Green Infrastructure Champions Program

This program is partially funded by the Rutgers New Jersey Agricultural Experiment Station, The Geraldine R. Dodge Foundation, NJ Sea Grant Consortium, The William Penn Foundation and is a collaboration of the Rutgers Cooperative Extension Water Resources Program and the Green Infrastructure Subcommittee of Jersey Water Works.

RUTGERS
New Jersey Agricultural Experiment Station

Sea Grant
NJ Sea Grant Consortium

Please enter your full name and affiliation in the chat. This is how will take attendance.

The Geraldine R. DODGE FOUNDATION
IMAGINE A BETTER NEW JERSEY

JERSEY WATER WORKS
Smart infrastructure. Strong communities.

WILLIAM PENN FOUNDATION

Green Infrastructure Champion Training: Class 8

"Retrofitting traditional detention basins with green infrastructure"

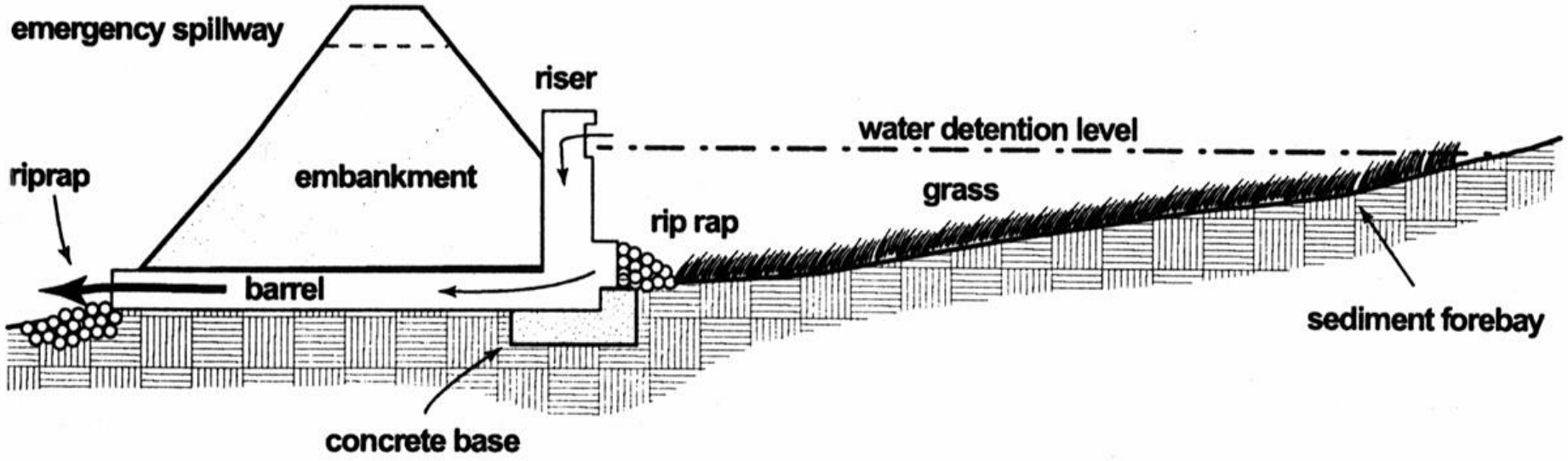
April 22, 2022
Virtual Class

RUTGERS
New Jersey Agricultural Experiment Station

What is a Detention Basin?

Detention basins are designed to detain stormwater runoff during a storm and slowly release the stormwater after the storm.

- Prevents downstream flooding
- Removes pollutants only through settling
- Typically goes dry 48 hours after storm
- Usually contains turfgrass that is regularly mowed
- Often contain concrete low-flow channel



Detention Basin

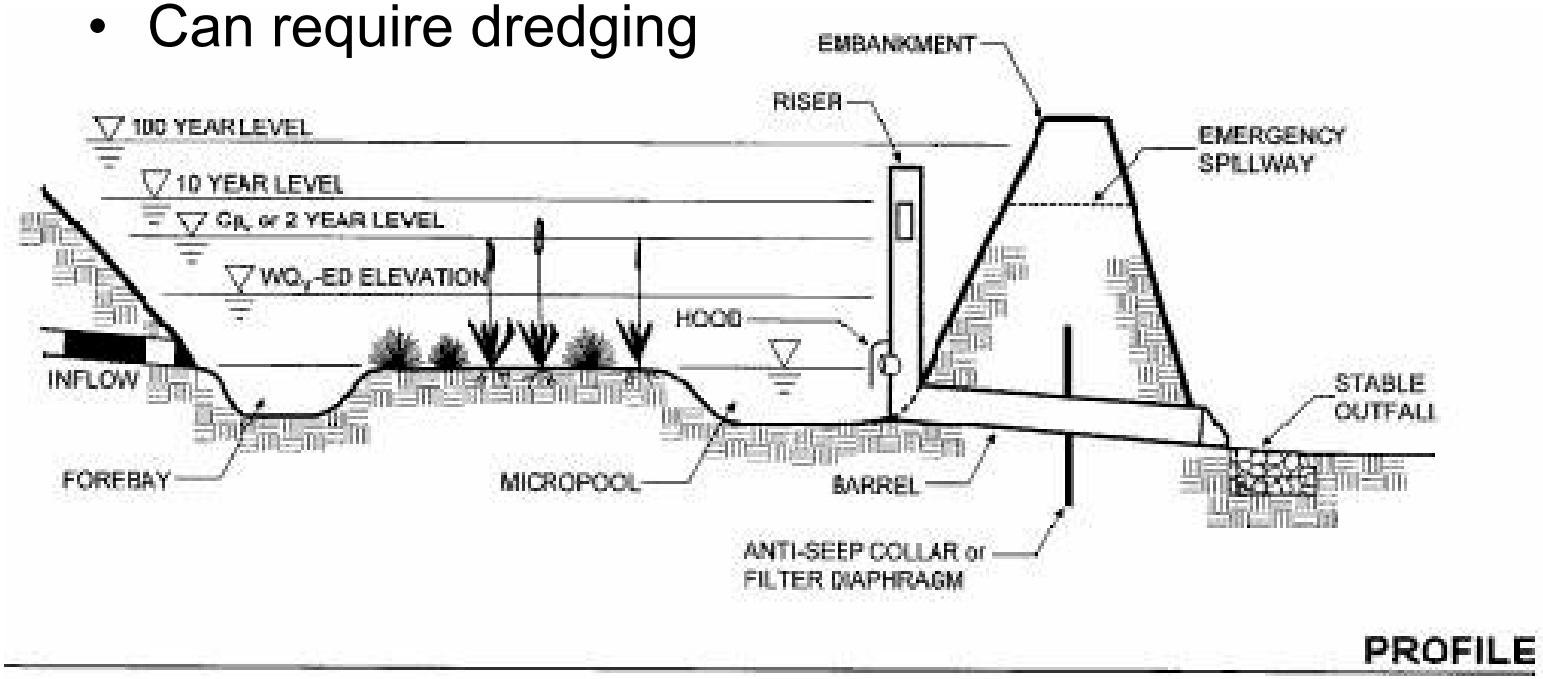
Detention Basin

What is a Retention Basin?

(a.k.a. stormwater ponds, wet retention ponds, wet ponds)

Retention basins maintain permanent pools and store stormwater runoff on top of existing standing water.

- Prevents downstream flooding
- Removes pollutants mainly through settling and algal uptake
- Always has a minimum of three feet of standing water
- Often attract geese
- Can require dredging



Traditional Retention Basin

Traditional Retention Basin

Detention Basin vs. Retention Basin

Does the basin hold a permanent pool of water?

