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New Jersey Agricultural Experiment Station

# What is the Role of the Rutgers Cooperative Extension Water Resources Program?

# Our Thought Process

1. Don’t think like an academic; think like a consultant
2. Motivation is improving quality of life, not making money
3. Take advantage of the brand (everyone loves and trust Rutgers)
4. Engage the students
5. Set clear expectations
6. Always find ways to improve the final deliverables
7. Empower local leaders and get the public involved

# Let’s talk about some of our programs

- Tech Assistance for CSO Communities
- Tech Assistance for MS4 Communities
- Stormwater Management in Your Schoolyard
- Green Infrastructure Planning, Design, and Implementation
- Green Infrastructure Champions

# New Jersey Technical Assistance Program for Combined Sewered Communities (21 Cities have Combined Sewers in New Jersey)

- Creating municipal action team for green infrastructure
- Conducting education and outreach programs for a variety of audiences (dischargers, politicians, residents, businesses, community groups)
- Developing Green Infrastructure Feasibility Studies
- Designing demonstration projects
- Soliciting funding including Environmental Infrastructure Trust applications

# Created Green Infrastructure Municipal Action Teams

- Camden SMART
- Newark DIG
- Paterson SMART
- Perth Amboy SWIM




# Community Meetings

- Several meetings across the City
- Residents completed short surveys and sketched on neighborhood maps to identify existing areas of flooding and potential areas for green infrastructure

# Site Visits and City Tours

- Conducted multiple visits and tours to individual neighborhoods
- Met with community leaders
- Photographed and measured green infrastructure opportunity sites

# COMMUNITY-BASED GREEN INFRASTRUCTURE FOR THE CITY OF CAMDEN

## Feasibility Study

November 2011

Camden County Municipal Utilities Authority

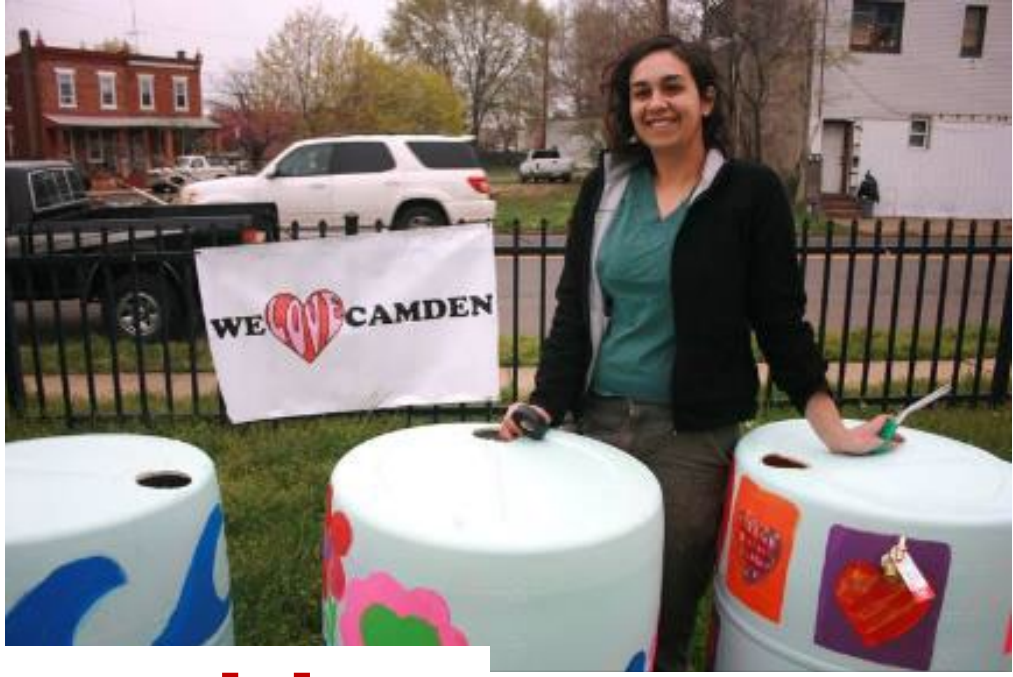
Rutgers New Jersey Agricultural Experiment Station

Water Resources Program

Camden SMART Initiative

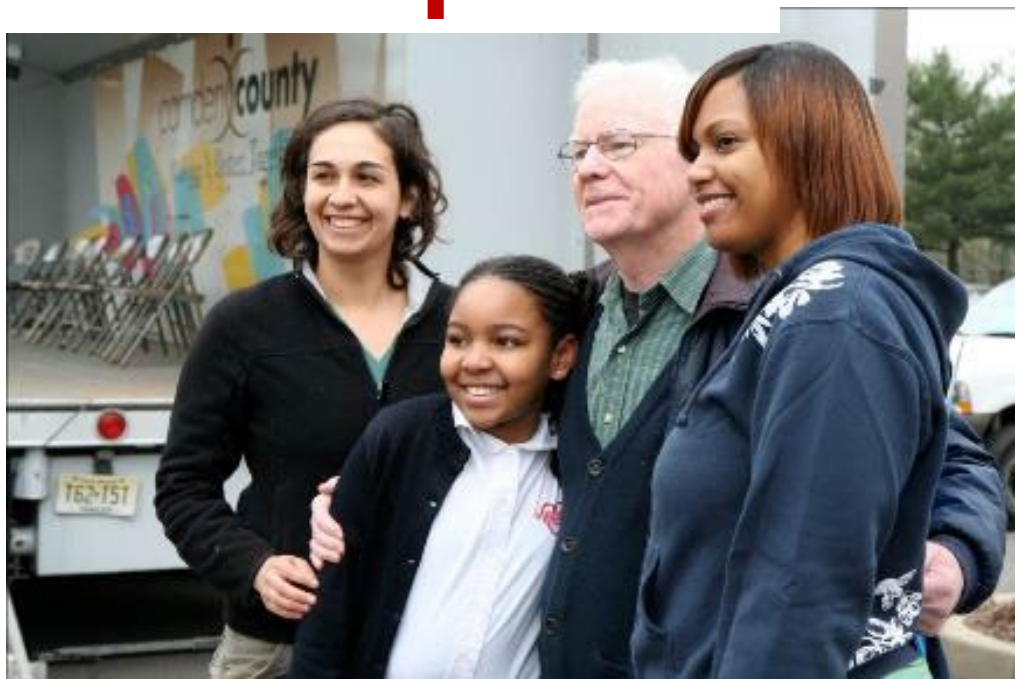
# Building Projects


Nationwide 4G LTE.
40, period.
metro


# It’s all about relationships

# It’s all about local champions



# It’s all about commitment

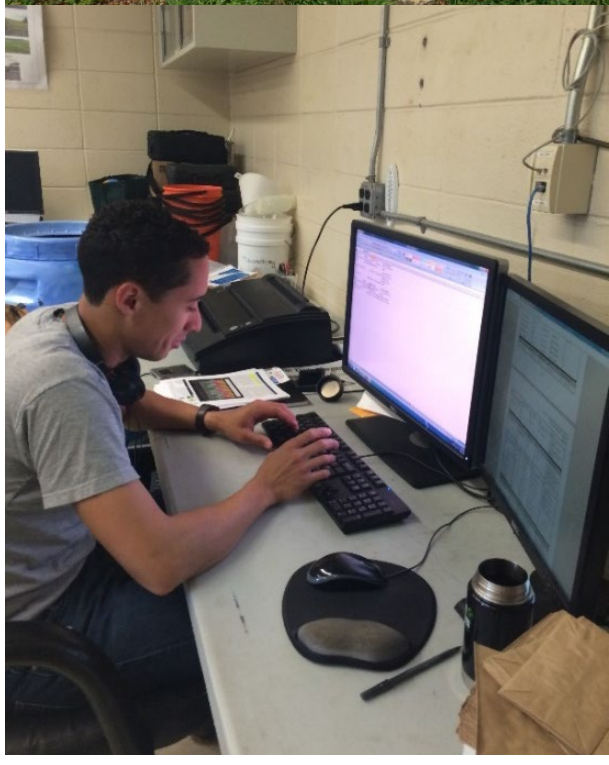

# It’s all about future generations

# Where are we now?

1. Received grants for $1.2 million to implement a green street projects in Newark (NJDEP/EPA)
2. Received $553,500 to implement green infrastructure at Newark Housing Authority site (NJDEP/EPA)
3. The Nature Conservancy received $8 million for re-establishing tree canopy in Newark (USDA)
4. Rutgers received $10 million to implement green infrastructure projects in Newark, Paterson, and Perth Amboy (NOAA)

