Stormwater & NPDES Training

May 21, 2019

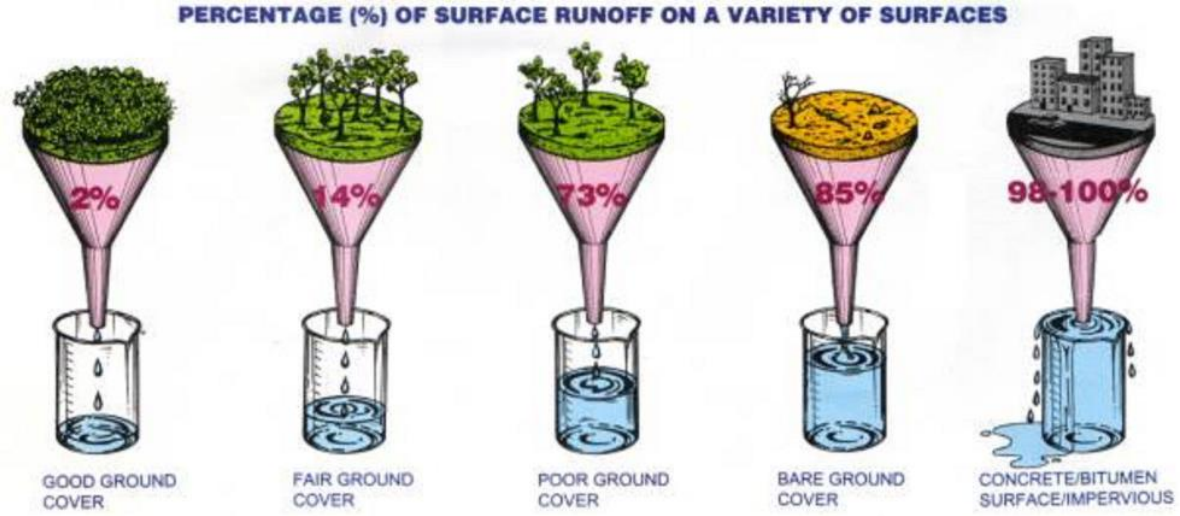
Vince Davis – Stormwater Engineer
Sara Esposito & Emily Whiting - NPDES Program

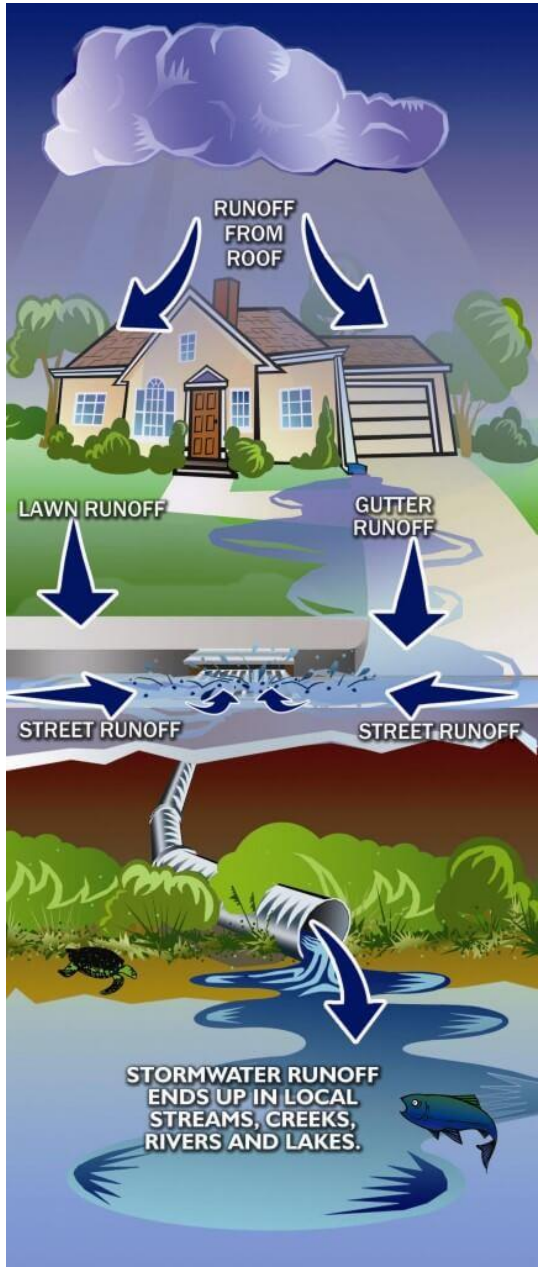
Agenda

- History of Stormwater Regulations
- Best Management Practices Design, Construction & Maintenance
  - Dry Pond
  - Wet Pond
  - Infiltration Basin
  - Infiltration Trench
  - Bioretention
  - Bioswale
- NPDES Inventory
  - BMPs
  - Structures
  - Map Viewer
- Water Quality Improvement Plans
  - Stream Restoration
  - Status

The Problem

- Everything on land eventually washes into our rivers and streams
- Stormwater runoff is the fastest growing source of pollution to our local waterways
- The best way to prevent pollution is at the source

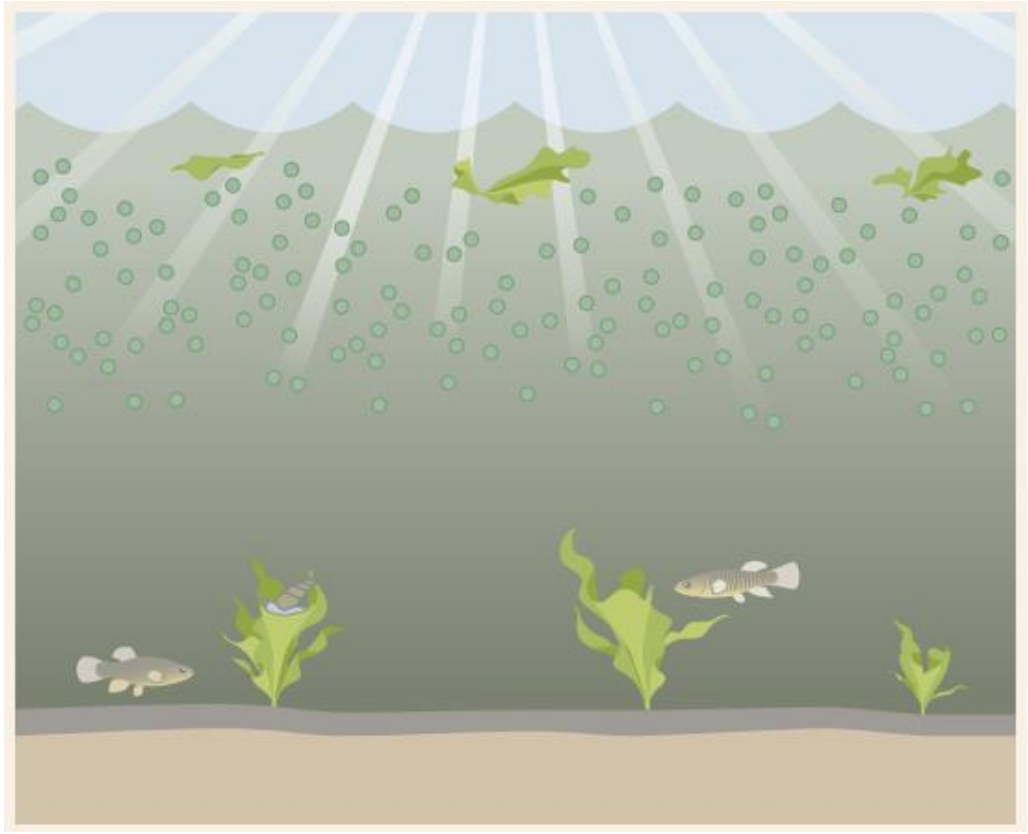




Pollution


Dog Waste
Oil/Grease
Paint
Fertilizer
Trash
Detergents
Sediment

Impacts to Water



Why Important?

What is NPDES?

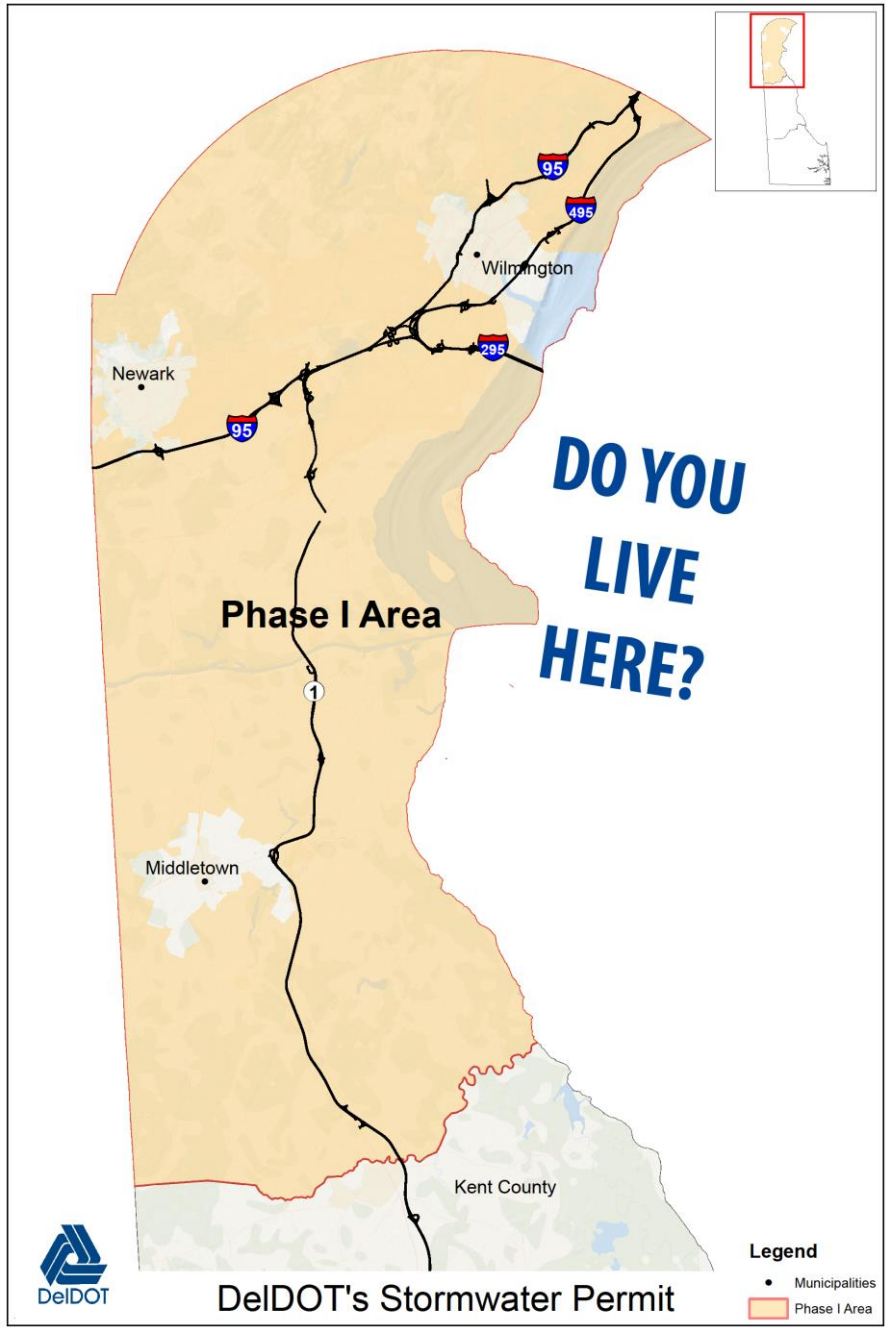
- **N**ational **P**ollutant **D**ischarge **E**limination **S**ystem
- NPDES program developed under the Clean Water Act
- NPDES permits limit the potential pollutants in stormwater in an effort to protect the waterways that receive the runoff
  - Many different types of NPDES permits:
    - Animal feeding operations
    - Wastewater
    - Stormwater
    - Commercial vessels (ships)
    - Industrial

NPDES Program @ DelDOT

- Municipal Separate Storm Sewer Systems (MS_4) Permits → Phase I & II
  - Illicit Discharge Detection
  - Good Housekeeping
  - Construction & Post Construction Stormwater Management
  - Public Education & Outreach about Clean Water
  - Water Quality Improvement Plans
- Industrial Permits → Maintenance Yard Environmental Compliance
- Construction General Permit → Stormwater / ES2M

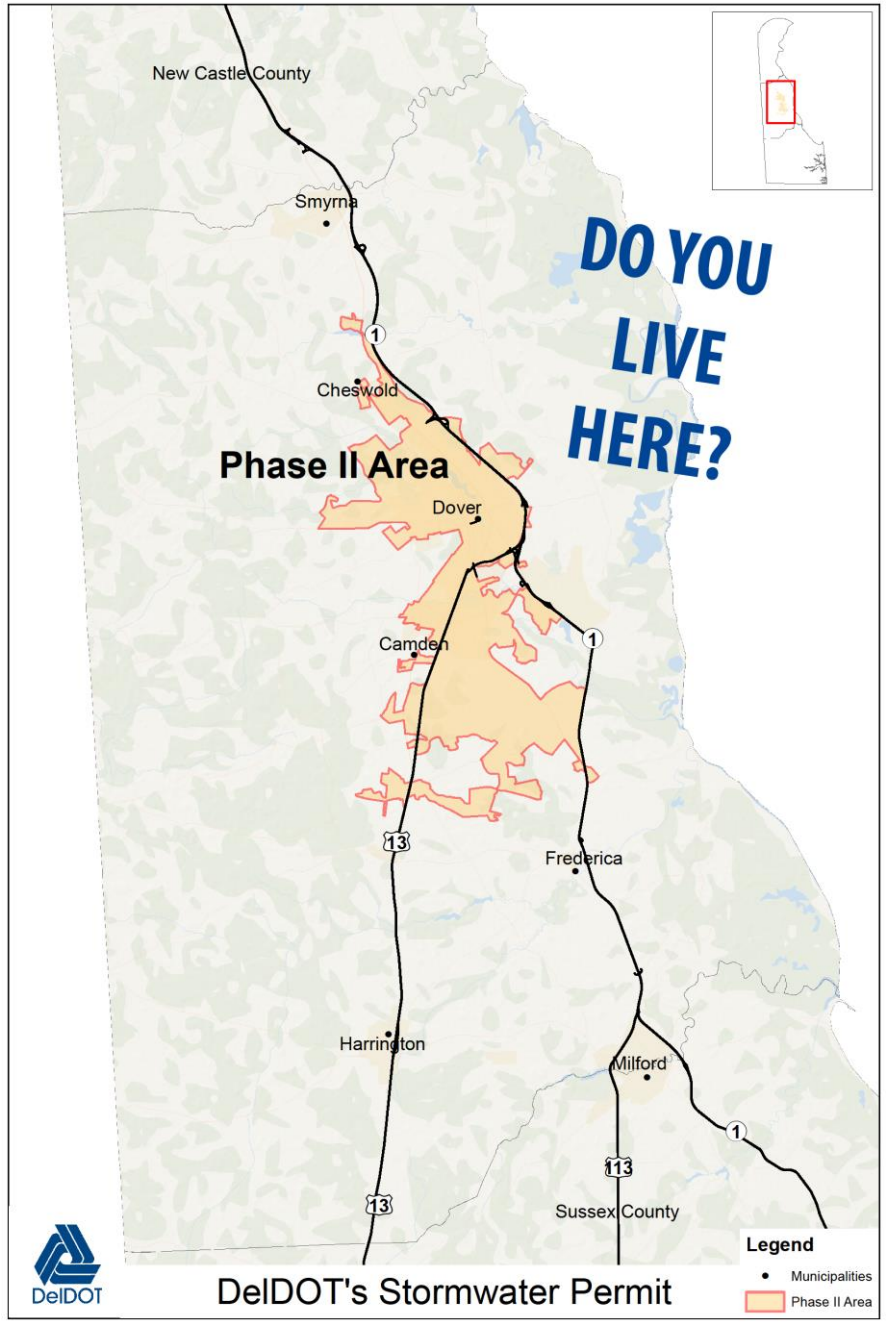
Phase I Permit

- New Castle County, excluding:
  - Newark, Middletown (Ph II)
  - Wilmington (Separate Ph I)
- Co-Permittees
  - DelDOT/NCC
  - Elsmere
  - Newport
  - Bellefonte
  - Delaware City
- New permit anticipated in 2019/2020



