

Sussex County Green Infrastructure Seminar Series  
Seminar 2

Friday, October 29, 2010  
1:00-3:00PM

Byram Township Municipal Building

***Detention Basin Retrofits and Maintenance***

Rutgers Cooperative Extension Water Resources Program

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**RUTGERS**  
New Jersey Agricultural  
Experiment Station



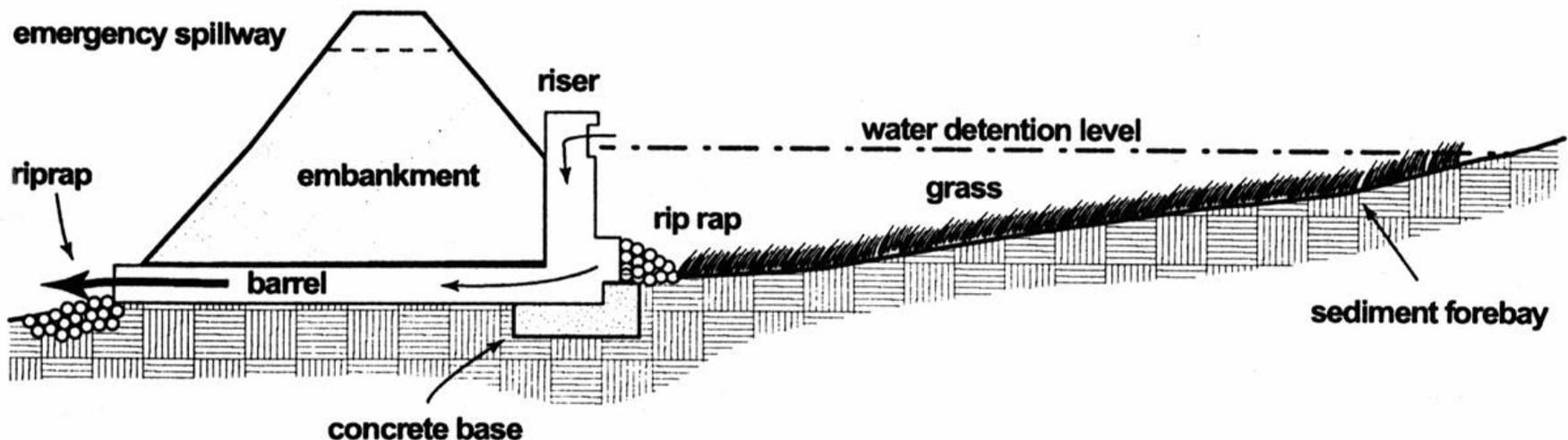
# Presentation Overview

1. Overview of various basin designs
2. Common landscaping and maintenance concerns
3. Maintenance requirements
4. Typical maintenance costs
5. Ways to reduce maintenance
6. Case Studies
7. Planning for maintenance
8. NJ BMP Manual – Maintenance Plan
9. References

# What is a Detention Basin?

Basins whose outlets have been designed to detain stormwater runoff for some minimum time to prevent downstream flooding. Provide quantity control, mowed regularly with concrete low-flow channels, dry except during and immediately following a storm event (typically 48 hours).

Basins can also treat stormwater runoff through settling of particles.



# Detention Basin



# Detention Basin

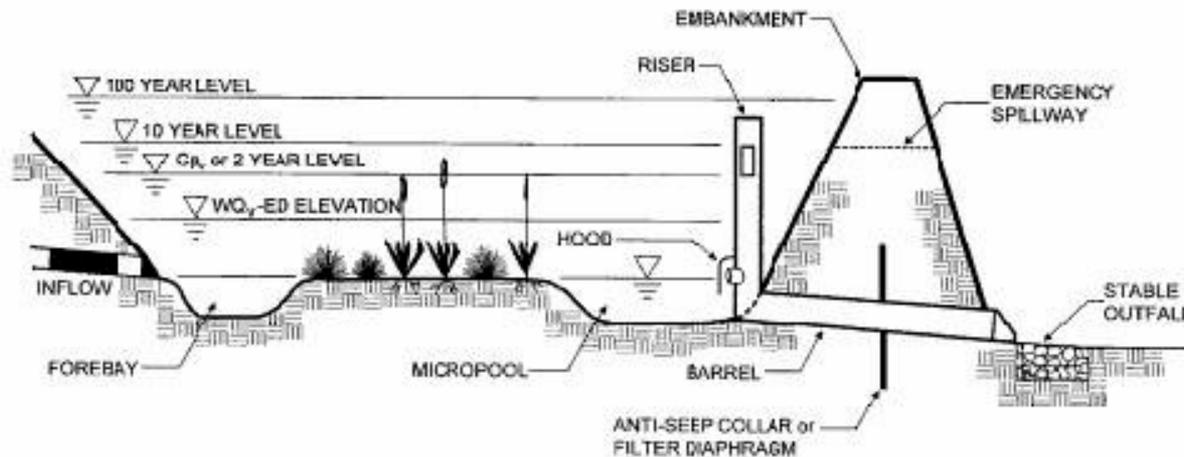


# What is a Retention Basin?

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

Retention basins are often used as landscape amenities with permanent pools of standing water, stormwater fills the basin during rainfall events and discharges until permanent water surface elevation is reached.

Ponds will treat incoming stormwater runoff by allowing particles to settle and algae to take up nutrients.