## Green Infrastructure Planning, Design, and Implementation for MS4 Communities (There are 564 municipalities in New Jersey)

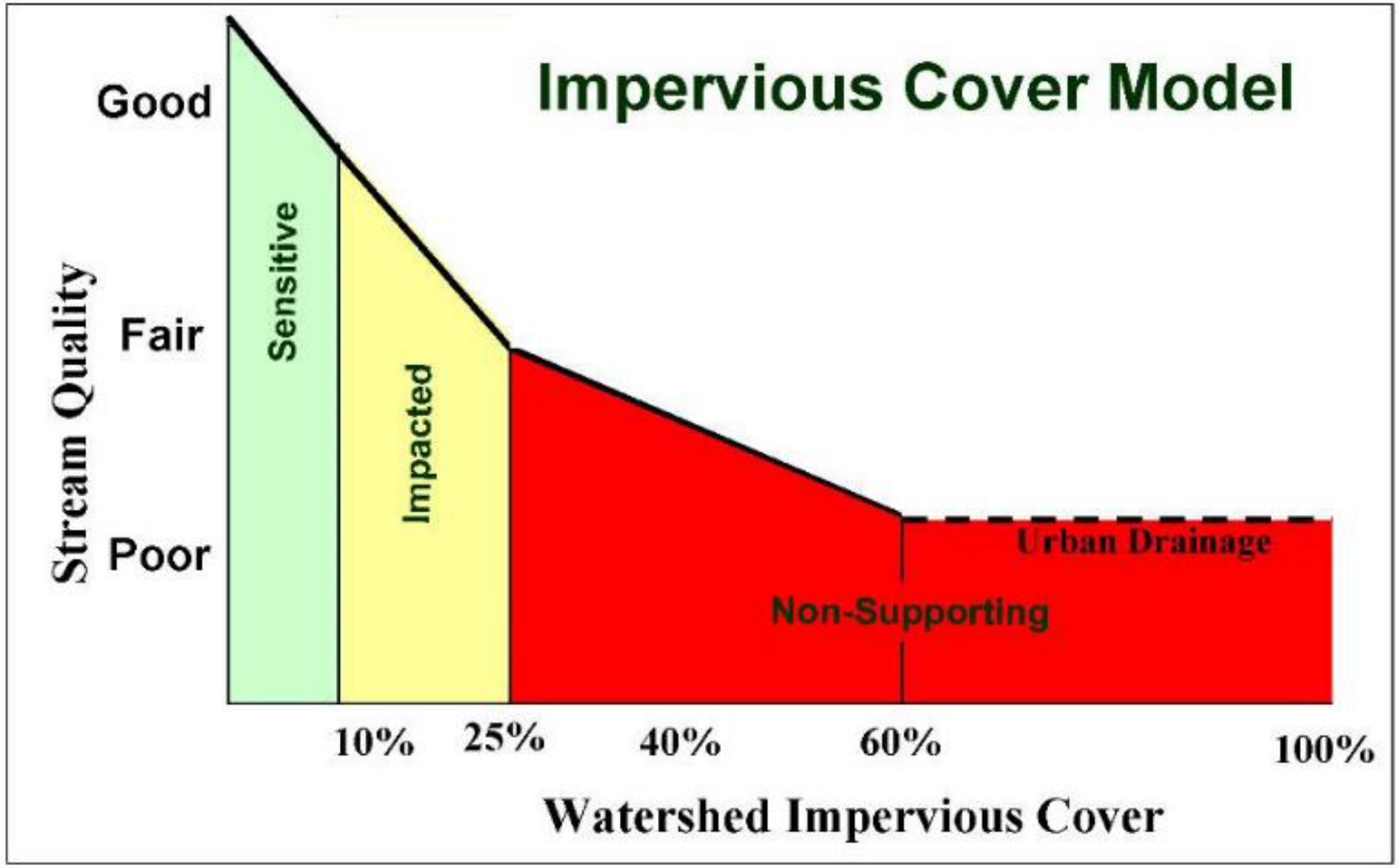
- Conducting Impervious Cover Assessments (ICAs)
- Hosting community meetings and delivering workshops
- Developing Impervious Cover Reduction Action Plans (RAPs)
- Designing and implementing demonstration projects
- Updating ordinances, building codes, and master plans



# Let's talk about some of our planning efforts for MS4 communities

- Regional Stormwater Management Plans (NJDEP)
- Watershed Restoration and Protection Plans (USEPA)
- Impervious Cover Assessments (ICAs) and Impervious Cover Reduction Action Plans (RAPs) (RCE Water Resources Program)
- Green Infrastructure Feasibility Studies

# What does the science say about impervious surfaces?




Reference: Tom Schueler and Lisa Fraley-McNeal, Symposium on Urbanization and Stream Ecology, May 23 and 24, 2008