NO – Detention

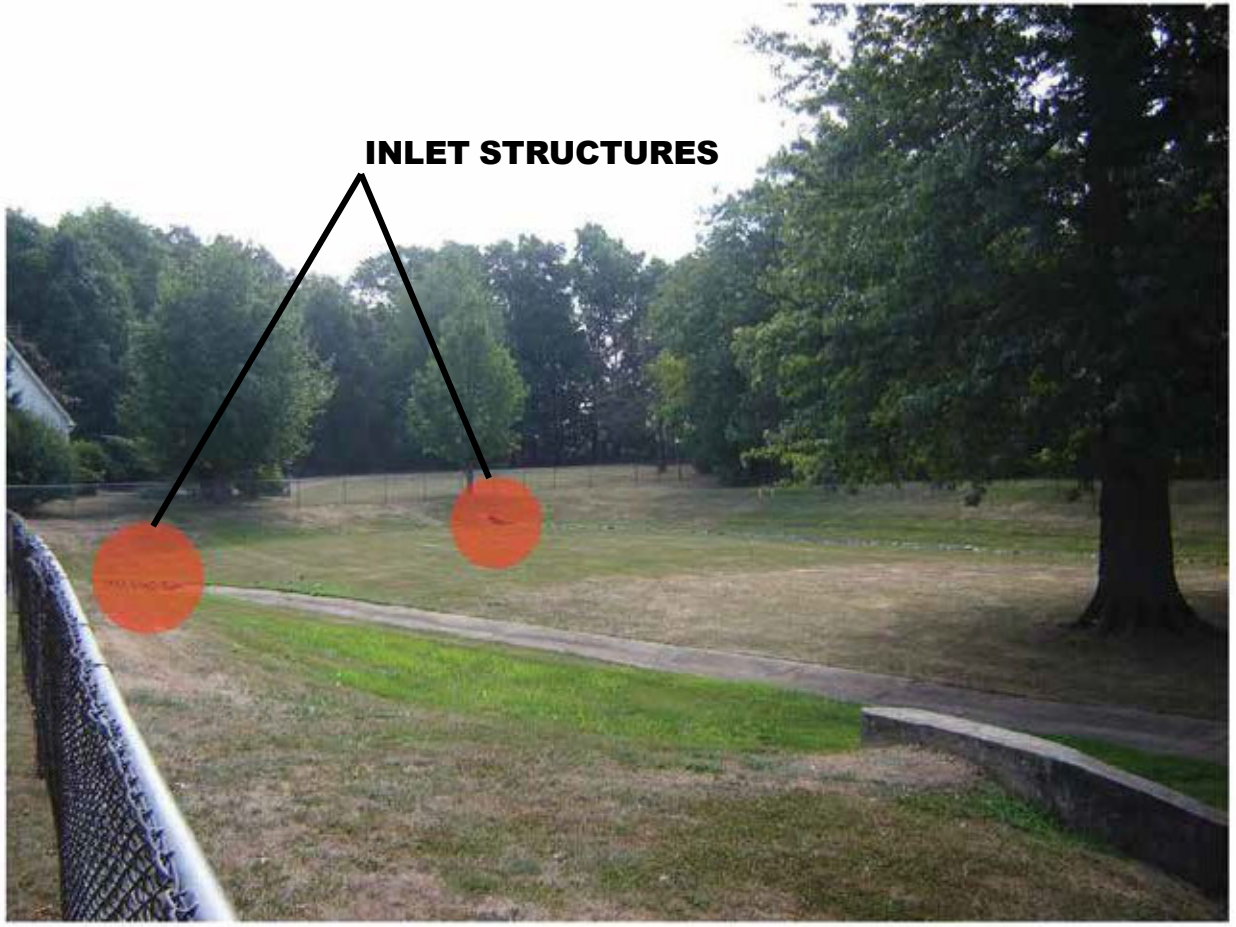
YES – Retention

USEPA

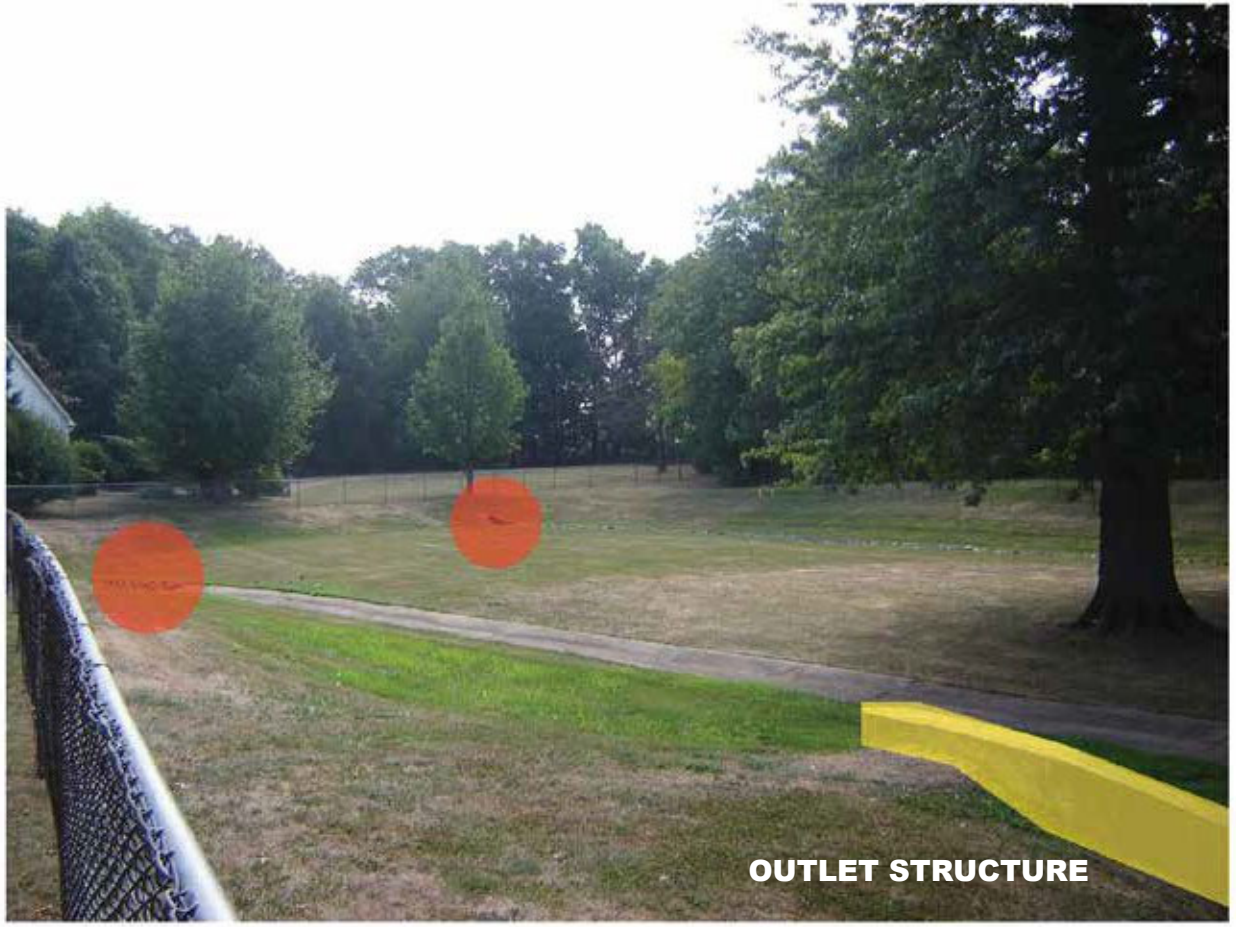
USEPA

Detention Basin Anatomy

Detention Basin Anatomy

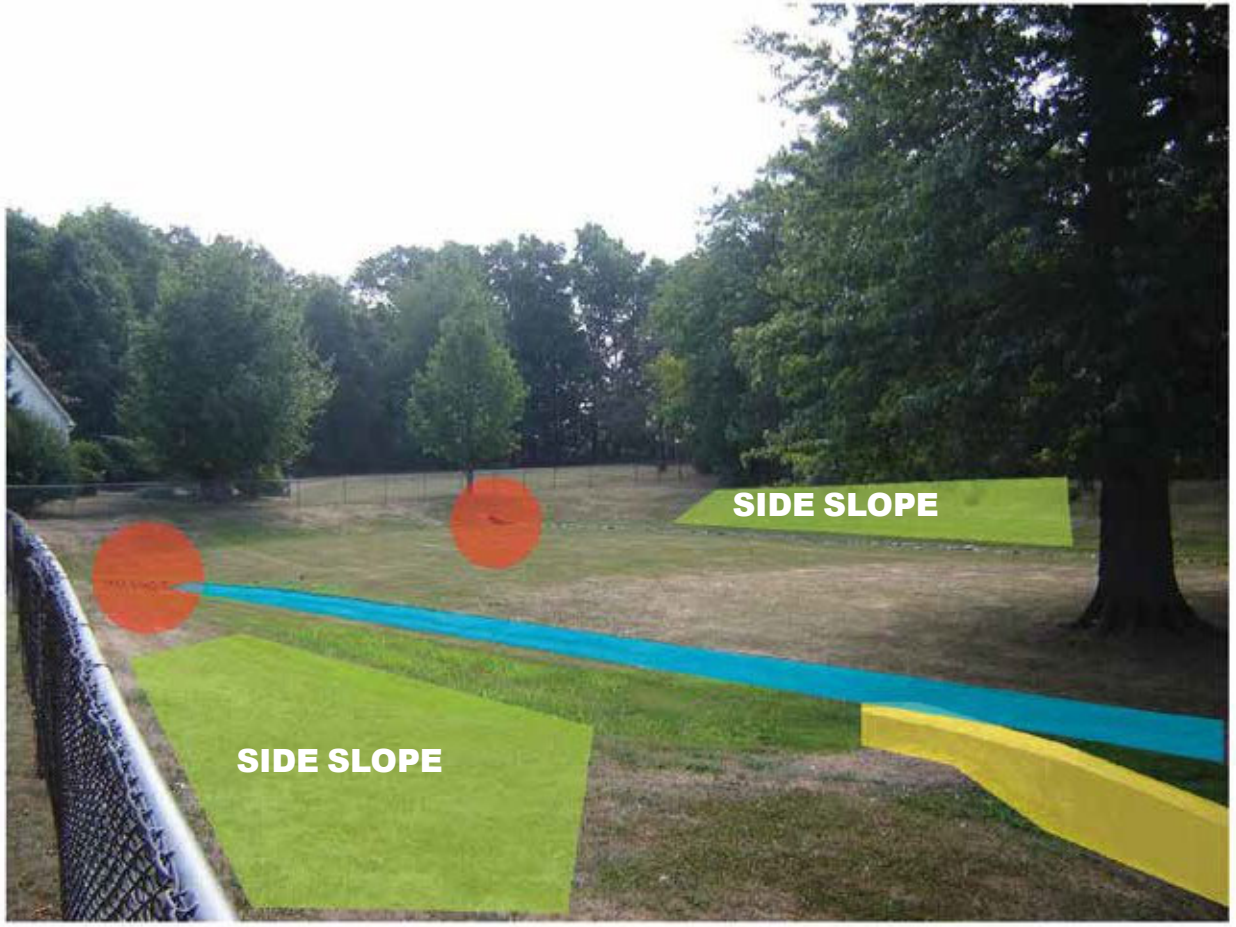


Detention Basin Anatomy

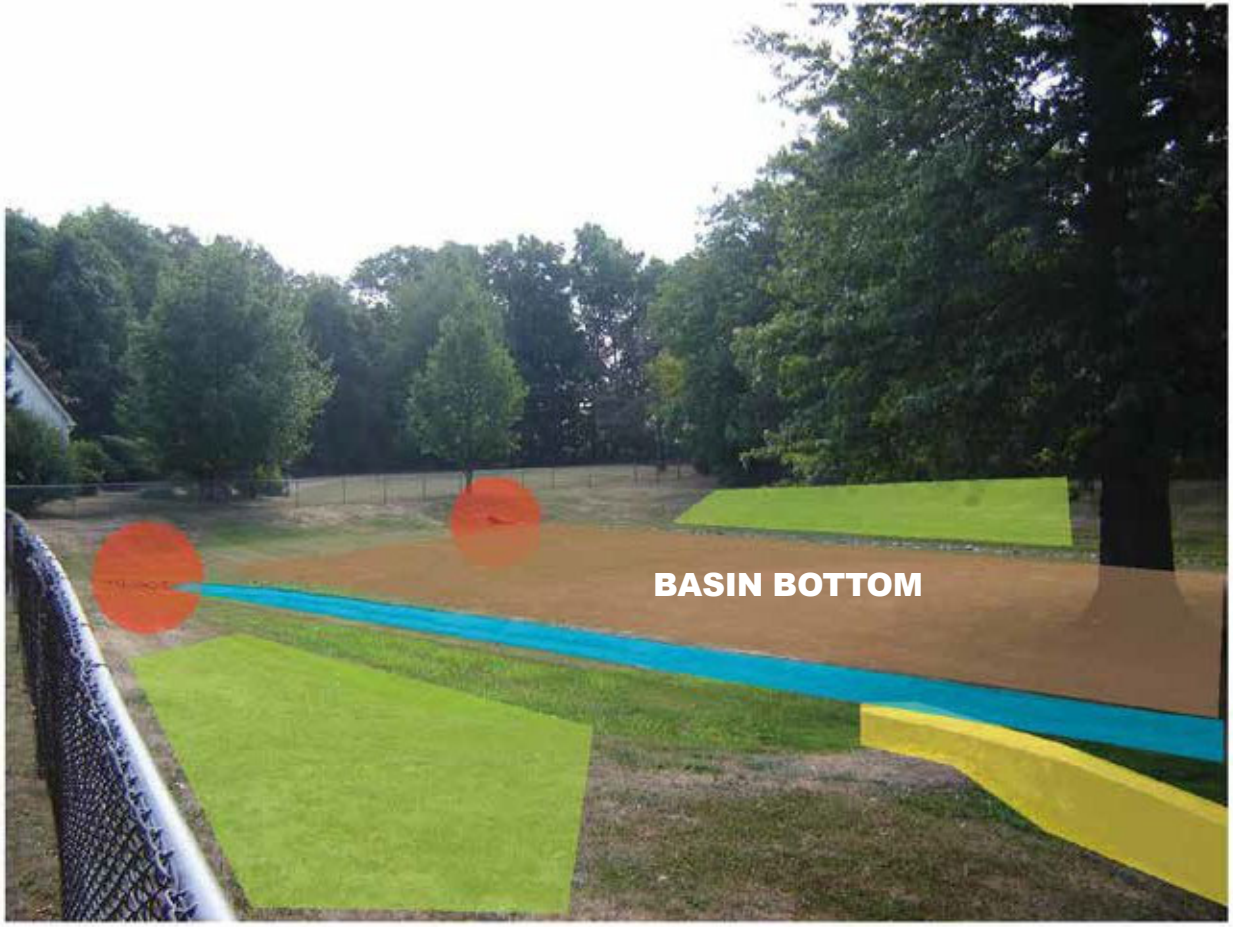


Detention Basin Anatomy

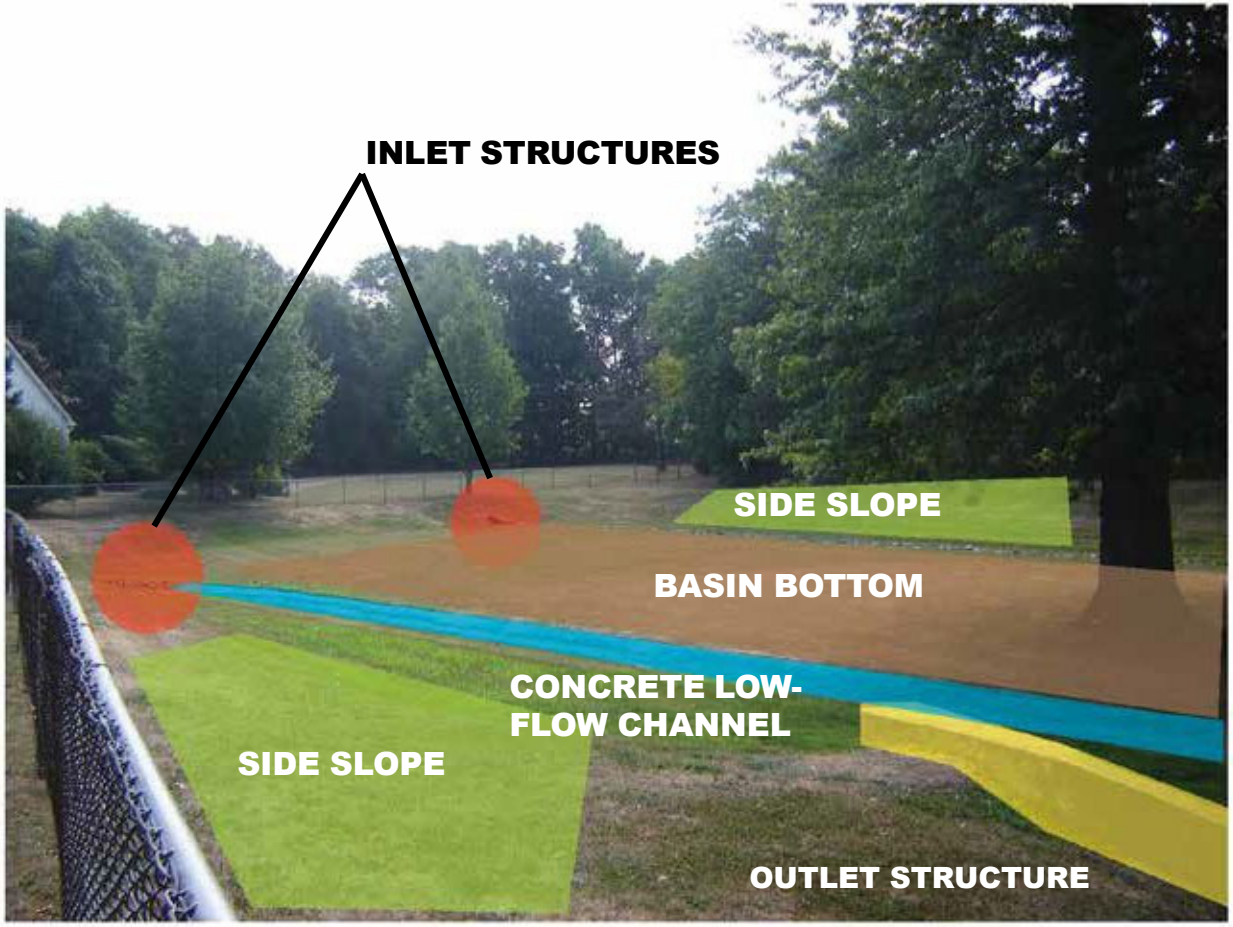
Detention Basin Anatomy



Detention Basin Anatomy



Detention Basin Anatomy



RUTGERS
New Jersey Agricultural
Experiment Station

Detention Basin Inspections

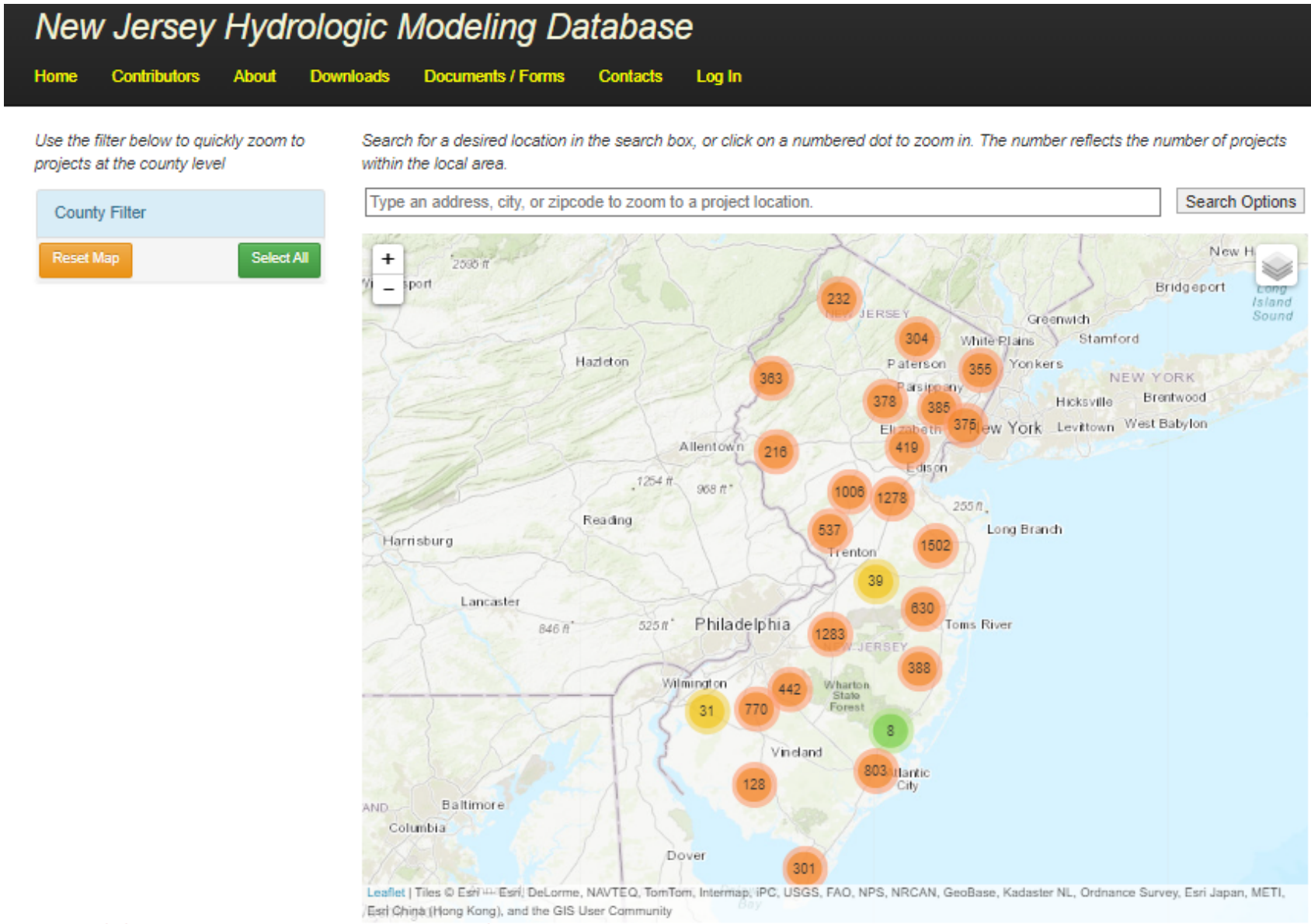
- Is there erosion of the side slopes or basin bottom?
- Is there sediment accumulation in the forebay or basin?
- Are the inlets and outlet devices free of debris and operational?
- Is the concrete low-flow channel clogged or broken?
- Is there standing water?
- Are there floatables accumulated in the basin?
- Is the grass healthy? Are there bare spots? Are there undesirable weeds or woody vegetation?
- Is there evidence of geese?