PROFILE

# 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

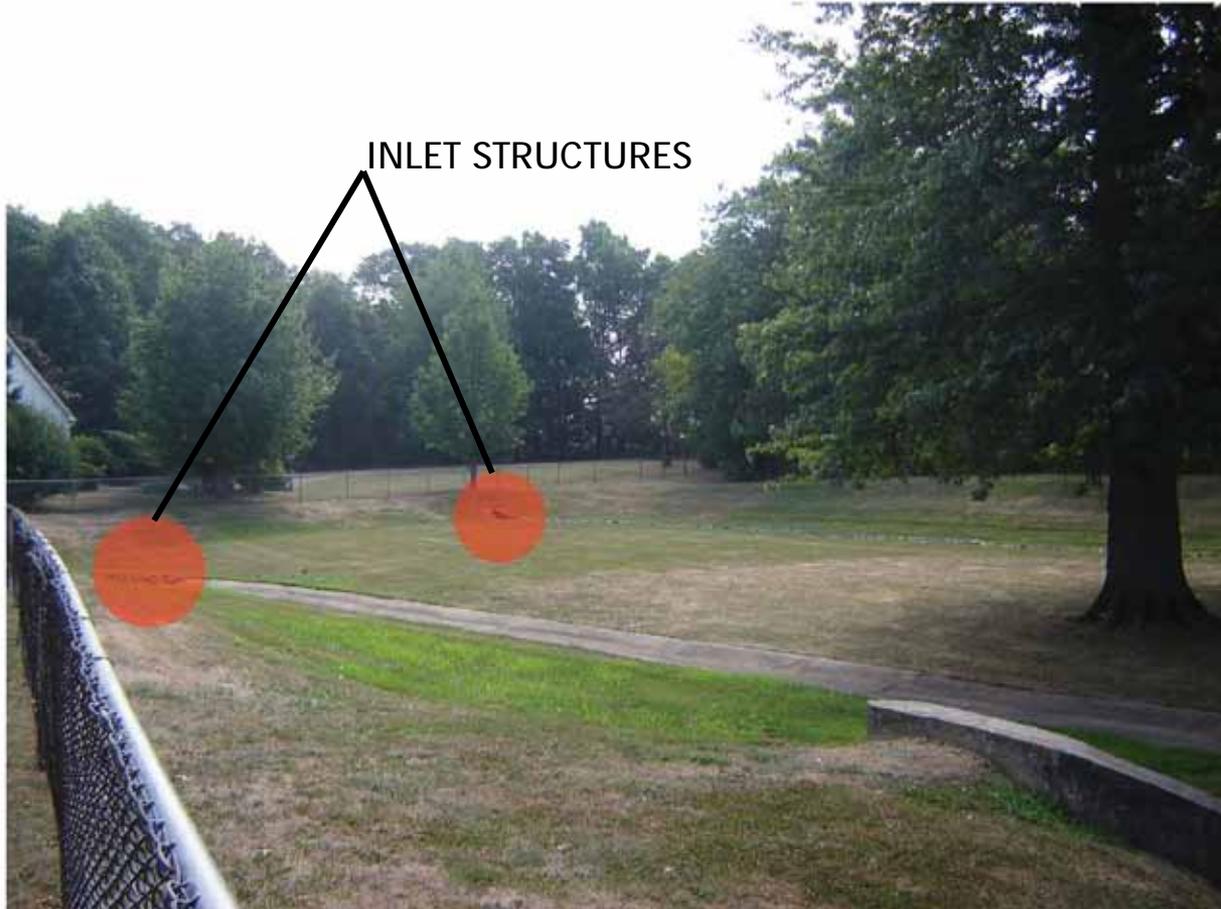


USEPA

# Detention Basin Anatomy



# Detention Basin Anatomy



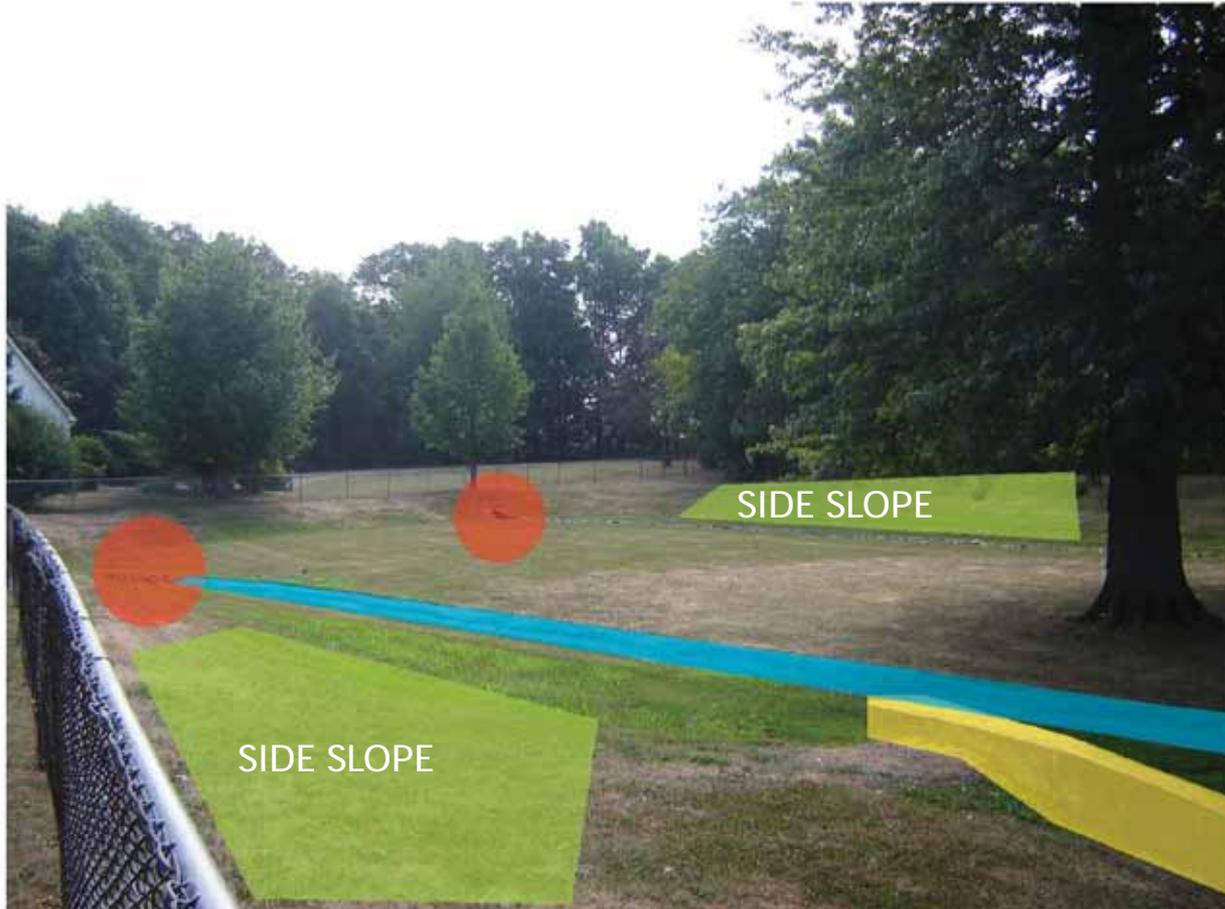
# Detention Basin Anatomy



# Detention Basin Anatomy



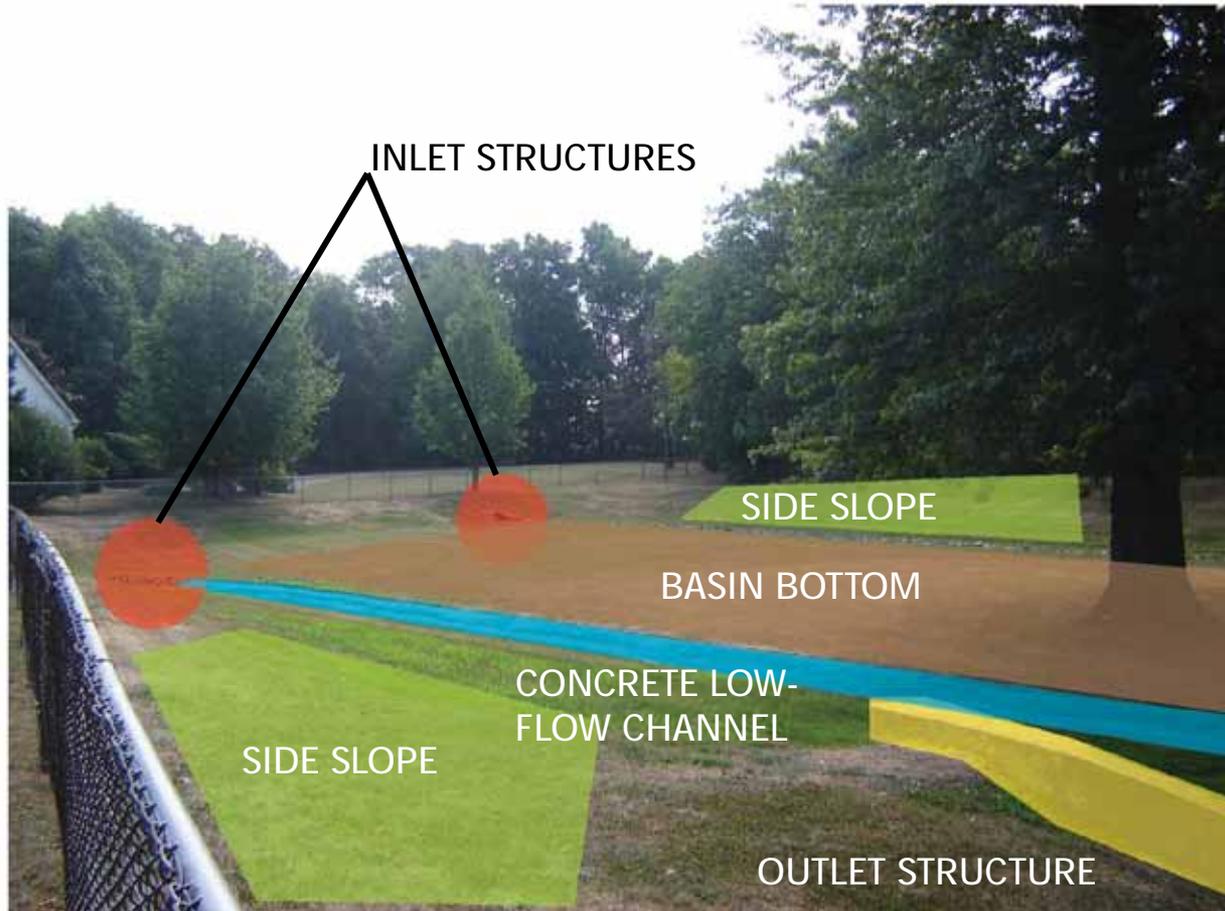
# Detention Basin Anatomy



# Detention Basin Anatomy



# Detention Basin Anatomy



# Common Concerns with Traditional Dry Detention Basins

1. Embankment and outlet stabilization
2. Sedimentation
3. Outlet blockages
4. Broken or clogged low-flow channels
5. Standing water or wet soils
6. Floatables and debris
7. Weeds or woody vegetation
8. Mowing and landscaping costs

# Maintenance Considerations

Activity	Schedule
<ul style="list-style-type: none"> <li>• Note erosion of pond banks or bottom</li> </ul>	Semiannual inspection
<ul style="list-style-type: none"> <li>• Inspect for damage to the embankment</li> <li>• Monitor for sediment accumulation in the facility and forebay</li> <li>• Examine to ensure that inlet and outlet devices are free of debris and operational</li> </ul>	Annual inspection
<ul style="list-style-type: none"> <li>• Repair undercut or eroded areas</li> <li>• Mow side slopes</li> <li>• Manage pesticide and nutrients</li> <li>• Remove litter and debris</li> </ul>	Standard maintenance
<ul style="list-style-type: none"> <li>• Seed or sod to restore dead or damaged ground cover</li> </ul>	Annual maintenance (as needed)
<ul style="list-style-type: none"> <li>• Remove sediment from the forebay</li> </ul>	5- to 7-year maintenance
<ul style="list-style-type: none"> <li>• Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25 percent</li> </ul>	25- to 50-year maintenance

# Maintenance Requirements

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

Properly designed and maintained wet detention basins can remove 80% of the suspended solids in urban runoff.

# Maintenance Requirements

## Routine Maintenance

# Routine Maintenance

- **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
- **Inspections**
  - Regular inspections by designated personnel, owner, or operator should be made and clear records kept

# Expected Costs for Annual 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
- Intensive maintenance including mowing, weed control, fertilization, etc. can range from \$500-\$3,500/acre annually

# Other Cost Considerations

$$C = 12.4V^{0.760}$$

where:

C = Construction, design, and permitting cost, and

V = Volume needed to control the 10-year storm (ft<sup>3</sup>).

Using this equation, typical construction costs are:

\$ 41,600	1 acre-foot pond
\$ 239,000	10 acre-foot pond
\$ 1,380,000	100 acre-foot pond

Source: USEPA

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>

# 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 on catch basins near the discharge to the detention system
- **Mechanical components maintenance**
  - Regular inspections and immediate repairs will reduce need for major replacements
- **Inspections**
  - Clearly identify appropriate personnel and have same individual conduct inspections at regular intervals

# Vegetation Management

## 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



*MANICURED EDGE*

*MEADOW AREA*

# Vegetation Management

## No mow zones

- In wet pond systems, eliminating regular mowing of the shoreline edge for a minimum of 5-10 feet and allowing vegetation to grow to a height of 24 to 30 inches is recommended for several reasons:
  - Reducing mowing will promote deeper root growth and soil stability at the pond edge.
  - The vegetation will filter runoff from surrounding areas reducing nutrients and other pollutants in the pond,
  - The vegetation will deter use of the facility by unwanted Canada geese through the physical and visual barrier,

# No Mow Zones



# No Mow Zones



# Vegetation Management

## Naturalized Plantings

- Install native plantings adapted to flood plain 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 is the “preferred” design option in the new BMP manual as it 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 to sites treated with glyphosate 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		Aquatic Vegetation for Wet Ponds	
<i>Botanical Name</i>	<i>Common Name</i>	<i>Botanical Name</i>	<i>Common Name</i>
<i>Asclepias incarnata</i>	Swamp Milkweed	<i>Pontederia cordata</i>	pickerelweed
<i>Aster novae-angliae</i>	New England Aster	<i>Sagittaria latifolia</i>	duck-potato
<i>Aster novi-belgi</i>	New York Aster	<i>Saururus cernus</i>	lizard tail
<i>Eupatorium perfoliatum</i>	Boneset	<i>Scirpus atrovirens</i>	green bulrush
<i>Iris pseudacorus</i>	Yellow-Flag	<i>Sparganium americanum</i>	lesser bur-reed
<i>Iris versicolor</i>	Blue-Flag		
<i>Lobelia cardinalis</i>	Cardinal Flower	Warm Season Grasses	
<i>Lobelia siphilitica</i>	Great Lobelia	<i>Botanical Name</i>	<i>Common Name</i>
<i>Vernonia noveboracensis</i>	New York Ironweed	<i>Agrostis alba</i>	Red Top
		<i>Agrostis palustris</i>	Creeping Bentgrass
		<i>Andropogon scoparius</i>	Little Bluestem
		<i>Andropogon virginicus</i>	Broomsedge
		<i>Calamagrostis canadensis</i>	Canada Wild Rye
		<i>Elymus canadensis</i>	Canada Wild Rye
		<i>Poa palustris</i>	Fowl Bluegrass
		<i>Puccinellia distans</i>	Alkaligrass
		<i>Tripsacum dactyloides</i>	Eastern Gamagrass
Common Wetland Plants			
<i>Botanical Name</i>	<i>Common Name</i>		
<i>Carex stricta</i>	tussock sedge		
<i>Carex vulpinoidea</i>	fox sedge		
<i>Carex crinita</i>	fringed sedge		
<i>Juncus effusus</i>	Soft Rush		

## 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

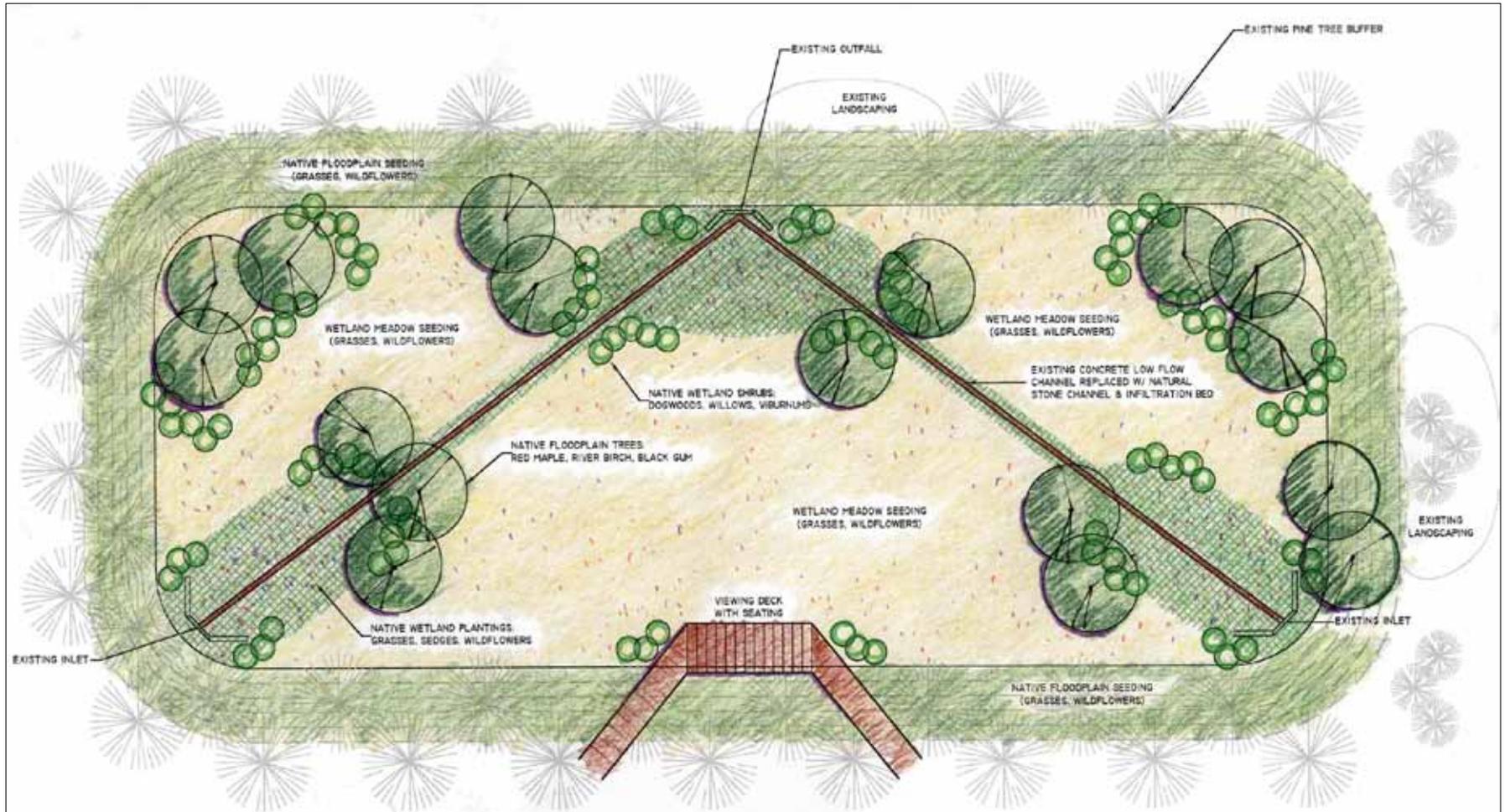


Egg Harbor Township  
New Jersey



# Naturalized Plantings

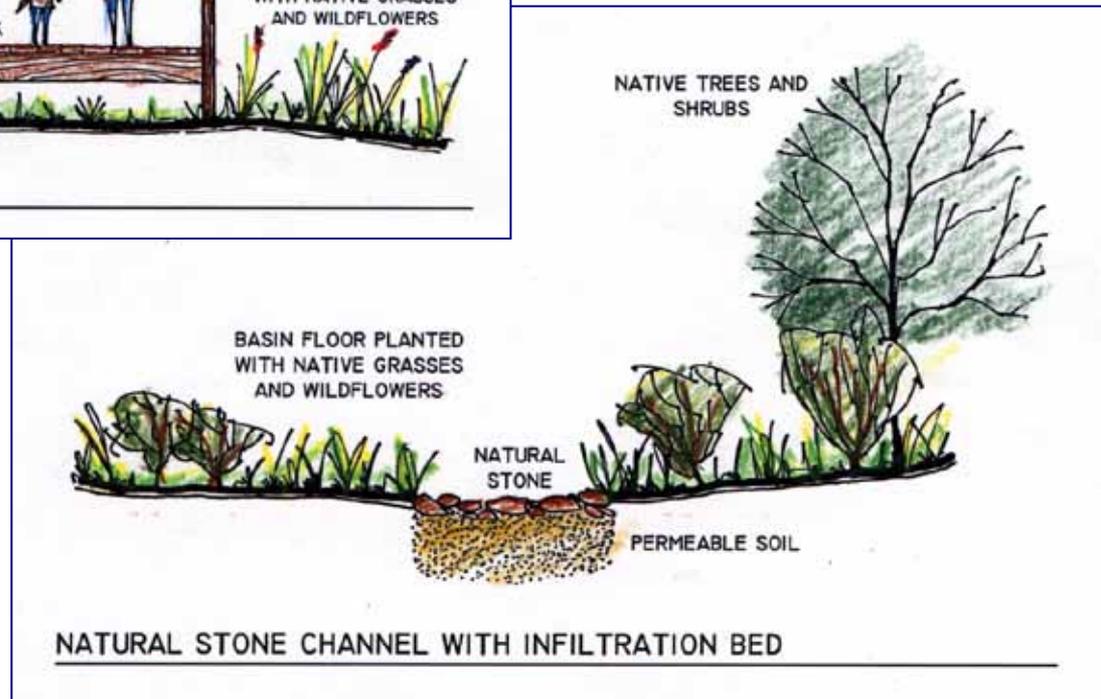
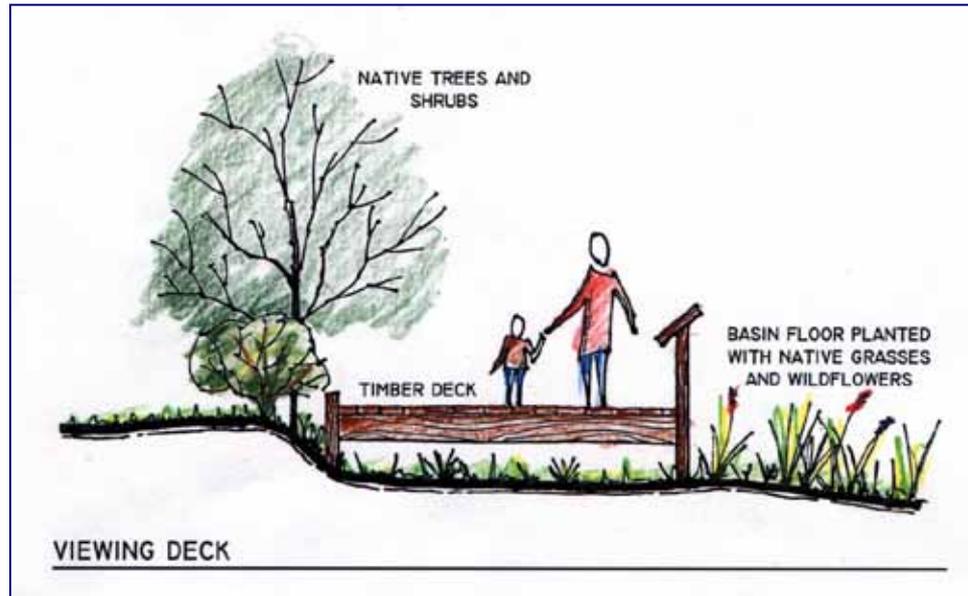
## Naturalized Detention Plan



# Naturalized Plantings

## Vegetated Basin

Hillsborough Township estimated they could save 200 man hours per year on mowing by implementing a naturalized detention basin program.