Phase II Permit

- Urbanized areas of Kent County
- New permit in 2019:
  - Expand Kent County limits
  - Add western portion of Sussex County
- Requirements less stringent than Phase I
- 2020 Census expected to kick more/all of Delaware into either a Phase I or Phase II



Industrial Permit

- 17 Maintenance Yards
- Focus on preventing contamination of stormwater runoff by properly handling and storing materials
  - Good housekeeping
  - Stormwater Pollution Prevention Plans
    - Quarterly wet/dry inspections
  - Wet weather monitoring (2/year)

Construction General Permit

- Required for all projects > 1 acre
- SWPP: Stormwater Pollution Prevention Plan is rolled into our Construction Plans…
  - EPA will ask for a SWPP
  - Required to have Pollution Prevention details
- Notice of Intent and annual fee $195
- Adapting to have the Contractor be a Co-Permittee on the NOI for shared responsibility

Permit Number	Project Name	Received Date	Project Type	Delegated Agency	County	Owner(s)
5986	T201407602 BR 1-350 N&S on SR 1 over Lewes/Rehoboth Canal	5/17/2019	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	Sussex	Delaware Department of Transportation
5950	T201880103 North District Improvements, Phase I	3/8/2019	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	Delaware Department of Transportation
5931	T201109001-SR 141 I95 Interchange to Jay Drive	1/29/2019	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	Delaware Department of Transportation
5930	T201200104, US 40 and SR 7 Intersection Improvements	1/29/2019	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	Delaware Department of Transportation
5912	WILMINGTON TRANSIT CENTER	12/6/2018	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	STATE OF DELAWARE
5899	SR273 RED MILL ROAD INTERSECTION IMPROVEMENTS	11/15/2018	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	DELAWARE DEPARTMENT OF TRANSPORTATION
5898	NORTH DISTRICT DOTS BUILDING	11/15/2018	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	DELAWARE DEPARTMENT OF TRANSPORTATION
5837	SR 72 ADVANCED UTILITY RELOCATION	9/25/2018	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	DELAWARE DEPARTMENT OF TRANSPORTATION
5836	ROAD A & SR 7 IMPROVEMENTS T2010009002	9/25/2018	DelDOT	Delaware (State of) Department of Transportation - Highway Operations Field Serv	New Castle	DELAWARE DEPARTMENT OF TRANSPORTATION

Stormwater / ES2M

*Delaware Sediment and Stormwater Regulations – Effective January 23, 1991
Regulations Amended – March 11, 1993

HB268 – Allowed for DelDOT to be a Delegated Agency – July 7, 1995

Proposed Regulations incorporating GTBMPs as preferred practice -March 2004
*Final Regulations (GTBMPs) –Effective April 11, 2005

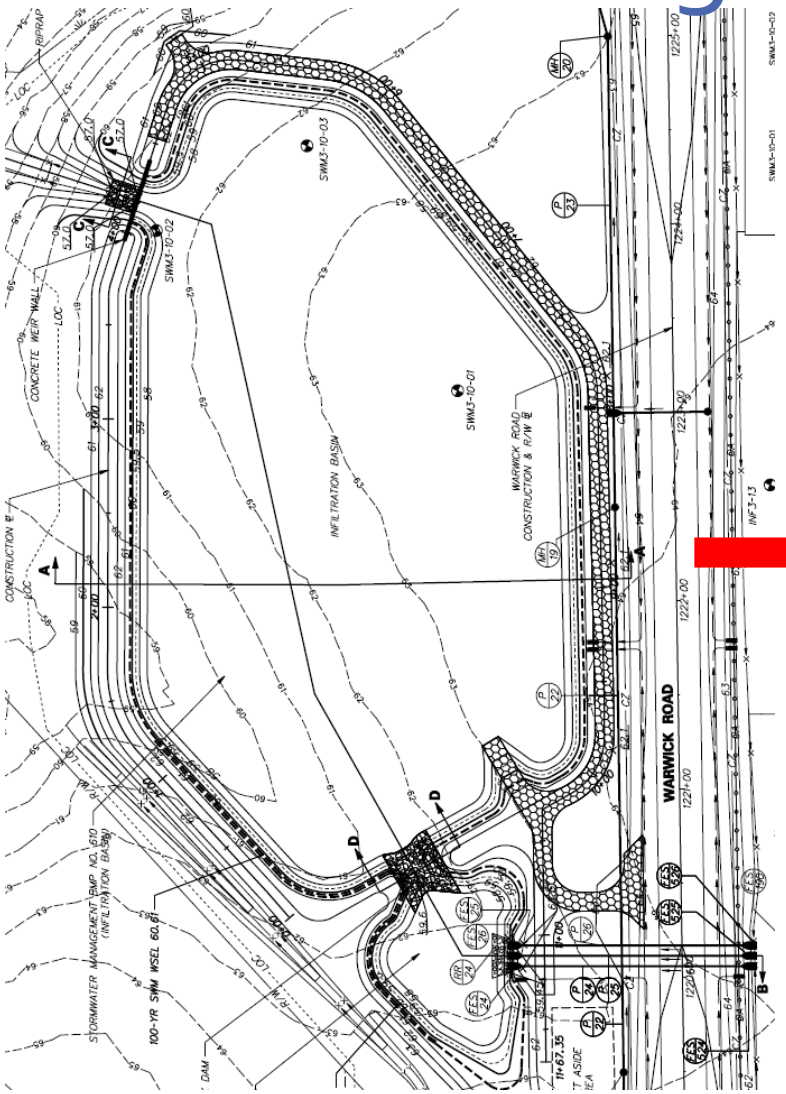
Governor Minner's Task Force (recommending revisions to regs) – April 2005

SB357 aka "Peterson Bill" signed into law– July 20, 2006

Regulatory Advisory Committee (RAC) first meeting (based on Task Force recommendation)– October 2007
*New Regulations Effective Date - January 1, 2014

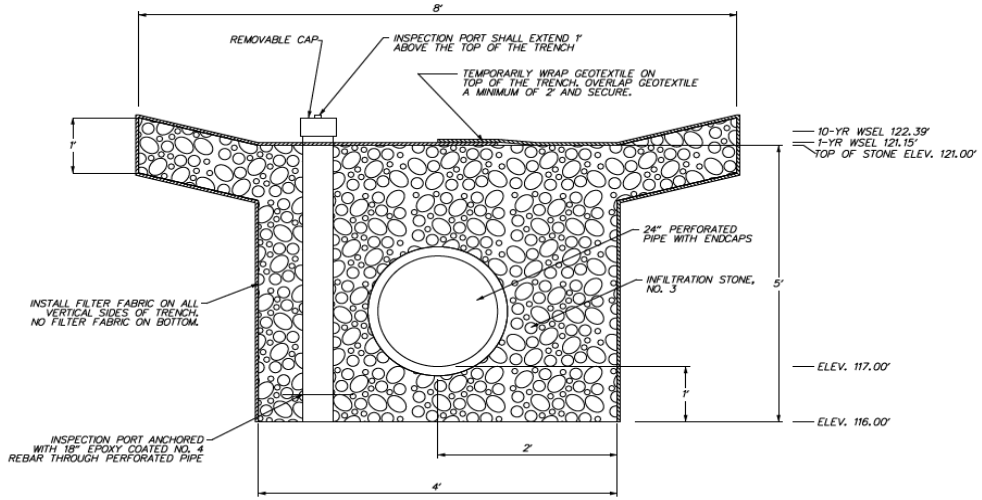
Baker v. DNREC, Regulations ruled invalid on procedural grounds - Oct 2015 (Superior Court), April 2016 (Supreme Court)
Reconvened RAC – Nov 2015
Invoked Emergency Regulations – Oct 2015 / April 2016
Senate Bill 253 - Effective June 24, 2016
House Bill 194 - Effective August 10, 2016
Senate Bill 204 - Effective July 11, 2018
*Present Regulations Effective – February 11, 2019

BMP Design, Construction & Maintenance



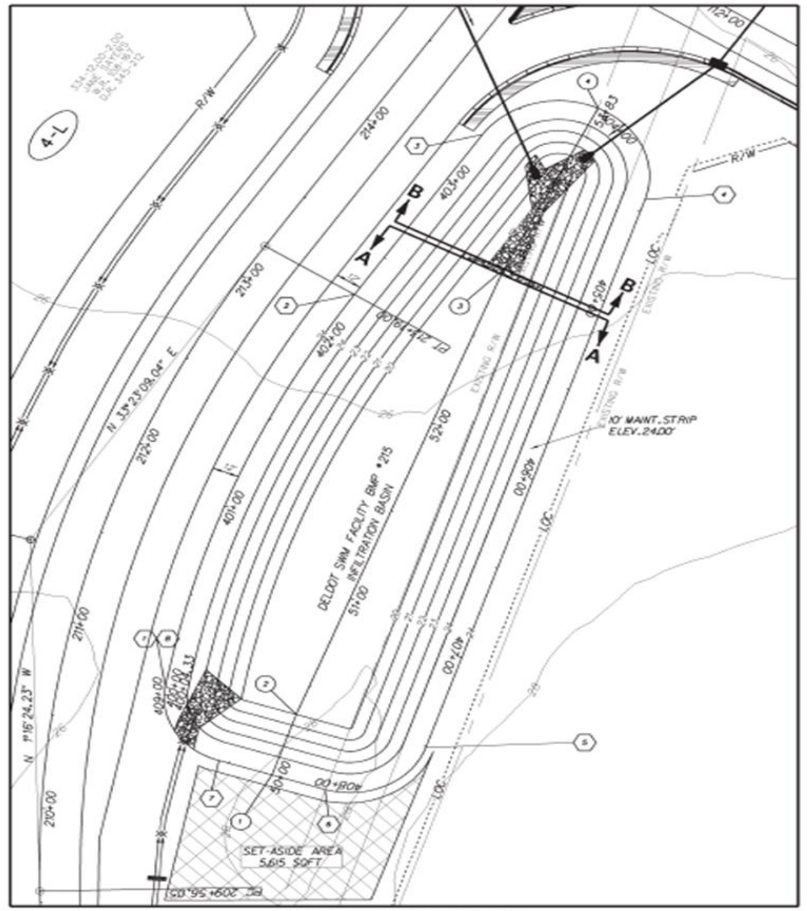
BMP Design

- Each BMP design has it's own design requirements
- Currently found in the DNREC "Delaware Post Construction Stormwater BMP Standards & Specifications"
- Basically designing for 3 storm events
  - RPv – Resource Protection Event (1yr storm, 2.7" rainfall – statewide)
    - Water Quality
  - Cv – Conveyance Event (10yr storm, county specific rainfall)
  - Fv – Flooding Event (100yr storm, county specific rainfall)
    - Water Quantity



NOT TO SCALE

BMP 973 INFILTRATION TRENCH – SECTION VIEW



PLAN – INFILTRATION BASIN
BMP # 215

BMP Design

- Project Level DURMM (PLD)

- DURMM v2.5 (Always download latest version!)

- Unit Hydrographs
  - Standard Unit Hydrograph (above C&D Canal)
  - Delmarva Unit Hydrograph (below C&D Canal)

- HydroCAD
  - Initial Abstraction Ratio - Ia / S
    - For calculating the RPv with HydroCAD, change the Ia/S ratio to 0.05. The reason for doing this is that using an adjusted value of 0.05 yields more accurate results for the smaller storm events.
    - The Cv and Fv calculations will still use the standard Ia/S ratio of 0.2
    - DURMM already takes this into account in its inherent calculations.

- Stormwater Info (DRC)

BMP Design

- Infiltration
  - 'Very Basic Infiltration Sizing' excel sheet on DRC
  - Divide measured infiltration rate by 2.5 (2.5 if measured with the bore hole test)

Amount of Infiltration Tests Needed

This information is an excerpt from the DSSR under 'Soil Investigation Procedures for Stormwater Best Management Practices'.

The minimum number of field measured infiltration tests are based on the proposed facility's dimensions as follows:

* For an infiltration trench with less than 10,000sf of impervious drainage area, one (1) test is required up to 500 linear feet and one (1) additional test per 250 linear feet of trench and sufficient to determine variability.

* For an infiltration trench with greater than 10,000sf of impervious drainage area, one (1) test is required up to 250 linear feet and one (1) additional test per 250 linear feet of trench and sufficient to determine variability.

* For an infiltrating bioretention system, one (1) test for the first 8,000sf, two (2) tests required for up to 16,000sf, and three (3) tests required for up to 25,000sf and one (1) additional test required for each additional 25,000sf. Test locations shall be distributed within the facility and sufficient to determine variability.

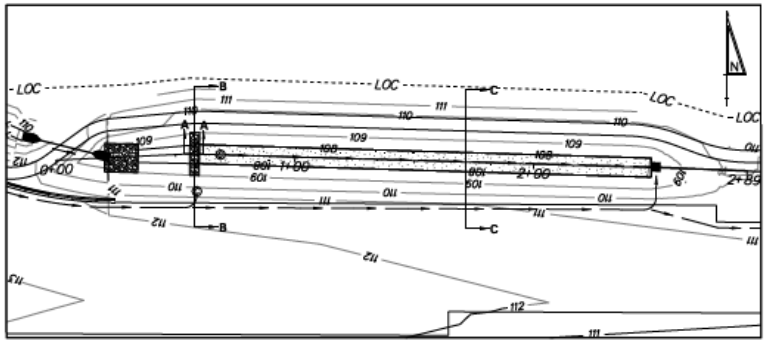
* For an infiltration basin, it is the same amount of tests as per the bioretention system.