Who does inspections?

MS4 Permit requires municipalities to ensure that all stormwater facilities (public and private) are being maintained and operating as designed.

- Municipality inspects public facilities
- Municipality require private facilities to be inspected by a stormwater professional
- Annual inspection reports are requires

Online Basin Database



https://hydro.rutgers.edu/

Example ~ Inspection Form

Hamilton Township Stormwater Infrastructure Assessment Program
Stormwater Basin Inspection Checklist

GENERAL INFORMATION	
	Site ID:
Name(s) person inspecting the basin:	Date:
Location Address and Cross Streets:	Watershed:
Name of Creek, Stream, or area into which the basin discharges:	Property Owner / Tax Parcel Block & Lot:
Contact information:	
STRUCTURAL COMPONENTS	
Basin description, size and depth:	Is the basin accessible to maintain? Yes / No Is it maintained: Mowed, clear of woody plants, inlet/outlet blockages?
Number of inlets:	Outlet diameter:

GENERAL OBSERVATIONS	YES	NO	NOTES/REMARKS
1) Any reports on the basin not functioning?			
2) Are there any unauthorized or malfunctioning structures in the basin?			
3) Are there concrete low flow channels. Is the water entering the basin directly exiting the basin outlet without coming in contact with the basin bottom soil and vegetation?			
4) Is there standing water or evidence of standing water in the basin?			
INLET/S			
1) Signs of breakage, damage, corrosion or rusting of inlet structure/pipe?			
2) Debris or sediment accumulation in or around the inlet clogging the inlet opening/pipe?			
3) Signs of erosion, scour or gullies; rock or vegetation above or around the inlet structure?			
4) Tree roots, woody vegetation growing close to or through the inlet structure or a situation impacting the structure's integrity?			
5) If the inlet has a pretreatment structure (trash rack, forebay) is it filled w/ debris or sediment?			
BASIN			
1) Accumulation of debris or litter within basin?			
2) Exposed dirt or earth visible, are there areas without vegetation or where turf is damaged?			
3) Excess sediment accumulation in the basin?			
4) Basin walls/embankment eroded, slumping, caved or being undermined?			

Hamilton Township Stormwater Infrastructure Assessment Program
Stormwater Basin Inspection Checklist

OUTLET	YES	NO	NOTES/REMARKS
1) Breakage, damage, corrosion or rusting to outlet pipe or conveyance?			
2) Signs of erosion, scour or gullies; rock or vegetation above or around the outlet structure?			
3) Debris or sediment accumulation in or around the outlet pipe (i.e. debris or sediment)?			
4) Accumulation of debris or litter in or around outlet?			
5) Tree roots or woody vegetation impacting the outlet or causing potential damage to the structure?			
SECONDARY/EMERGENCY OVERFLOW SPILLWAY			
1) Are pipes, conduits, or conveyances free of debris, clogs and in good condition? (i.e. no visible cracks, breakage slumping)			
2) Large tree or root growth close to pipes or conveyances with the potential to crack structure or impede flow?			
3) Signs of erosion, scour or gullies; rock or vegetation above or around the spillway?			
BASIN OUTFALL AREA			
1) Signs of stormwater exiting the basin in an uncontrolled manner over or through wall or berm?			
2) Signs of erosion, scour or gullies; rock or vegetation at or down slope of the outfall?			

RECOMMENDATIONS FOR WATER QUALITY IMPROVEMENTS	
1) Reduce mowing 2) Plant buffers 3) Establish meadows 4) Retrofit with infiltration structures or other strategies 5) Other	

SUMMARY AND NOTES: Identify unique characteristics and/or opportunities

Types of Maintenance

- Routine Maintenance
  - Vegetation management
  - Debris and litter removal
  - Mechanical components maintenance
- Non-Routine Maintenance
  - Stabilization and erosion control repairs
  - Sediment removal
  - Outlet repair or replacement

Routine Maintenance

Routine Maintenance Requirements

- Vegetation management
  - Mowing should be done where/when it is needed (traditionally, 10-14 times per year)
  - Effective groundcovers must be kept healthy to prevent erosion and damage to the system
- Debris and litter removal
  - Inlets and outlets should be regularly cleared of debris and litter to prevent obstructions and reduced efficiency of the system
- Mechanical components maintenance
  - All mechanical equipment, such as gates, valves, locks, or other components must be kept in working order should an emergency arise

Routine Maintenance

Routine Maintenance for Mechanical Components

- Regular inspections will reduce the need for major replacements

Expected Costs for Routine Maintenance

- Approximately 3-5% of construction cost for annual maintenance of dry detention basin or wet detention pond
- Mowing can cost between $100-$500 per visit
- Additional costs for weed control, debris pickup, clearing grates, ~~applying fertilizer~~

Reducing Routine Maintenance

- Vegetation management
  - Reduce need for mowing
  - Eliminate any use of commercial fertilizers and pesticides in stormwater management facilities

- Debris and litter removal
  - Install simple low-cost retrofits or catch basins near the discharge of the detention system

- Mechanical components maintenance
  - Regular inspections and immediate repairs will reduce the need for major replacements

Non-Routine Maintenance

Non-Routine Maintenance

- Stabilization and erosion control repairs
  - If vegetation fails on embankments or in the basin, soil replacement, reseeding, and stabilization should occur immediately
- Sediment removal
  - During the establishment of a new basin, the basin should be inspected for excessive sedimentation. After establishment, the basin should be inspected twice a year, and excessive sediment accumulated in the basin should be removed.
- Outlet repair or replacement
  - Should the system stop functioning as designed, the outlet structure may require repair or replacement

Non-Routine Maintenance

Reducing Costs for Non-Routine Maintenance

- Stabilization and erosion control repairs
  - Ensure basin designs do not incorporate steep embankments (greater than 3:1)
  - Maintain healthy groundcovers by not mowing basin areas to less than 4 inches in height
- Sediment removal
  - Install manufactured pre-treatment device prior to stormwater discharging to basins
  - Install a settling forebay near inlets where access can be provided and reached with available excavation equipment
- Outlet repair or replacement
  - Conduct regular inspections to ensure system is functioning properly and debris and litter are not clogging the outlet
  - Provide and maintain clear access to all structures of the system

Expected Costs for Non-Routine Maintenance

- Sediment removal estimated to be needed:
  - Every 5-15 years for wet pond
  - Every 2-10 years for a dry pond
- Expected costs for sediment removal:
  - Mobilization $2,500 - $5,000 (dependent on size of project)
  - Dredging work $10/cy - $20/cy (dependent on depth of sediment)
  - Disposal off-site $45/cy - $75/cy (extremely variable and dependent on hauling distance, quality of material, and disposal requirements)
- Expected costs for pre-cast concrete replacement outlet structure:
  - $5,000 - $15,000 depending on size of structure, access, and complexity of the installation

Stabilization and Erosion Control Repairs

- Ensure basin designs do not incorporate steep embankments (greater than 3:1)
- Maintain healthy groundcovers by not mowing basin areas to less than 4 inches in height

Sediment Removal

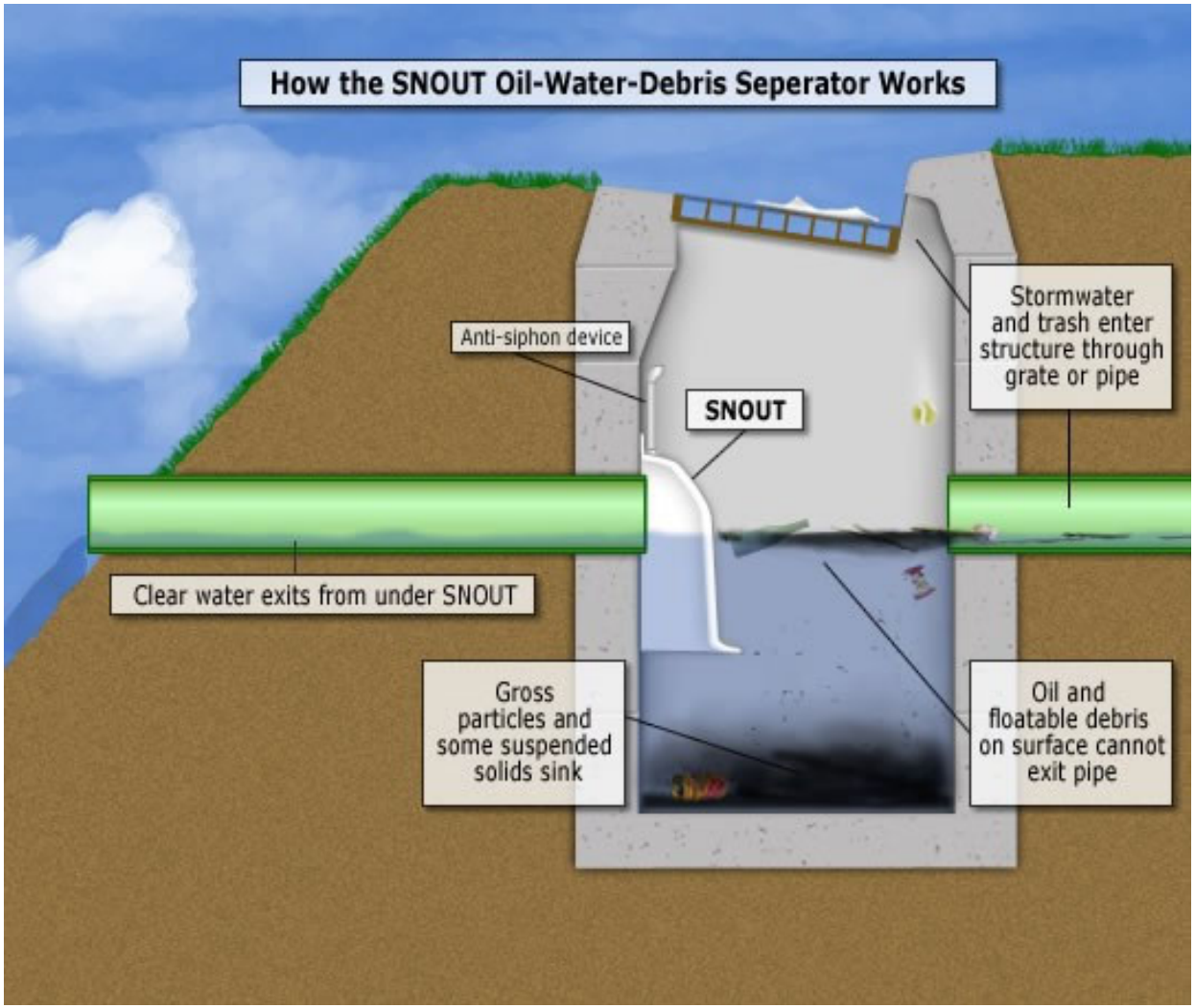
Manufactured Pre-Treatment Systems

- Intended to capture sediments, metals, hydrocarbons, floatables, and/or other pollutants in stormwater runoff before being conveyed to a storm sewer system, additional stormwater quality treatment facility, or waterbody

- Adequate for small drainage areas that contain a predominance of impervious cover that is likely to contribute high hydrocarbon and sediment loadings, such as small parking lots and gas stations; for larger sites, multiple devices may be necessary

- Devices are normally used for pre-treatment of runoff before discharging to other, more effective stormwater quality treatment facilities

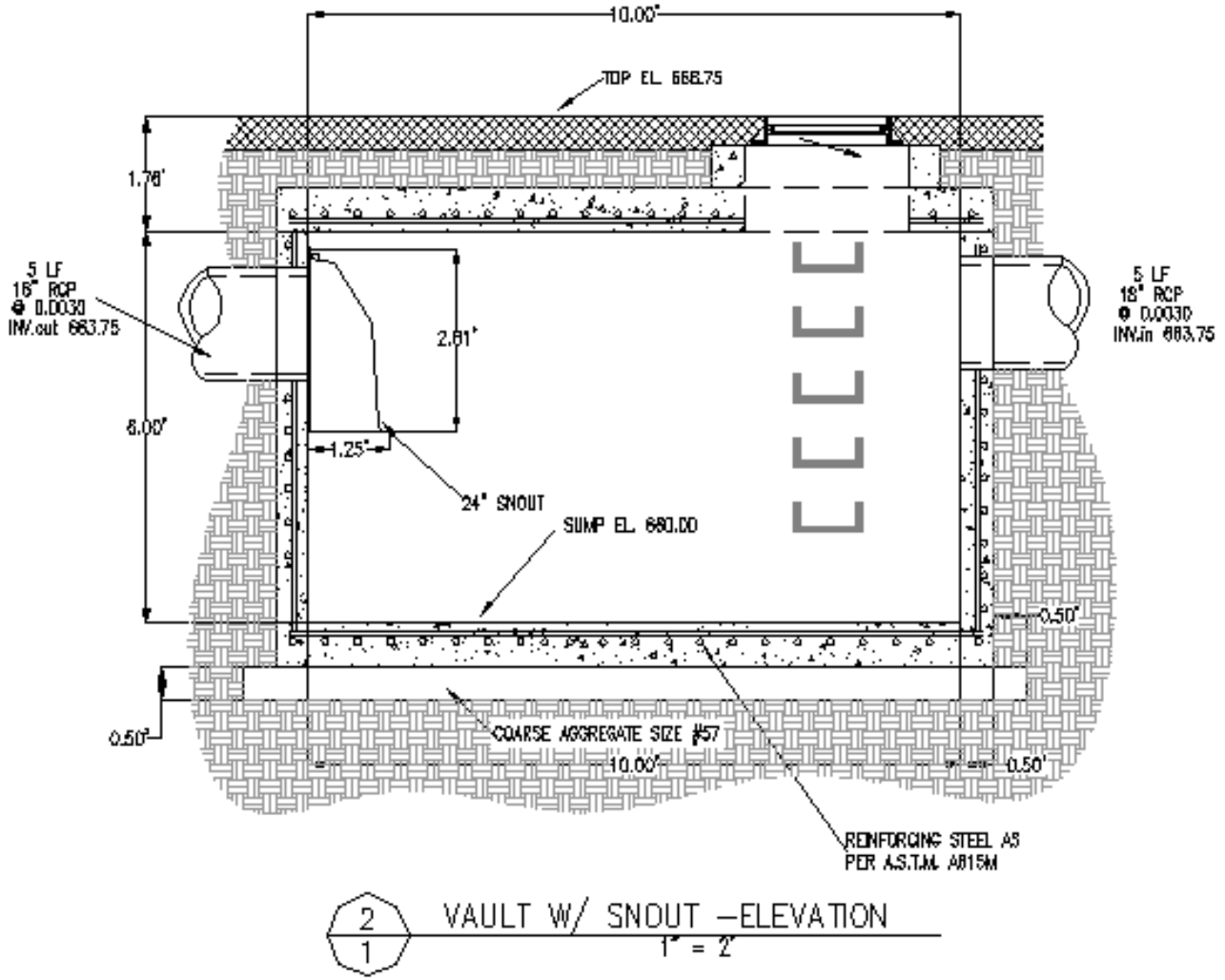
Debris and Litter Removal



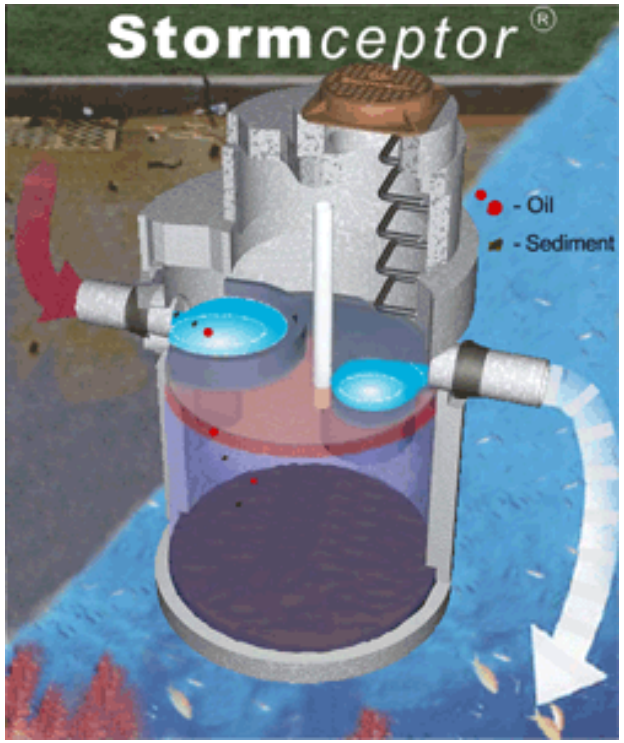
RUTGERS
New Jersey Agricultural Experiment Station