# Naturalized Plantings & Mosquitoes

- Mosquitoes can breed in almost any wet area containing standing water, including:
  - Containers/old tires
  - Catch basins
  - Gutters
  - Low wet spots in lawns
- Healthy naturalized systems provide habitat to many mosquito predators, including:
  - Dragonflies
  - Damselflies
  - Water Striders
  - Backswimmers
  - Predacious Diving Beetles
- Always provide and maintain access for inspection and treatment



[www.richard-seaman.com](http://www.richard-seaman.com)

# Mechanical Components Maintenance

- Regular inspections and immediate repairs will reduce need for major replacements



# Regular Inspections

At a minimum, regular inspections should:

- Document any erosion or sedimentation and identify any needs for repair or replacement
- Provide review of the inlet and outlet structures and note any deterioration, evidence of malfunctions, or collection of debris
- Document condition of the vegetation, noting any evidence of poor health, establishment of exotic species or weeds, woody growth on embankments, or need for any replacement
- Note any standing water or evidence of extended ponding not intended in the design or function of the system
- Note whether clear access to the facility is being maintained as per the design plans
- Document current and recent weather conditions and include a digital photograph of the facility

# Maintenance Requirements

## 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

# 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

# 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
  - Retrofit system for water-quality treatment
- **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

# 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



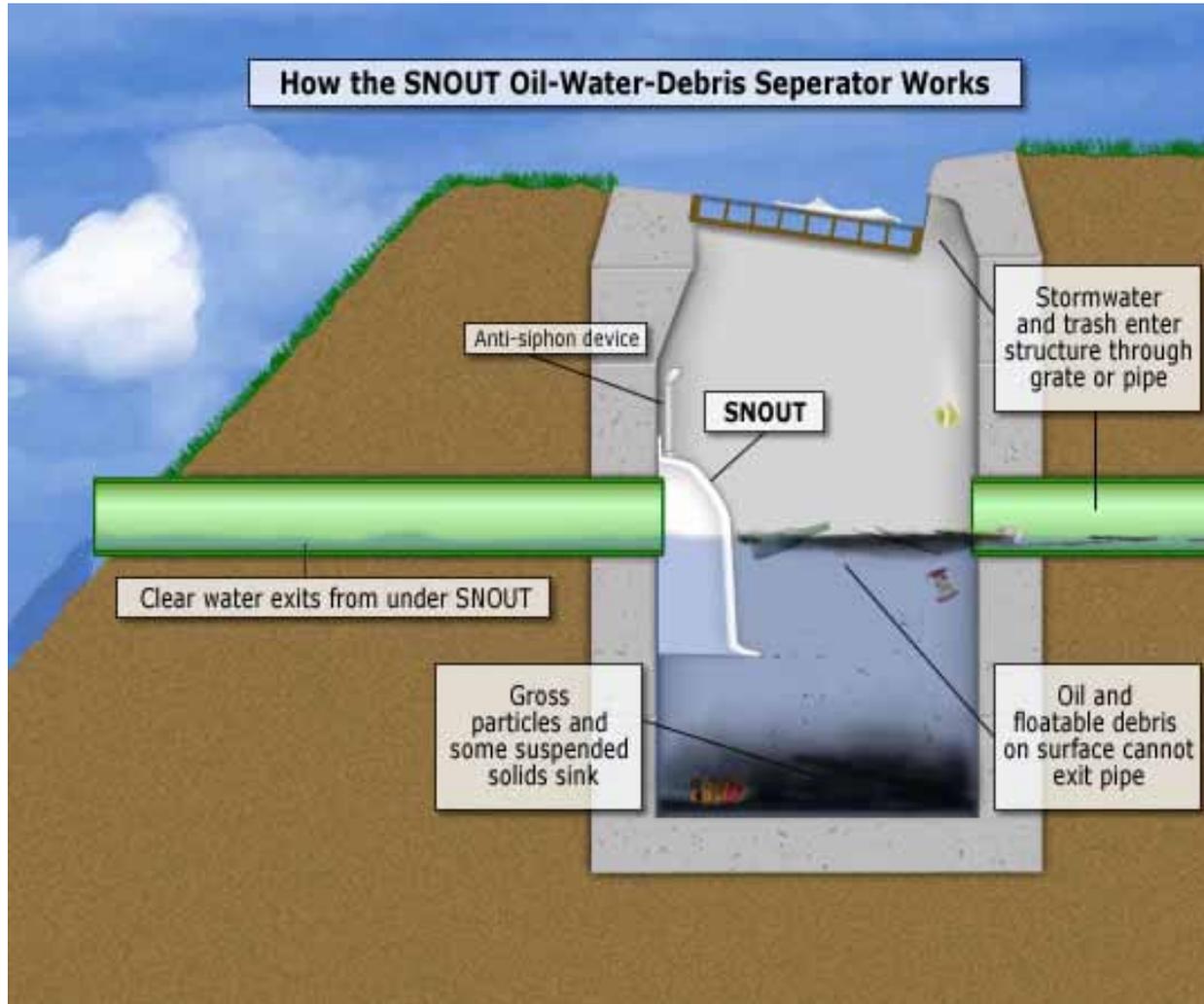
# Sediment Removal

## 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.

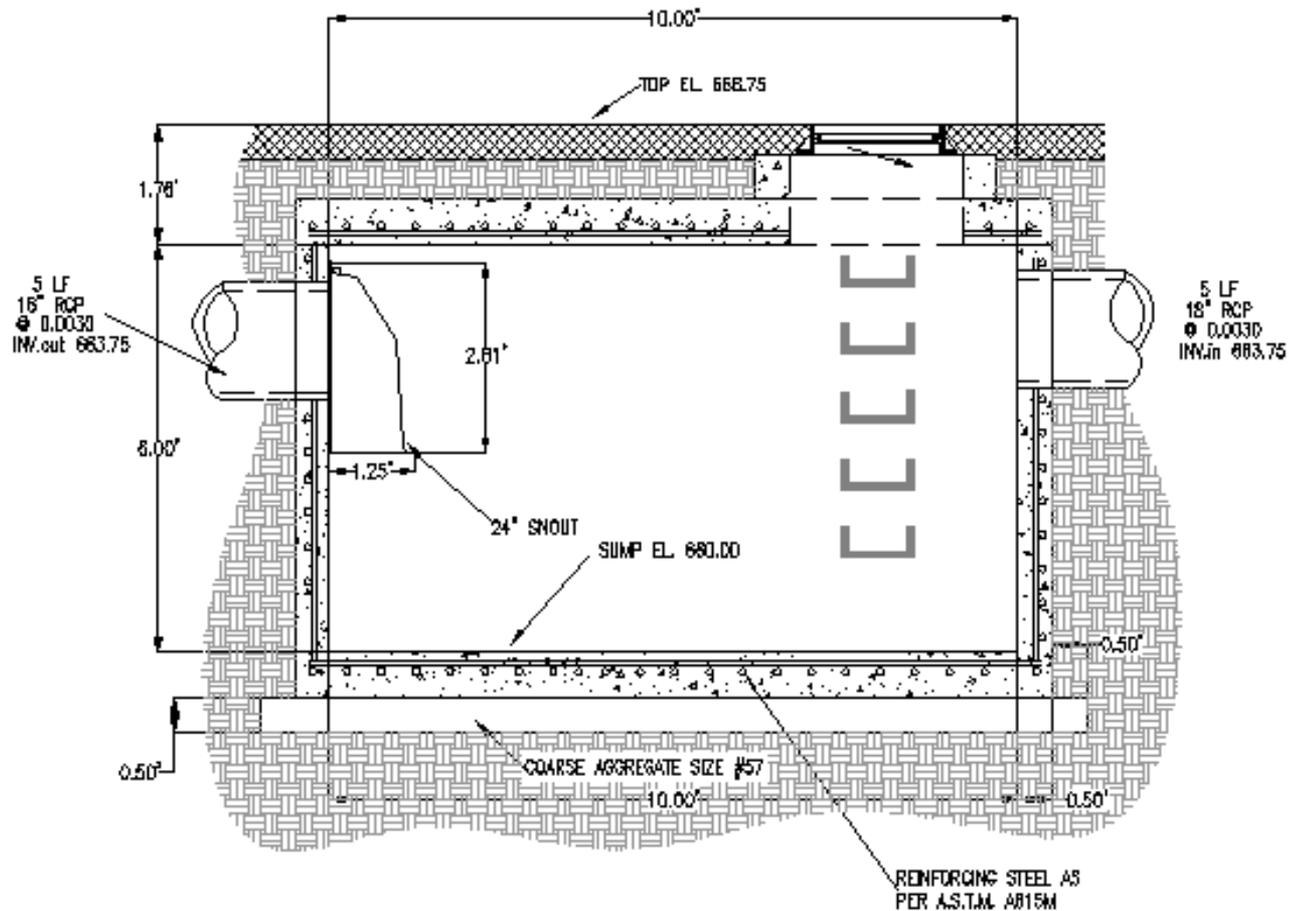
# Debris and Litter Removal

## Low Cost "Snout" Debris Separator



# Debris and Litter Removal

## Low Cost "Snout" Debris Separator

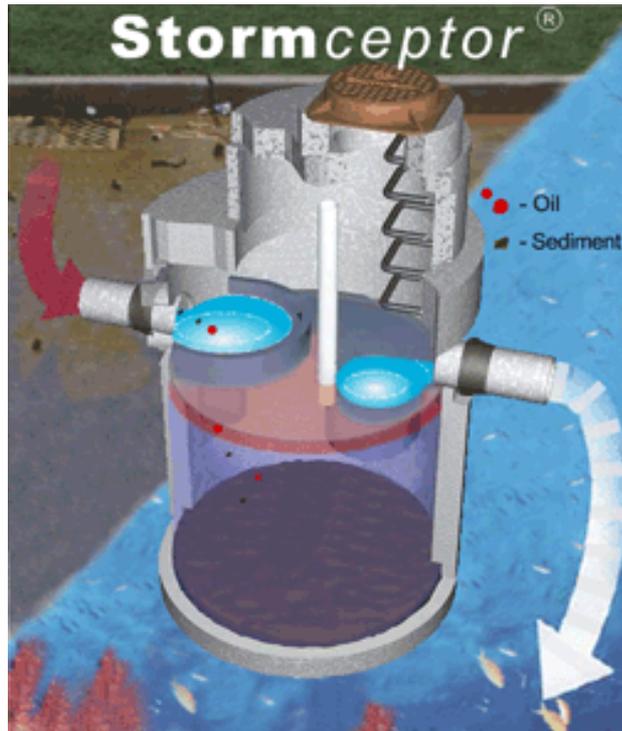


2  
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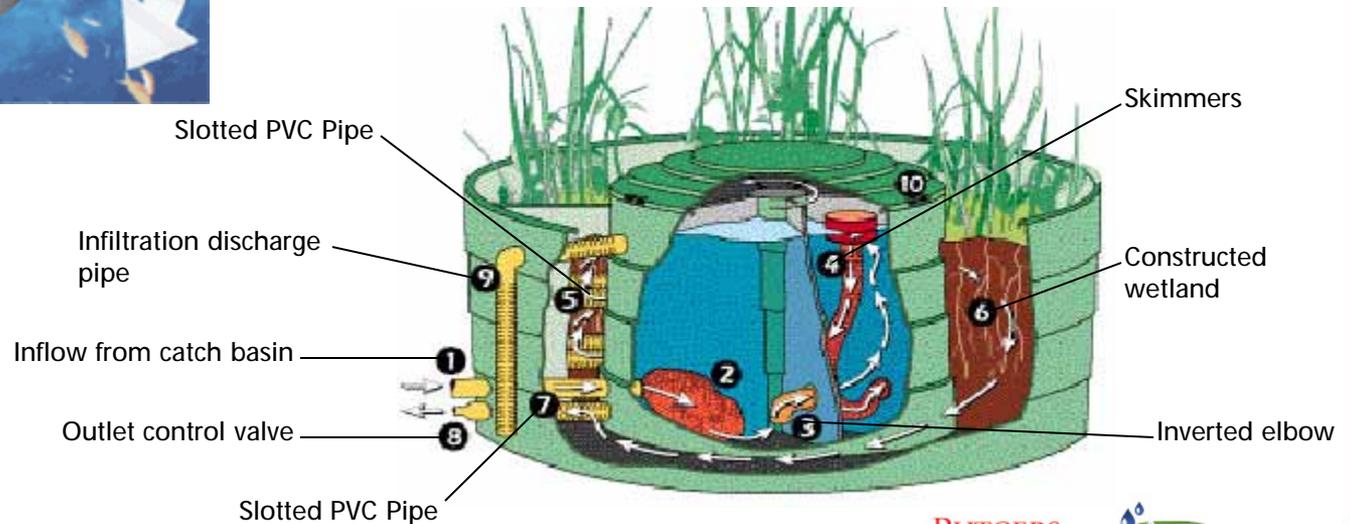
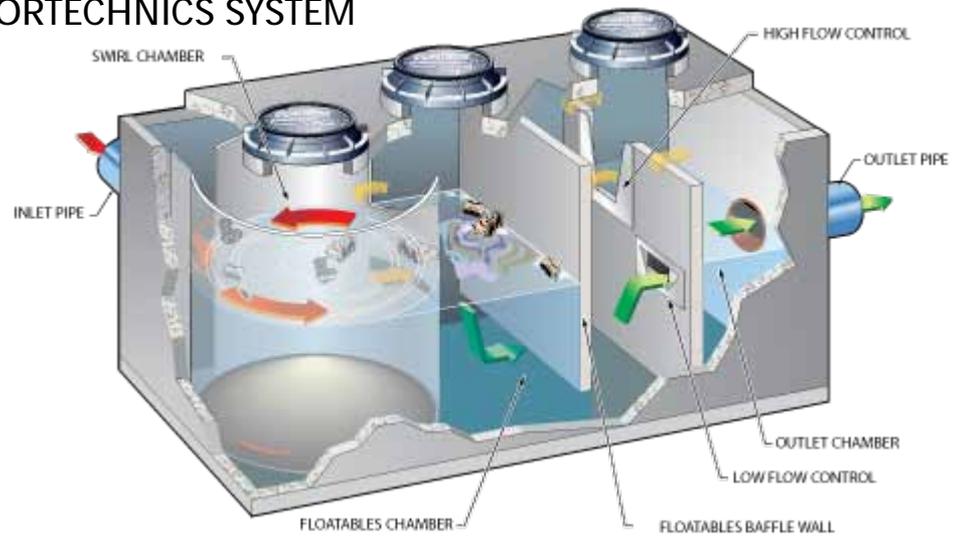
Vault w/ SNOUT - ELEVATION