BMP Design

- Information from SWM Report / SWM Sheets / Construction Plan Sheets
- Model plan sheets / convey necessary information

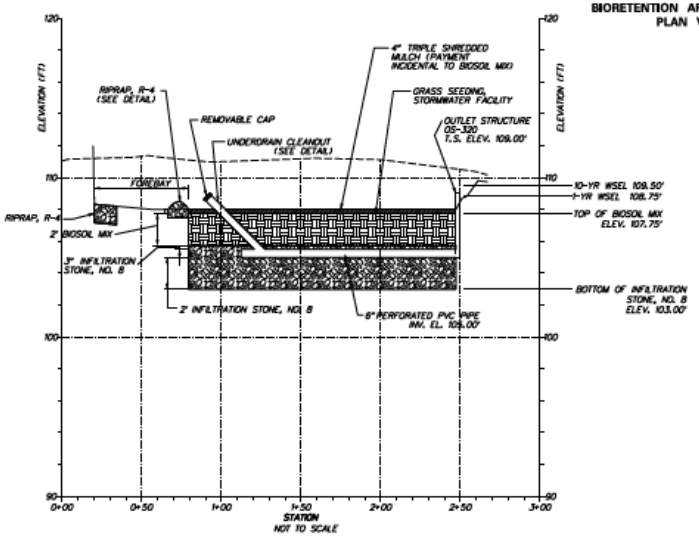
** BIORETENTION AREA MODEL PLAN **
SHEET 1/2

BMP DATA		
SWM FACILITY NO.	DRAINAGE AREA AC.	CN
986	2.8	88

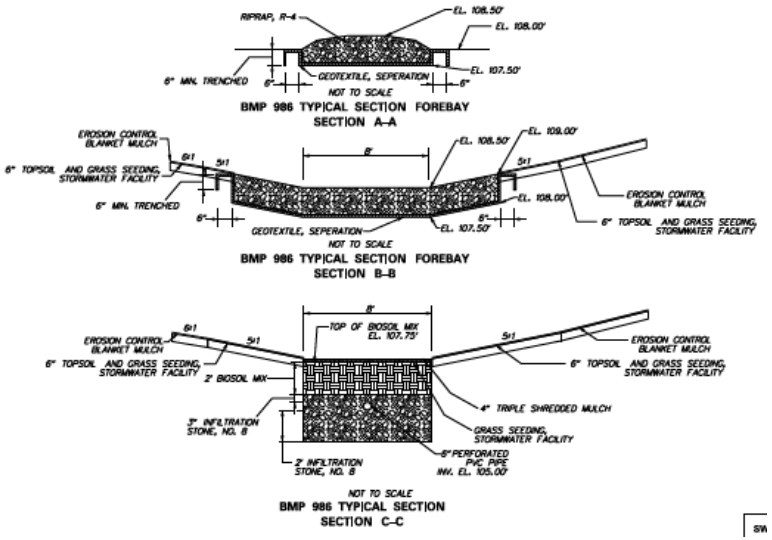


BIORETENTION AREA – BMP 986
PLAN VIEW

INSERT SEQUENCE OF CONSTRUCTION
(USE BIORETENTION SEQUENCE OF CONSTRUCTION FROM DRC AS A GUIDE.)



BMP 986 BIORETENTION PROFILE



BMP Design / Construction

• SEQUENCE OF CONSTRUCTION

INFILTRATION BASIN CONSTRUCTION SEQUENCE AND NOTES

IF THE INFILTRATION BASIN IS TO BE USED AS A SEDIMENT BASIN DURING CONSTRUCTION, GRADING SHALL ONLY BE COMPLETED TO 1-FOOT ABOVE THE PERMANENT BOTTOM ELEVATION AT ALL TIMES.

A. INITIAL CONSTRUCTION:

1. INSTALL STABILIZED CONSTRUCTION ENTRANCE(S) AS NEEDED.
2. CLEAR AND GRUB FOR INSTALLATION OF PERIMETER EROSION AND SEDIMENT CONTROLS.
3. INSTALL PERIMETER CONTROLS AS SHOWN ON THE PLANS.
4. CLEAR AND GRUB REMAINING AREA FOR INFILTRATION BASIN CONSTRUCTION MAKING SURE NOT TO IMPEDE WITHIN 1-FOOT OF THE PERMANENT BOTTOM ELEVATION.
5. CONSTRUCT BASIN OUTLET AND OUTFALL AS SHOWN ON THE PLANS.
6. COMPLETE BASIN EXCAVATION TO MAINTAIN A MINIMUM OF 1-FOOT COVER ABOVE THE PERMANENT BOTTOM ELEVATION. NO EQUIPMENT SHALL BE USED WITHIN 1-FOOT OR AT THE PERMANENT BOTTOM ELEVATION. SIDE SLOPES AND FOREBAYS SHALL BE CONSTRUCTED AS PER FINAL DESIGN ELEVATION AND CONFIGURATION.

Bioretention Area Sequence of Construction

***This is only a guide. The actual sequence on the plans need to be customized for each bioretention area.**

Before any construction begins on the bioretention area, contact the designated CR a minimum of 2 working days in advance so that the required facility nstruction checklist can be completed. Also, all areas draining to the oretention area must be at final grade and stabilized. Stabilization shall be proved by the Stormwater Engineer prior to facility construction. Absolutely no heeled or tracked equipment shall be allowed within 2 feet of the permanent ttom elevation. All #8 stone used in the bioretention area shall conform to the iltration stone specification from Section 910.

the bioretention area is going to be used as a sediment trap during construction refer to ne additional thoughts below that would need to be interspersed within these notes.

1. Should bioretention area construction be necessary prior to vegetative stabilization of the contributing drainage area(s) as approved by the Engineer with concurrence from the Stormwater Engineer, the minimum shall be required:
   a. Inflow swales will have an 18" compost filter log placed 25 feet before the edge of the proposed bioretention area or closer if directed by the Engineer.
   b. Other inflow areas, including side slopes, will have silt fence or 18" compost filter log installed so that runoff is intercepted before entering the bioretention area.

Bioswale / Vegetated Channel

- Bottom above seasonal high water
- 50% of RPv peak flow rate < 4" height
- 2' min – 8' max bottom width
- Side slopes no steeper than 3:1
- Residence Time*:
  - Bioswales: 9 minute
  - Channels: 5 minute

*Calculated at 50% of the RPv peak flow rate

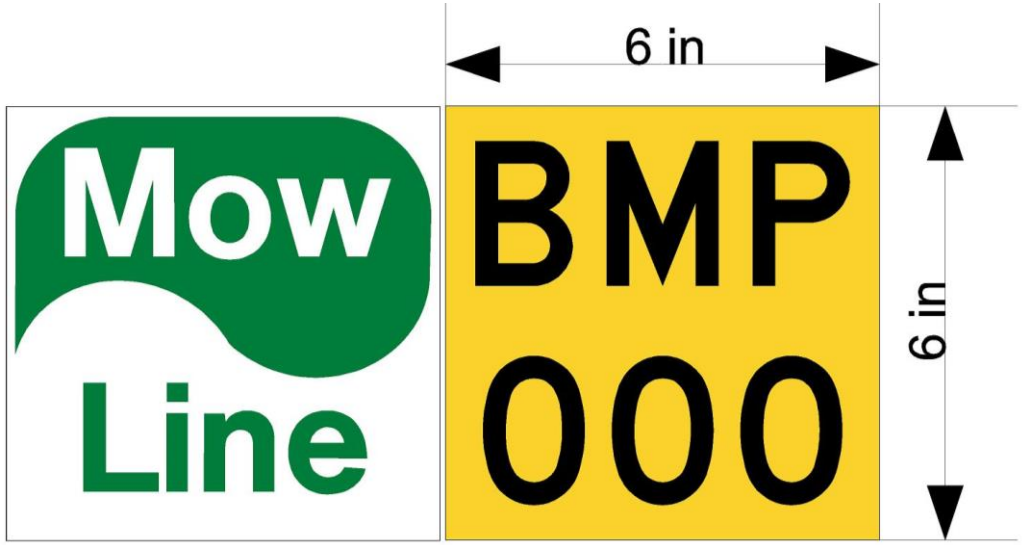
RPv Bioswale Performance		
Runoff Volume (in/acre)	BMP performance	
	HSG A/B	HSG C/D
> 1.50 in / acre	44%	21%
0.76 - 1.50 in / acre	47%	23%
0.16 - 0.75 in / acre	57%	27%
0.00 - 0.15 in / acre	95%	95%

RPv Grassed Channel Performance		
Runoff Volume (in/acre)	BMP performance	
	HSG A/B	HSG C/D
> 1.50 in / acre	16%	8%
0.76 - 1.50 in / acre	18%	9%
0.16 - 0.75 in / acre	22%	11%
0.00 - 0.15 in / acre	100%	100%

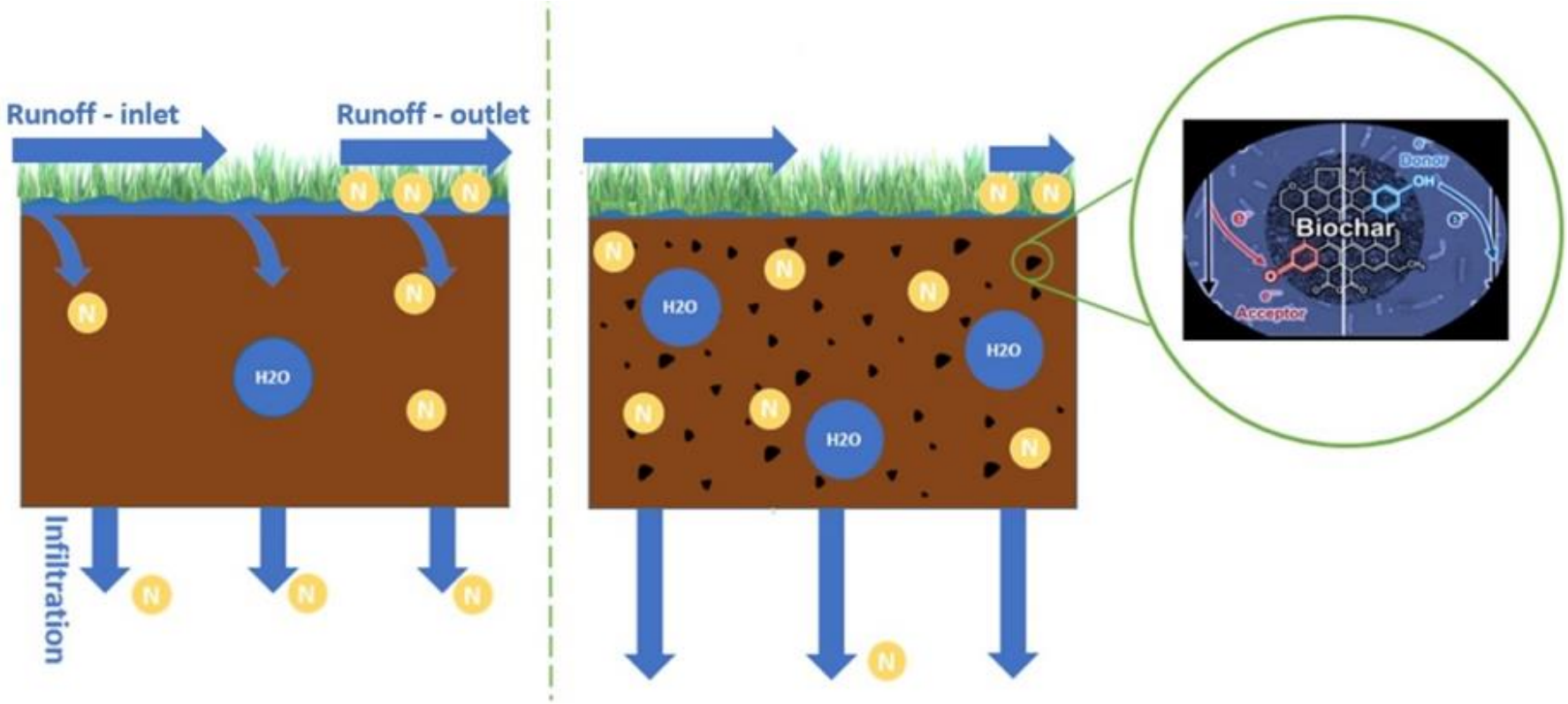
BMP 656 – US301

Bioswale - Challenges

- Identification!
  - Add a "no mow" sign and a "BMP ID #" sign at the start/upstream side of the bioswale (in centerline)
  - Add a "no mow" sign to the end/downstream side of the bioswale (in centerline)
  - For back-to-back bioswales the additional downstream "no mow" sign can be eliminated since the upstream sign of the next bioswale will take its place.
  - Also applies to infiltration trenches, infiltration basins with no outlet structure, etc



Bioswale - Opportunities



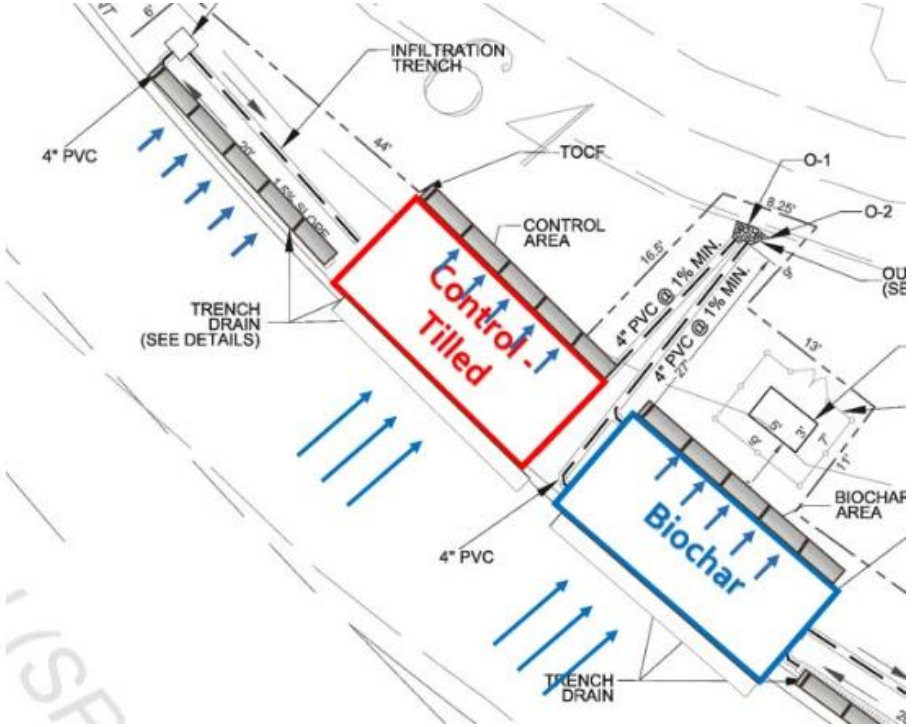
UD Biochar Research

Facility Number	Phase	Final Rating	Facility Type
621	3	Removed	Biofiltration Swale
628	3	Removed	Biofiltration Swale
641	3	Removed	Biofiltration Swale
642	3	Removed	Biofiltration Swale
662	2A	Removed	Biofiltration Swale
668	2A	Removed	Biofiltration Swale
681	2A	Removed	Biofiltration Swale
685	2A	Removed	Biofiltration Swale
688	2A	Removed	Biofiltration Swale
689	2A	Removed	Biofiltration Swale
721	1A	Removed	Biofiltration Swale
724	1A	Removed	Biofiltration Swale
727	1A	Removed	Biofiltration Swale
728	1A	Removed	Biofiltration Swale
729	1A	Removed	Biofiltration Swale
730	1A	Removed	Biofiltration Swale
732	1A	Removed	Biofiltration Swale
738	1A	Removed	Biofiltration Swale
739	1A	Removed	Biofiltration Swale
740	1A	Removed	Biofiltration Swale
741	1A	Removed	Biofiltration Swale
742	1A	Removed	Biofiltration Swale
743	1A	Removed	Biofiltration Swale
746	1A	Removed	Biofiltration Swale
747	1A	Removed	Biofiltration Swale

US 301 Bioswale Removal

Bioswale - Opportunities

UD Biochar Research
896 Northbound before
Summit Bridge



Control:

Tilled

Biochar:

Tilled + 4% biochar

Reduces peak flow by ~ 83% and runoff volume by ~88% over 84 storms

Dry Pond

- Bottom 1’ above seasonal high water
- Forebays required
- Min. 3” orifice with trash protection (or weir wall)
  - Trying a 5’x5’ concrete pad in front to assist with weeds/wetness
- Side slopes no steeper than 3:1
- Min. longitudinal slope 2% across bottom

Runoff Reduction	
RPv – Detention Allowance	100%
Cv	1%
Fv	0%
Pollutant Reduction	
TN Reduction	Not less than 20%
TP Reduction	Not less than 20%
TSS Reduction	Not less than 60%