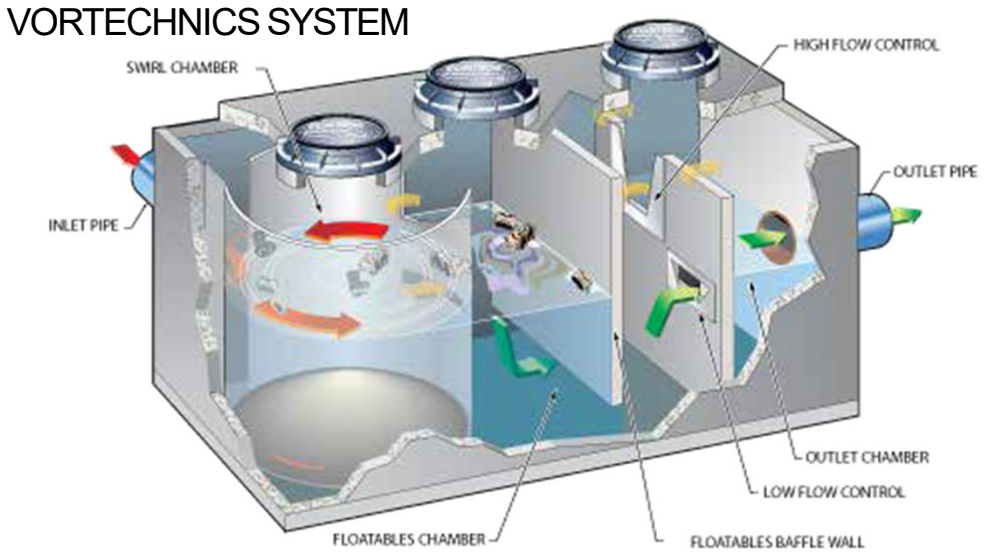
Debris and Litter Removal

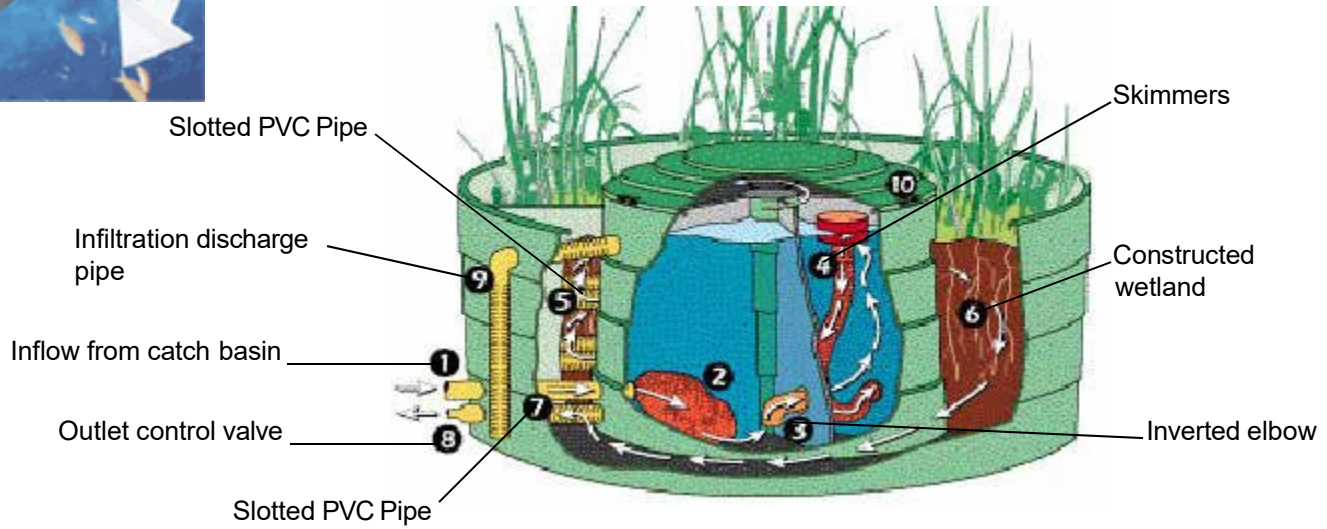
Low Cost “Snout” Debris Separator



Manufactured Pre-Treatment Systems







Outlet Repair or Replacement

- Conduct regular inspections to ensure system is functioning properly and debris and litter are not clogging the outlet
- Provide and maintain clear access to all structures of the system



Planning for Maintenance

RUTGERS
New Jersey Agricultural Experiment Station

Planning for Maintenance

- Identify individual/s or organization/s responsible for inspections and maintenance:
  - Public Entity
  - Homeowner's Association
  - Property Owner
- Provide a clear procedure for recording inspections and reporting maintenance needs
- Develop a routine maintenance schedule
- Develop and use a standard inspection form
- Clearly mark access areas for inspections and maintenance
- Identify and provide any specialized equipment or tools needed to properly maintain the facility
- Develop an emergency protocol should the system fail or not function as designed

Maintenance Plan Diagram

Pilot Maintenance Program
Hamilton Township Stormwater Basins
Englewood Basin

BASIN LOCATION
Behind 125 Englewood Ave at end of street.

Legend:

- Allow basin to naturalize.
- No mow zone.
- Area to mow and keep clear.

Maintenance Notes:

- Limit monthly mowing to a 6-8 ft. perimeter area around the basin.
- Maintain 4-6 ft. clear zone around inlets and outlet on a monthly basis.
- Reduce mowing of basin bottom to once per year.

Maintenance Plan Outline

I. INTRODUCTION & OVERVIEW

II. FACILITY DESCRIPTION

III. CONSTRUCTION MANAGEMENT

A. Sequencing
B. Quality Control

IV. MAINTENANCE

A. Responsibilities
B. Schedules
C. Access
D. Safety
E. Equipment, Tools, and Supplies
F. Cleaning of Inlet and Outlet Structures
G. Landscape Care
   1. Mowing
   2. Removal of Invasive Vegetation
   3. Replacement of Vegetation
   4. General Herbaceous Care
   5. General Shrub Care
   6. On-Site Fertilizer and Pesticide Use
   7. Wildlife Management

V. INSPECTIONS

A. Responsibilities
B. Schedules
C. Inspection List
D. Emergency Plan

NJ BMP Maintenance Manual Requirements

1. Identify person/s responsible for preventive and corrective maintenance
2. Identify specific preventive and corrective maintenance tasks and detailed information on specific structural components or nonstructural measures
3. Provide a schedule of regular inspections and tasks
4. Provide cost estimates of maintenance tasks
5. Include detailed logs of all preventive and corrective maintenance performed
6. Identify specialized tools or equipment needed
7. Recommend corrective responses if emergency arises
8. Provide guidance for safety during inspections and maintenance
9. Identify approved disposal and recycling sites and procedures for sediment, trash, and debris
10. Include an as-built construction plan

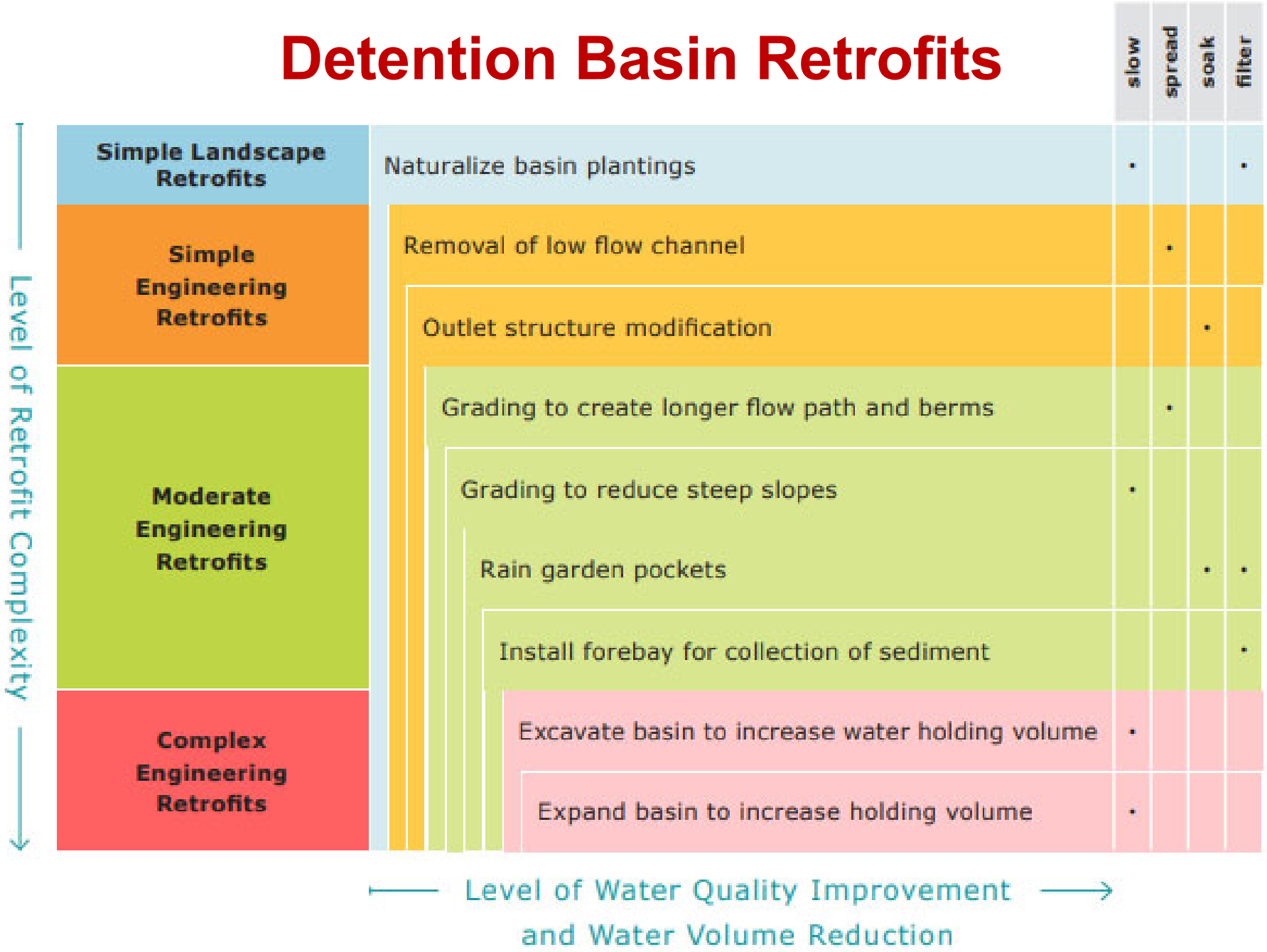
Summary

1. With proper design and up front planning, routine maintenance of stormwater facilities can be accomplished without putting undue burden on operations personnel and budgets.
2. Non-routine maintenance requirements need to be accounted for and with regular inspections, these activities can be planned for and expected costs incorporated into operations budgets avoiding large unexpected capital expenditures.
3. Many options exist to modify existing systems to either reduce need for regular maintenance and/or improve the effectiveness of the system for both water quantity and water quality controls.

How can we do it better?

- Improve pollutant removal efficiency
- Improve volume control
- Improve infiltration
- Enhance wildlife habitat
- Sequester carbon
- Provide pollinator habitat
- Create attractive and educational places
- Reduce maintenance
- Save money

Detention Basin Retrofits



Produced by: Pennsylvania Environmental Council—Stormwater Solutions

#1 Simple Landscape Retrofit

Meadow Management

- Reduce mowing frequency of the basin bottom and embankments to a single monthly mowing at a height of 6-8 inches during the months of May through September

Meadow Management

Naturalized Plantings

- Install native plantings adapted to floodplain and wetland conditions and eliminate regular mowing
- Requires upfront funds to design, purchase materials, and install vegetation
- Often these costs can be offset through the use of local volunteers or nonprofit environmental organizations
- This approach requires careful planning and a commitment to maintain new plantings during the establishment period
- These plantings can often be done in conjunction with basin repairs and/or retrofits
- This approach improves the effectiveness of the stormwater facility to treat water quality as well as water quantity

Naturalized Plantings

Naturalized Plantings

- Seed in the spring or fall at a minimum rate of 10-15 lbs/acre
- Can be applied via broadcasting, hydroseeding, or with a native 'TRUAX' seed drill
- Need to be mulched during establishment with weed free straw or wood fiber mulch
- Can be applied to bare soil, over-seeded, or sites treated with glysophate herbicide
- Seed mix should contain warm-season companion grasses in combination with wildflowers
- Require a single annual mowing at a height of no less than 6 inches

Cherry Hill Township saved $20,000 per year on mowing costs by naturalizing detention basins.