1" = 2'

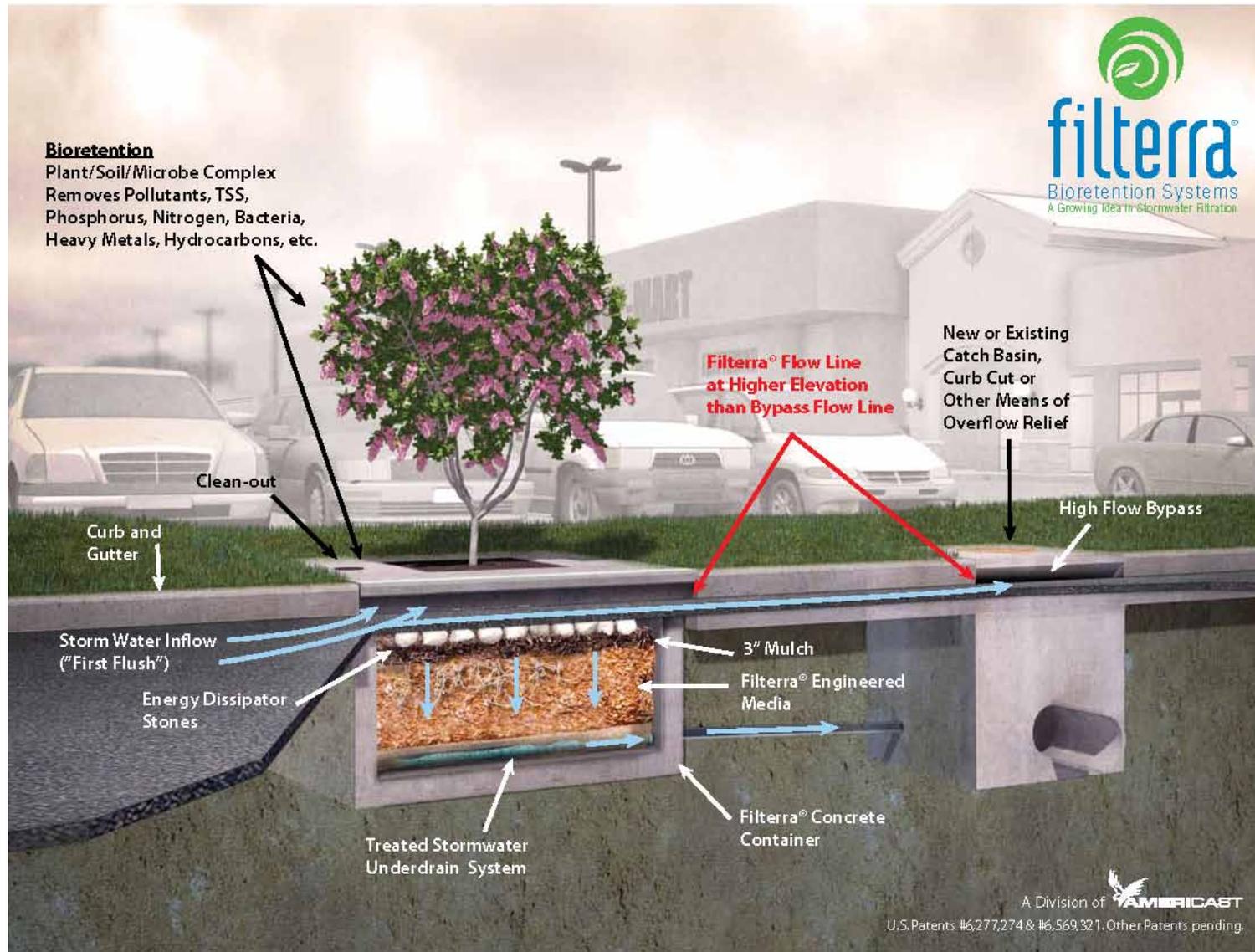
# Manufactured Pre-Treatment Systems



VORTECHNICS SYSTEM



# Manufactured Pre-Treatment Systems



# Manufactured Pre-Treatment Systems

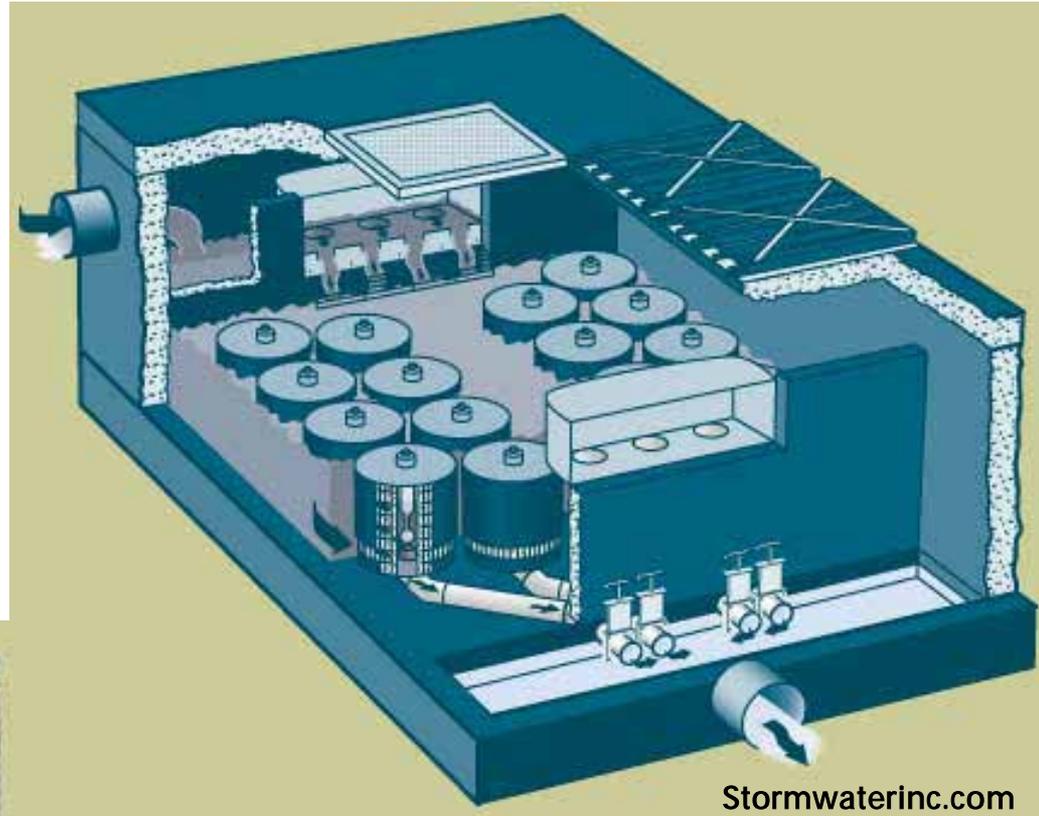
## The StormFilter System

### Major Components

- Precast Vault
- Filter Cartridges

### Considerations

- Sizing
- Optional Filter Media
- 2.5' of Head needed
- Maintenance



NOTE: Has received preliminary approval from NJ Office of Innovative Technology & Market Development

# Manufactured Pre-Treatment Systems

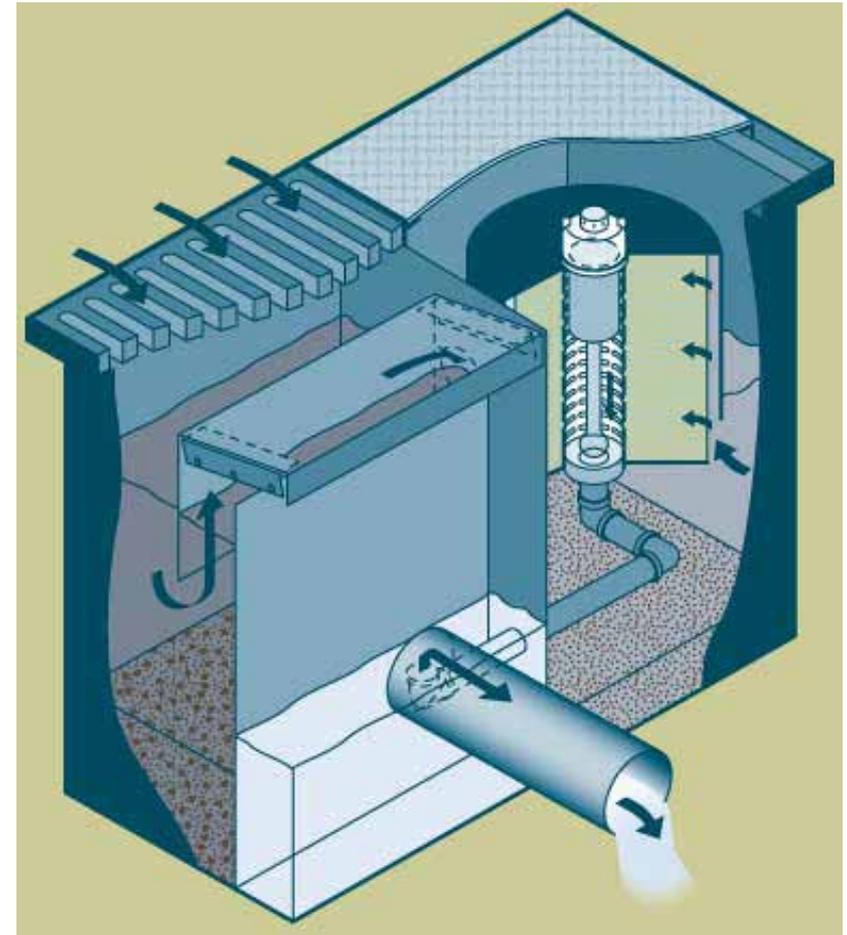
## The Catchbasin StormFilter System

### System Features and Benefits

- Targets site-specific pollutants
- Low cost, heavy gauge, all steel construction (Concrete units also available)
- Internal bypass that minimizes re-suspension of trapped pollutants

### General Specifications

- StormFilter capacity - 15 gpm/cartridge (up to 4 cartridges)
- Peak hydraulic capacities:  
Standard Steel Units -- 1.0 cfs  
Deep Steel Units - 3.0 cfs  
Concrete Units - 2.0 cfs
- Hydraulic drop (Rim to Invert): -  
Standard Steel Unit - 2.3'  
Deep Steel Unit - 3.3'  
Concrete Unit - 2.75' to 2.9' "
- Outlet pipe diameter - up to 12"
- Load-bearing capacities:  
Concrete Units - H-20  
Steel Units - H-20 with concrete collar