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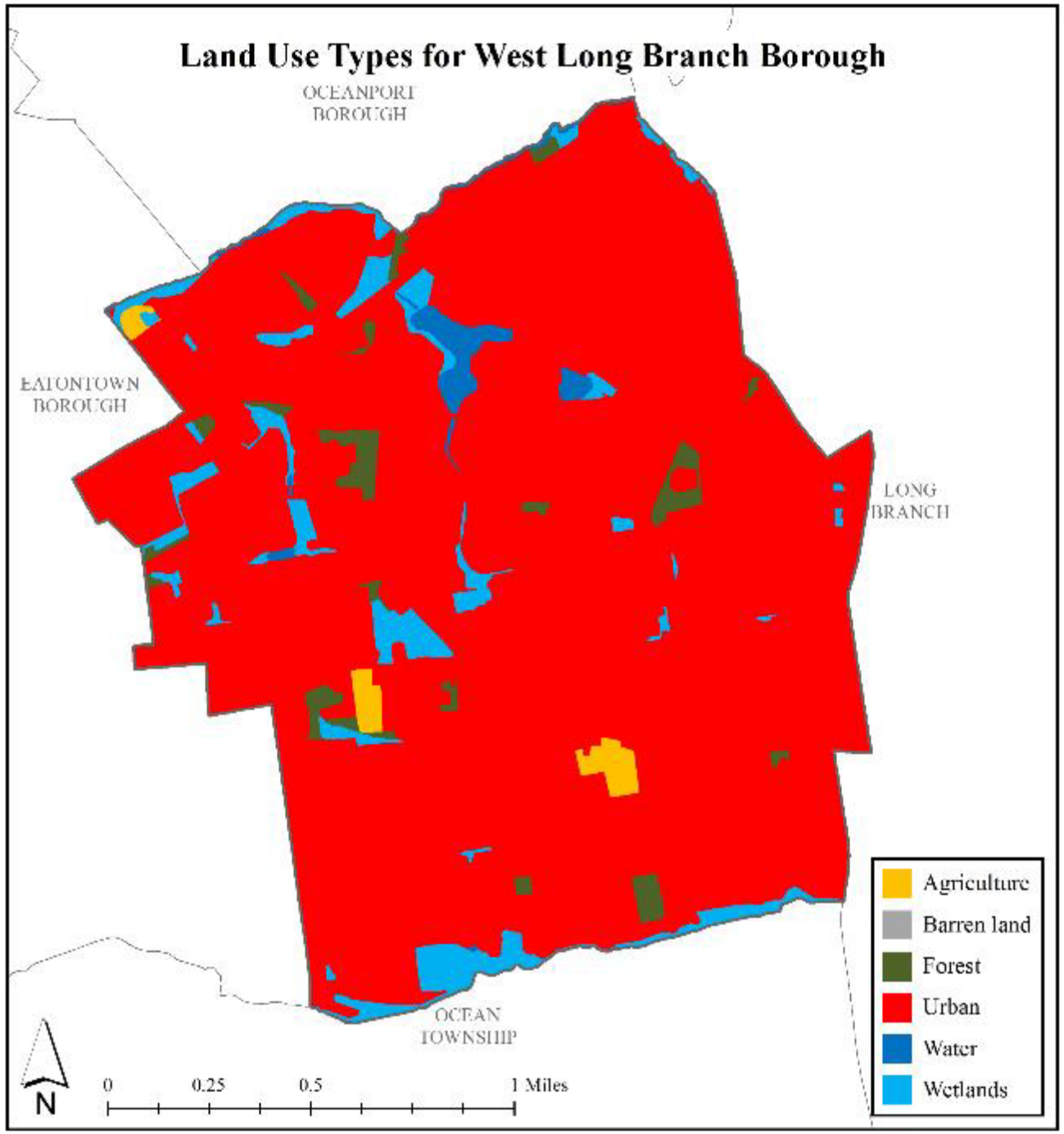
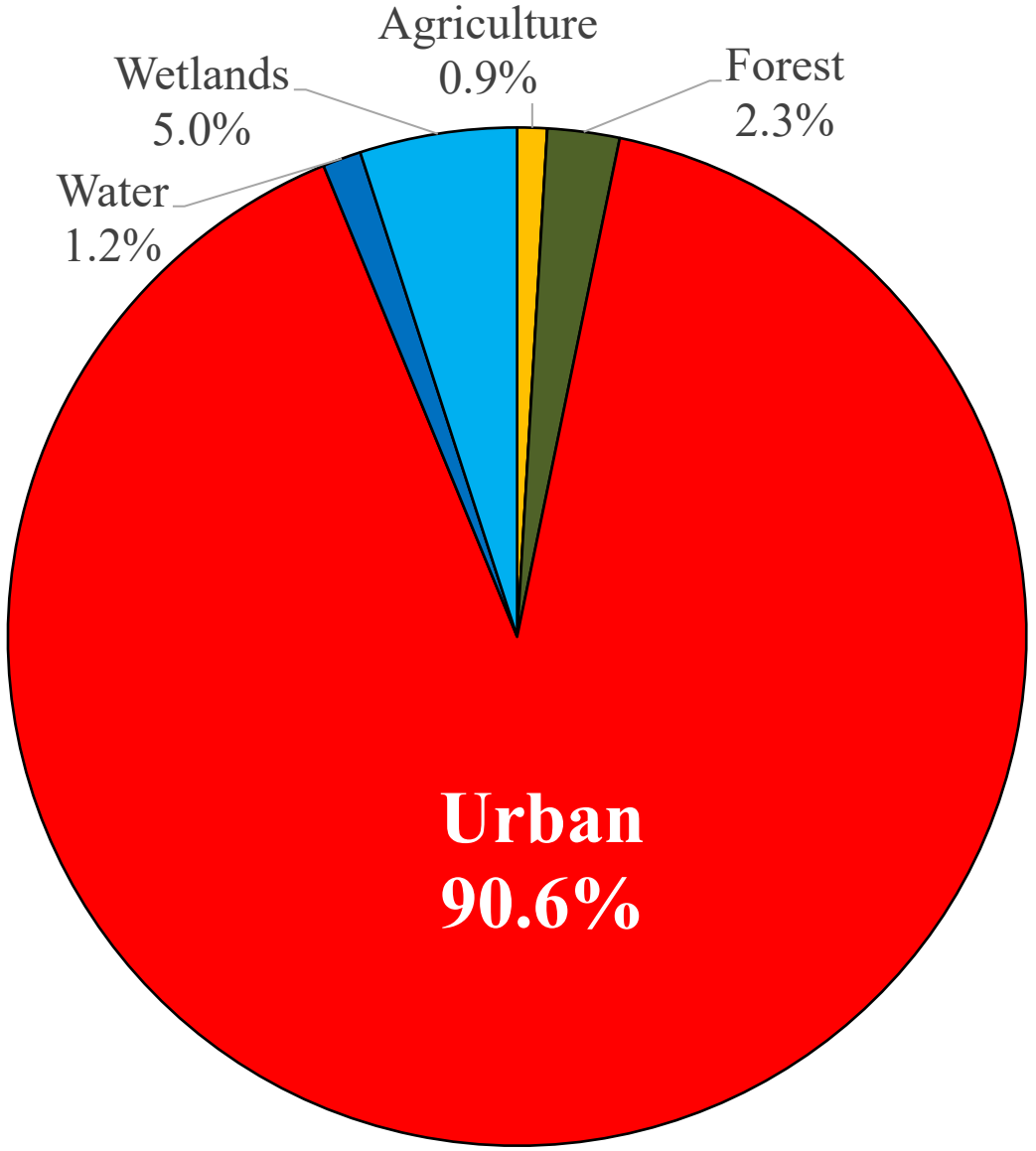
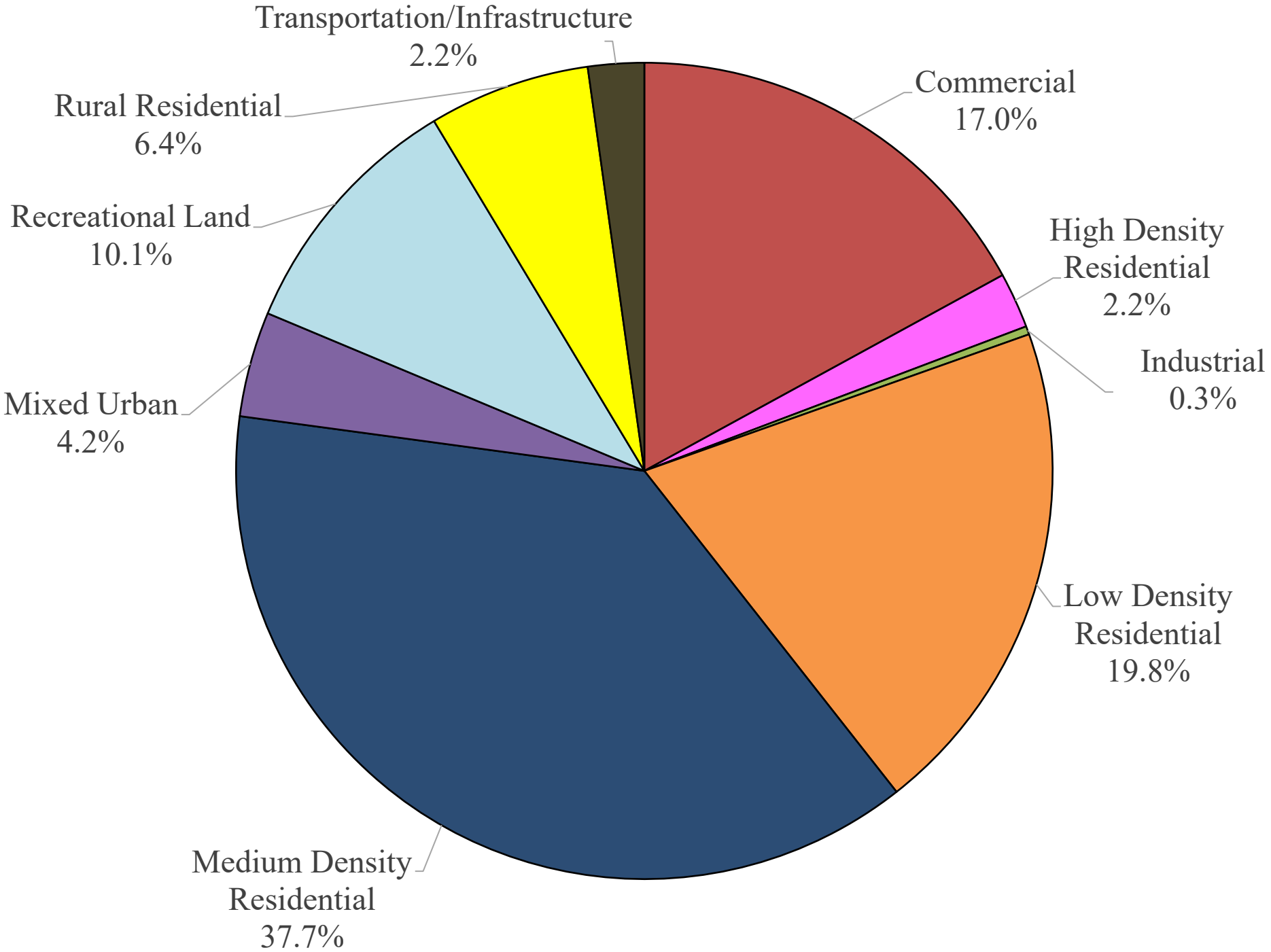
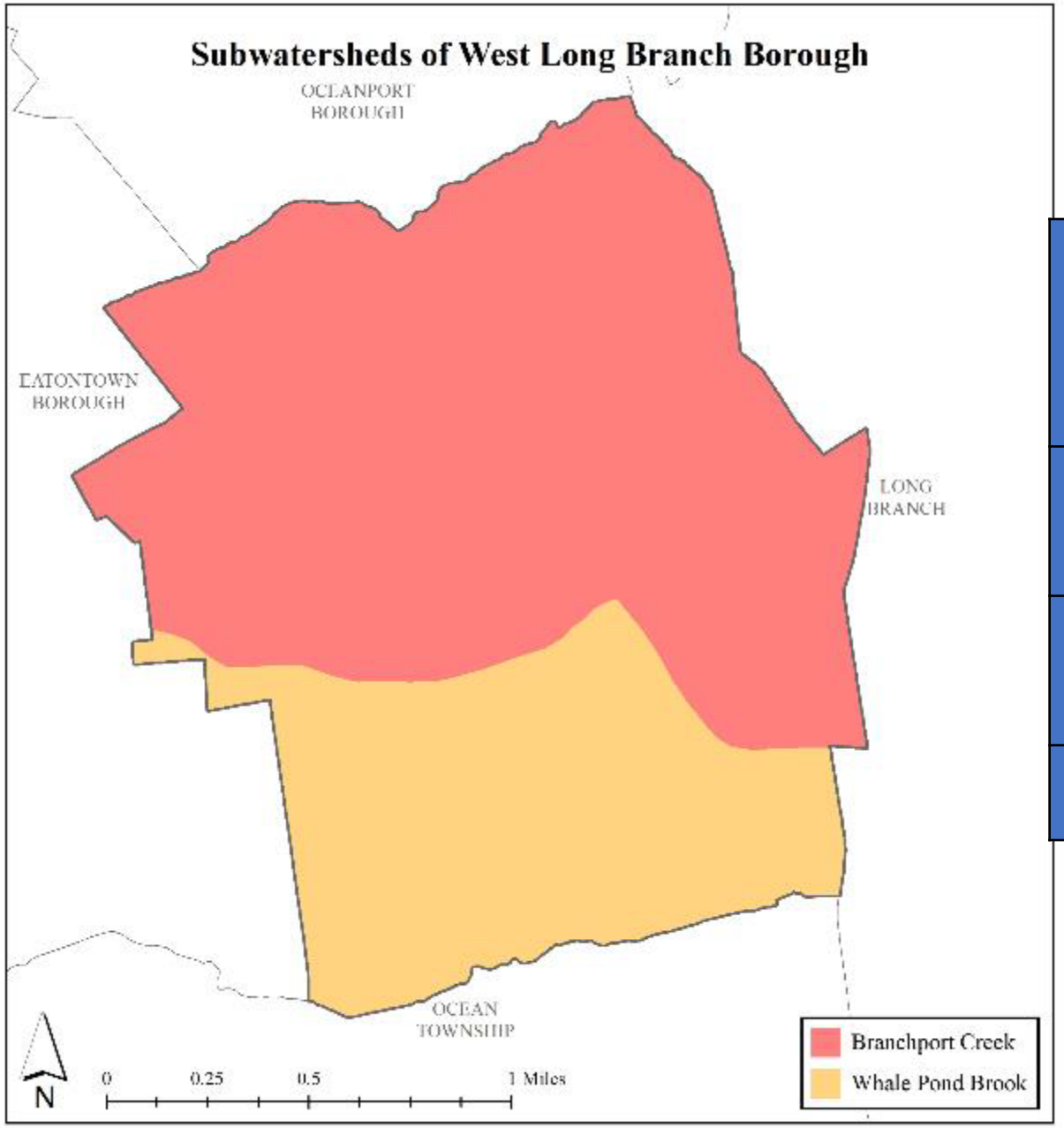
# Impervious Cover Assessment (ICA)