Naturalized Plantings

Common Wildflowers	
Botanical Name	*Common Name*
Asclepias incarnata	Swamp Milkweed
Aster novae-angliae	New England Aster
Aster novi-belgi	New York Aster
Eupatorium perfoliatum	Boneset
Iris versicolor	Blue-Flag
Lobelia cardinalis	Cardinal Flower
Lobelia siphilitica	Great Lobelia
Vernonia noveboracensis	New York Ironweed

Common Wetland Plants	
Botanical Name	*Common Name*
Carex stricta	tussock sedge
Carex vulpinoidea	fox sedge
Carex crinita	fringed sedge
Juncus effusus	Soft Rush

Aquatic Vegetation for Wet Ponds	
Botanical Name	*Common Name*
Pontederia cordata	pickerelweed
Sagittaria latifolia	duck-potato
Saururus cernus	lizard tail
Scirpus atrovirens	green bulrush
Sparganium americanum	lesser bur-reed

Warm Season Grasses	
Botanical Name	*Common Name*
Agrostis alba	Red Top
Agrostis palustris	Creeping Bentgrass
Andropogon scoparius	Little Bluestem
Andropogon virginicus	Broomsedge
Calamogrostis canadensis	Canada Wild Rye
Elymus canadensis	Canada Wild Rye
Poa palustris	Fowl Bluegrass
Puccinellia distans	Alkaligrass
Tripsacum dactyloides	Eastern Gamagrass

NOTE:

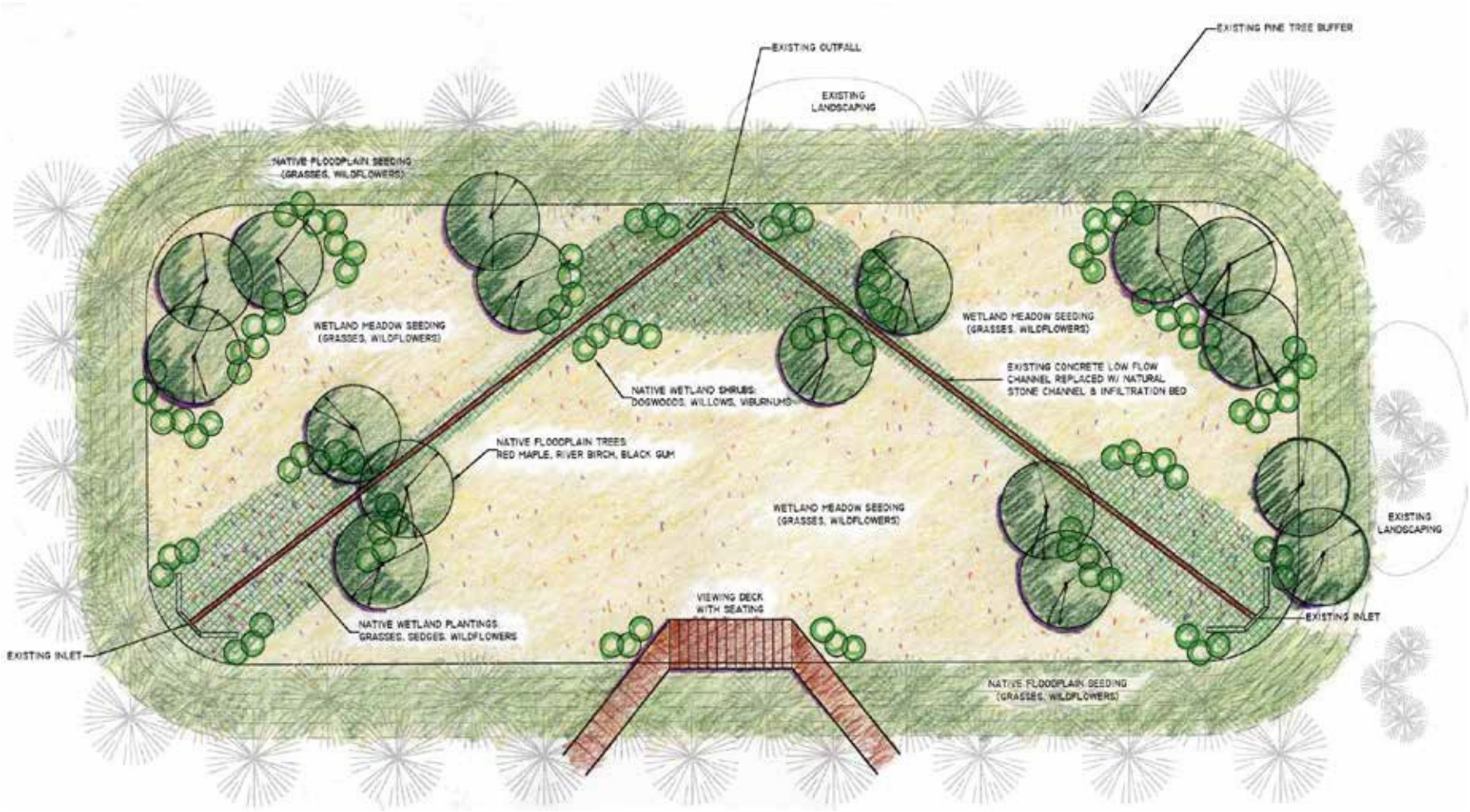
Native wildflower and grass seed mixes available from Ernst Conservation Seeds in Meadville, PA

Native plant material available from Pinelands Nursery in Columbus, NJ

Naturalized Plantings

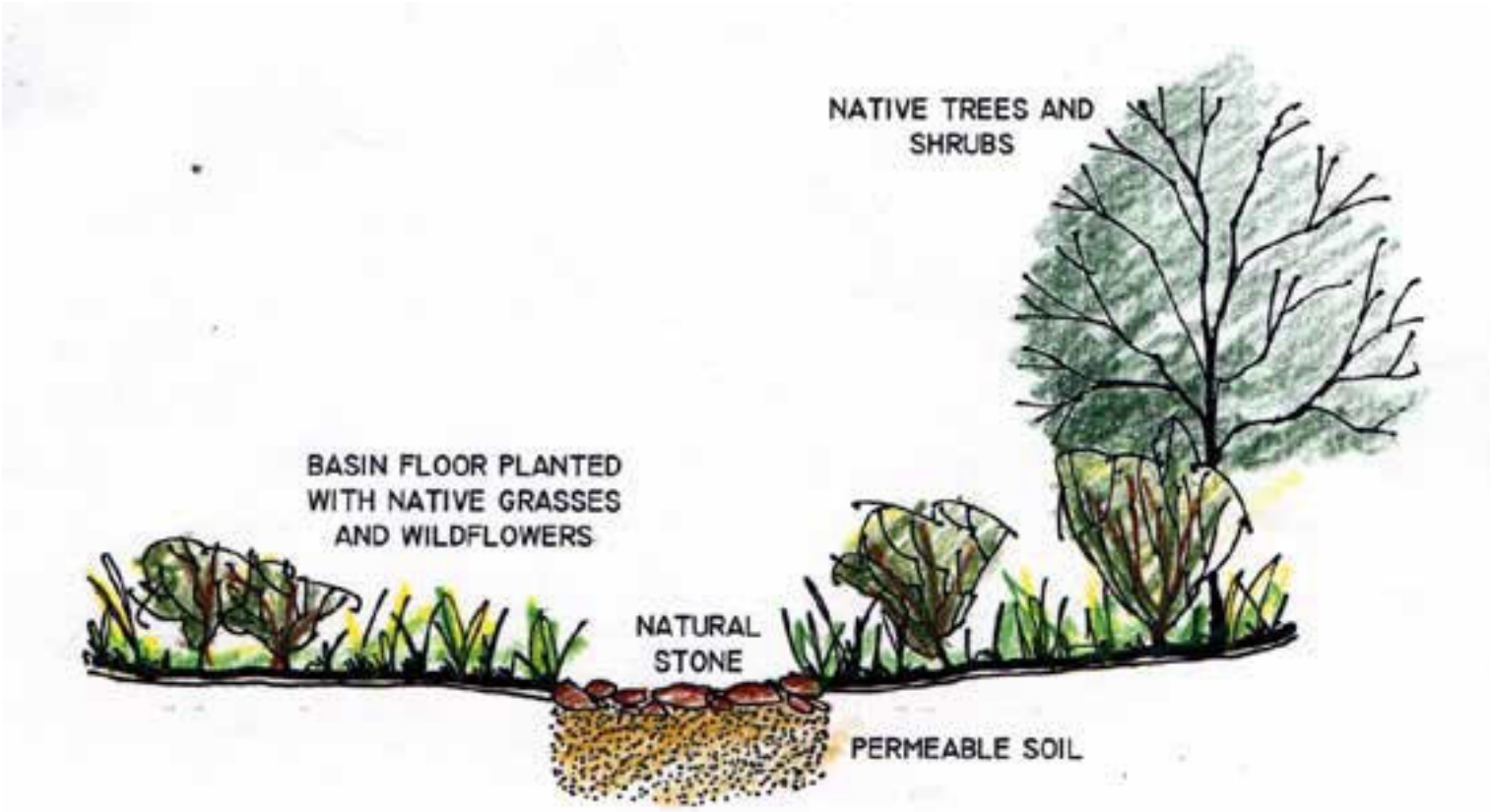
Egg Harbor Township
New Jersey

Naturalized Plantings



#2 Simple Engineering Retrofits

Removal of Concrete Low-Flow Channel



NATURAL STONE CHANNEL WITH INFILTRATION BED

RUTGERS
New Jersey Agricultural
Experiment Station

#2 Simple Engineering Retrofits

Outlet Structure Modification

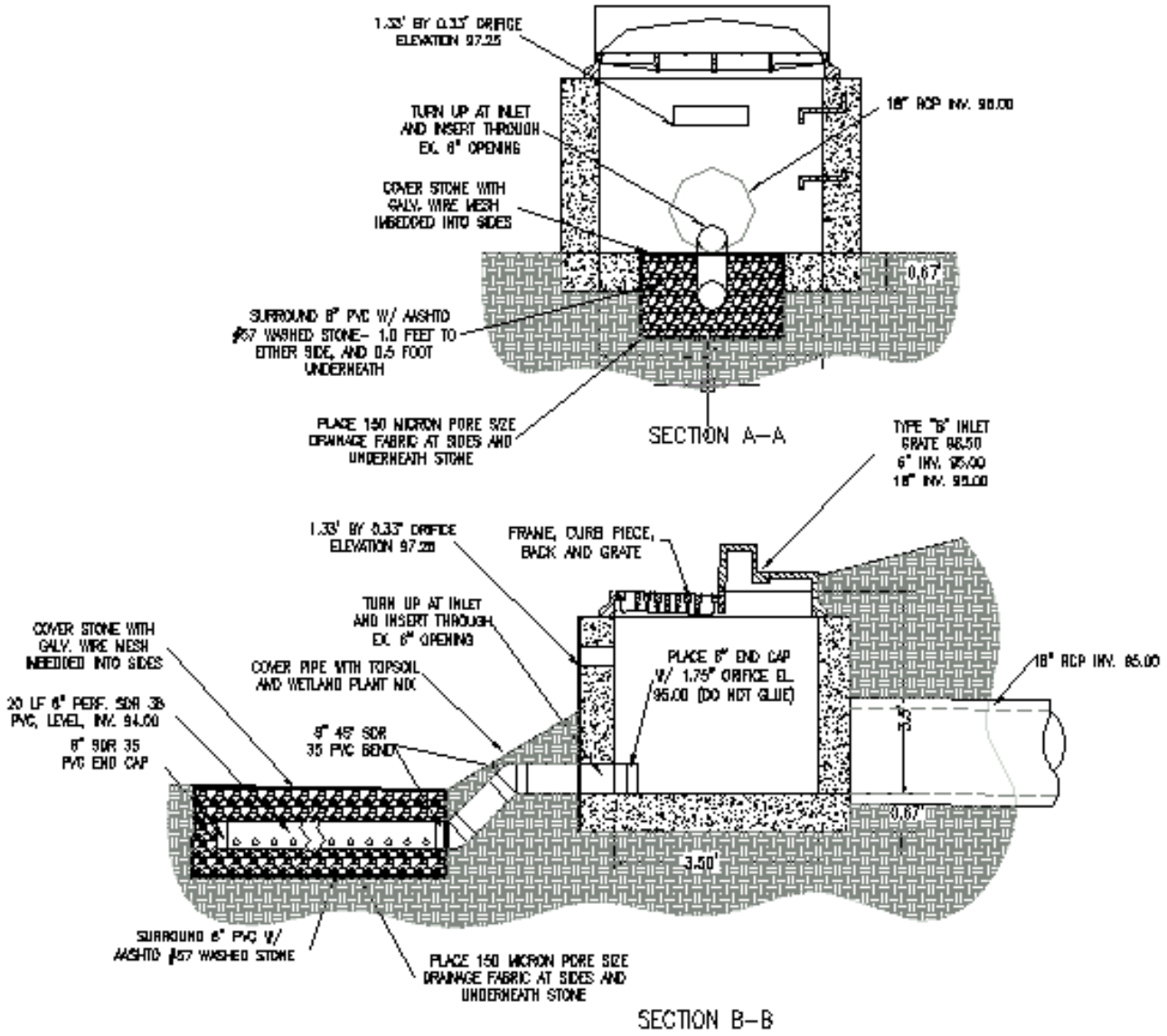
Before

#2 Simple Engineering Retrofits

Outlet Structure Modification

After

Outlet Structure Modification



Outlet Structure Modification

Outlet Structure Modification

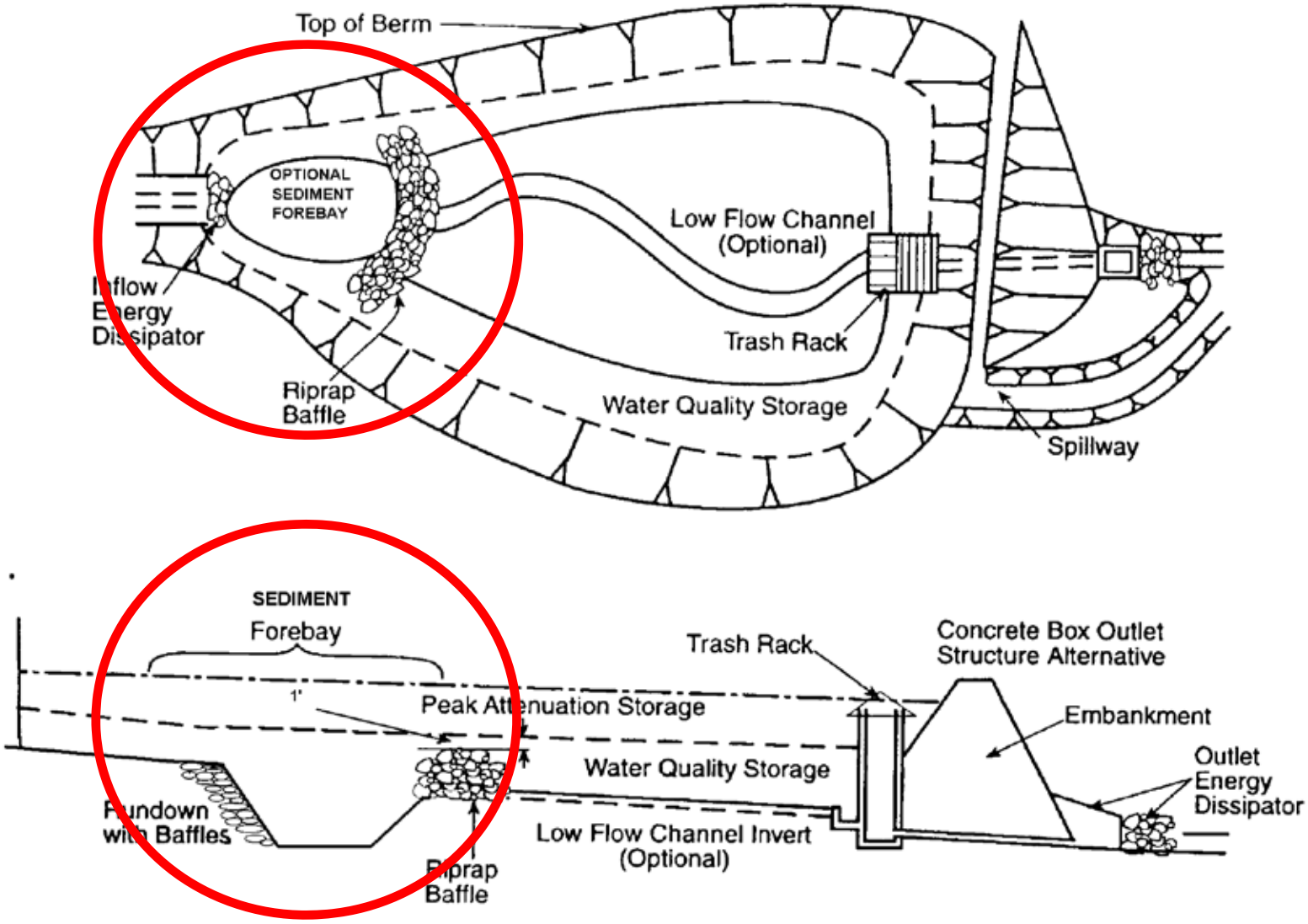
#3 Moderate Engineering Retrofits

- Grading to create longer flow path and berms
- Grading to reduce steep slopes
- Rain garden pockets
- Install forebay for collection of sediment