# 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



# RETROFIT

1. Extended Detention Basin
2. Outlet
3. Water Quality



# Retrofit: Extended Detention Basin

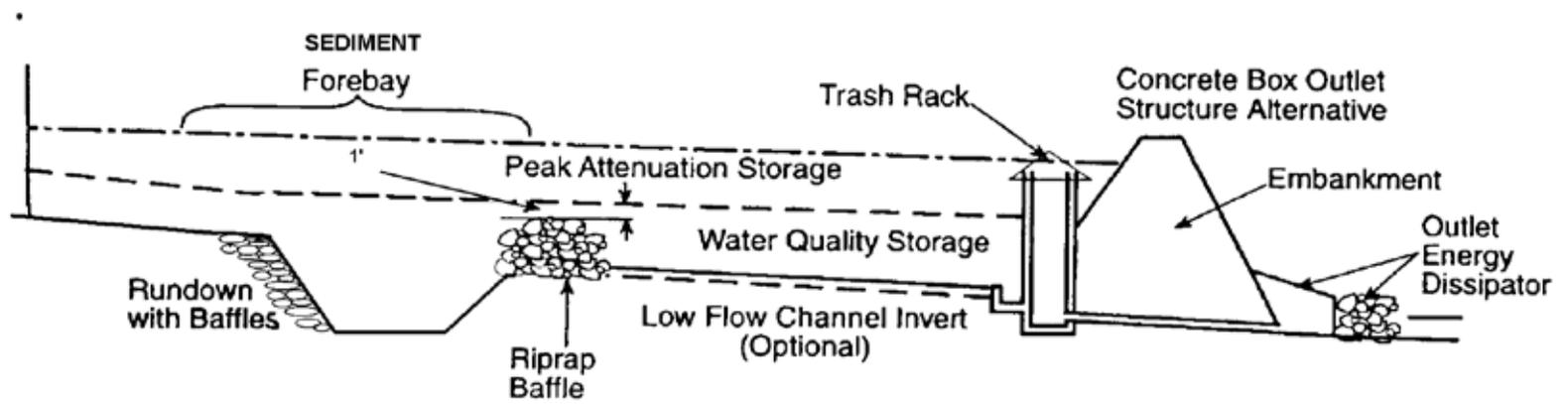
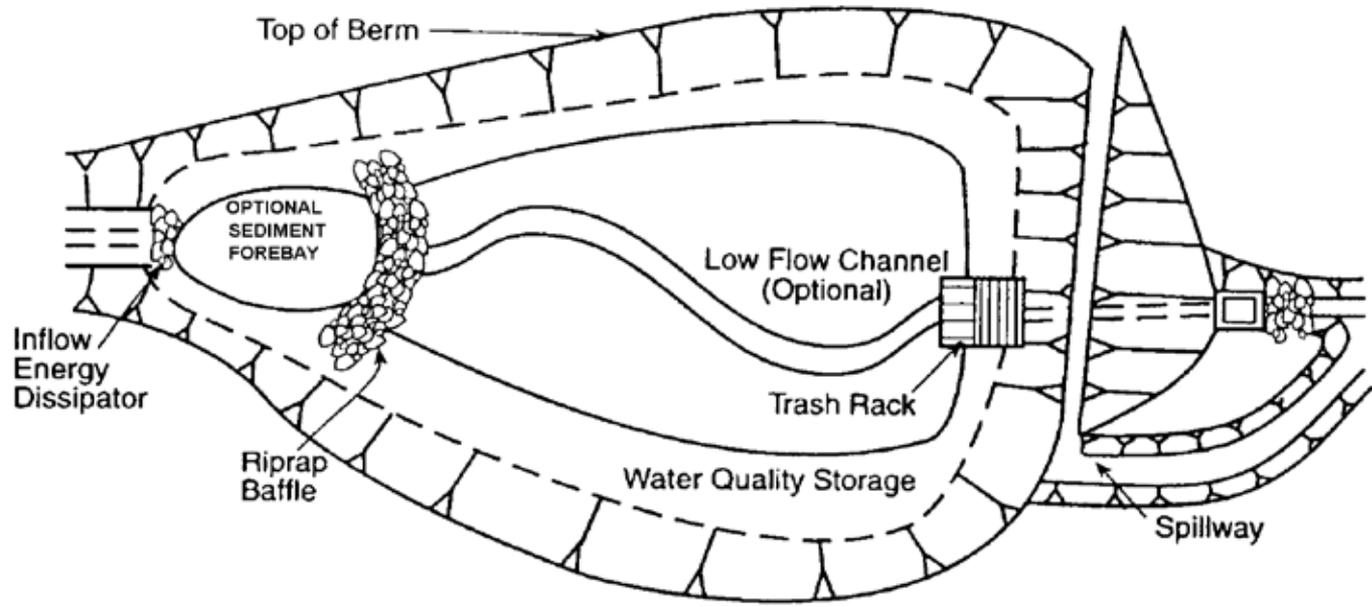
- Extended detention can address both the stormwater runoff quantity and quality impacts of land development.
- The lower stages of an extended detention basin can detain runoff from the Stormwater Quality Storm for extended periods of time, thereby promoting pollutant removal through sedimentation.
- 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

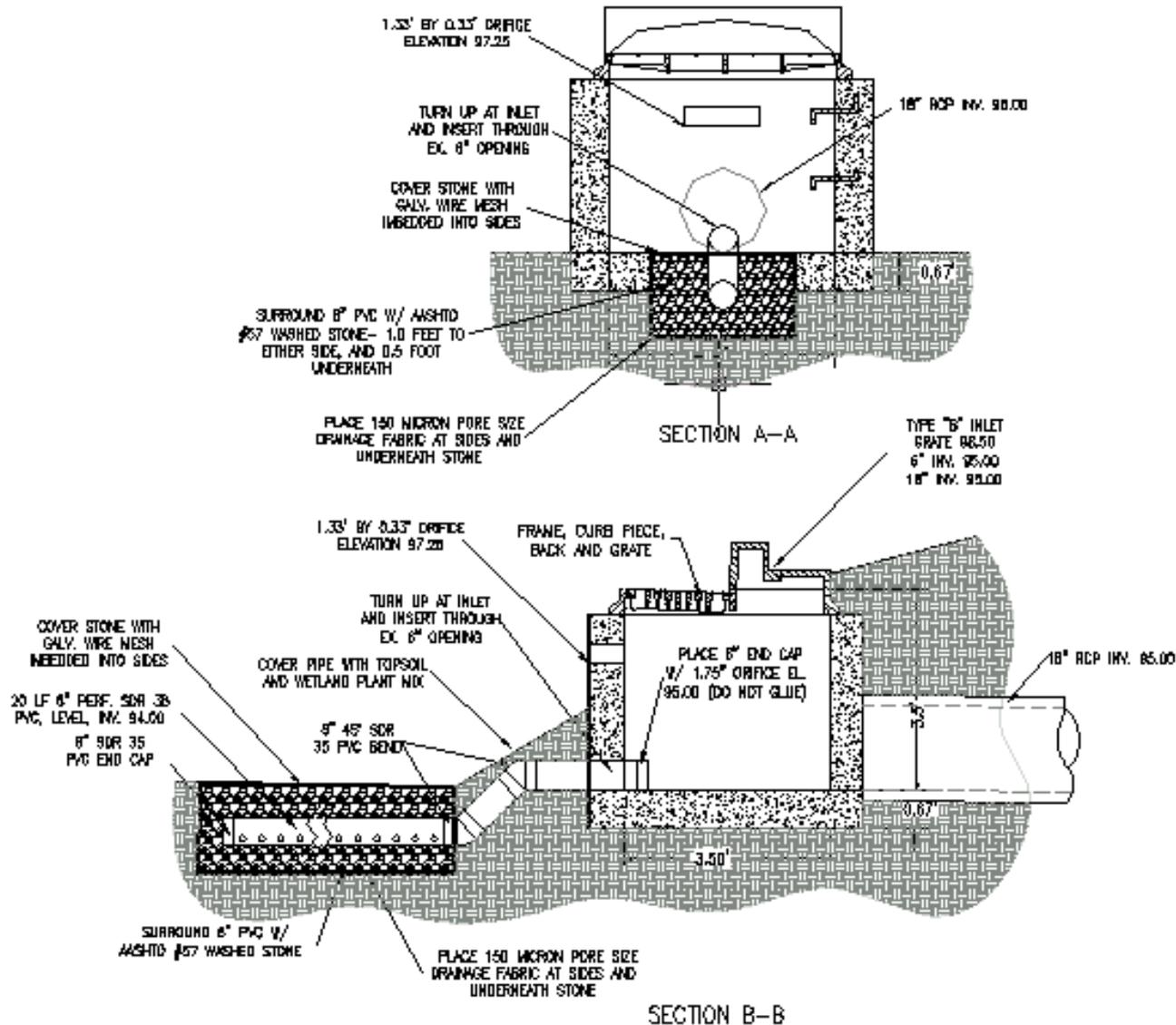
- The basic design parameters for an extended detention basin are its *storage volume* and *detention time*.
- An extended detention basin must have the correct combination of storage volume and outflow capacity to contain and *slowly* discharge the design runoff volume over a prescribed period of time.



# Extended Detention Basin Concept



# Retrofit: Outlet Modification



# Retrofit: Outlet Modification



# Retrofit: Outlet Modification



8.12.2003

# Retrofit: Water Quality

- Basins
  - Vegetate with Native Species
  - Remove Concrete Low Flow Channels
  - Install Permeable Weirs
- Storm Inlet Filtering Devices
- Manufactured Treatment Devices
- Disconnect Impervious Surfaces

*Capturing, treating and infiltrating the runoff generated by the water quality storm.*



# 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

Roadside Drainage Retrofit Program  
Hunterdon County, NJ



Sediment Deposits



Eroding roadway sub-base

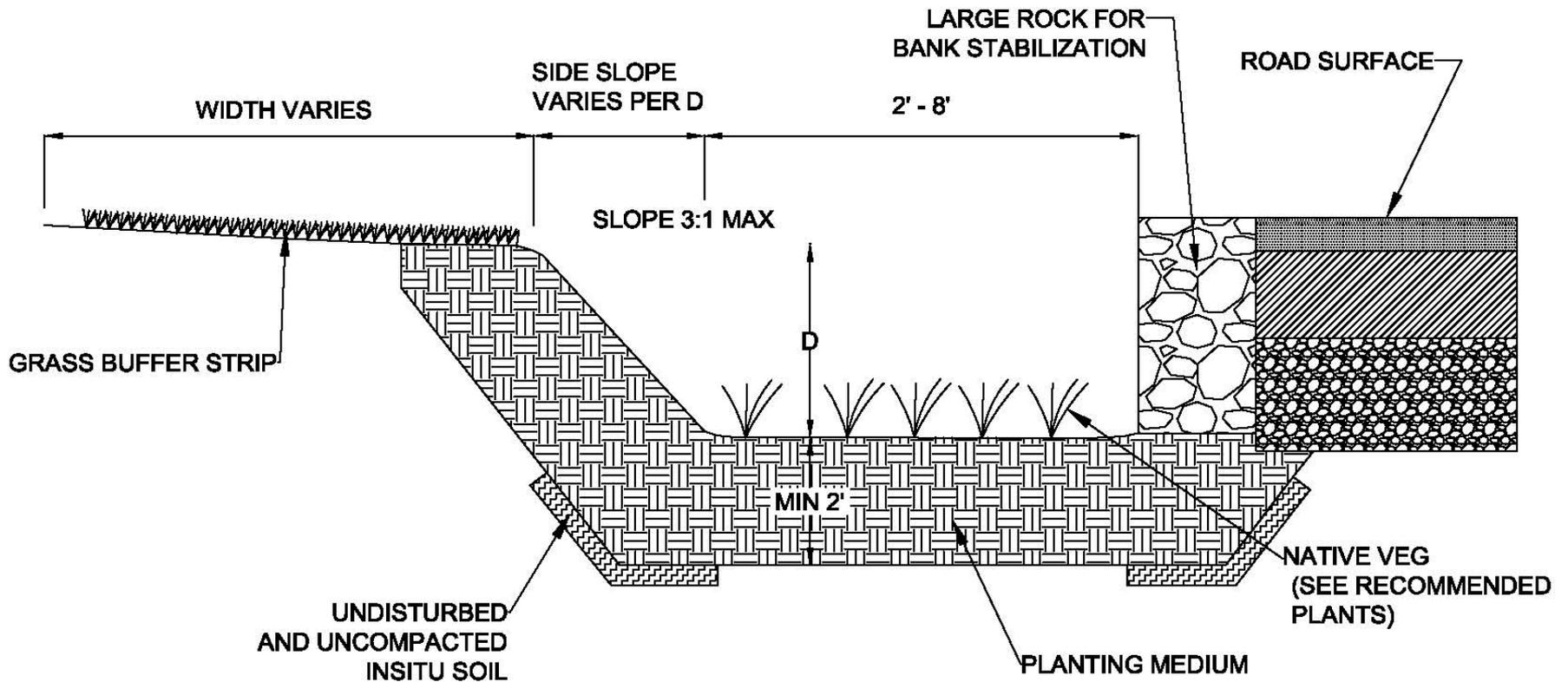
# Case Studies

Roadside Drainage Retrofit Program  
Hunterdon County, NJ

- Develop cost-effective designs strategies to address the roadside drainage issues associated with these watersheds
- Develop cost-effective routine maintenance practices to reduce sediment loads
- Build capacity within the local municipalities to implement the design and maintenance strategies in a cost-effective manner

# Case Studies

Roadside Drainage Retrofit Program  
Hunterdon County, NJ

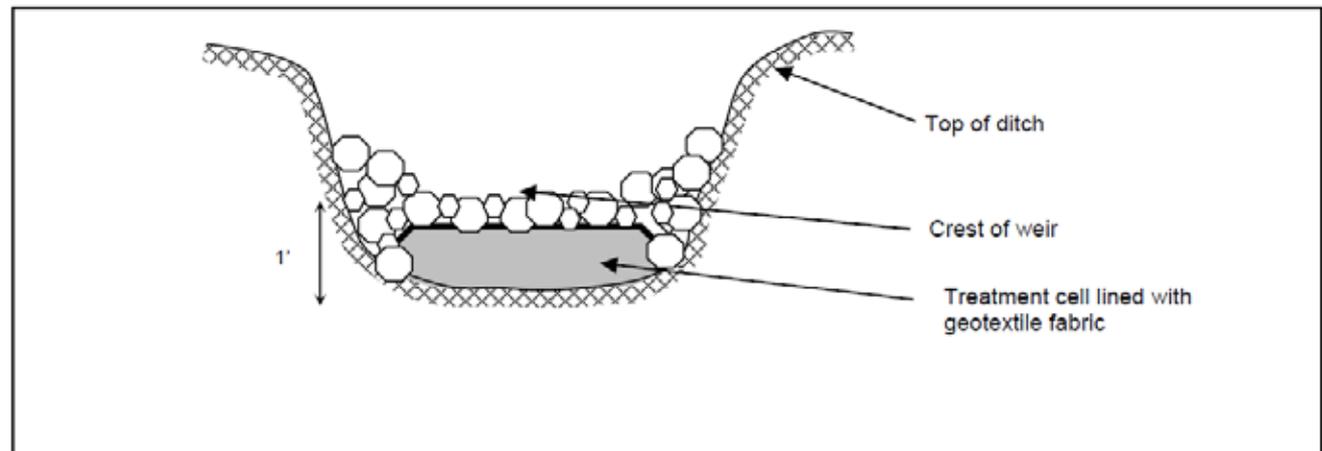
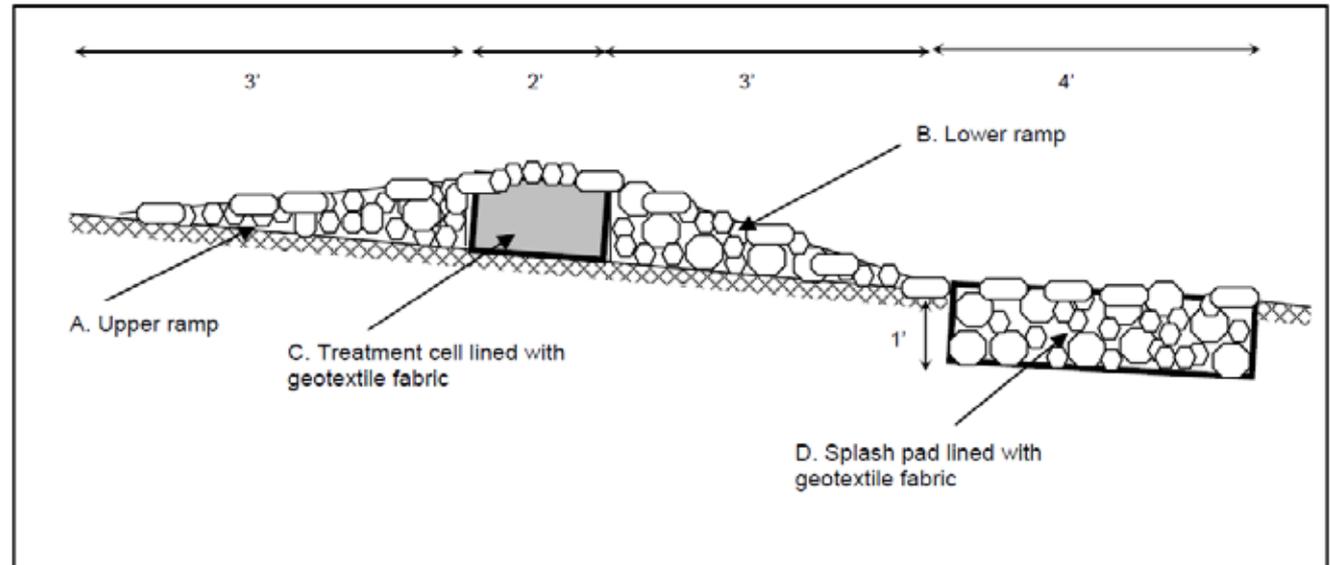