Land Use Types for West Long Branch Borough
OCEANPORT BOROUGH
EATONTOWN BOROUGH
LONG BRANCH
OCEAN TOWNSHIP
N
0
0.25
0.5
1 Miles
Agriculture
Barren land
Forest
Urban
Water
Wetlands


Agriculture 0.9%
Forest 2.3%
Wetlands 5.0%
Water 1.2%
Urban 90.6%


Transportation/Infrastructure
2.2%
Commercial
17.0%
Rural Residential
6.4%
High Density
Residential
2.2%
Recreational Land
10.1%
Industrial
0.3%
Mixed Urban
4.2%
Low Density
Residential
19.8%
Medium Density
Residential
37.7%




| Subwatershed | Total Area (ac) | Impervious Cover (ac) | % |
|---|---|---|---|
| Branchport Creek | 1,258 | 436 | 35.3% |
| Whale Pond Brook | 596 | 156 | 26.2% |
| Total | 1,854 | 592 | 32.3% |

| Subwatershed | Impervious Cover (acres) | NJ Water Quality Storm (Mgal) | Annual Rainfall of 47.6" (Mgal) |
|---|---|---|---|
| Branchport Creek | 436 | 14.8 | 563.5 |
| Whale Pond Brook | 156 | 5.3 | 201.6 |
| Total | 592 | 20.1 | 765.1 |

# Rainfall Intensity for Design Storms for Various Time Periods (Monmouth County)

| Year | 2-yr (in) | 10-yr (in) | 100-yr (in) |
|---|---|---|---|
| 1999 | 3.38 | 5.23 | 8.94 |
| 2020 | 3.38 | 5.28 | 9.12 |
| 2100 | 4.02 | 6.22 | 11.26 |

| Subwatershed | Impervious Cover (acres) | Rainfall 2020 | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| | | (in) | (in) | (in) |
| | | 3.38 | 5.28 | 9.12 |
| Branchport Creek | 436 | 40.0 | 62.5 | 108.0 |
| Whale Pond Brook | 156 | 473.7 | 740.0 | 1,278 |
| Total | 592 | 5,608 | 8,760 | 15,131 |

| Subwatershed | Impervious Cover (acres) | Rainfall 2100 | | |
|---|---|---|---|---|
| | | 2-yr | 10-yr | 100-yr |
| | | (in) | (in) | (in) |
| | | 4.02 | 6.22 | 11.26 |
| Branchport Creek | 436 | 47.6 | 73.6 | 133.3 |
| Whale Pond Brook | 156 | 563.4 | 871.7 | 1,578 |
| Total | 592 | 6,670 | 10,320 | 18,682 |

# Comparing Runoff Volume Results for Various Years

| Design Storm | 1999 (Mgal) | 2020 (Mgal) | 2100 (Mgal) |
|---|---|---|---|
| 2-yr | 5,608 | 5,608 | 6,670 |
| 10-yr | 8,677 | 8,760 | 10,320 |
| 100-yr | 14,833 | 15,131 | 18,682 |