BMP 851 – Weldin Road

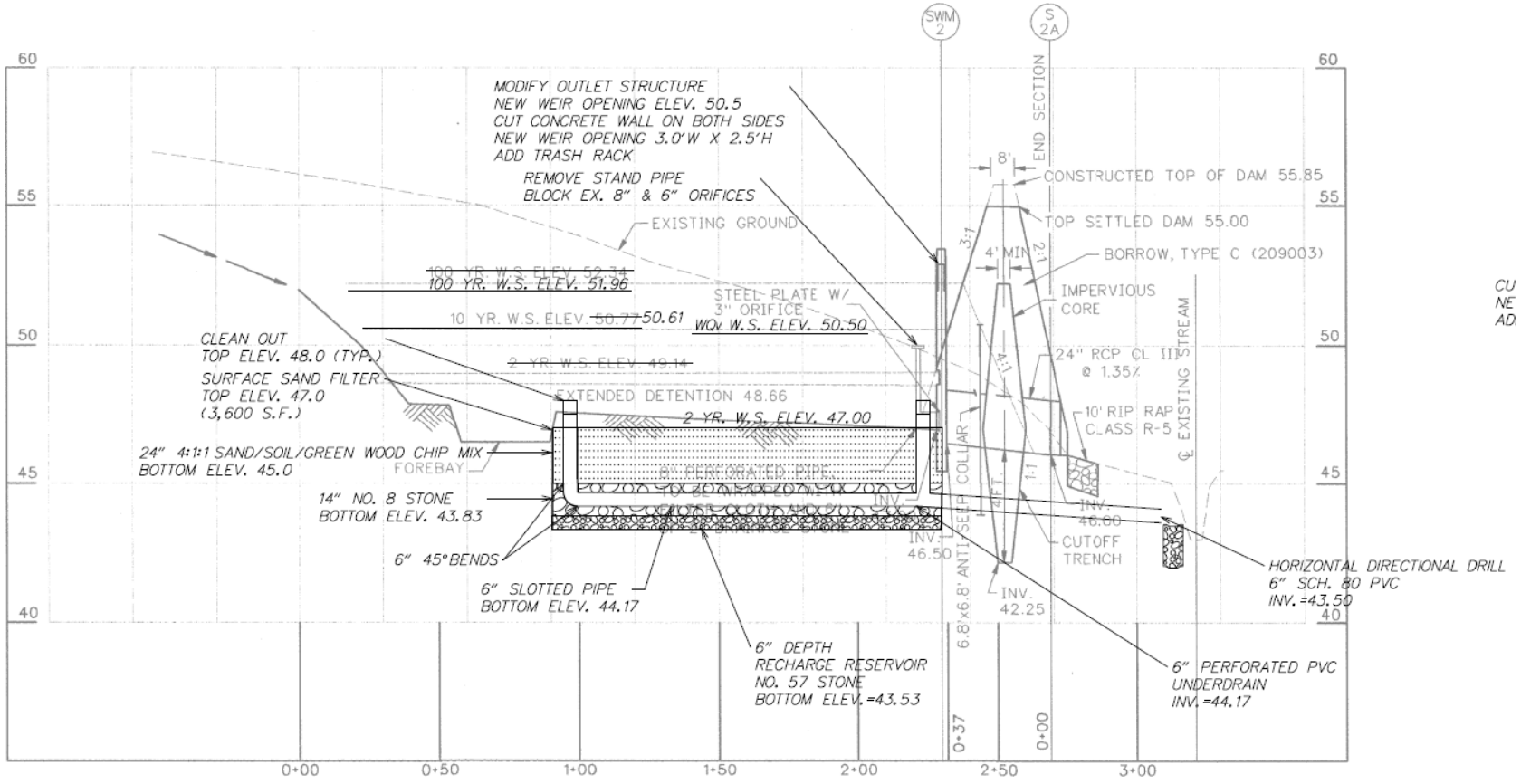
Dry Pond - Challenges

BMP 177 – SR 1

BMP 86 – Rt 896

Dry Pond - Opportunities

- Converting BMP 85 to Surface Sand Filter
- 2’ of Sand Mix:
  - 4:1:1 ratio of sand/ soil/green wood chip mix
  - #8 stone and underdrain similar to bioretention
  - No plants
- Christina WQIP credits (more to come)



PROFILE VIEW OF SURFACE SAND FILTER FOR BMP 85

Wet Pond

- Liner / permanent pool determined by soil investigation
- Forebays required
- Min. 3" orifice with trash protection (or weir wall)
- Side slopes no steeper than 3:1
- Min. 4' depth, max. 8'
- Safety Bench
  - 10' wide 1' above perm. pool (unless 4:1 flatter slopes)
  - 10' wide 1' below perm. pool

Runoff Reduction	
RPv – 48-HR Detention Allowance	**100%**
Cv	**1%**
Fv	**0%**
Pollutant Reduction	
TN Reduction	**Not less than 30%**
TP Reduction	**Not less than 55%**
TSS Reduction	**Not less than 60%**

BMP 711 – US 301

Wet Pond - Challenges

BMP 855 – 202/141

Levels Mitigation Area – US 301

Wet Pond - Challenges

BMP 7 – SR 1

Wet Pond - Challenges

BMP 629 – Rt 54

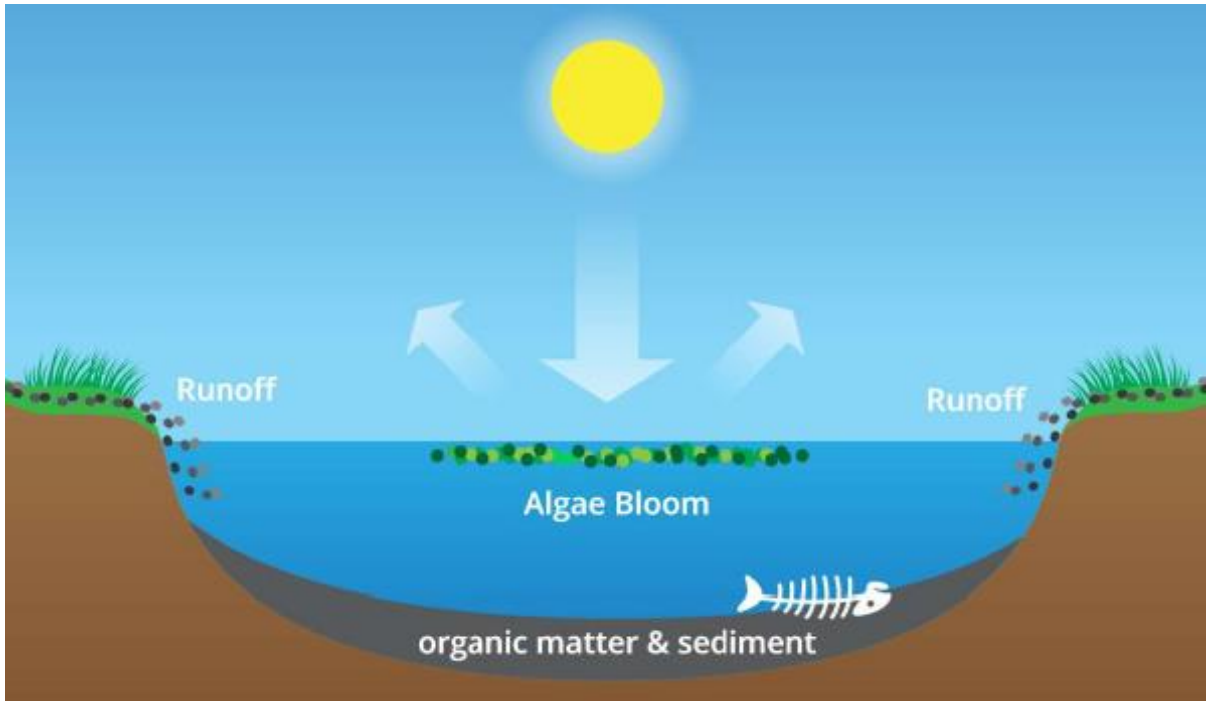
BMP 333 – Rt 26
Millville

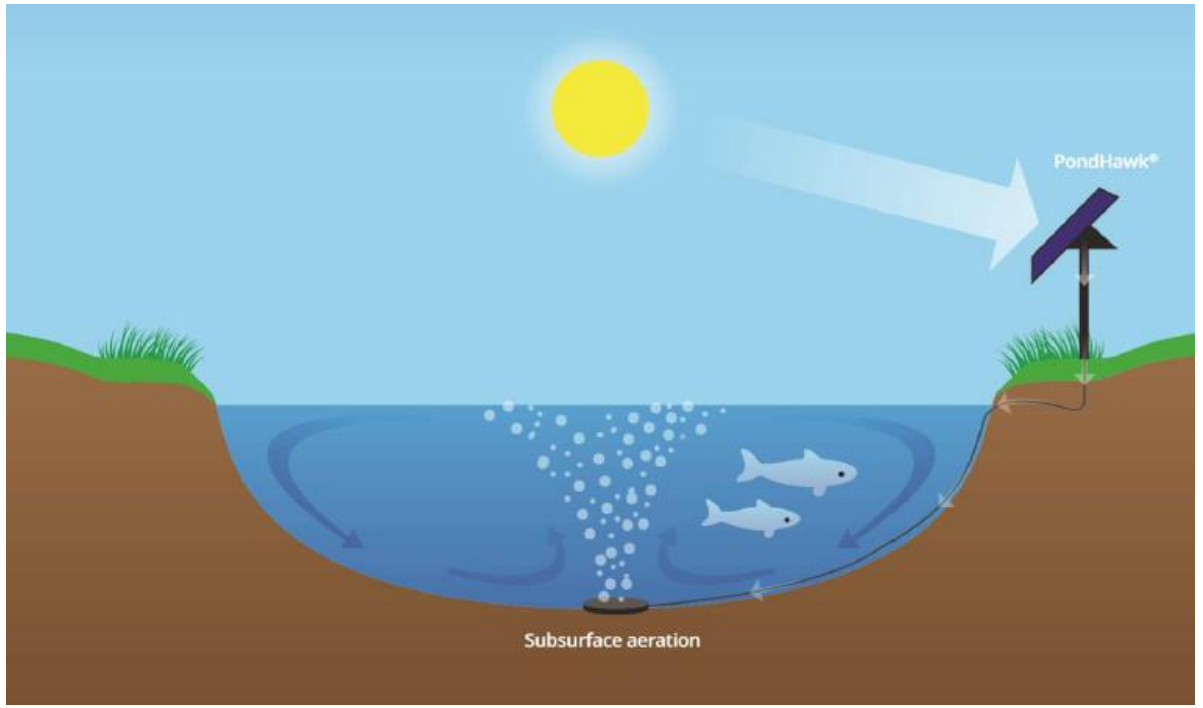
Wet Pond - Opportunities

BMP 629 – Rt 54

BMP 333 – Rt 26
Millville

Wet Pond - Opportunities





From Pond Hawk

Wet Pond - Opportunities

BMP 95 – SR 1**

Stolen Image

Infiltration Basin

- Bottom 2′ above seasonal high water*
- Pretreatment/Forebays required*
- Min. infiltration rate = 1.0 in/hr*
- Design Rate = Tested Rate / **2.5*** (2.5 if measured with the bore hole test)
- Infiltrate RPv within 48 hours; Fv within 72*
- Side slopes no steeper than 4:1
- Protection during construction is key!
  - 2′ soil lift if used as sediment basin
  - Compost log perimeter / forebays

* Applies to all infiltration practices

Runoff Reduction	
Retention Allowance	100%
RPv	**100% of Retention Storage**
Cv	**100% of Retention Storage**
Fv	**100% of Retention Storage**
Pollutant Reduction	
TN Reduction	**100% of Load Reduction**
TP Reduction	**100% of Load Reduction**
TSS Reduction	**100% of Load Reduction**

BMP 610 – US 301

Infiltration Trench

- Bottom 2’ above seasonal high water
- Pretreatment/Forebays required
- Min. infiltration rate = 1.0 in/hr
- Design Rate = Tested Rate / 2.5**
- Stone: Min. 0.5”, max. 2.5”; 0.4 porosity
- Geotextile
- Inspection Port
- Infiltrate RPv within 48 hours; Fv within 72
- Protection during construction is key!

Runoff Reduction	
Retention Allowance	100%
RPv	**100% of Retention Storage**
Cv	**100% of Retention Storage**
Fv	**100% of Retention Storage**
Pollutant Reduction	
TN Reduction	**100% of Load Reduction**
TP Reduction	**100% of Load Reduction**
TSS Reduction	**100% of Load Reduction**

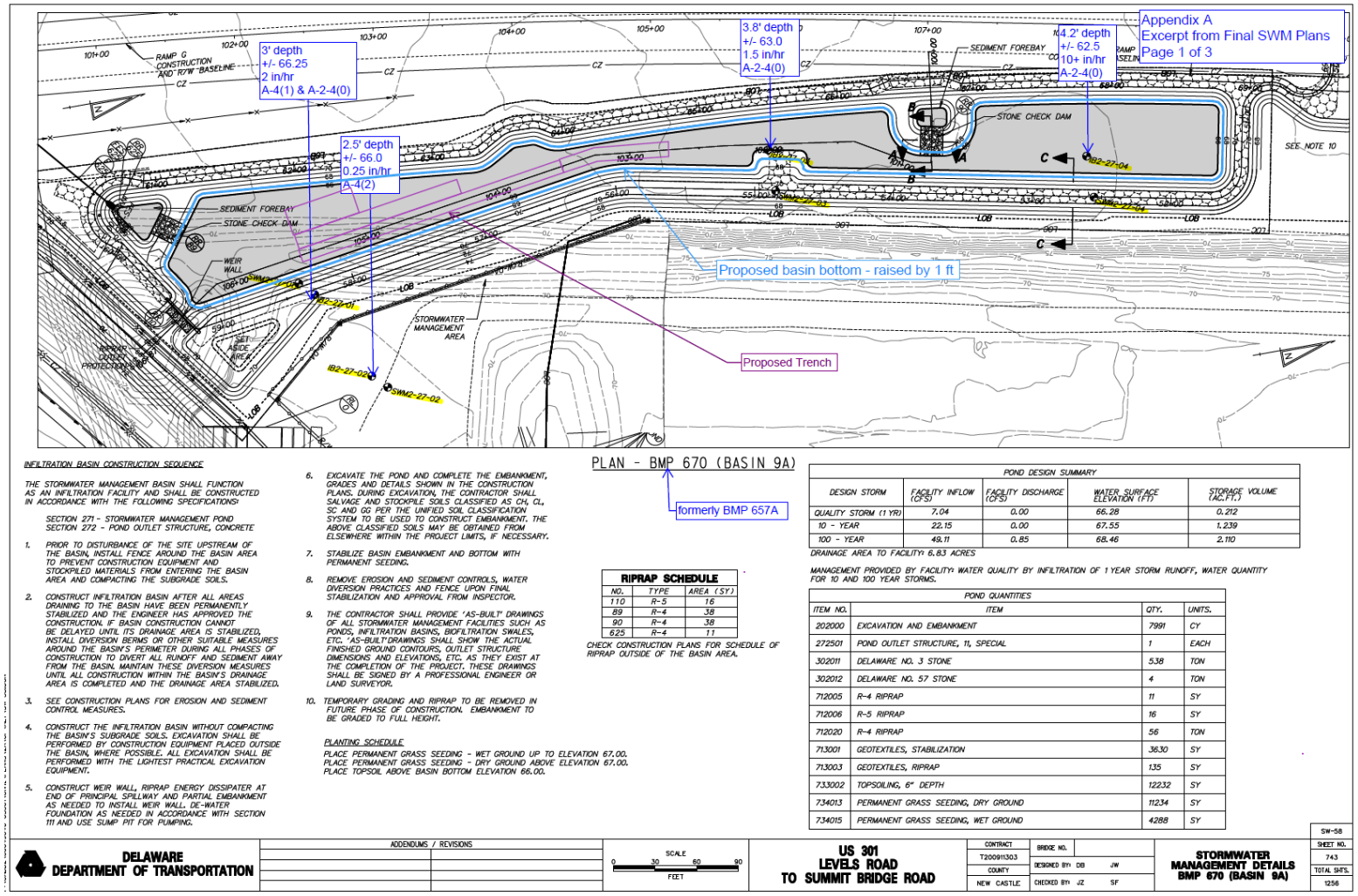
BMP 708 – US 301

Infiltration - Challenges

BMP 883 – SR 1/Thompsonville

BMP 706 – US 301

Infiltration - Opportunities



PLAN - BMP 670 (BASIN 9A)

formerly BMP 657A

INFILTRATION BASIN CONSTRUCTION SEQUENCE

THE STORMWATER MANAGEMENT BASIN SHALL FUNCTION AS AN INFILTRATION FACILITY AND SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:

SECTION 271 - STORMWATER MANAGEMENT POND
SECTION 272 - POND OUTLET STRUCTURE, CONCRETE

1. PRIOR TO DISTURBANCE OF THE SITE UPSTREAM OF THE BASIN, INSTALL FENCE AROUND THE BASIN AREA TO PREVENT CONSTRUCTION EQUIPMENT AND STOCKPILED MATERIALS FROM ENTERING THE BASIN AREA AND COMPACTING THE SUBGRADE SOILS.
2. CONSTRUCT INFILTRATION BASIN AFTER ALL AREAS DRAINING TO THE BASIN HAVE BEEN PERMANENTLY STABILIZED AND THE ENGINEER HAS APPROVED THE CONSTRUCTION. IF BASIN CONSTRUCTION CANNOT BE DELAYED UNTIL ITS DRAINAGE AREA IS STABILIZED, INSTALL DIVERSION BERMS OR OTHER SUITABLE MEASURES AROUND THE BASIN'S PERIMETER DURING ALL PHASES OF CONSTRUCTION TO DIVERT ALL RUNOFF AND SEDIMENT AWAY FROM THE BASIN. MAINTAIN THESE DIVERSION MEASURES UNTIL ALL CONSTRUCTION WITHIN THE BASIN'S DRAINAGE AREA IS COMPLETED AND THE DRAINAGE AREA STABILIZED.
3. SEE CONSTRUCTION PLANS FOR EROSION AND SEDIMENT CONTROL MEASURES.
4. CONSTRUCT THE INFILTRATION BASIN WITHOUT COMPACTING THE BASIN'S SUBGRADE SOILS. EXCAVATION SHALL BE PERFORMED BY CONSTRUCTION EQUIPMENT PLACED OUTSIDE THE BASIN, WHERE POSSIBLE. ALL EXCAVATION SHALL BE PERFORMED WITH THE LIGHTEST PRACTICAL EXCAVATION EQUIPMENT.
5. CONSTRUCT WEIR WALL, RIPRAP ENERGY DISSIPATER AT END OF PRINCIPAL SPILLWAY AND PARTIAL EMBANKMENT AS NEEDED TO INSTALL WEIR WALL. DE-WATER FOUNDATION AS NEEDED IN ACCORDANCE WITH SECTION 111 AND USE SUMP PIT FOR PUMPING.
6. EXCAVATE THE POND AND COMPLETE THE EMBANKMENT, GRADES AND DETAILS SHOWN IN THE CONSTRUCTION PLANS. DURING EXCAVATION, THE CONTRACTOR SHALL SALVAGE AND STOCKPILE SOILS CLASSIFIED AS CH, CL, SC AND OD PER THE UNIFIED SOIL CLASSIFICATION SYSTEM TO BE USED TO CONSTRUCT EMBANKMENT. THE ABOVE CLASSIFIED SOILS MAY BE OBTAINED FROM ELSEWHERE WITHIN THE PROJECT LIMITS, IF NECESSARY.
7. STABILIZE BASIN EMBANKMENT AND BOTTOM WITH PERMANENT SEEDING.
8. REMOVE EROSION AND SEDIMENT CONTROLS, WATER DIVERSION PRACTICES AND FENCE UPON FINAL STABILIZATION AND APPROVAL FROM INSPECTOR.
9. THE CONTRACTOR SHALL PROVIDE 'AS-BUILT' DRAWINGS OF ALL STORMWATER MANAGEMENT FACILITIES SUCH AS PONDS, INFILTRATION BASINS, BIOFILTRATION SWALES, ETC. 'AS-BUILT' DRAWINGS SHALL SHOW THE ACTUAL FINISHED GROUND CONTOURS, OUTLET STRUCTURE DIMENSIONS AND ELEVATIONS, ETC. AS THEY EXIST AT THE COMPLETION OF THE PROJECT. THESE DRAWINGS SHALL BE SIGNED BY A PROFESSIONAL ENGINEER OR LAND SURVEYOR.
10. TEMPORARY GRADING AND RIPRAP TO BE REMOVED IN FUTURE PHASE OF CONSTRUCTION. EMBANKMENT TO BE GRADED TO FULL HEIGHT.

PLANTING SCHEDULE

PLACE PERMANENT GRASS SEEDING - WET GROUND UP TO ELEVATION 67.00.
PLACE PERMANENT GRASS SEEDING - DRY GROUND ABOVE ELEVATION 67.00.
PLACE TOPSOIL ABOVE BASIN BOTTOM ELEVATION 66.00.

RIPRAP SCHEDULE

NO.	TYPE	AREA (SY)
110	R-5	16
89	R-4	38
90	R-4	38
625	R-4	11

CHECK CONSTRUCTION PLANS FOR SCHEDULE OF RIPRAP OUTSIDE OF THE BASIN AREA.

POND DESIGN SUMMARY

DESIGN STORM	FACILITY INFLOW (CFS)	FACILITY DISCHARGE (CFS)	WATER SURFACE ELEVATION (FT)	STORAGE VOLUME (AC.FT.)
QUALITY STORM (1 YR)	7.04	0.00	66.28	0.212
10 - YEAR	22.15	0.00	67.55	1.239
100 - YEAR	49.11	0.85	68.46	2.110

DRAINAGE AREA TO FACILITY: 6.83 ACRES

MANAGEMENT PROVIDED BY FACILITY: WATER QUALITY BY INFILTRATION OF 1 YEAR STORM RUNOFF, WATER QUANTITY FOR 10 AND 100 YEAR STORMS.

POND QUANTITIES

ITEM NO.	ITEM	QTY.	UNITS.
202000	EXCAVATION AND EMBANKMENT	7991	CY
272501	POND OUTLET STRUCTURE, 11, SPECIAL	1	EACH
302011	DELAWARE NO. 3 STONE	538	TON
302012	DELAWARE NO. 57 STONE	4	TON
712005	R-4 RIPRAP	11	SY
712006	R-5 RIPRAP	16	SY
712020	R-4 RIPRAP	56	TON
713001	GEOTEXTILES, STABILIZATION	3630	SY
713003	GEOTEXTILES, RIPRAP	135	SY
733002	TOPSOILING, 6" DEPTH	12232	SY
734013	PERMANENT GRASS SEEDING, DRY GROUND	11234	SY
734015	PERMANENT GRASS SEEDING, WET GROUND	4288	SY

DELAWARE DEPARTMENT OF TRANSPORTATION

ADDENDUMS / REVISIONS

SCALE 0 30 60 90 FEET

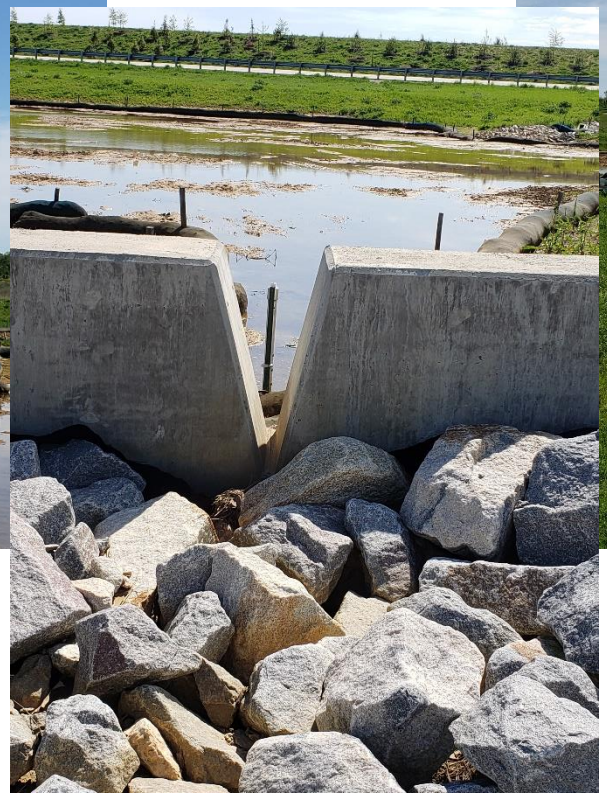
US 301 LEVELS ROAD TO SUMMIT BRIDGE ROAD

CONTRACT T200911303 | COUNTY NEW CASTLE | BRIDGE NO. | DESIGNED BY: DB JW | CHECKED BY: JZ SF

STORMWATER MANAGEMENT DETAILS BMP 670 (BASIN 9A)

SW-58 | SHEET NO. 743 | TOTAL SHTS. 1256

Infiltration - Opportunities



BMP 663 – US 301

Bioretention

- Bottom 2’ above seasonal high water (bottom of underdrain)
- Pretreatment/Forebays required
- Min. infiltration rate = 1.0 in/hr* or underdrain with a 2’ No. 8 stone sump
- Infiltrate (or drain thru underdrain) RPv within 48 hours; Fv within 72
- Side slopes no steeper than 3:1
- DNREC Biosoil Mix topped with triple shredded mulch (60% concrete sand, 30% triple shredded mulch, 10% compost)
- Either Stormwater Seed Mix or Shrubs depending on location

Runoff Reduction	
Retention Allowance	100%
RPv	**100% of Retention Storage**
Cv	**100% of Retention Storage**
Fv	**100% of Retention Storage**
Pollutant Reduction	
TN Reduction	**100% of Load Reduction**
TP Reduction	**100% of Load Reduction**
TSS Reduction	**100% of Load Reduction**

BMP 299 – Valley Road

Bioretention - Challenges

BMP 316 – Christiana
Mall SR 1 Exit

BMP 589 – Carter Road

Bioretention - Opportunities

Resource Center Raingarden

Forebay

BMP 610 – US 301

BMP 663 – US 301

Forebay - Challenges

BMP 586 – Carter Road

BMP 126 – Coastal Highway

Forebay - Challenges

BMP 126 – Coastal Highway

Forebay - Challenges

Sand Filters

Lancaster Pike

Sand Filters

Lancaster Pike

BMP Maintenance Costs

Traditional BMPs

- Inspection: $ 300
- Annual Mowing: $ 100
- Minor Maint.: $ 650
- Major Maint.: $ 3,500
  (20 years, yearly)
- NPDES coord.: $ 150

- Avg Annual BMP: $ 4,700
- 20 Year BMP Cost: $ 94,000
- 238 Trad. BMPs Annual: $ 1,118,600

Non-Traditional BMPs

- Inspection: $ 250
- Annual Mowing: $ 50
- Minor Maint.: $ 150
- Major Maint.: $ 100
- (20 years, yearly)
- NPDES coord.: $ 150

- Avg Annual BMP: $ 700
- 20 Year BMP Cost: $ 14,000
- 356 Non. Trad. BMPs Annual: $ 249,200

* Excludes initial construction

Grand Annual Total: $1,367,800 per year

BMP 21

- Jenny Run / BMP 21
  - Initiated 2013
  - Wet pond maintenance
    - Inlet Riprap protection
    - Sediment Forebay
  - 200 feet outfall restoration with 15’ of elevation drop
  - Construction Bid $219,000
  - Constructed Completed November 2017

Before

After

After

After

After

NPDES Inventory

Storm System Inventory

- Number of Catchbasins: 61,518
- Number of Total Structures: 98,171
- Length of Swales: 20,593,766 lf (3,900 miles)
- Length of Stormdrain Pipe: 8,822,894 lf (1,671 miles)
- Number of BMPs: 594
- Inventoried since 2006.
  - Some data is old or incomplete, especially on high traffic roads.
  - Working to update, ie 2018 inventory of missing I-95 data
  - Also working to create better process of receiving data post construction

MS4 Inventory and Inspection

BMP Inspections

- NPDES Ph I / II permits require yearly inspections
- BMPs are rated A → D based on maintenance needs
  - A = no maintenance required
  - B = minor maintenance required; workorders sent via Maximo
    - Trash; minor erosion/stabilization; riprap repairs; vegetation
  - C = major maintenance required; maintenance plans generated and work is contracted out
    - Major erosion/stabilization; forebay/basin dipout;
  - D = retrofit needed; construction plans generated and work is contracted out
    - BMP design/construction issues; No longer functioning