# Case Studies

Roadside Drainage Retrofit Program  
Hunterdon County, NJ

## Modified Check Dam Designs

NOTE: Treatment cell can be filled with material to limit phosphorus

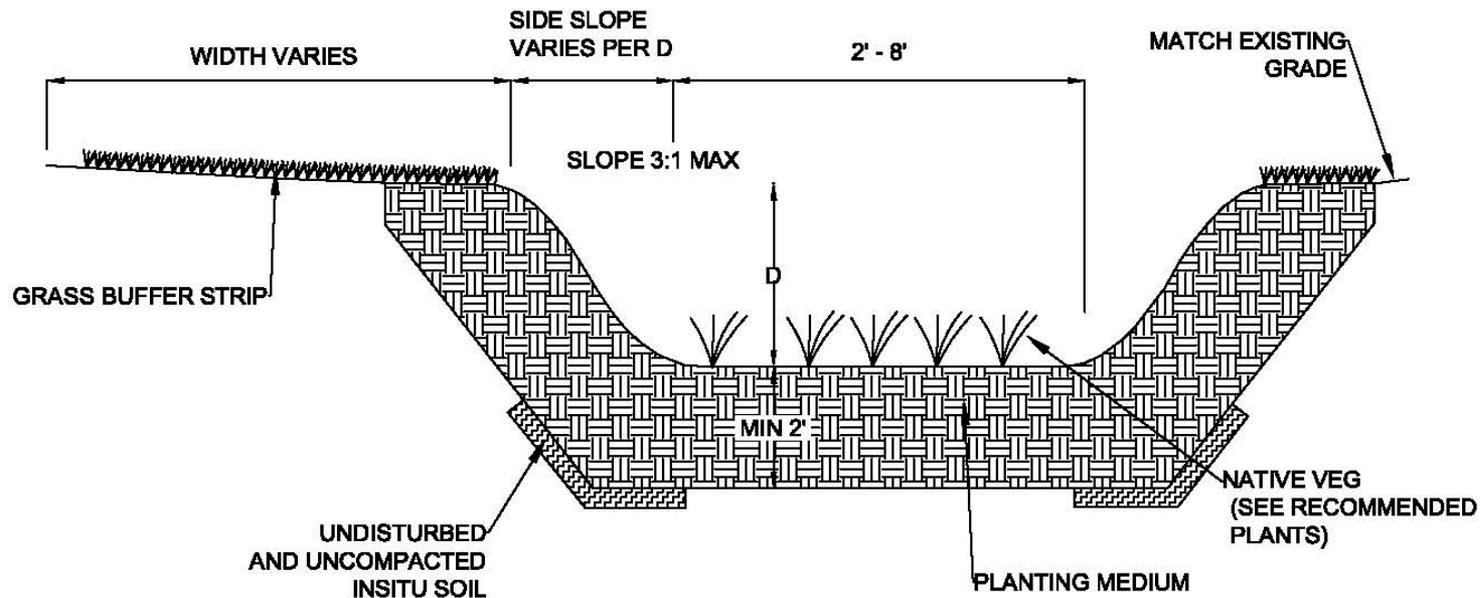


Courtesy of Washington State, King County DOT

# Case Studies

## Roadside Drainage Retrofit Program Hunterdon County, NJ

Rebuild existing swale to be wider and deeper within the right of way and the given space on North Side. Vegetate with native grasses and plants. On South Side, rebuild section of swale and install a check dam. Swale to follow NJ Standards for Soil Erosion and Sediment Control and guidance from NJDEP BMP Manual.



# Case Studies

Morris County DPW Extended Detention Swale Project  
Wharton, NJ

EXISTING CONDITIONS





# 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

Hillsborough Detention Basin Retrofit Program  
Somerset County, NJ



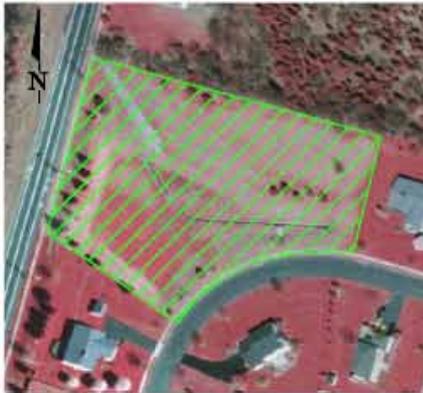
VALIS ROAD



WESCOTT ROAD



PRALL ROAD



FRANCIS ROAD

## TABLE OF CONTENTS

SHEET C-1:	COVER SHEET
SHEET S-1:	VALIS AND PRALL ROAD
SHEET S-2:	FRANCIS AND UPDIKE STREET
SHEET S-3:	WESCOTT ROAD
SHEET S-4:	VALIS AND PRALL ROAD (ALTERNATIVE LANDSCAPING PLAN)
SHEET S-5:	FRANCIS AND UPDIKE STREET (ALTERNATIVE LANDSCAPING PLAN)
SHEET S-6:	WESCOTT ROAD (ALTERNATIVE LANDSCAPING PLAN)



UPDIKE ROAD

APRIL 30, 2009

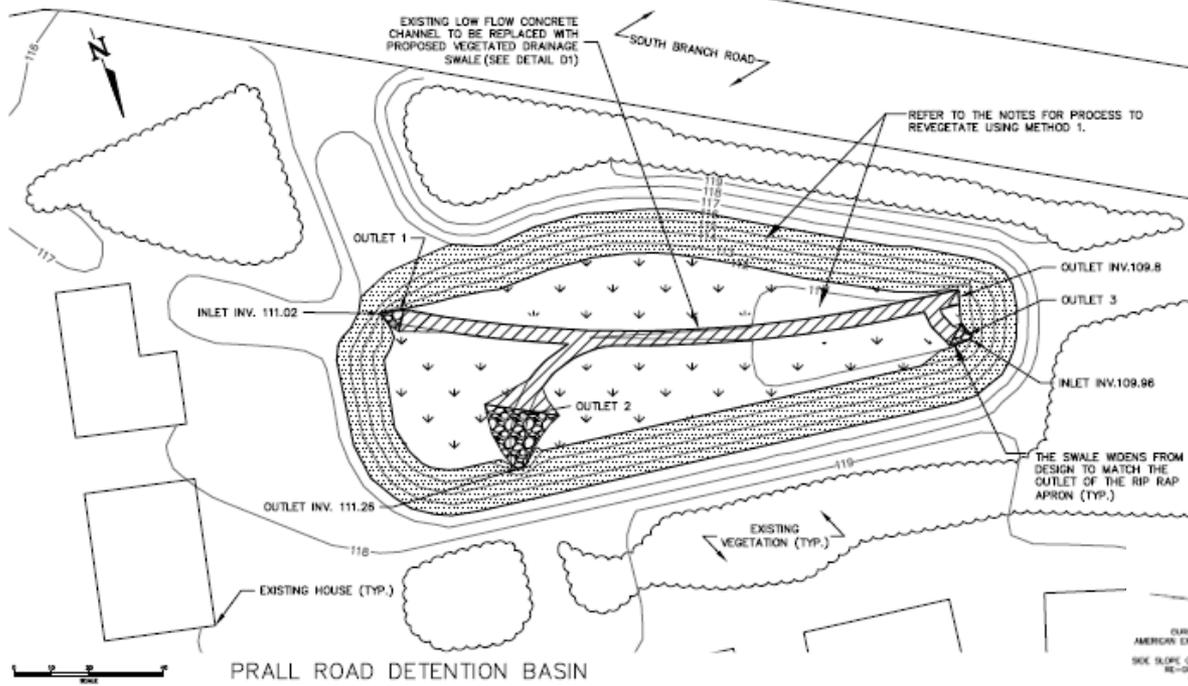
# RUTGERS

New Jersey Agricultural  
Experiment Station

# Case Studies

## Hillsborough Detention Basin Retrofit Program Somerset County, NJ

## Prall Road



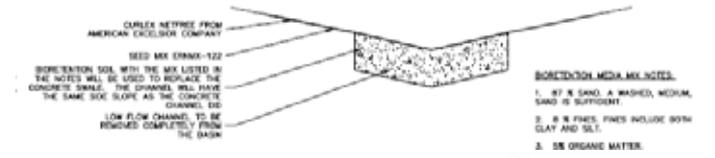
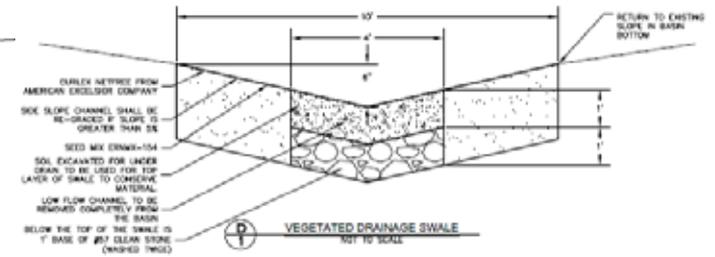
- NOTES:
1. THE RIP RAP APRONS OF PRALL ROAD WILL NOT BE ALTERED FROM THEIR EXISTING DESIGN.
  2. THE FIRST RESEEDING METHOD FOR THE BASINS ARE SHOWN ON SHEET S-2 AND S-3.
  3. THE SECOND RESEEDING METHOD FOR EACH BASIN IS SHOWN ON SHEET S-5.

### RIP RAP APRON DETAILS

OUTLET	Lo (FT)	W (FT)	DSO (IN)
1	6	16	6
2	6	20	6
3	3	8	3

**LEGEND**

ERNMX-127		EXISTING VEGETATION		
ERNMX-123		EXISTING CONTOURS		95
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**

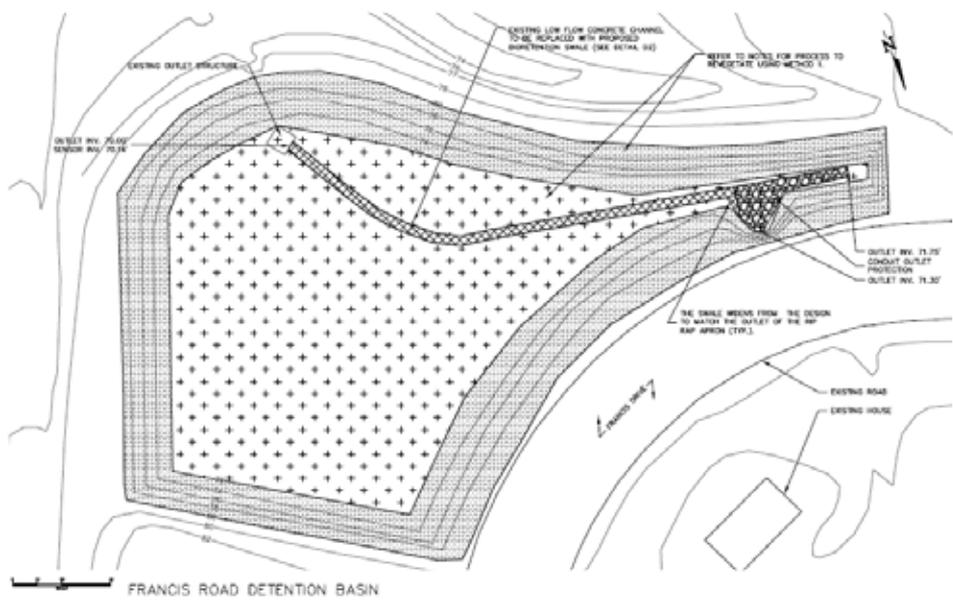
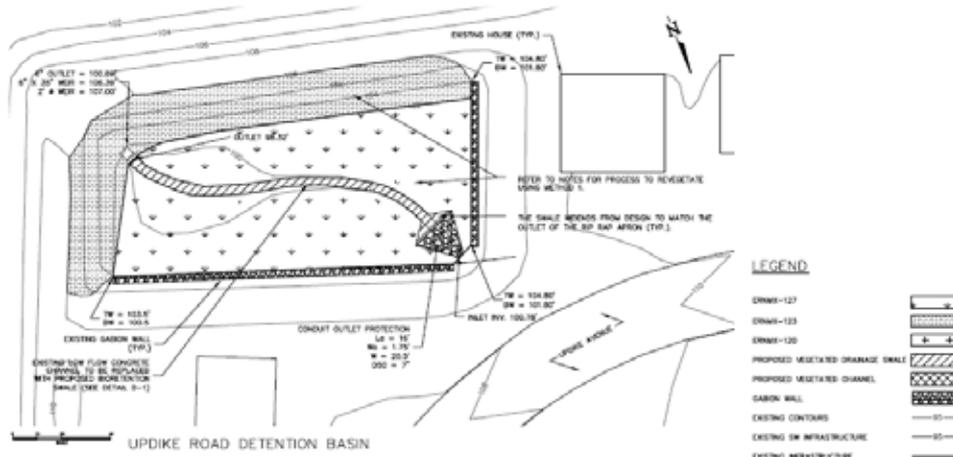