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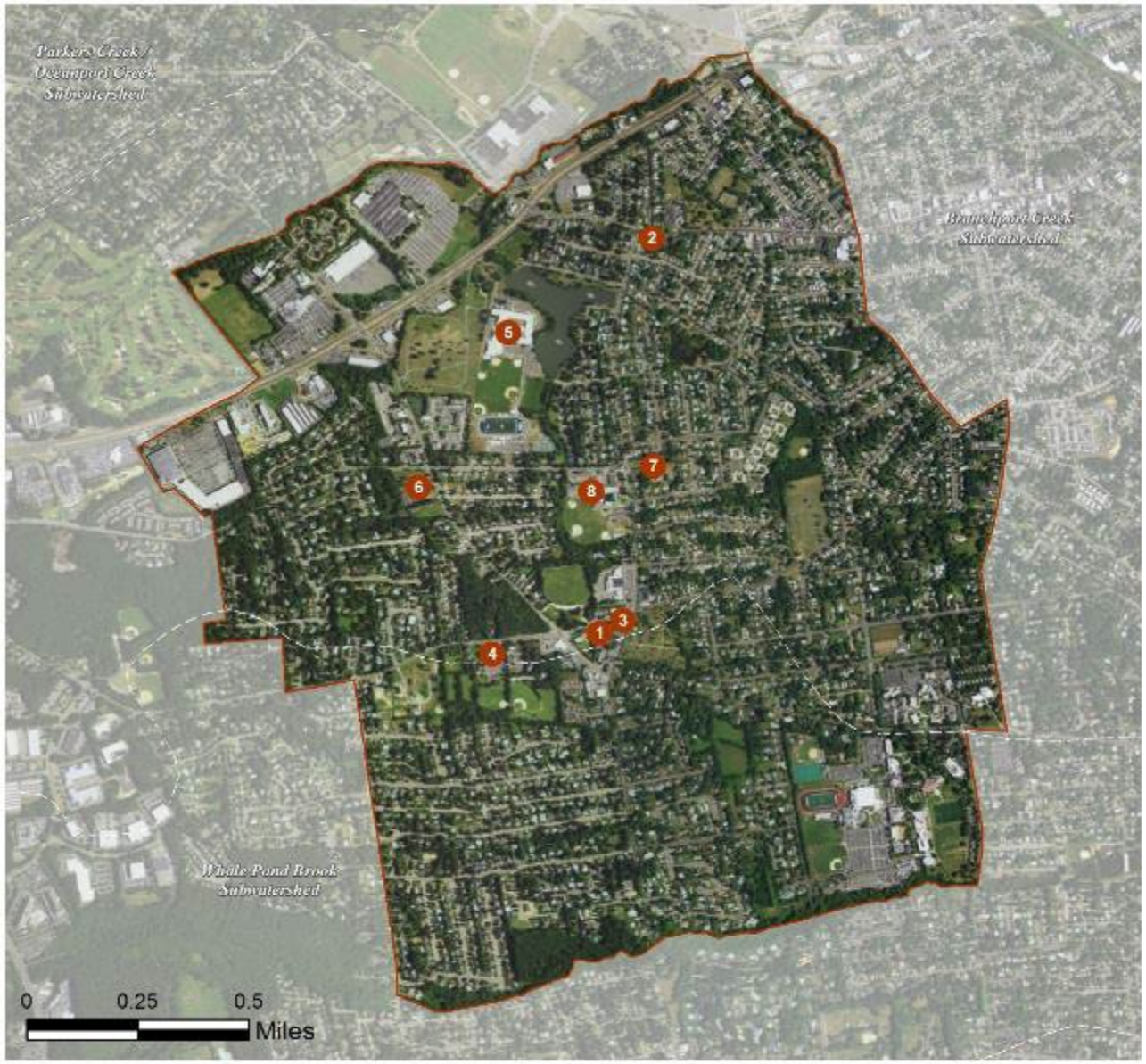
# Impervious Cover Reduction Action Plan (RAP)

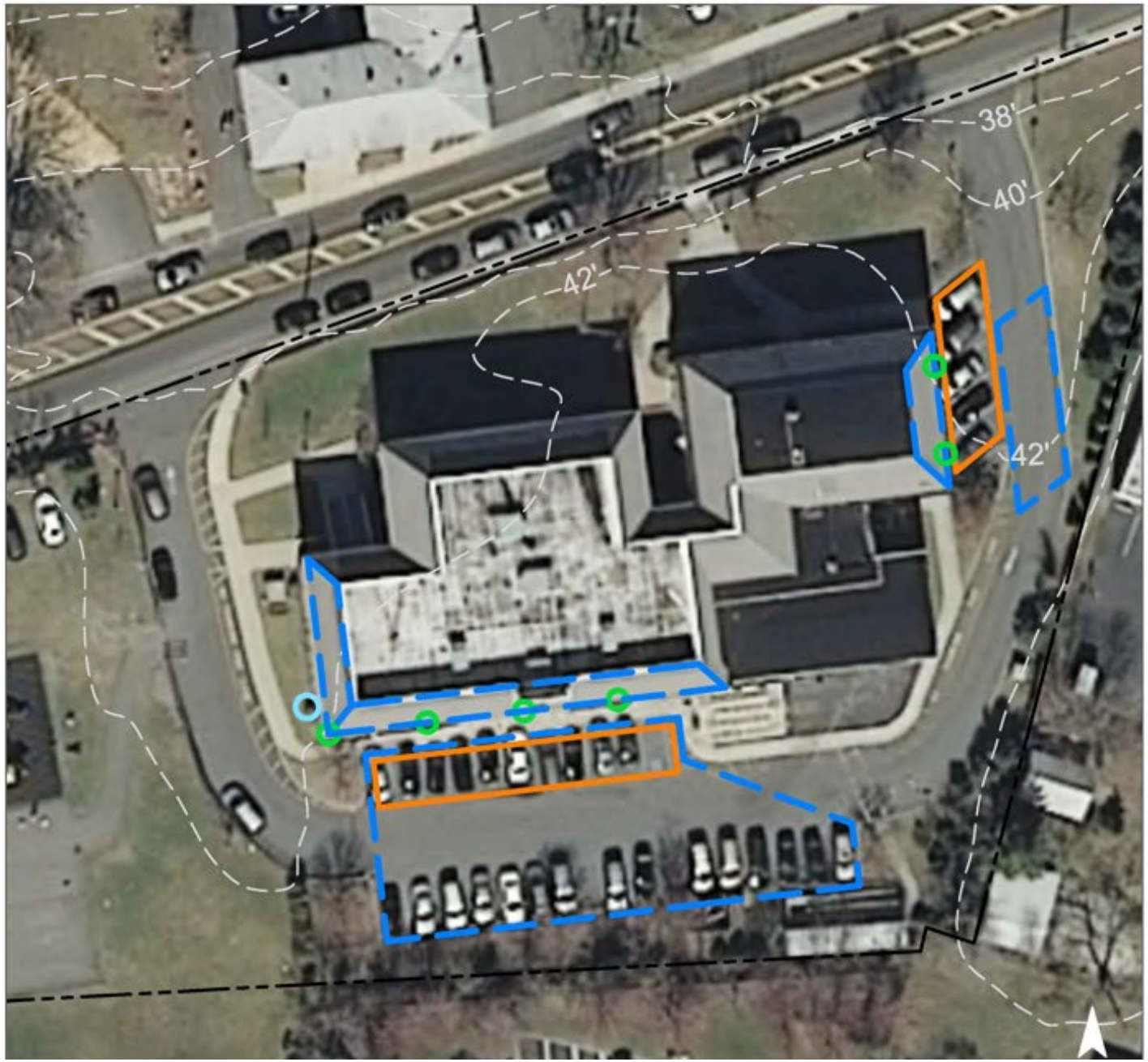
## WEST LONG BRANCH BOROUGH: GREEN INFRASTRUCTURE SITES




**SITES WITHIN THE BRANCHPORT CREEK SUBWATERSHED:**

1. Frank Antonides Elementary School
2. Lutheran Church Reformation
3. Old First United Methodist Church
4. Saint Jerome's Catholic Church and School
5. Shore Regional High School
6. Sovereign Bank
7. West Long Branch Community Center
8. West Long Branch Public School

# GREEN INFRASTRUCTURE RECOMMENDATIONS




**Frank Antonides Elementary School**

- disconnected downspouts
- pervious pavements
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