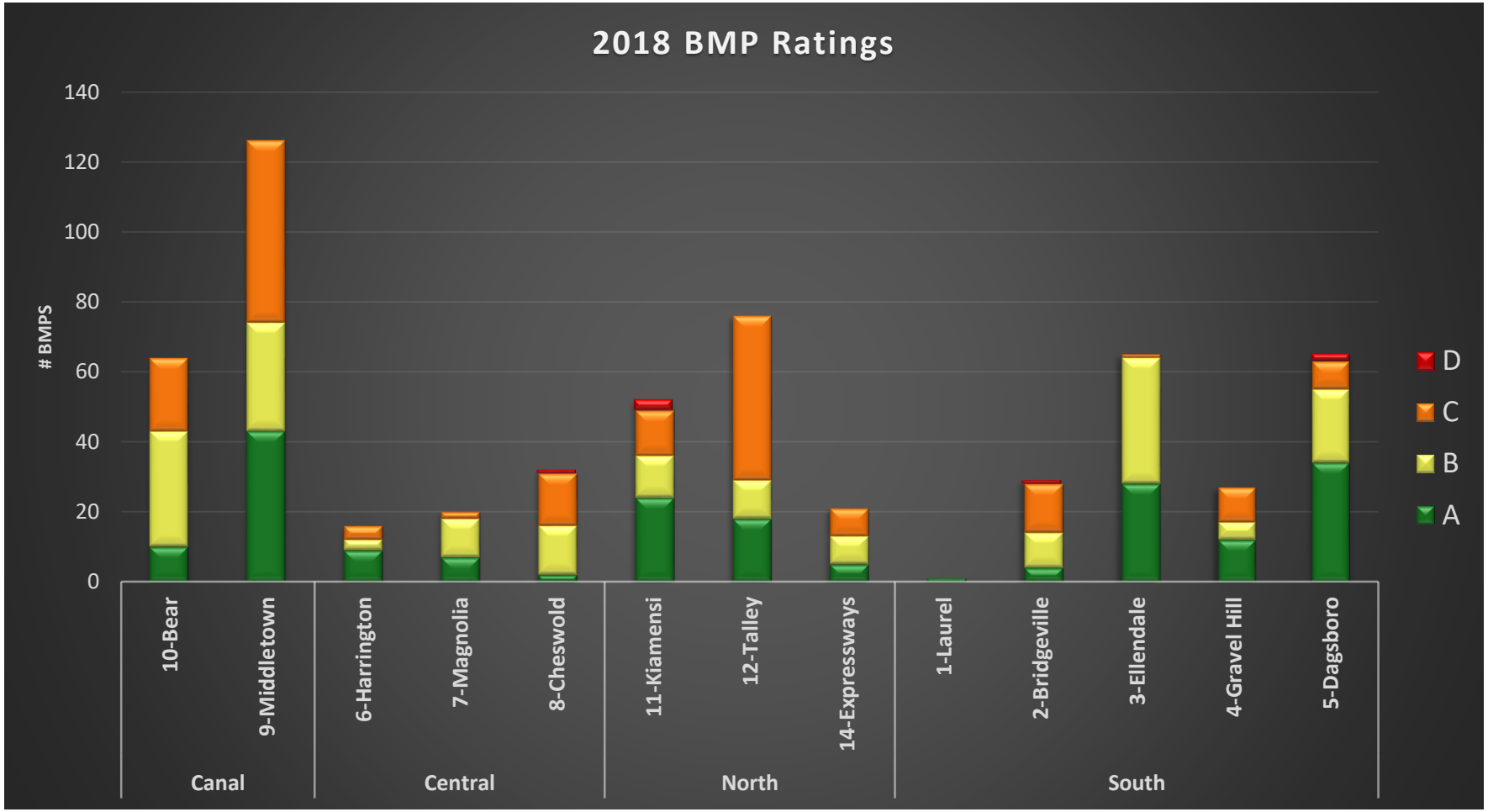
DELAWARE DEPARTMENT OF TRANSPORTATION — 2019 BMP INSPECTIONS

BMP # 533

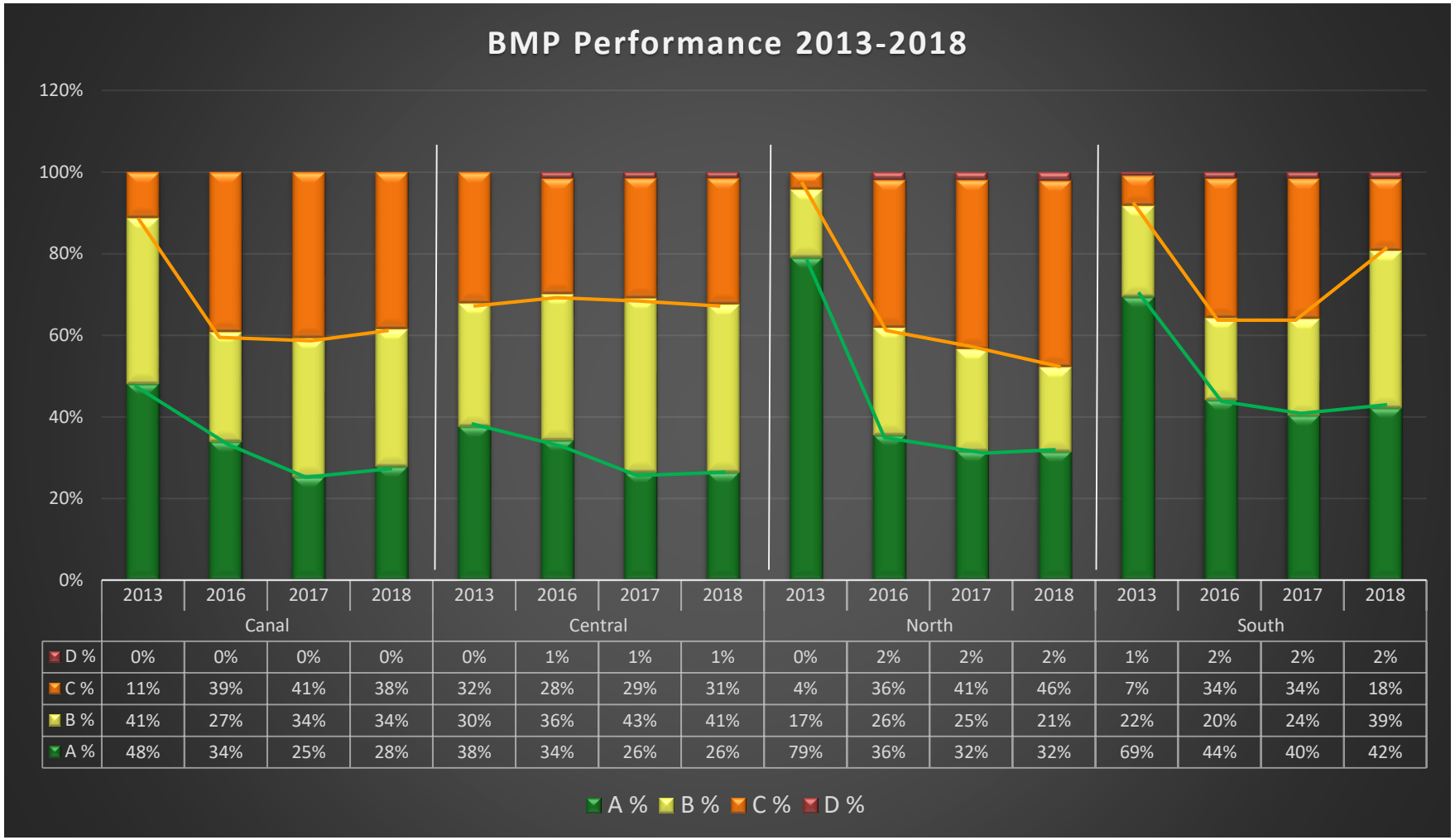
Inspection Date	03/04/2019	
Inspection Team	RB	
District	CANAL DISTRICT	
Maintenance Area (Location)	26 - CANAL	
Maintenance Area (Work Order)	26 - RICH REIMER	
BMP Type	WET POND	
Maintenance Road Number	006277	
2019 Performance Rating	B - MINOR MAINTENANCE	
No Prior Performance Rating	N/A	
Last Spillway Inspection	03/04/2019	
Drainage Area (Ac)		
Action Item (s)	X	MAINTENANCE WORK ORDER
		INVASIVE SPECIES CUT LIST
	X	INVASIVE SPECIES SPRAY LIST
		CONTRACTED WORK
		RETROFIT
BMP Location		

BMPs per District

- 594 total BMPs currently accepted as DelDOT's responsibility
- 85 to be added with US 301
  - 28 filter strips/bioswales removed since pretreatment)

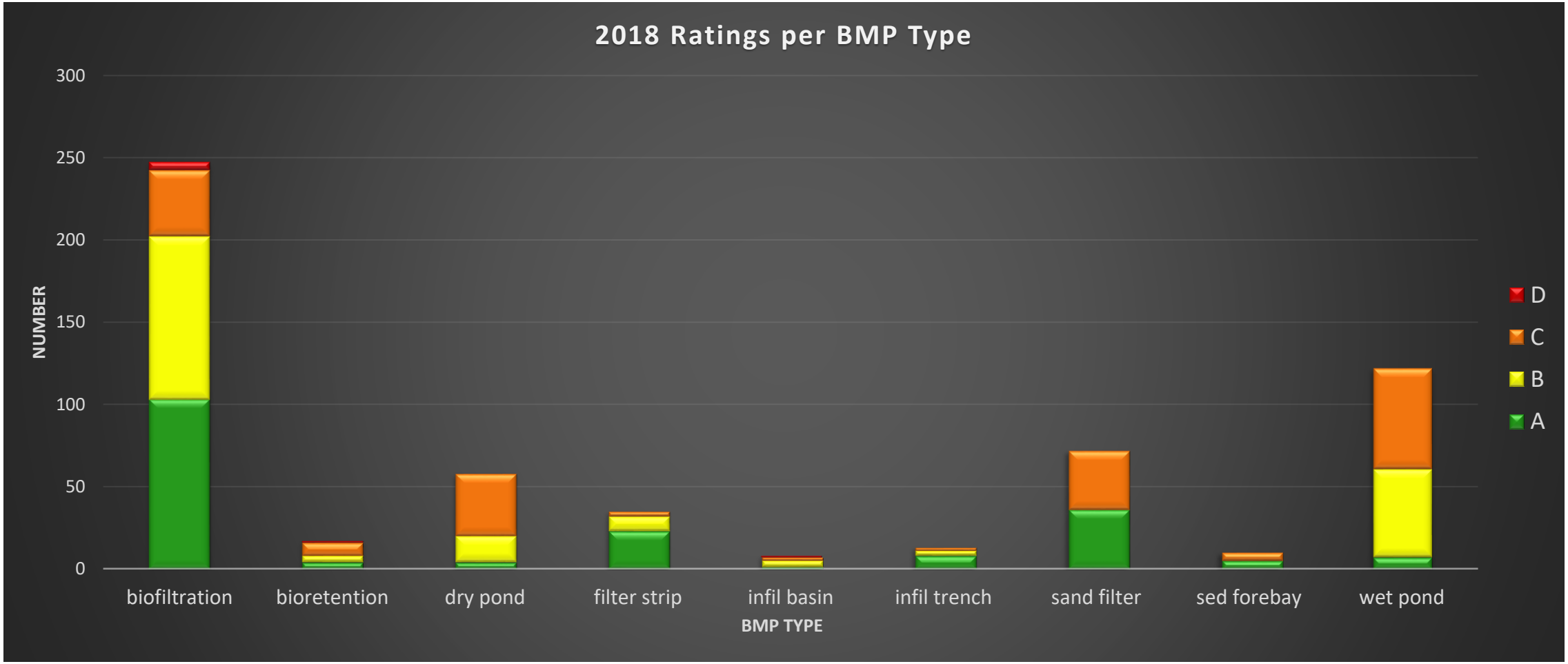


2013-2018 Inspection Summary



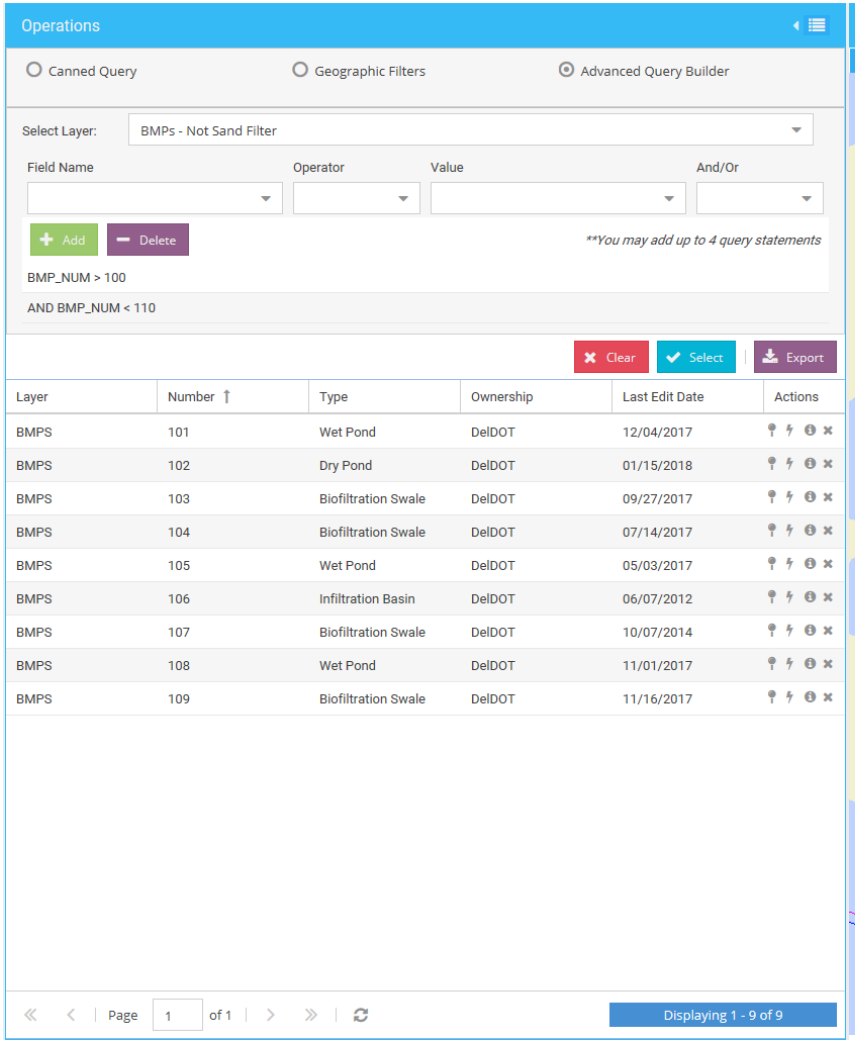
	Canal				Central				North				South			
	2013	2016	2017	2018	2013	2016	2017	2018	2013	2016	2017	2018	2013	2016	2017	2018
D %	0%	0%	0%	0%	0%	1%	1%	1%	0%	2%	2%	2%	1%	2%	2%	2%
C %	11%	39%	41%	38%	32%	28%	29%	31%	4%	36%	41%	46%	7%	34%	34%	18%
B %	41%	27%	34%	34%	30%	36%	43%	41%	17%	26%	25%	21%	22%	20%	24%	39%
A %	48%	34%	25%	28%	38%	34%	26%	26%	79%	36%	32%	32%	69%	44%	40%	42%

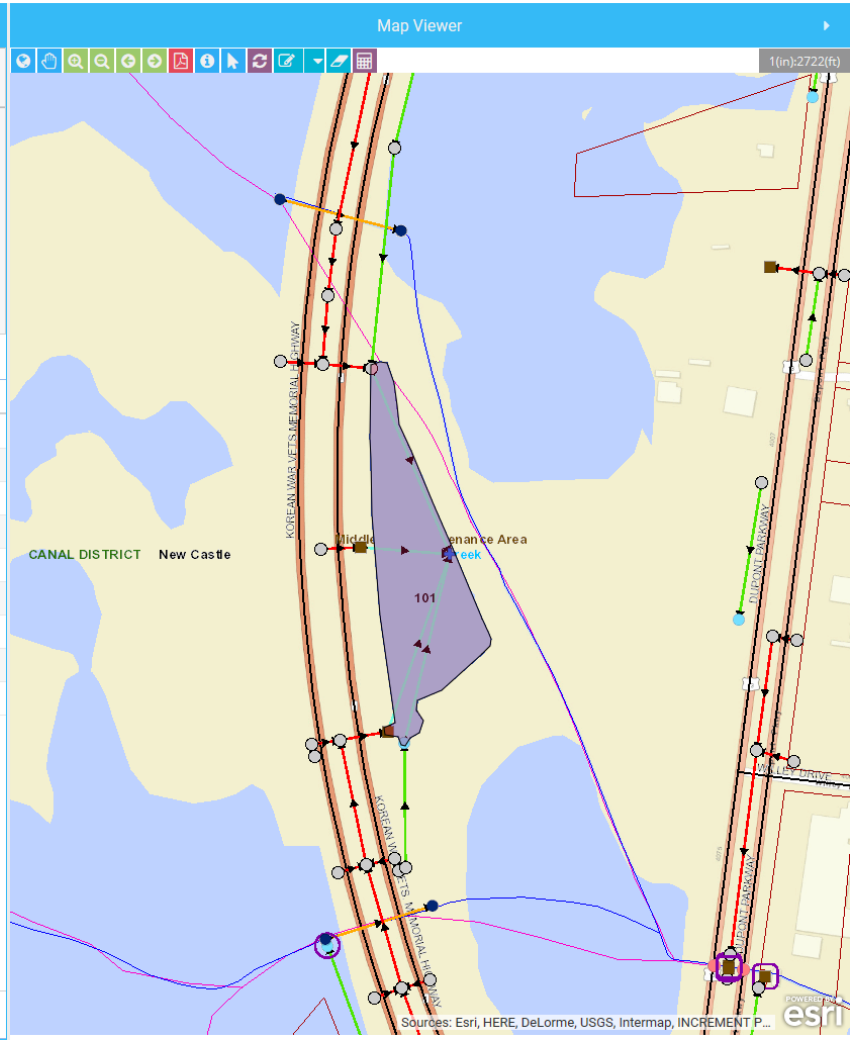
2018 Ratings per BMP Type



NPDES Map Viewer

- Access/Request Log-In: https://newarkgis.kci.com/deldotwebviewer/index.html#login
- User Guide Tutorials: https://www.deldot.gov/Programs/stormwater/index.shtml?dc=mapviewer