Check dams to spread water and increase flow paths

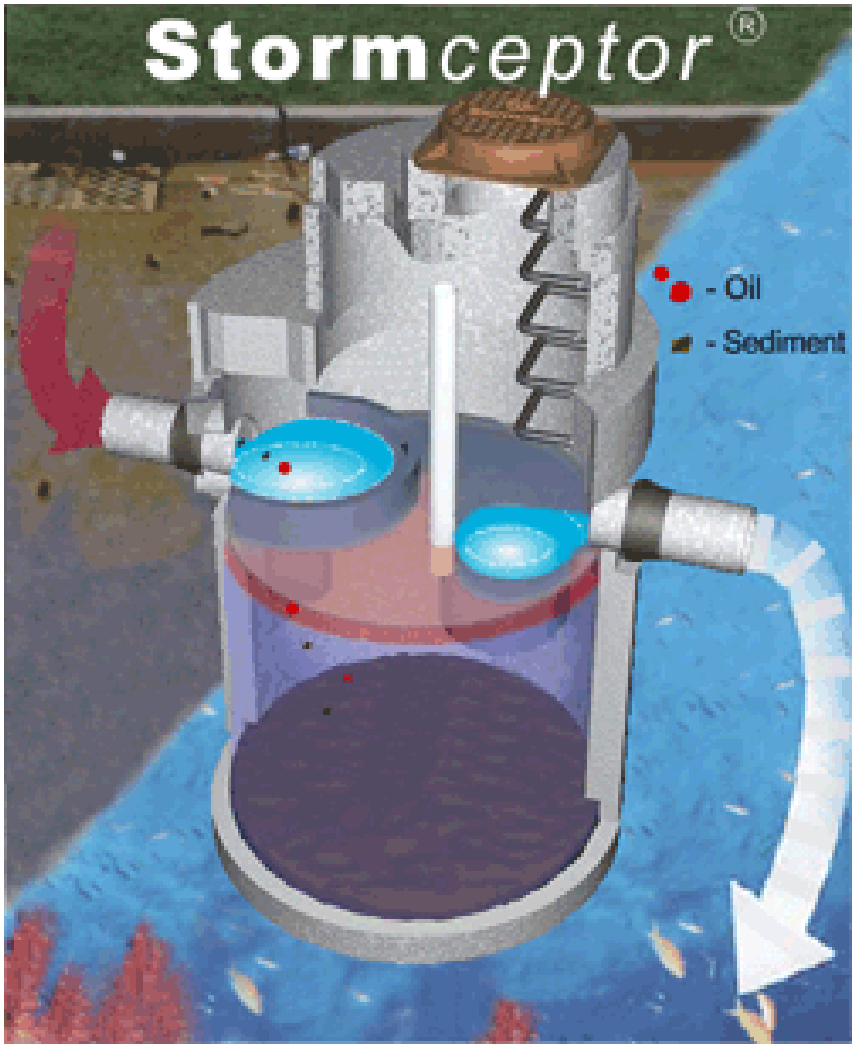
Rain garden pockets

Install forebay for collection of sediment



NJ BMP Manual

Alternative to Forebay



#4 Complex Engineering Retrofits

Extended Detention Basin

- Extended detention can address both the stormwater runoff quantity and quality impacts of land development
- The lower stages of an extended detention basin can detain runoff from the Stormwater Quality Storm for extended periods of time, thereby promoting pollutant removal through sedimentation
- Higher stages in the basin can also attenuate the peak rates of runoff from larger storms for flood and erosion control
- Extended detention basins are designed for complete evacuation of runoff and normally remain dry between storm events
- To enhance soluble pollutant removal, the lower stages of an extended detention basin may also be designed with a permanent pool and partially function as either a wetland or retention basin

Keys for Extended Detention Basin

- The basic design parameters for an extended detention basin are its ***storage volume*** and ***detention time***

- An extended detention basin must have the correct combination of storage volume and outflow capacity to contain and ***slowly*** discharge the design runoff volume over a prescribed period of time

Expected Costs for Naturalized Plantings and Retrofits

- Native seeding or plantings
  - Native seed costs: $25/lb - $45/lb
  - Installation costs: range from $80 - $150 per 1000 sq. ft.
  - Native wetland plants costs: $200 - $250 per 1000 sq. ft. installed
- “Snout” installation - $500
- Pre-manufactured treatment device installation
  - $10,000 - $60,000 depending on size and complexity of the installation
- Settling forebay or permeable weir installation
  - $2,500 - $5,000 for filter fabric, rip-rap stone, and installation, depending on size and access
- Pre-cast concrete retrofit outlet structure:
  - $5,000 - $10,000 installed depending on size of structure, access, and complexity of the installation

Case Studies

Case Studies

Teaberry Run
Moorestown, NJ

EXISTING CONDITIONS

Case Studies

Teaberry Run
Moorestown, NJ

AFTER INSTALLATION

Case Studies

Teaberry Run
Moorestown, NJ

1 YEAR LATER

Case Studies

Baker Elementary School
Moorestown, NJ

EXISTING CONDITIONS

Case Studies

Baker Elementary School
Moorestown, NJ

PLANTING

Case Studies

Baker Elementary School
Moorestown, NJ

1 YEAR LATER

Case Studies

Mercer County SCD Wildflower Detention Basin Planting Program New Jersey

- Reduce need for watering
- Eliminate use of chemical fertilizers and pesticides
- Minimize mowing
- Provide visual contrast in the landscape and provide habitat

Case Studies

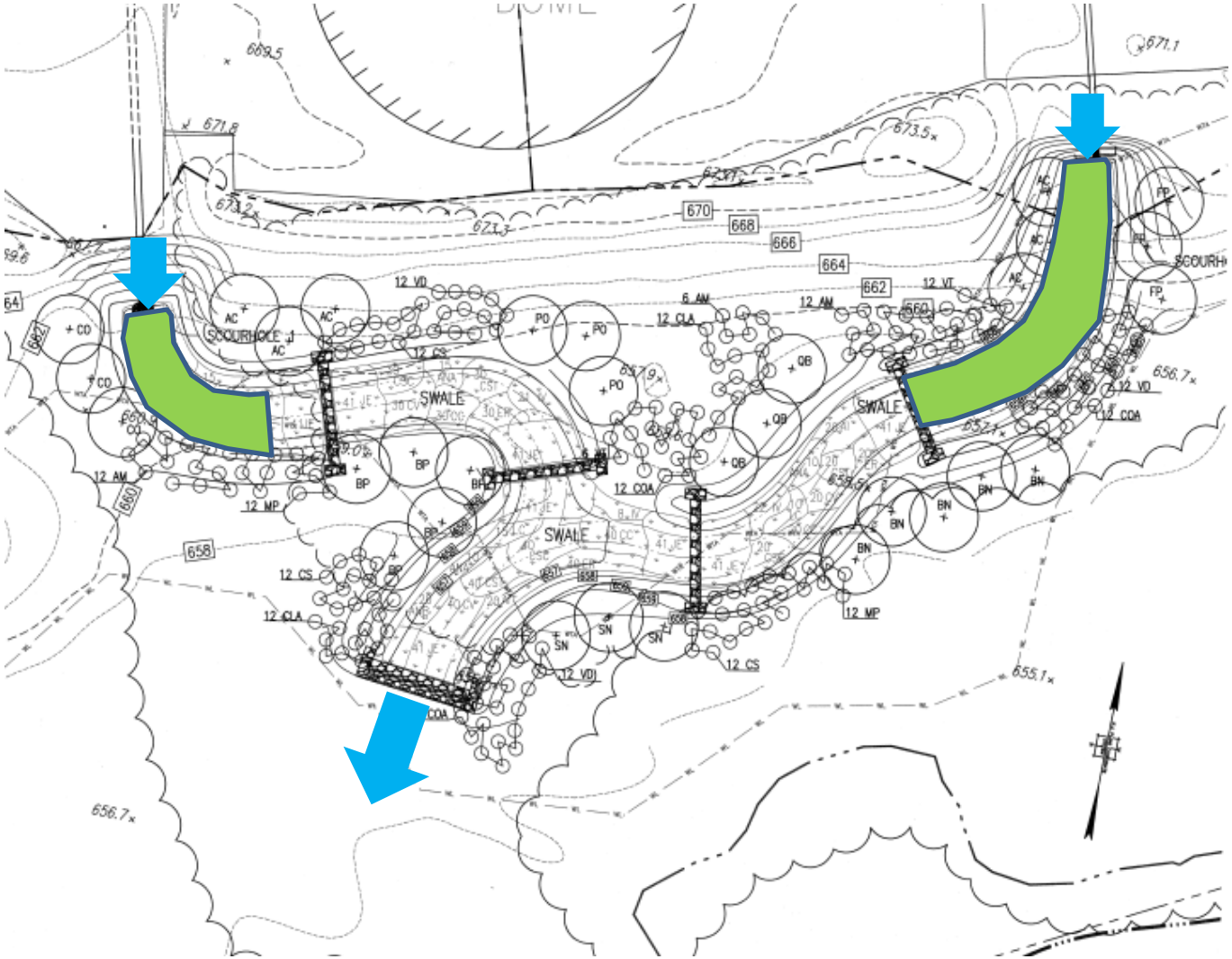
Morris County DPW Extended Detention Swale Project
Wharton, NJ

EXISTING CONDITIONS

Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

PROPOSED PLAN



Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

CONSTRUCTION

Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

CONSTRUCTION

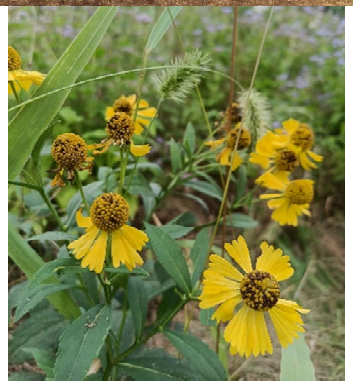
Case Studies

Morris County DPW Extended Detention Swale Project
Wharton, NJ

COMPLETED PROJECT

Case Studies

Highland Park High School Detention Basin
Naturalized Vegetation Project



Case Studies

Hillsborough Detention Basin Retrofit Program - Somerset County, NJ

VALIS ROAD

WESCOTT ROAD

PRALL ROAD

FRANCIS ROAD

TABLE OF CONTENTS

APRIL 30, 2009

UPDIKE ROAD

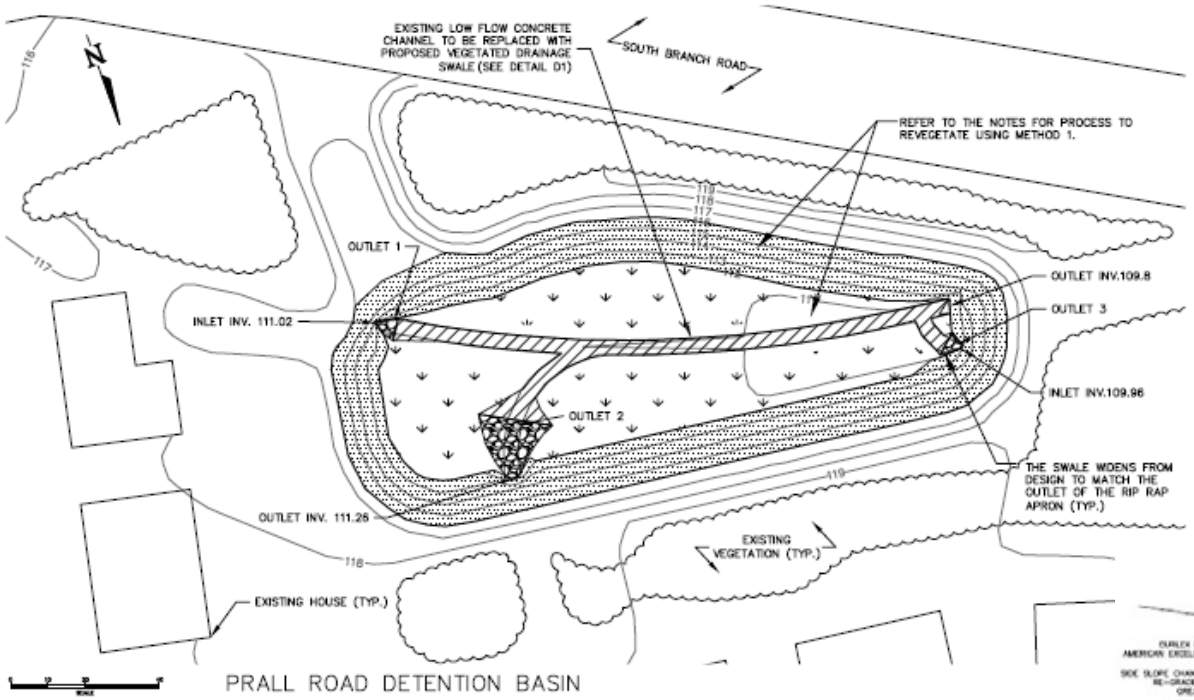
RUTGERS

New Jersey Agricultural Experiment Station

Case Studies

Hillsborough Detention Basin Retrofit Program
Somerset County, NJ

Prall Road



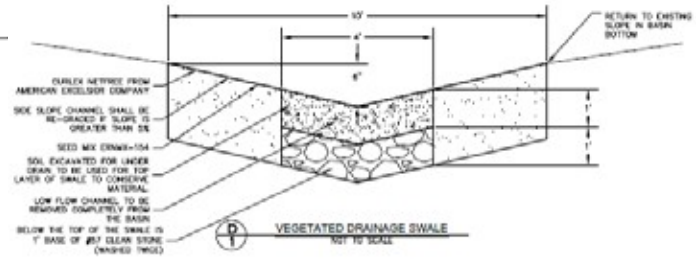
NOTES:
1. THE RIP RAP APRONS OF PRALL ROAD WILL NOT BE ALTERED FROM THEIR EXISTING DESIGN.
2. THE FIRST RESEEDING METHOD FOR THE BASINS ARE SHOWN ON SHEET S-2 AND S-3.
3. THE SECOND RESEEDING METHOD FOR EACH BASIN IS SHOWN ON SHEET S-5.