### EXISTING SITE ELEMENTS

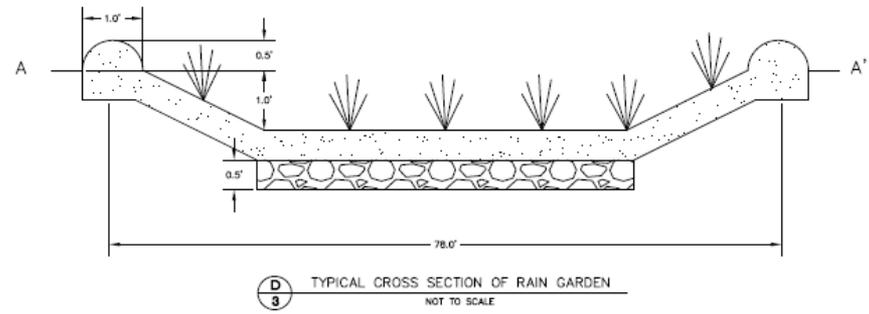
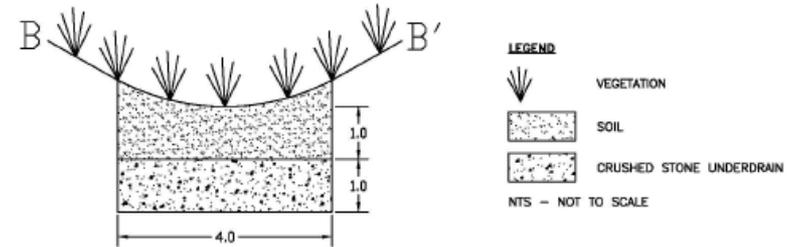
-  EXISTING VEGETATION
-  EXISTING LOW FLOW CONCRETE CHANNEL
-  EXISTING RIP RAP APRON
-  EXISTING RESIDENCE
-  DIRECTION OF WATER FLOW

# Case Studies

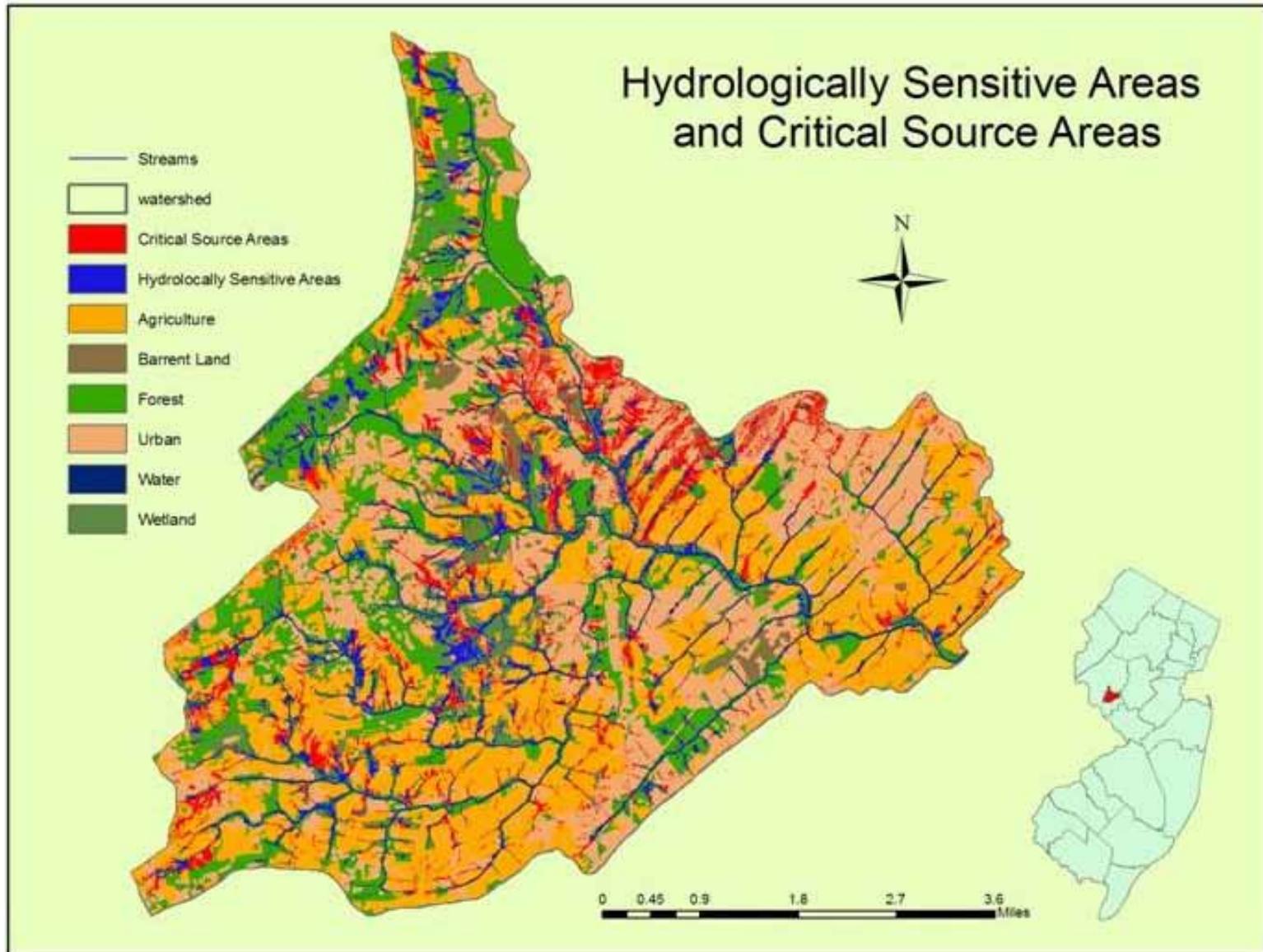
## Hillsborough Detention Basin Retrofit Program Somerset County, NJ



## Uppike Road and Francis Road



# Case Studies – Neshanic River Watershed



# Case Studies

Neshanic River Watershed  
Hunterdon County, NJ





# NESHANIC RIVER WATERSHED

MBD-0035



## PROPOSED SHRUBS - WET CONDITIONS

- Arrowwood Viburnum
- Cranberry Viburnum
- Inkberry
- Nannyberry
- Spicebush
- Sweet Pepperbush
- Virginia Magnolia

## PROPOSED HERBACEOUS - WET CONDITIONS

- Bee Balm
- Bladder Sedge
- Blue Lobelia
- Blueflag Iris
- Cardinal Flower
- Fox Sedge
- Longhair Sedge
- Monkeyflower
- New England Aster
- New York Aster
- Soft Rush
- Swamp Milkweed
- Turtlehead
- Tussock Sedge

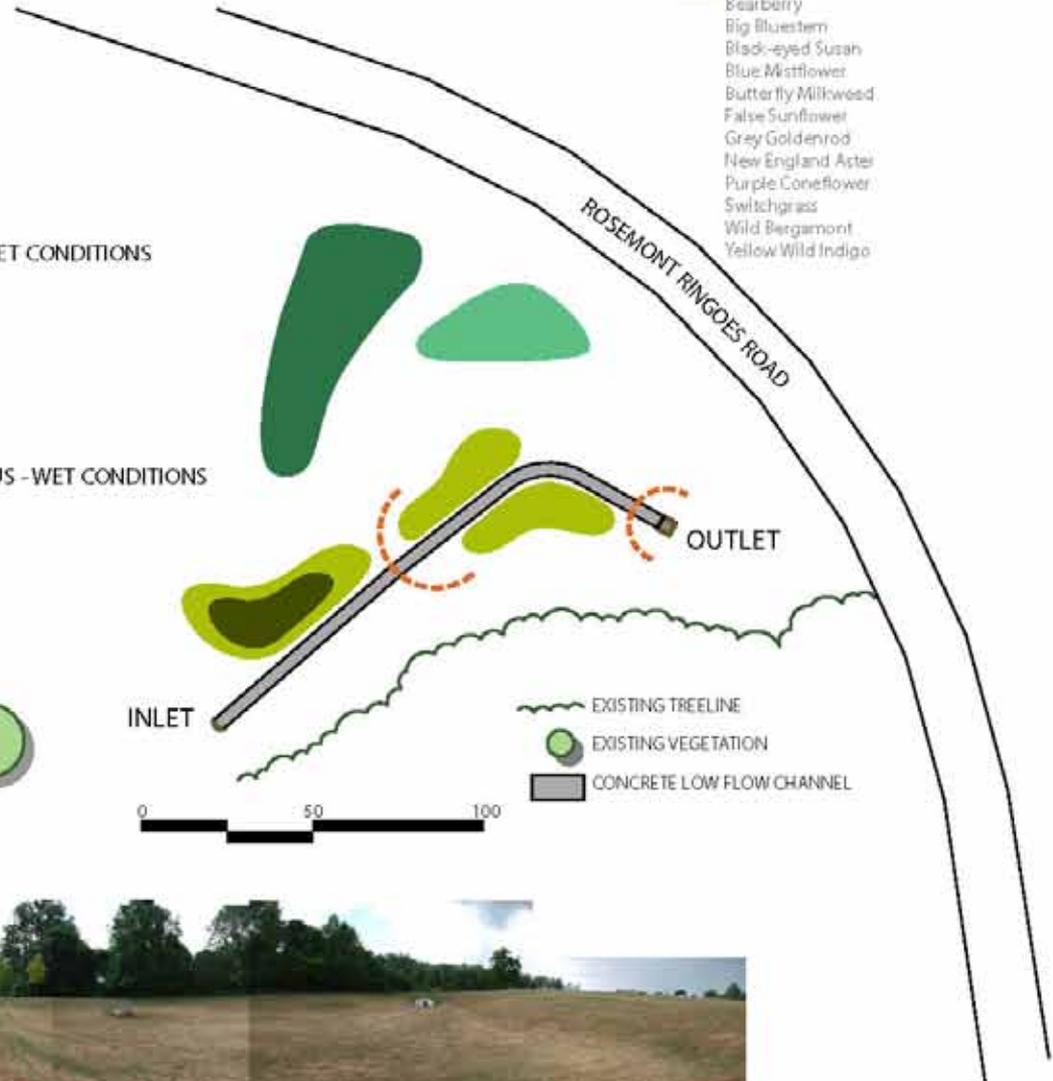
## PERMEABLE BERM

## PROPOSED SHRUBS - DRY CONDITIONS

- Bayberry
- Blackhaw Viburnum
- Mapleleaf Viburnum
- Witchhazel

## PROPOSED HERBACEOUS - DRY CONDITIONS

- Bearberry
- Big Bluestem
- Black-eyed Susan
- Blue Mistflower
- Butterfly Milkweed
- False Sunflower
- Gray Goldenrod
- New England Aster
- Purple Coneflower
- Switchgrass
- Wild Bergamont
- Yellow Wild Indigo





# NESHANIC RIVER WATERSHED

MBD-0054



- PROPOSED SHRUBS - WET CONDITIONS**
  - Arrowwood Viburnum
  - Cranberry Viburnum
  - Inkberry
  - Nannyberry
  - Spicebush
  - Sweet Pepperbush
  - Virginia Magnolia

- PROPOSED HERBACEOUS - WET CONDITIONS**
  - Bee Balm
  - Bladder Sedge
  - Blue Lobelia
  - Blueflag Iris
  - Cardinal Flower
  - Fox Sedge
  - Longhair Sedge
  - Monkeyflower
  - New England Aster
  - New York Aster
  - Soft Rush
  - Swamp Milkweed
  - Turtlehead
  - Tussock Sedge

- PROPOSED SHRUBS - DRY CONDITIONS**
  - Bayberry
  - Blackhaw Viburnum
  - Mapleleaf Viburnum
  - Witchhazel

- PROPOSED HERBACEOUS - DRY CONDITIONS**
  - Bearberry
  - Big Bluestem
  - Black-eyed Susan
  - Blue Mistflower
  - Butterfly Milkweed
  - False Sunflower
  - Grey Goldenrod
  - New England Aster
  - Purple Coneflower
  - Switchgrass
  - Wild Bergamont
  - Yellow Wild Indigo