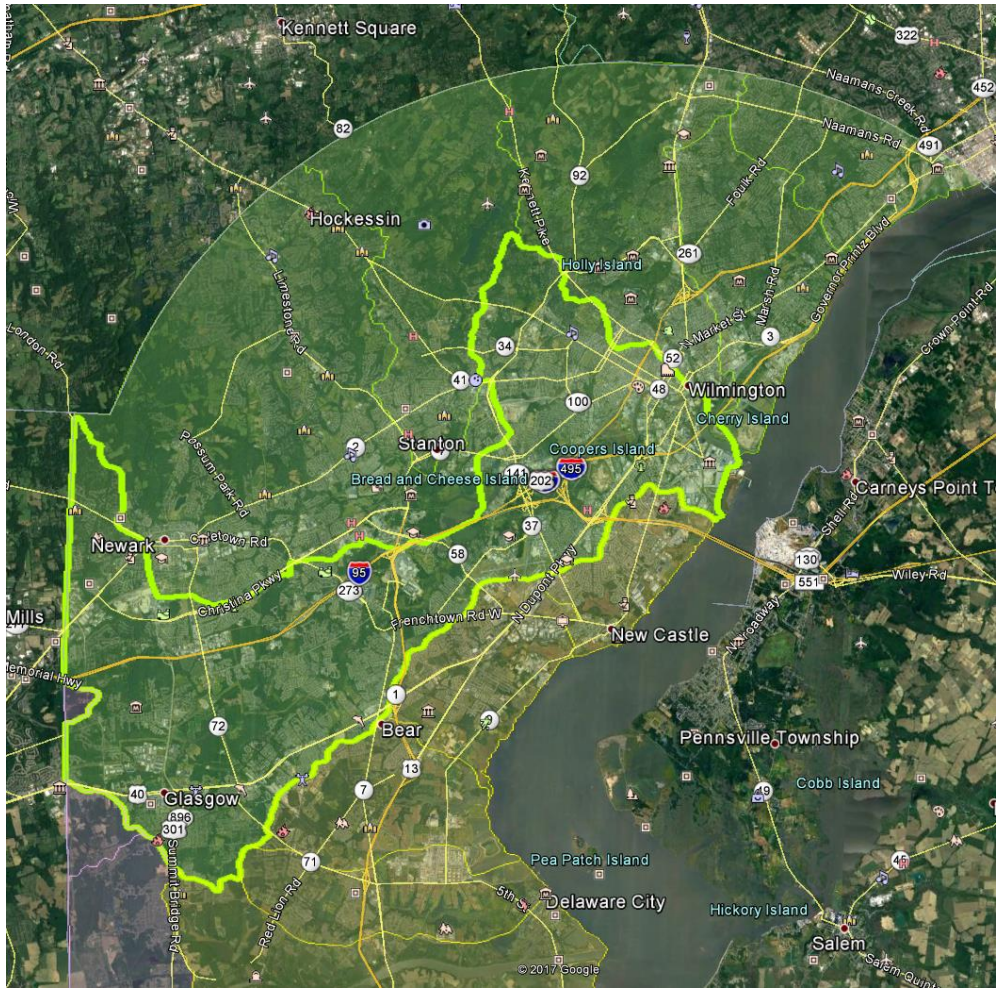




Water Quality Improvement Plans

- This permit: Christina River and Dragon Run watersheds
- Develop plan to reduce at least 3% of effective impervious area
  - Green infrastructure: Infiltration, Bioretention
  - Non-traditional: Stream Restorations, Tree Planting, Septic Removal
- Estimating $25-$30 million dollars to implement the two WQIPs (DelDOT $10-15 million)
- Next permit? Implement the two WQIPs; plan two more watersheds (White Clay & Blackbird Creek)

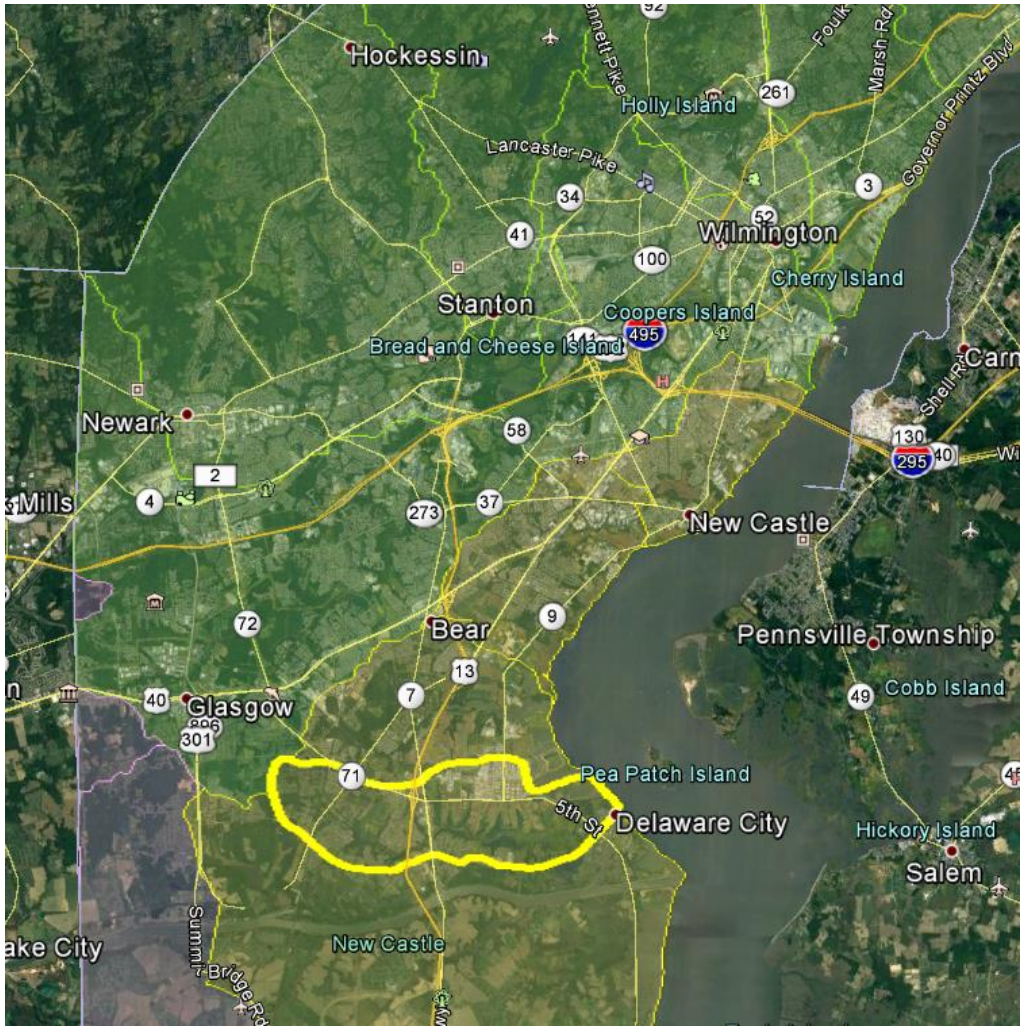
Christina River WQIP



By the Numbers:

- 10,601 total impervious acres
- 7,438 effective impervious acres
- 3% Effective Impervious = 224 acres to be treated
- Existing Stream Restorations (2007 on) = 18 acres
- Existing Stormwater Facilities (2007 on) = 30 acres
- Outstanding EIA to be Treated = 175 acres (+/-)

Dragon Run WQIP



By the Numbers:

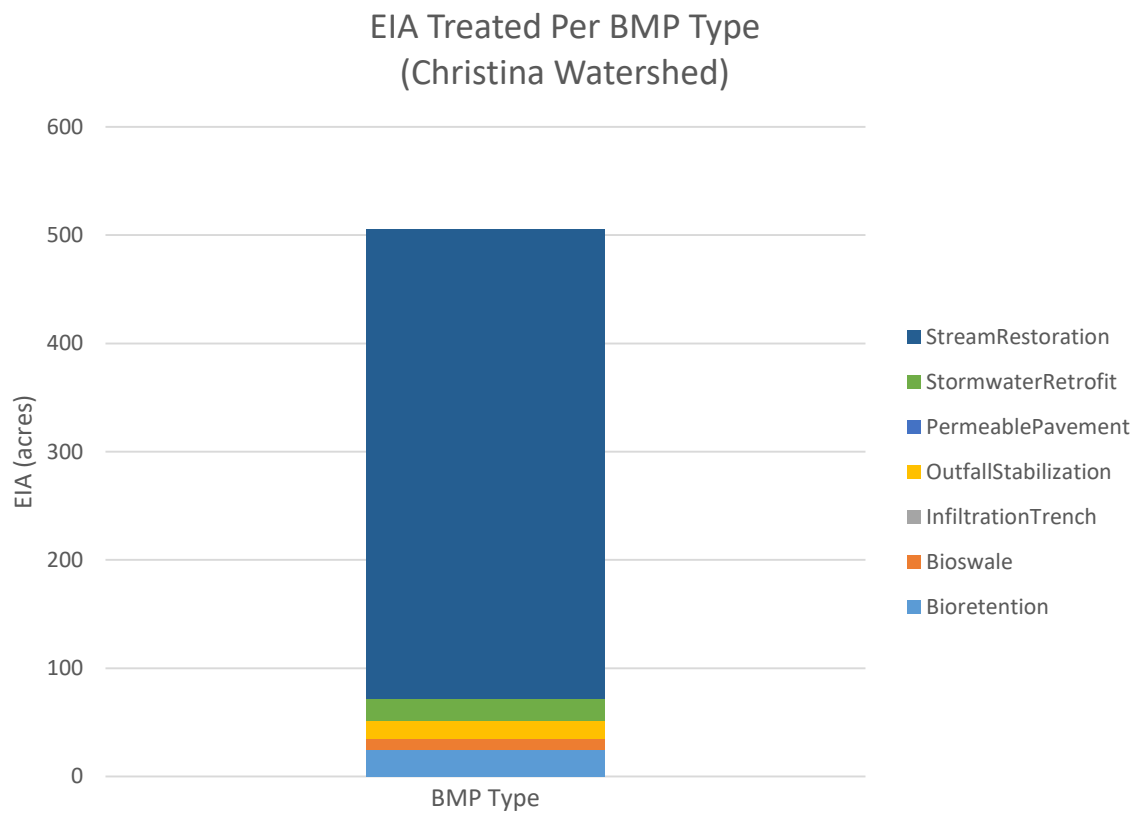
- 694 total impervious acres
- 387 effective impervious acres
- 3% Effective Impervious = 11.6 acres to be treated
- Existing Stream Restorations (2007 on) = 0 acres
- Existing Stormwater Facilities (2007 on) = 0 acres
- Outstanding EIA to be Treated = 11.6 acres

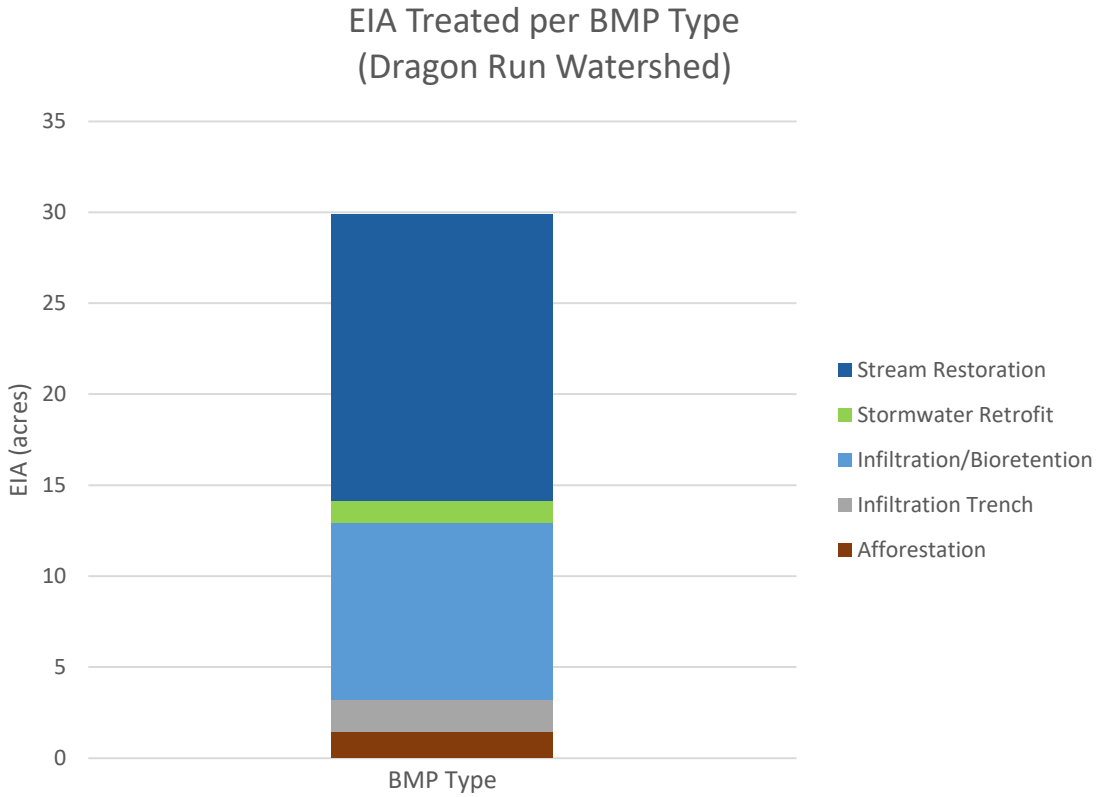
BMP Targeting

BMP	Average cost per 1 acre of EIA ($)
Bioretention	$250,000
Stormwater Retrofit	$100,000
Infiltration Trench	$370,000
Bioswale	$190,000
Permeable Pavement	$350,000
Afforestation	$75,000
Pavement Removal	$375,000
Outfall Stabilization / Regenerative Stormwater Conveyance	$75,000
Stream Restoration	~~$125,000~~ **$55,000**

- Stream credit estimate of 1 acre per 100 ft restored increased to 3 acres per 100 ft restored.
- Average cost now $55,000 per EIA

BMP Targeting





Stream Restorations

- Early settlers did a great job clearing trees & making streams straight and deep

Stream Restorations

- Modern times "helped": Added impervious cover & increase amount of runoff going to streams

Middletown
1954

Stream Restorations

- Modern times "helped": Added impervious cover & increase amount of runoff going to streams