# West Long Branch Borough

1 Frank Antonides Elementary School

2 Lutheran Church Reformation

3 Old First United Methodist Church

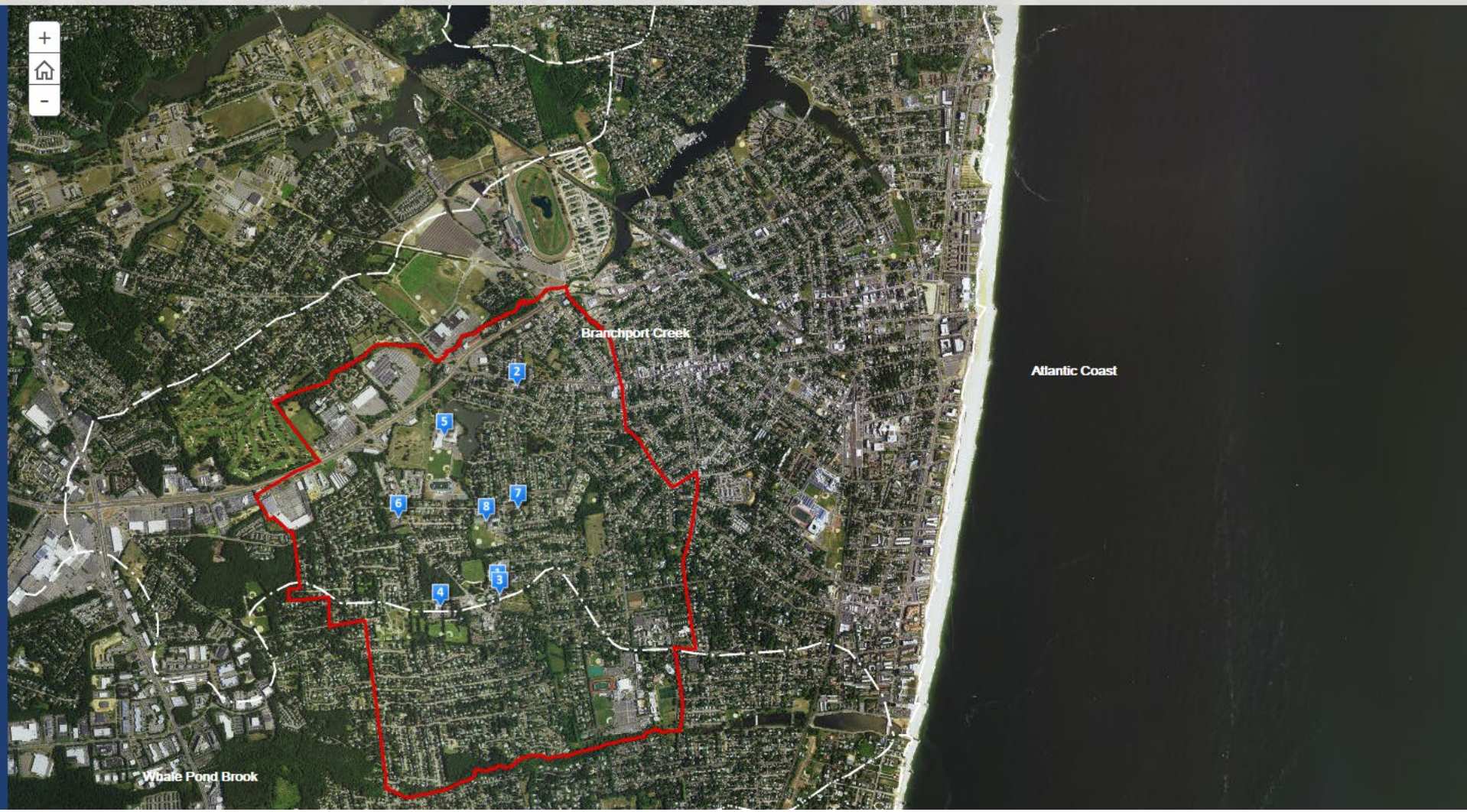
4 Saint Jerome's Catholic Church and School

5 Shore Regional High School

6 Sovereign Bank

7 West Long Branch Community Center

8 West Long Branch Public School



# West Long Branch Borough

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1 Frank Antonides Elementary School


2 Lutheran Church Reformation


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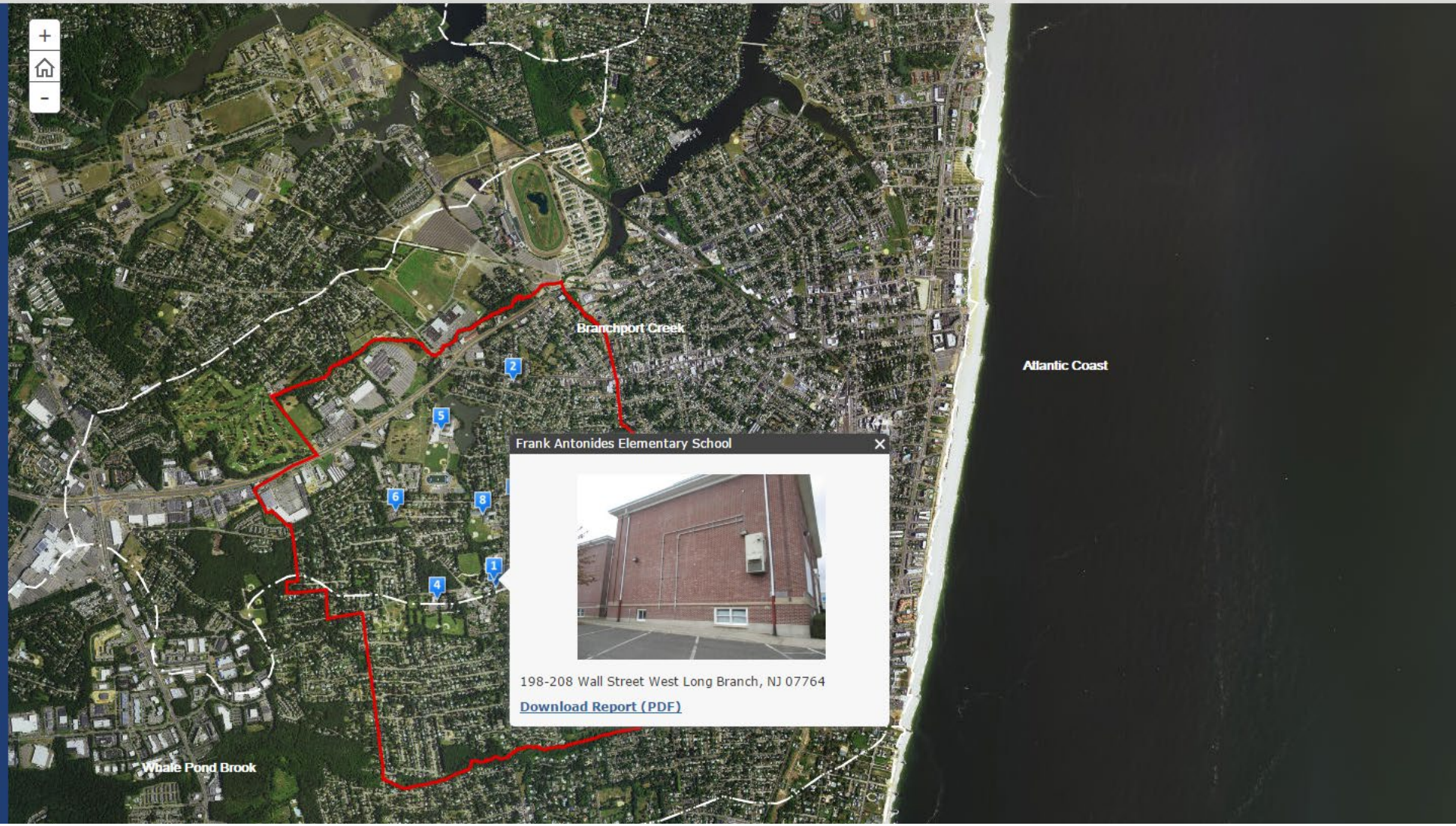