- EXISTING TREELINE
- EXISTING VEGETATION
- CONCRETE LOW FLOW CHANNEL



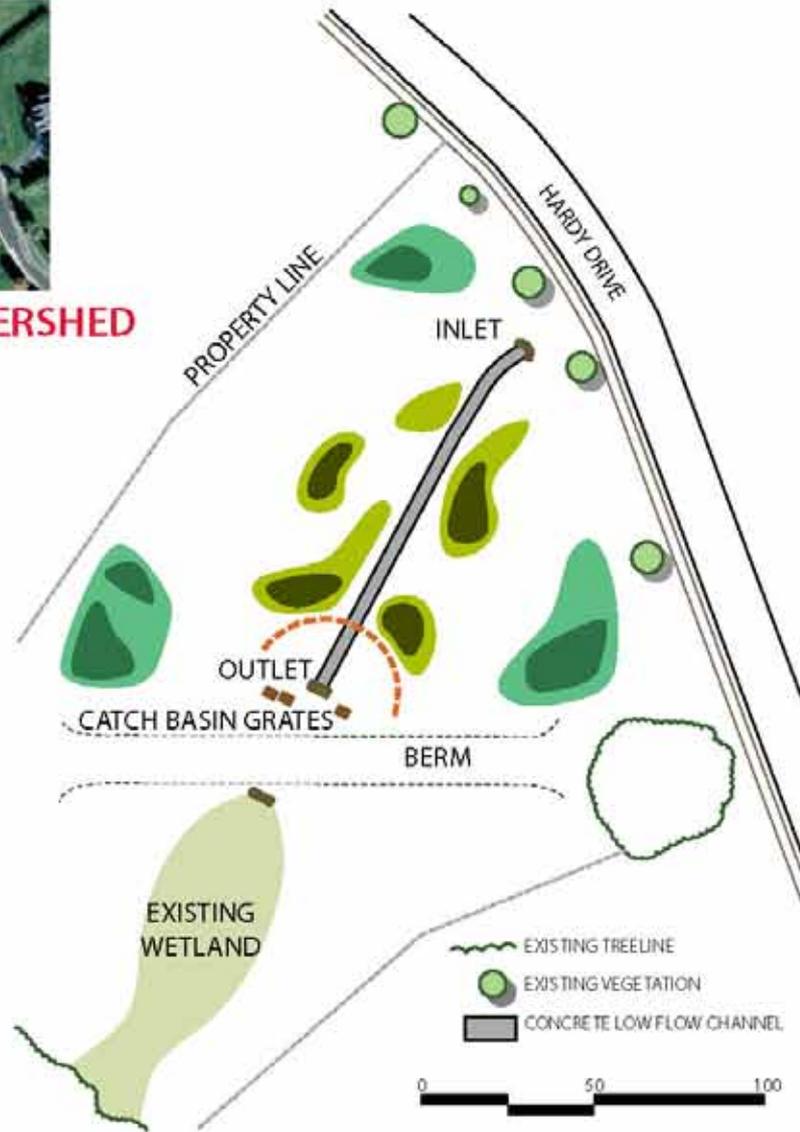
PERMEABLE BERM





## NESHANIC RIVER WATERSHED

MBD-0136



### PROPOSED SHRUBS - WET CONDITIONS

- Arrowwood Viburnum
- Cranberry Viburnum
- Inkberry
- Nannyberry
- Spicebush
- Sweet Pepperbush
- Virginia Magnolia

### PROPOSED HERBACEOUS - WET CONDITIONS

- Bee Balm
- Bladder Sedge
- Blue Lobelia
- Blueflag Iris
- Cardinal Flower
- Fox Sedge
- Longhair Sedge
- Monkeyflower
- New England Aster
- New York Aster
- Soft Rush
- Swamp Milkweed
- Turtlehead
- Tussock Sedge

### PROPOSED SHRUBS - DRY CONDITIONS

- Bayberry
- Blackhaw Viburnum
- Mapleleaf Viburnum
- Witchhazel

### PROPOSED HERBACEOUS - DRY CONDITIONS

- Bearberry
- Big Bluestem
- Black-eyed Susan
- Blue Mistflower
- Butterfly Milkweed
- False Sunflower
- Grey Goldenrod
- New England Aster
- Purple Coneflower
- Switchgrass
- Wild Bergamont
- Yellow Wild Indigo

--- PERMEABLE BERM

**RUTGERS**

New Jersey Agricultural  
Experiment Station





## NESHANIC RIVER WATERSHED

MBD-0069

### PROPOSED SHRUBS - WET CONDITIONS

- Arrowwood Viburnum
- Cranberry Viburnum
- Inkberry
- Nannyberry
- Spicebush
- Sweet Pepperbush
- Virginia Magnolia

### PROPOSED HERBACEOUS - WET CONDITIONS

- Bee Balm
- Bladder Sedge
- Blue Lobelia
- Blueflag Iris
- Cardinal Flower
- Fox Sedge
- Longhair Sedge
- Monkeyflower
- New England Aster
- New York Aster
- Soft Rush
- Swamp Milkweed
- Turtlehead
- Tussock Sedge

### PROPOSED SHRUBS - DRY CONDITIONS

- Bayberry
- Blackhaw Viburnum
- Mapleleaf Viburnum
- Witchhazel

### PROPOSED HERBACEOUS - DRY CONDITIONS

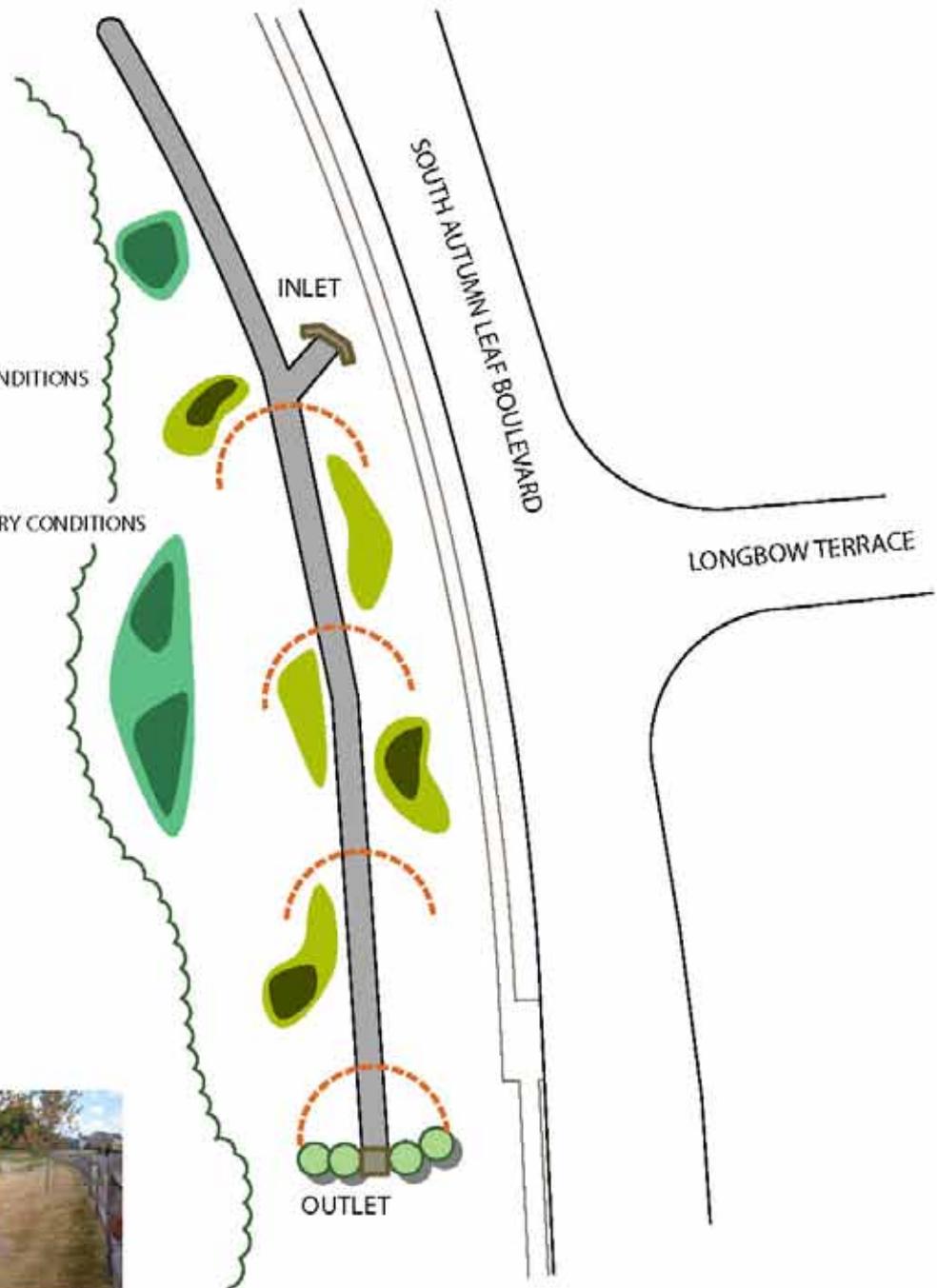
- Bearberry
- Big Bluestem
- Black-eyed Susan
- Blue Mistflower
- Butterfly Milkweed
- False Sunflower
- Grey Goldenrod
- New England Aster
- Purple Coneflower
- Switchgrass
- Wild Bergamont
- Yellow Wild Indigo

--- PERMEABLE BERM

~ EXISTING TREELINE

● EXISTING VEGETATION

■ CONCRETE LOW FLOW CHANNEL





## NESHANIC RIVER WATERSHED

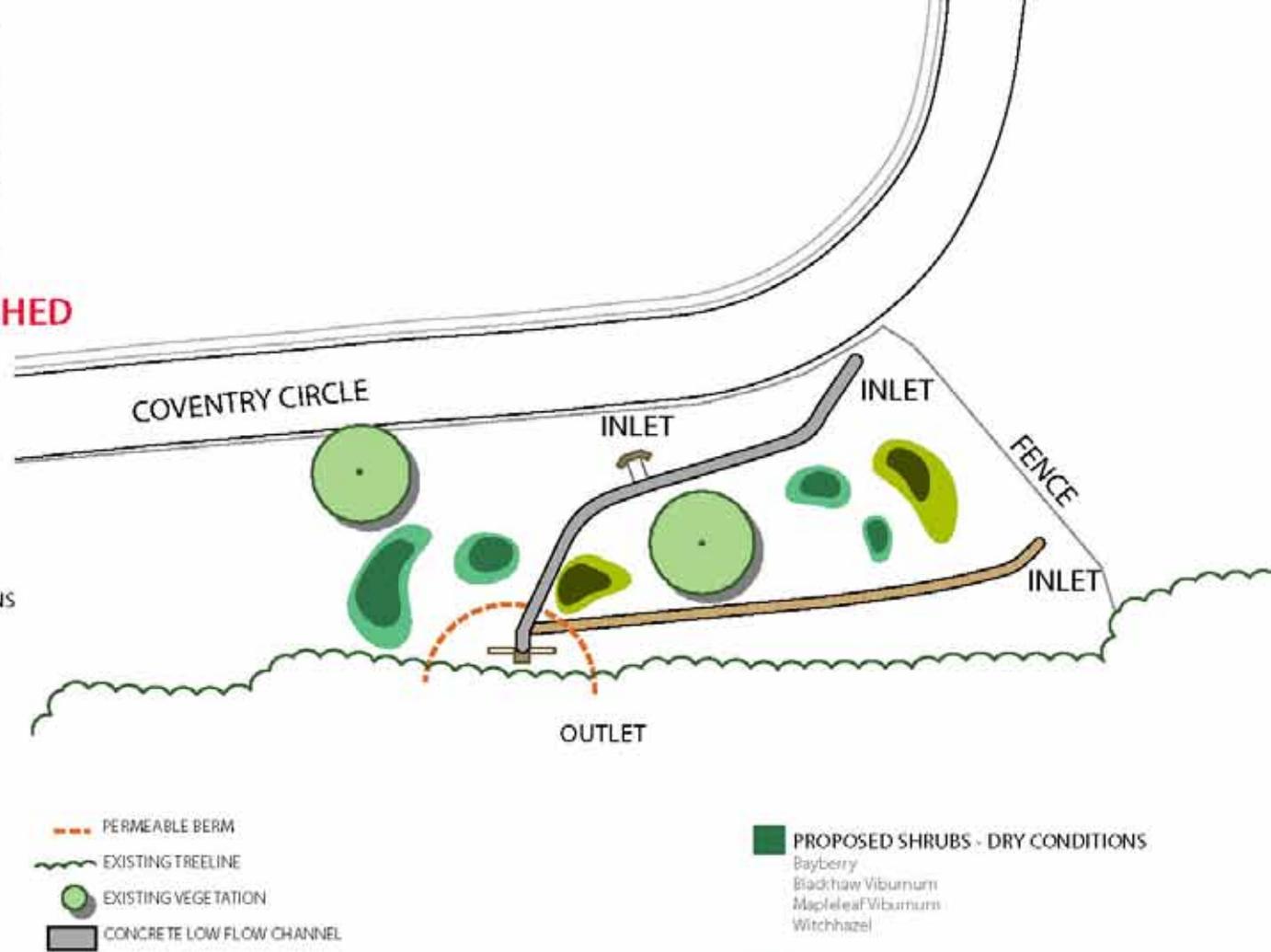
MBD-0150

### PROPOSED SHRUBS - WET CONDITIONS

- Arrowwood Viburnum
- Cranberry Viburnum
- Inkberry
- Nannyberry
- Spicebush
- Sweet Pepperbush
- Virginia Magnolia

### PROPOSED HERBACEOUS - WET CONDITIONS

- Bee Balm
- Bladder Sedge
- Blue Lobelia
- Blueflag Iris
- Cardinal Flower
- Fox Sedge
- Longhair Sedge
- Monkeyflower
- New England Aster
- New York Aster
- Soft Rush
- Swamp Milkweed
- Turtlehead
- Tussock Sedge



### PROPOSED SHRUBS - DRY CONDITIONS

- Bayberry
- Blackhaw Viburnum
- Mapleleaf Viburnum
- Witchhazel

### PROPOSED HERBACEOUS - DRY CONDITIONS

- Bearberry
- Big Bluestem
- Black-eyed Susan
- Blue Aster
- Butterfly Milkweed
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- Grey Goldenrod
- New England Aster
- Purple Coneflower
- Switchgrass
- Wild Bergamont
- Yellow Wild Indigo



# Conclusions and Recommendations

# Opportunities

Sussex County  
New Jersey



# Opportunities

Sussex County  
New Jersey



# Opportunities

Sussex County  
New Jersey



# 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

# 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 & Conclusion

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.

# References

We recommend: *New Jersey Stormwater Best Management Practices Manual*  
Available at: <http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.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.

# Upcoming Seminars...

## ***Green Infrastructure: Projects & Programs for Green Teams & Environmental Commissions***

Monday, November 8, 2010

6:30-8:30PM

Sussex County Administrative Center

## ***Green Infrastructure Planning, Design & Implementation: Training for Design Professionals***

Tuesday, November 30, 2010

1:00-3:00PM

Sussex County Administrative Center

Visit [www.water.rutgers.edu](http://www.water.rutgers.edu) to register for each seminar.

# *QUESTIONS?*

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