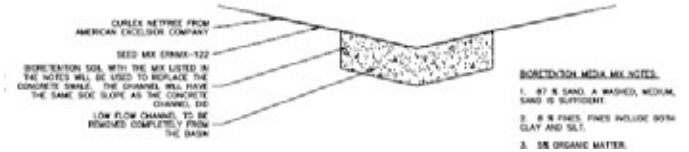
RIP RAP APRON DETAILS

OUTET	Lo (FT)	W (FT)	D50 (IN)
1	6	15	6
2	8	20	6
3	3	8	3

LEGEND

ERNMX-127	EXISTING VEGETATION
ERNMX-123	EXISTING CONTOURS
PROPOSED VEGETATED DRAINAGE SWALE	EXISTING SW INFRASTRUCTURE
EXISTING RIP RAP APRON	EXISTING INFRASTRUCTURE





Case Studies

Prall Road Detention Basin Retrofit
Township of Hillsborough, NJ

PROPOSED PLANTS SPECIES + QUANTITIES

Herbaceous plantings 4' on center:
- BIG BLUESTEM - 110 plugs
- INDIAN GRASS - 130 plugs
- LITTLE BLUESTEM - 125 plugs
- SWITCHGRASS - 130 plugs

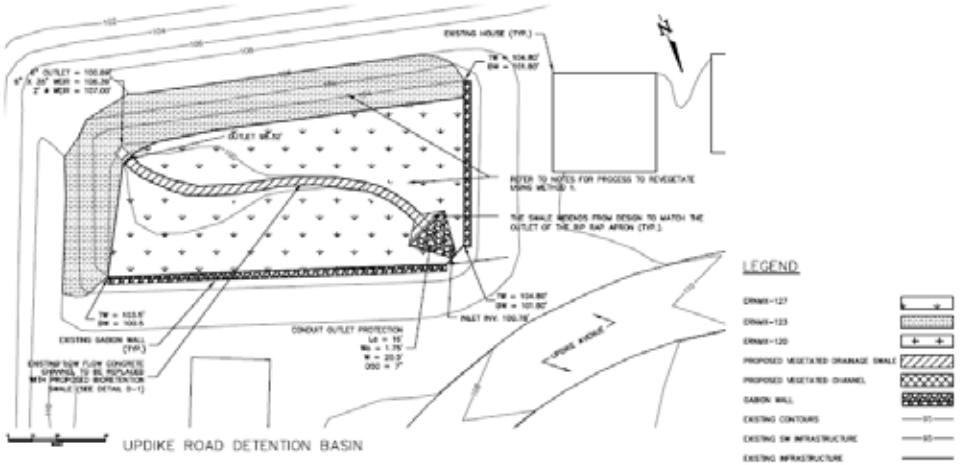
Herbaceous plantings 3' on center:
- FOX SEDGE - 80 plugs
- SOFT RUSH - 45 plugs

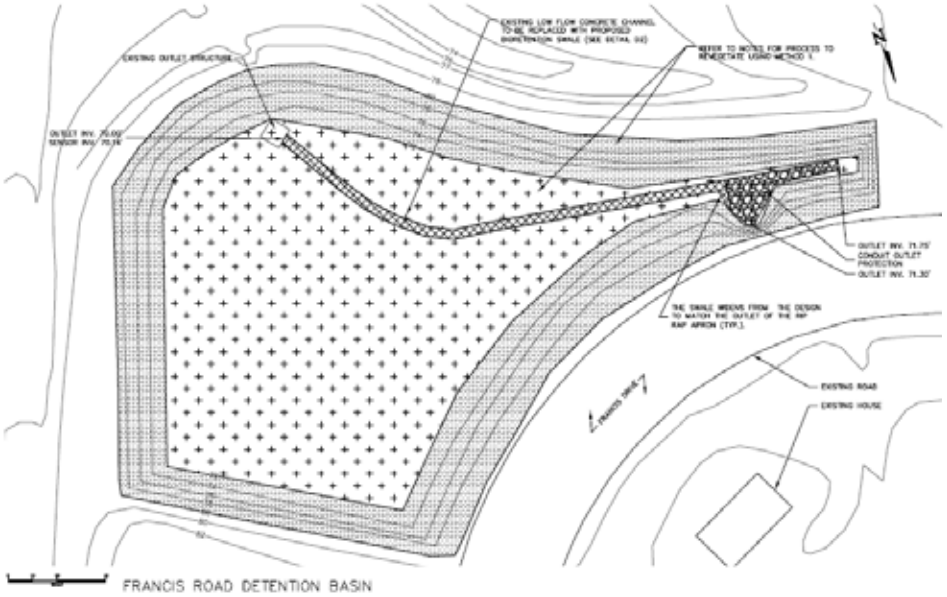
620 PLANTS TOTAL

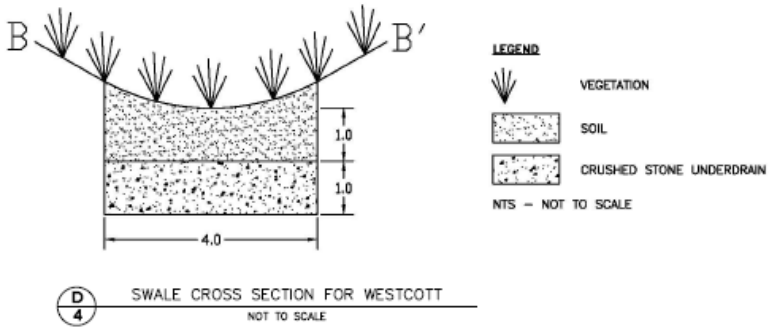
Case Studies

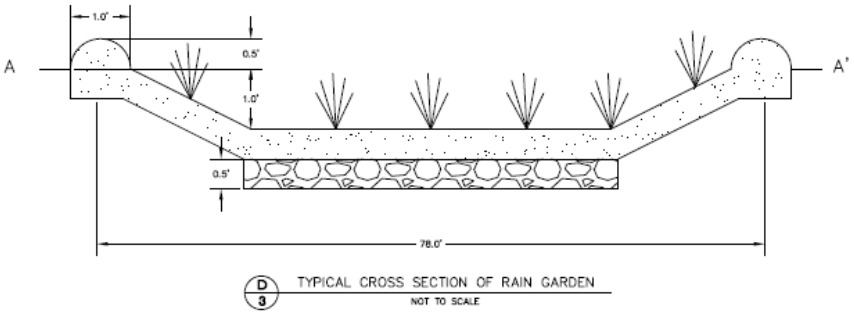
Hillsborough Detention Basin Retrofit Program
Somerset County, NJ