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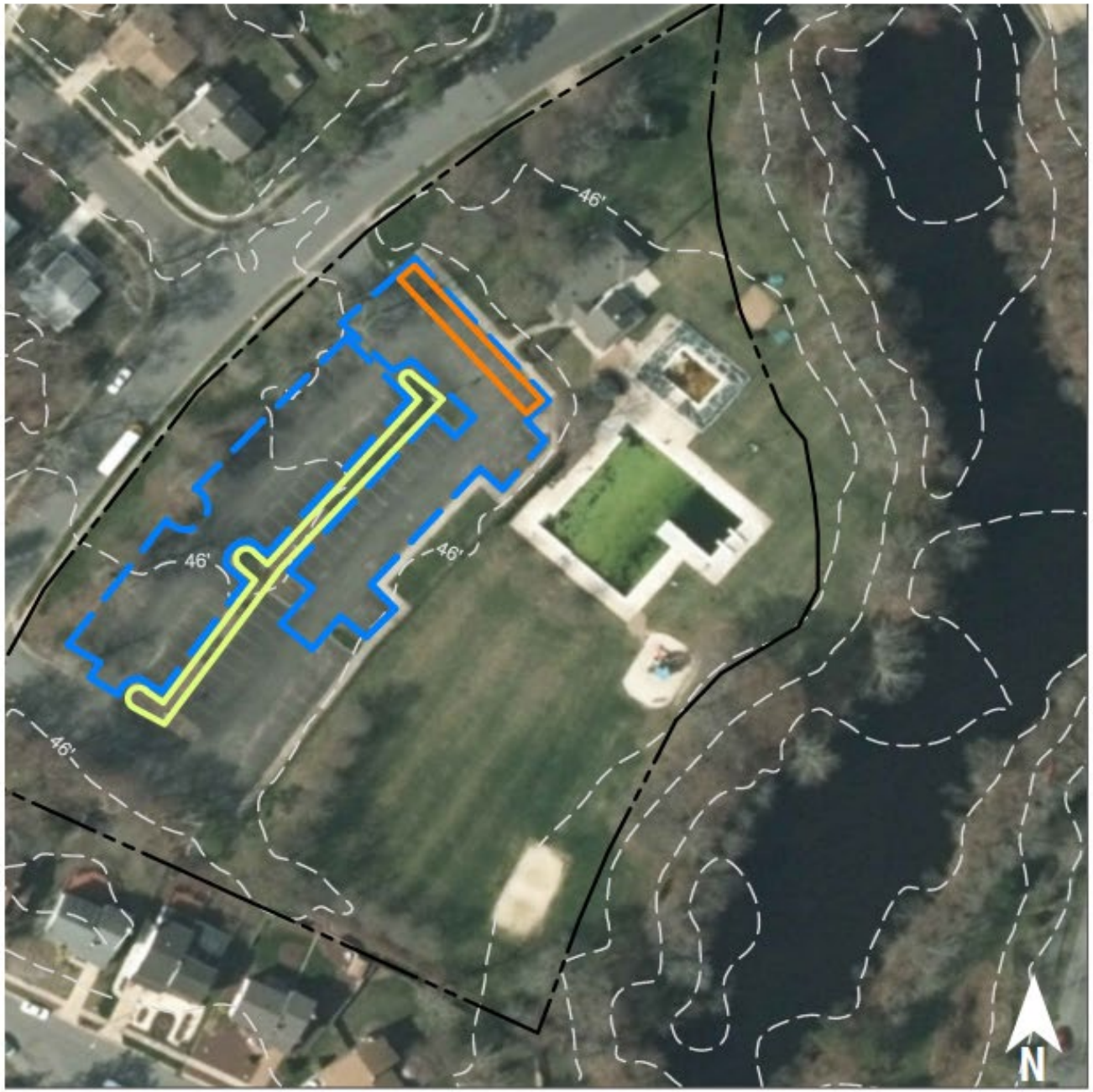
# Green Infrastructure Feasibility Study

- A high-end visual presentation of opportunities
- Provides green infrastructure overview
- Incorporates ICA and RAP information
- User-friendly format




bioretention system

pervious pavement

drainage area

property line

2015 Aerial: NJOIT, OGIS

0' 50' 100'

# BARTON RUN SWIM CLUB

100 Lakeside Drive
Marlton, NJ 08053

Stormwater is currently directed to an existing catch basin. Installing rain gardens in the parking lot islands can capture, treat, and infiltrate stormwater runoff from the parking lot. Replacing parking spaces with porous pavement can capture and infiltrate runoff from the other side of the parking lot. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.



| Impervious Cover | | Existing Loads from Impervious Cover (lbs/yr) | | | Runoff Volume from Impervious Cover (Mgal) | |
|---|---|---|---|---|---|---|
| % | sq. ft. | TP | TN | TSS | From the 1.25" Water Quality Storm | For an Annual Rainfall of 44" |
| 30 | 51,770 | 2.5 | 26.1 | 237.7 | 0.040 | 1.42 |

| Recommended Infrastructure Practices | Recharge Potential (Mgal/yr) | TSS Removal Potential (lbs/yr) | Maximum Volume Reduction Potential (gal/storm) | Peak Discharge Reduction Potential (cu. ft./second) | Estimated Size (sq. ft.) | Estimated Cost |
|---|---|---|---|---|---|---|
| Bioretention systems | 0.288 | 48 | 21,834 | 0.82 | 2,765 | $13,825 |
| Pervious pavement | 0.352 | 59 | 26,651 | 1.00 | 2,410 | $60,250 |

# CURRENT CONDITION

# CONCEPT DESIGN

# Where are we now?

1. Received grants for $1.6 million to implement a MS4 Technical Assistance Program (NJDEP/EPA)
2. Hired four engineers to work in NE, NW, Central and South Jersey with MS4 communities
3. The Green Infrastructure Feasibility Study is the foundation of the Watershed Improvement Plan that each municipality must prepare
4. We have completed green infrastructure plans for over 250 of the 564 municipalities.

# Green Infrastructure Champions Program

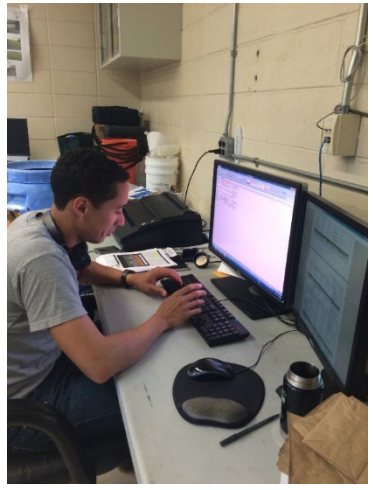
- 10 online classes (free)
- Certified after five classes
- Resources provided to certified Green Infrastructure Champions
- Not exclusive to New Jersey
- Creates an army of minions to advocate for green infrastructure

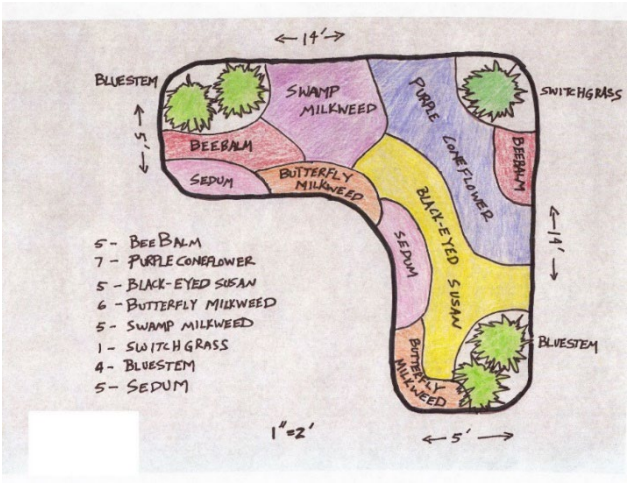

LET IT GROW


EXIT

# Green Infrastructure Champion Training Program Classes

1. How to identify green infrastructure projects in your town
2. Moving from planning to implementation of green infrastructure





# Green Infrastructure Champion Training Program Classes

3. Maintaining green infrastructure practices/projects

4. Stormwater management regulations, policies, and ordinances

# Green Infrastructure Champion Training Program Classes

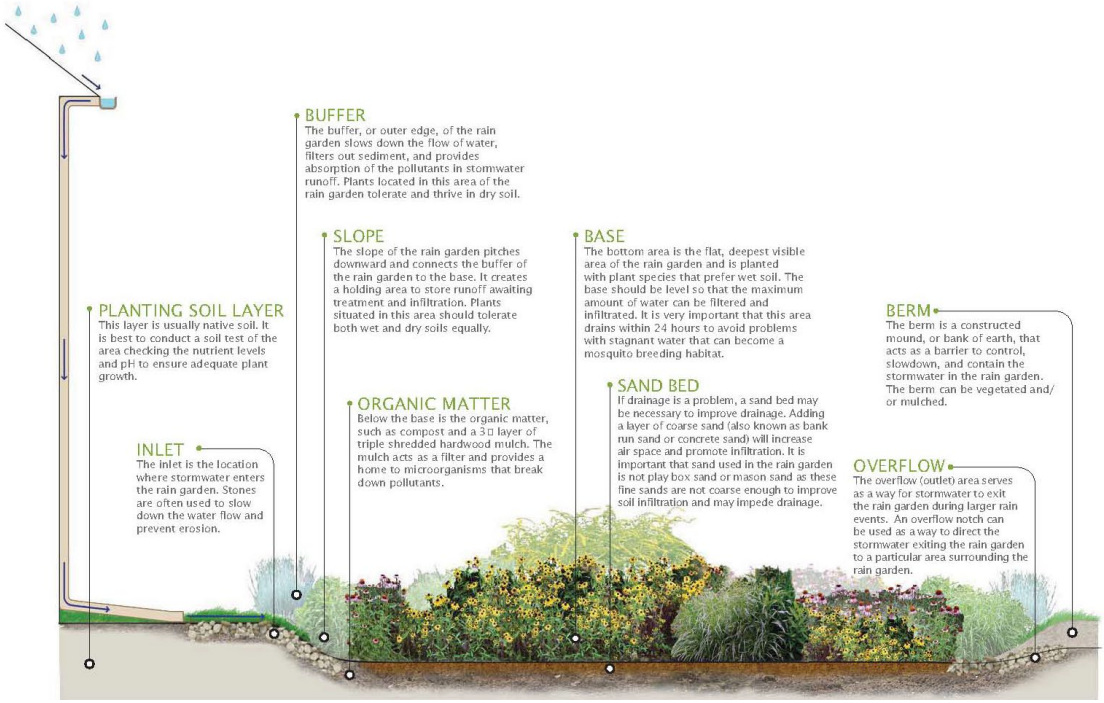
5. Green infrastructure planning and implementation for Sustainable Jersey points

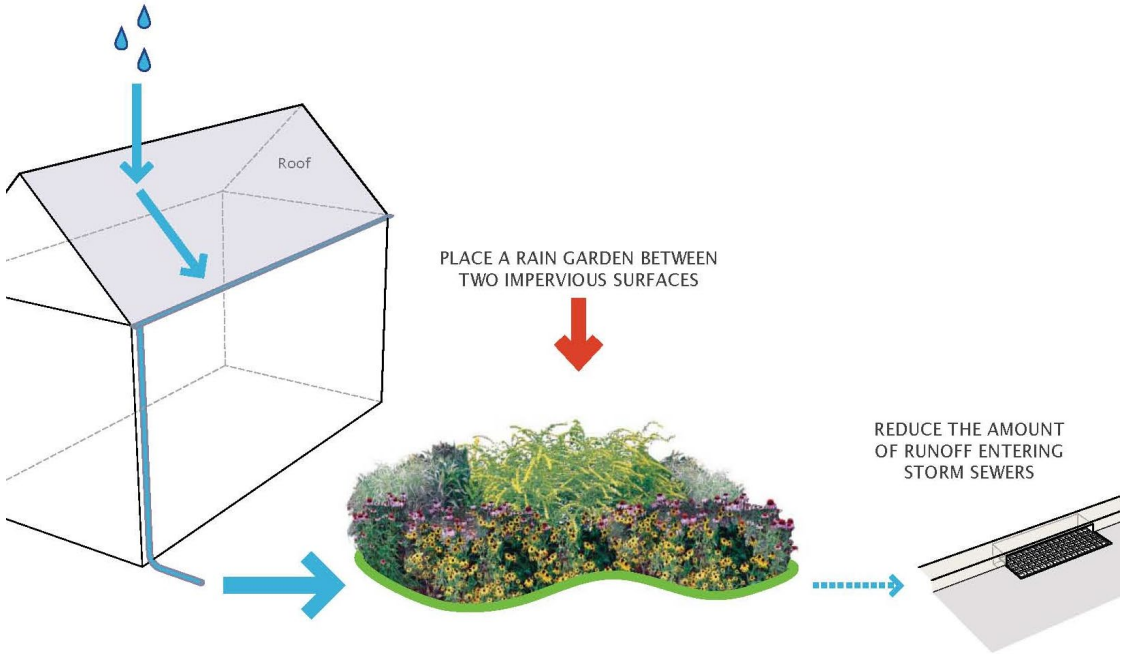
6. Green infrastructure projects for schools

# Green Infrastructure Champion Training Program Classes

7. How to design and build a rain garden

8. Retrofitting traditional detention basins with green infrastructure



# Green Infrastructure Champion Training Program Classes

9. Developing green infrastructure master plans for an entire site or neighborhood

10. Using green infrastructure to promote climate resiliency

# Green Infrastructure Champions

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

Cheryl Reardon works for the Association of New Jersey Environmental Commissions.

Nathaniel Sajdak works for the Wallkill River Watershed Management Group.

Laura McBride created the Deal Lake Watershed Alliance.

# More Green Infrastructure Champions

Green Infrastructure Champions are also from very urban areas like the City of Newark and Jersey City

Kim Gaddy, National EJ Director for Clean Water Action and South Ward Environmental Alliance

Dawn Giambalvo, Director of Innovation Department of Infrastructure Office of Innovation Jersey City, NJ

Nicole Miller, Principal of MnM Consulting, Co-Chair of NewarkDIG, Co-Chair Jersey Water Works

# So what?

**Ann Marchioni and Jane Kinkle on the Caldwell Environmental Commission – Green Infrastructure Champions, 2019**

- Prepared a Sustainable Jersey Grant for Green Infrastructure Planning and to build two rain gardens
- Received $20,000
- Project was a great success
- They wrote another grant to NJDEP's 319h Program
- NJDEP gave them another $91,106 to build three more rain gardens

**Laura McBride was concerned about the algae in a nearby lake. She forms the Deal Lake Watershed Alliance but is unsure what to do. One year later in 2019 she become a Green Infrastructure Champion.**

- Offers rain garden workshop
- Secures funding to build a roadside rain garden to protect the lake
- Receives open space funding to restore a piece of municipally-owned vacant land next to the lake – rain gardens, boat launch, porous pavement
- Annual Gala that raises significant funding for lake restoration activities
- Pressures town to do good

**Doriann Kerber, State Environmental Chair of the Lions Club Int'l and Environmental Commissioner.**
**Green Infrastructure Champion, 2019**

- Supporting 10 green infrastructure projects throughout Middlesex County
- Working with youth groups to install rain gardens (Boy Scouts, Girl Scouts, and Leo Club)
- Working directly with schools
- Shares her knowledge to empower other community members
- Tables at all the local environmental events


**Kim Gaddy, 3rd generation Newark resident and founder and Director of the South Ward Environmental Alliance in Newark, has 20 years experience as an Environmental Justice Organizer fighting against air and water pollution in Newark. Green Infrastructure Champion, 2020**

- Founding member of NewarkDIG
- Green Infrastructure Advocate in Newark
- Lead community effort to incorporate green infrastructure into CSO Long-Term Control Plan
- Ensures residents' voices are heard and they are active participants in decision making policies that impact their neighborhood
- Working with the City on green infrastructure workforce development

**David Kois is a municipal planner and zoning official. Green Infrastructure Champion, 2021**

- Developed a green infrastructure master plan for the Hillsborough Municipal Complex
- Led the effort to install five rain gardens and naturalize a detention basin
- Secured over $300K for green infrastructure projects in his town
- Changed the culture of the municipal government employees to embrace green infrastructure
- One of 20 Green Infrastructure Champions from Hillsborough

**Nicole Miller, Principal of MnM Consulting**, is a communications professional with more than a decade of experience creating targeted publicity and marketing campaigns for a range of clients in private industry and the non-profit sector. She is the co-Chair of NewarkDIG (doing infrastructure green) incorporating green infrastructure  into long-term control plan to eliminate CSOs. Green Infrastructure Champion, 2023

NEWARK DIG
doing infrastructure green

# Where are we now?

1. Over 600 certified Green Infrastructure Champions
2. Secured funding to support Champions in underserved communities
3. Train-the-Trainer Program to have Champions design rain gardens for homeowners in their community
4. Program will start again on January 10, 2025, registration will open in November 2024

# Stormwater Management in Your Schoolyard (1,321,709 students in 2,312 public schools)

- Delivering K-12 educational programs
- Engaging student in design process
- Building green infrastructure practices on school properties
- Assisting with green certification for schools

RUTGERS UNIVERSITY
Water Resources Program
New Jersey Agricultural Experiment Station

# *QUESTIONS?*

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