Updike Road and Francis Road



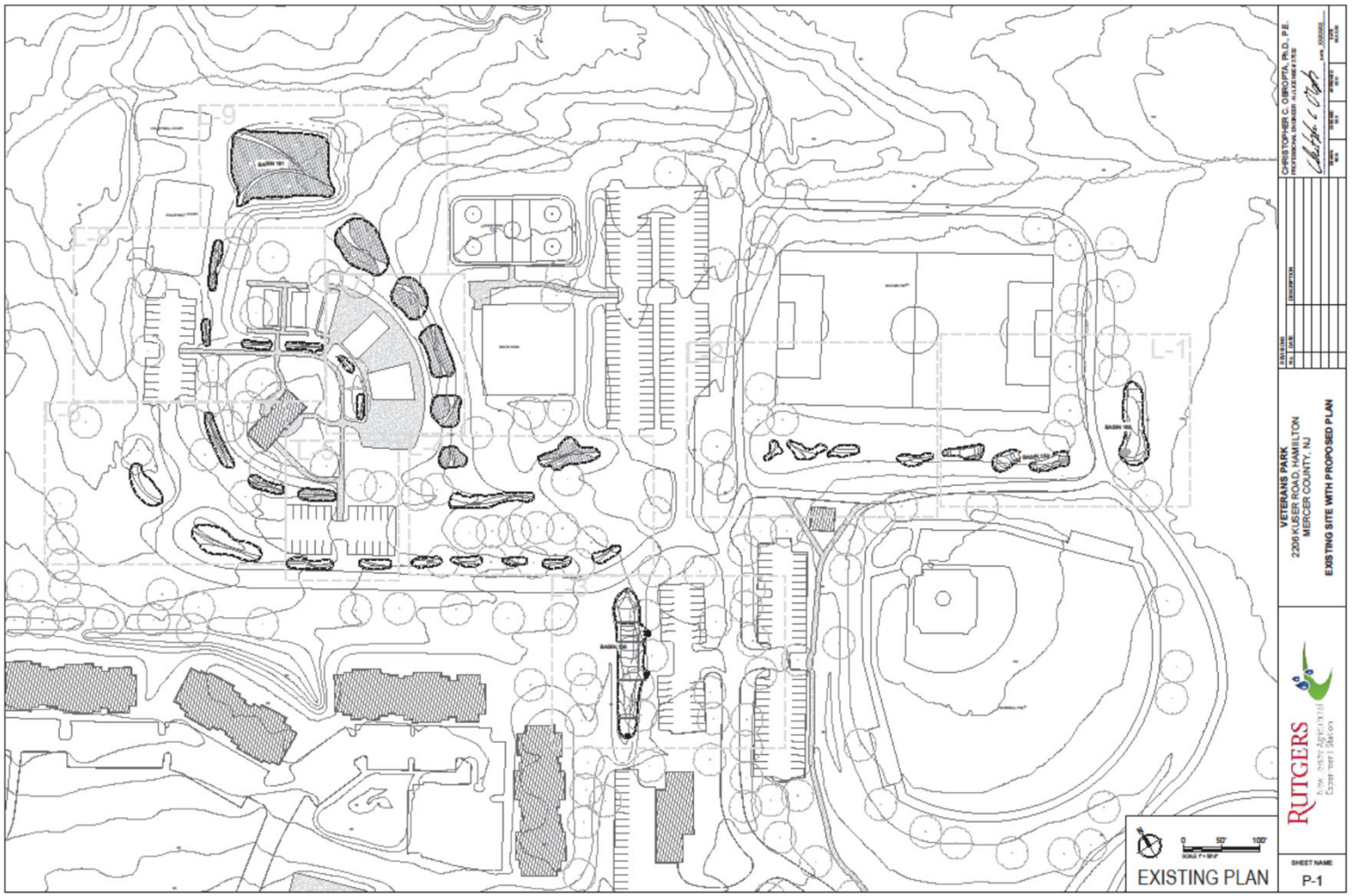




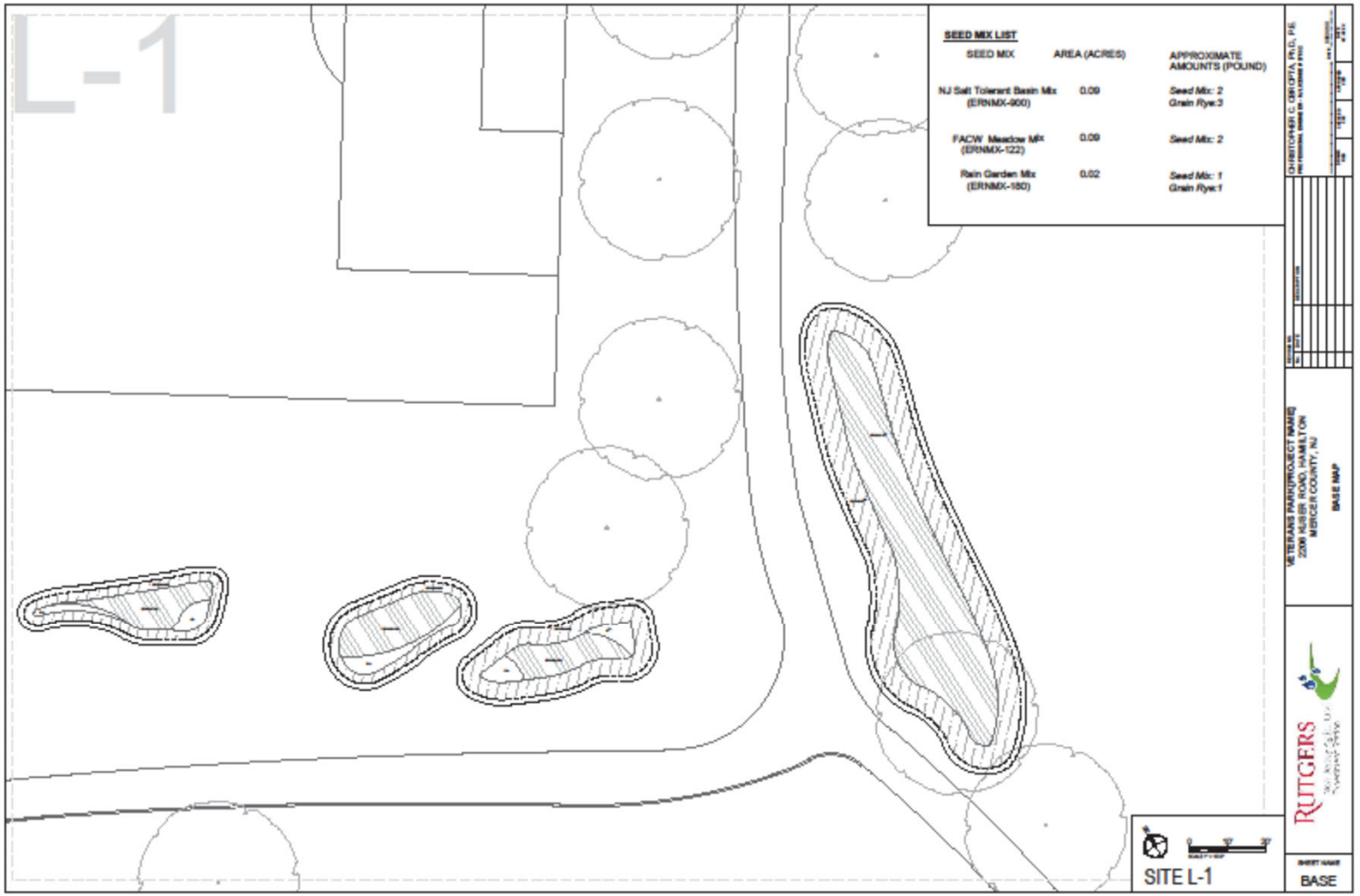


Veterans Park, Hamilton Township

Veterans Park, Concept Master Plan



Construction Documents

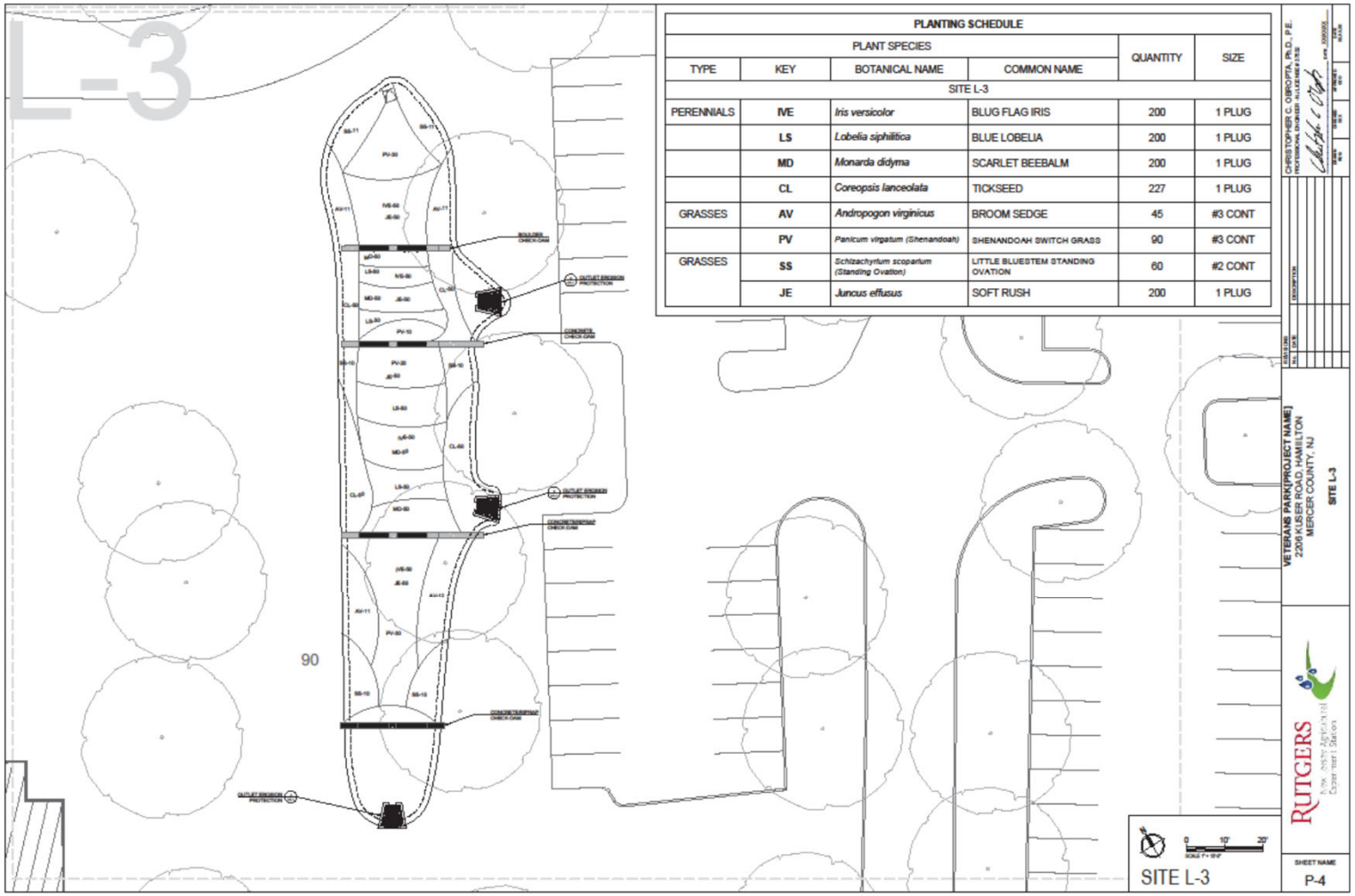


Process

Post Installation

Post Installation

Construction Documents



PLANTING SCHEDULE

PLANT SPECIES				QUANTITY	SIZE
TYPE	KEY	BOTANICAL NAME	COMMON NAME		
SITE L-3					
PERENNIALS	IVE	*Iris versicolor*	BLUG FLAG IRIS	200	1 PLUG
	LS	*Lobelia siphilitica*	BLUE LOBELIA	200	1 PLUG
	MD	*Monarda didyma*	SCARLET BEEBALM	200	1 PLUG
	CL	*Coreopsis lanceolata*	TICKSEED	227	1 PLUG
GRASSES	AV	*Andropogon virginicus*	BROOM SEDGE	45	#3 CONT
	PV	*Panicum virgatum (Shenandoah)*	SHENANDOAH SWITCH GRASS	90	#3 CONT
GRASSES	SS	*Schizachyrium scoparium (Standing Ovation)*	LITTLE BLUESTEM STANDING OVATION	60	#2 CONT
	JE	*Juncus effusus*	SOFT RUSH	200	1 PLUG

Construction Documents - Rendering

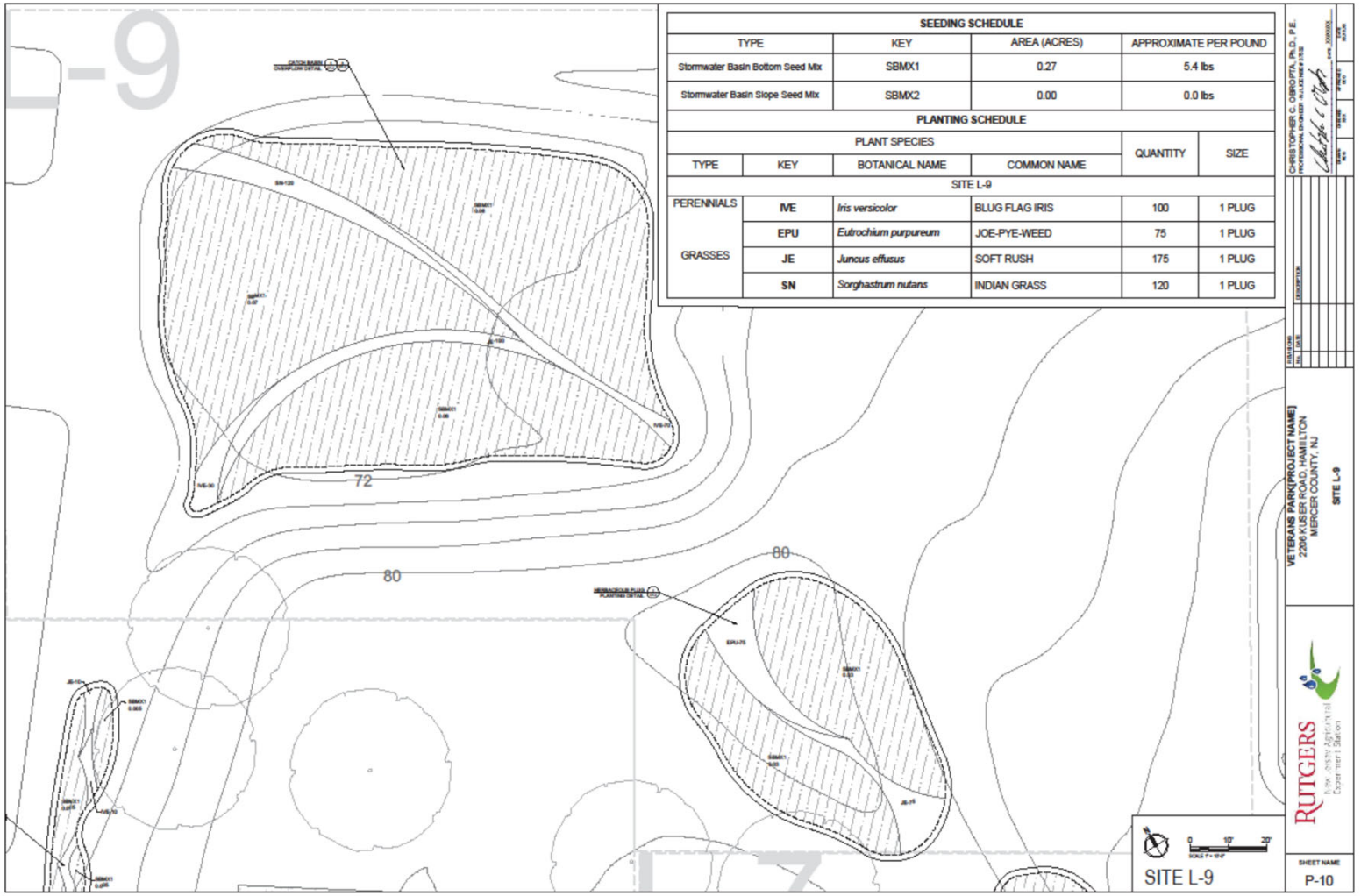
Process

Post Installation

Problems

Solutions

Construction Documents



SEEDING SCHEDULE

TYPE	KEY	AREA (ACRES)	APPROXIMATE PER POUND
Stormwater Basin Bottom Seed Mix	SBMX1	0.27	5.4 lbs
Stormwater Basin Slope Seed Mix	SBMX2	0.00	0.0 lbs

PLANTING SCHEDULE

PLANT SPECIES				QUANTITY	SIZE
TYPE	KEY	BOTANICAL NAME	COMMON NAME		
SITE L-9					
PERENNIALS	IVE	*Iris versicolor*	BLUG FLAG IRIS	100	1 PLUG
	EPU	*Eutrochium purpureum*	JOE-PYE-WEED	75	1 PLUG
GRASSES	JE	*Juncus effusus*	SOFT RUSH	175	1 PLUG
	SN	*Sorghastrum nutans*	INDIAN GRASS	120	1 PLUG

CHRISTOPHER C. OBROPTA, Ph.D., P.E.

VETERANS PARK[PROJECT NAME]
2206 KUSER ROAD, HAMILTON
MERCER COUNTY, NJ

SITE L-9

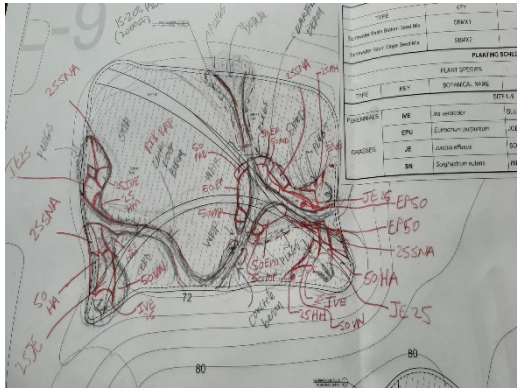
RUTGERS
New Jersey Agricultural Experiment Station

SITE L-9

SHEET NAME
P-10

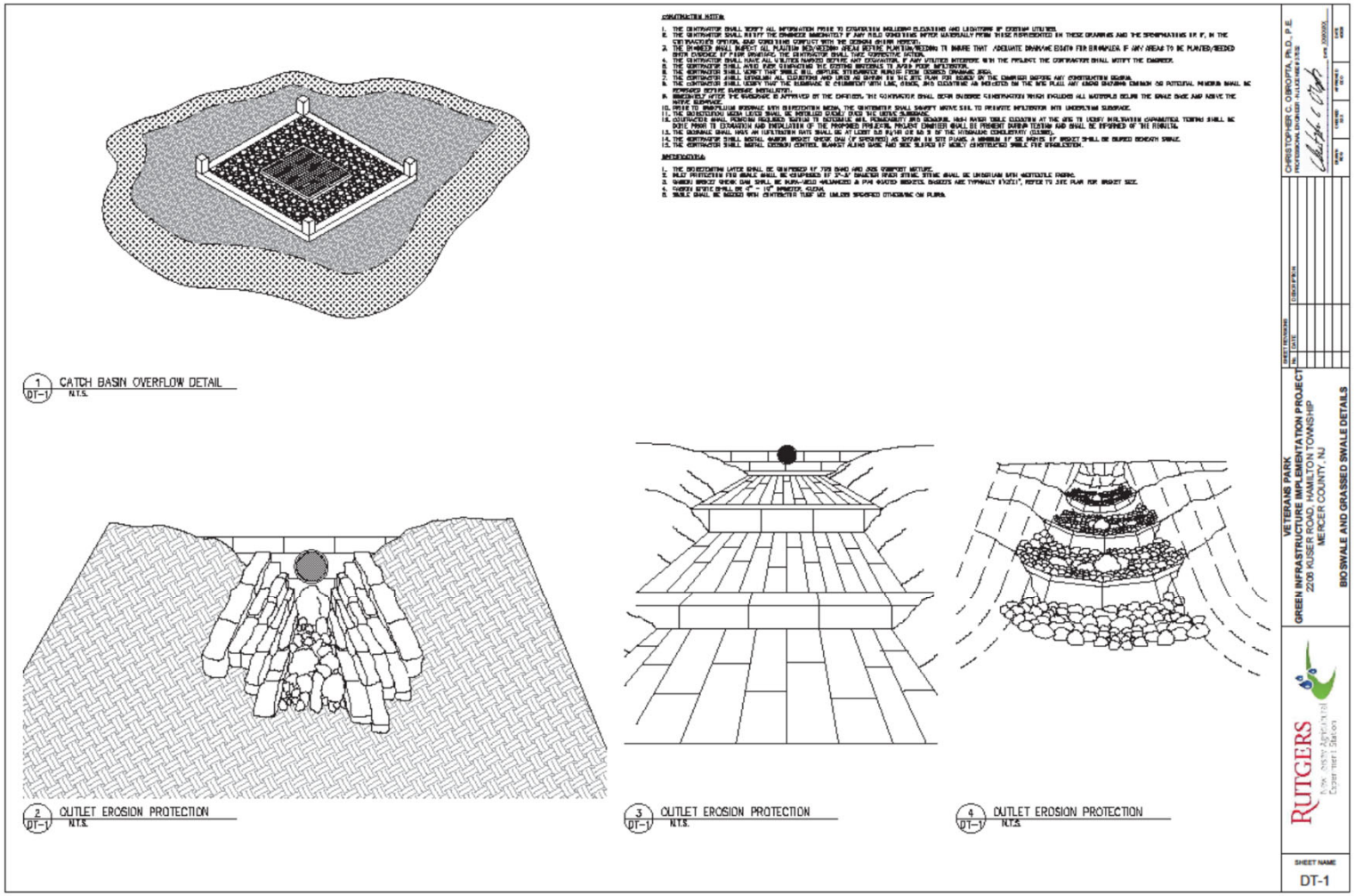
Construction Documents - Rendering

Process



Post Installation – Spring 2021

Outlet/Overflow Protection Concrete Re-use Methods



Process

Post Installation

Post Installation

Post Installation

How to get Started

1. Conduct a detention basin inventory
2. Perform detention basin inspections
3. Identify basins best to retrofit
4. Develop concepts
5. Seek funding
6. Finalize construction drawings and specifications
7. Build it
8. Maintain it

Conclusion

Retrofitting detention basins is a cost-effective way to:

- Improve pollutant removal efficiency
- Improve volume control
- Improve infiltration
- Enhance wildlife habitat
- Sequester carbon
- Provide pollinator habitat
- Create attractive and educational places
- Reduce maintenance
- Save money

References

We recommend: ***New Jersey Stormwater Best Management Practices Manual***
Available at: http://www.njstormwater.org/bmp_manual2.htm

Design References:

1. Maintaining Your BMP, A Guidebook for Private Owners and Operators in Northern Virginia, Northern Virginia Planning District Commission, Division of Environmental Services, February 2000.
2. Sustainable Sites and Natural Landscapes, Northeastern Illinois Planning Commission, January 2004.
3. Stormwater Management Basins and Their Maintenance, Monmouth County Mosquito Extermination Commission, 1999.
4. Minnesota Urban Small Sites BMP Manual, Metropolitan Council/Barr Engineering Co.
5. Maintaining Wet Detention Ponds, Land-of-Sky Regional Council, Asheville, NC.
6. Storm Water Technology Fact Sheet, Wet Detention Ponds, USEPA, 1999.
7. Establishing Wildflowers Tip-Sheet, Mercer County Soil Conservation District, 1995.
8. Indiana Wetland Conservation Plan Fact Sheet, Did You Know?...Healthy Wetlands Devour Mosquitoes, Indiana Department of Natural Resources.
9. The Maintenance of Residential Stormwater Management Areas, USDA NRCS, January 2000.
10. Operation, Maintenance, and Management of Stormwater Management Systems, Watershed Institute, Inc. and USEPA, August 1997.
11. Pennsylvania Environmental Council Stormwater Solutions


QUESTIONS?

QUESTIONS?

Rutgers Cooperative Extension
Water Resources Program

Chris Perez
Email: cperez@envsci.rutgers.edu

Alex Ciorlian
Email: acc209@envsci.rutgers.edu

www.water.rutgers.edu

RUTGERS
New Jersey Agricultural Experiment Station