Middletown
2017

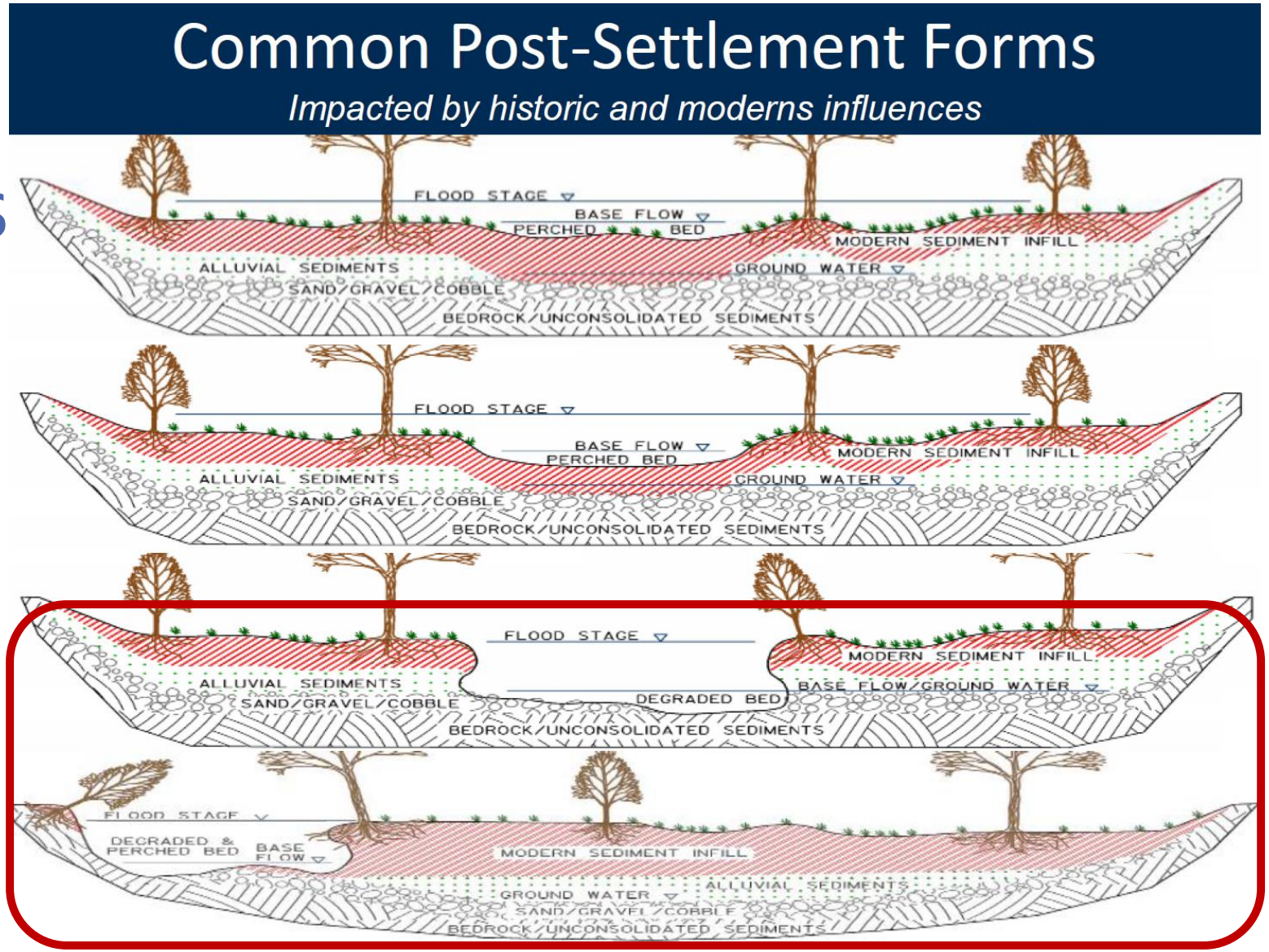
Stream Restorations

- Result: Incised / No Floodplain, High Stress / Eroding, Poor Habitat, etc

Stream Restorations

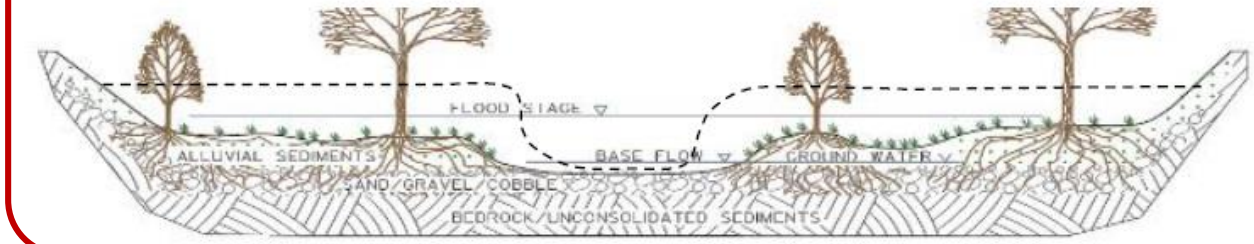
Stream Restorations

Stream Restorations

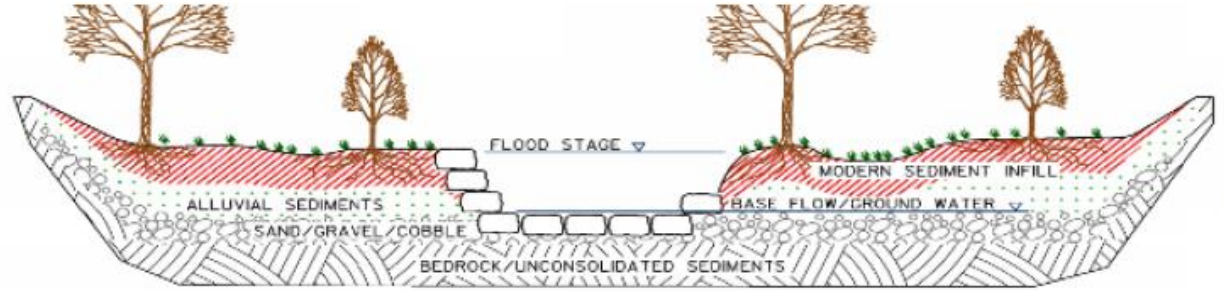


Stream Restorations

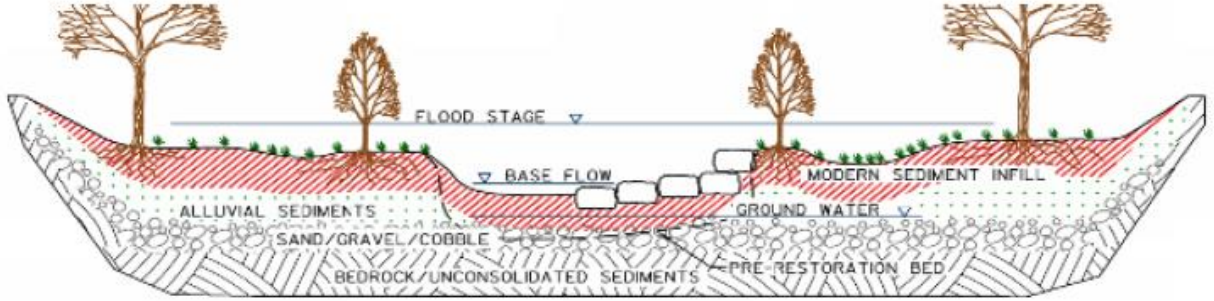
Basic Restoration Strategies



1 Removal of modern sediment to re-connect floodplain. (Rosgen Priority 2)



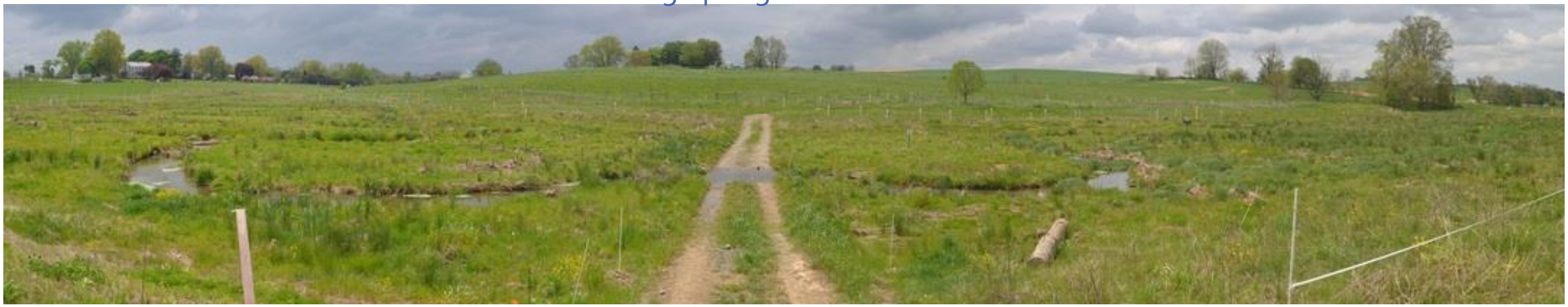
2 Incised channel stabilization to store modern sediment. (Rosgen Priority 3)



3 Raise streambed to store modern sediment and tie into modern terrace. (Rosgen Priority 1)

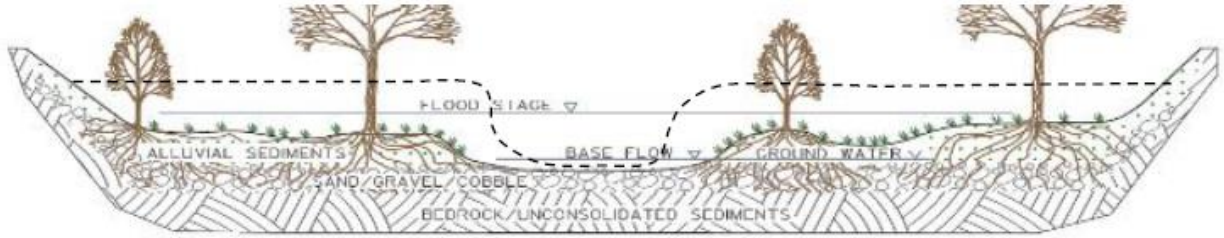
Stream Restorations

Big Spring Bend - PA

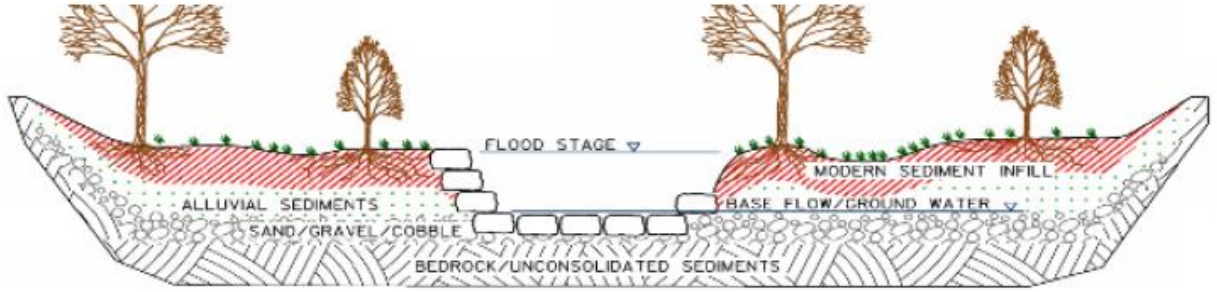


Stream Restorations

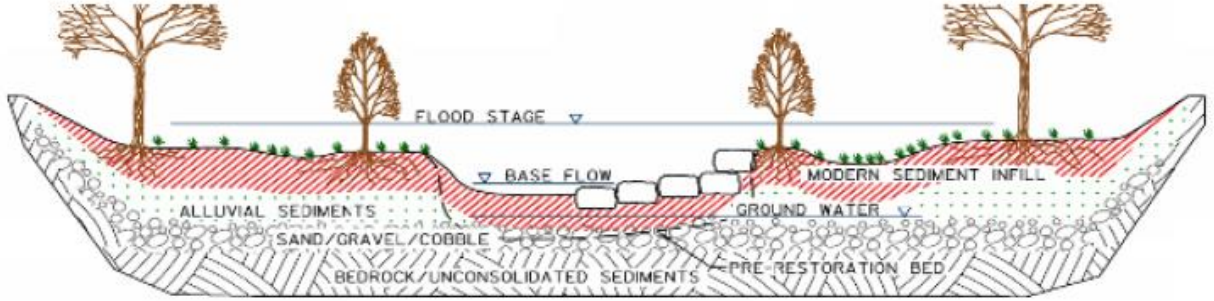
Basic Restoration Strategies



1 Removal of modern sediment to re-connect floodplain. (Rosgen Priority 2)



2 Incised channel stabilization to store modern sediment. (Rosgen Priority 3)

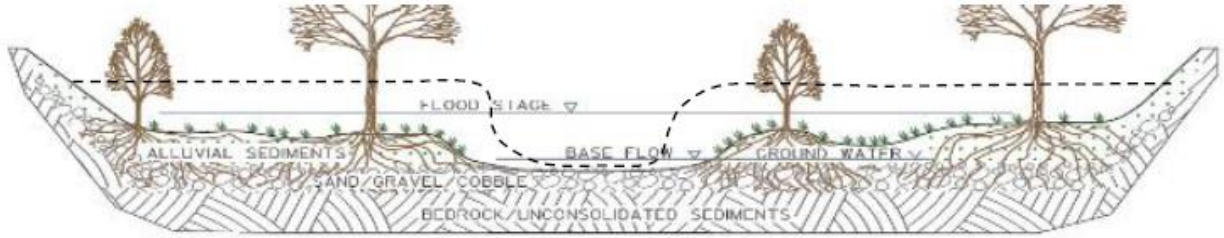


3 Raise streambed to store modern sediment and tie into modern terrace. (Rosgen Priority 1)

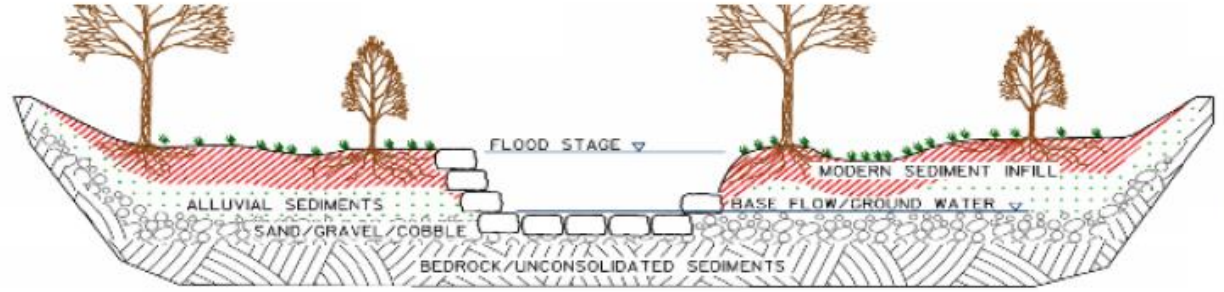
Stream Restorations

Stream Restorations

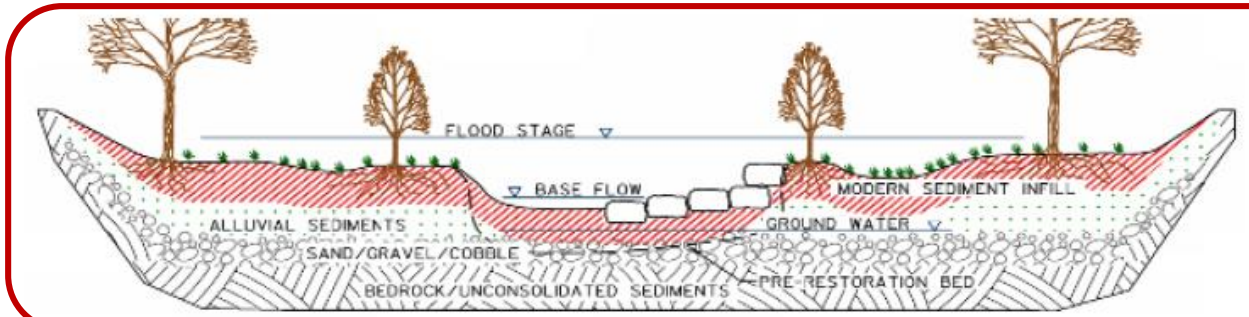
Basic Restoration Strategies



1 Removal of modern sediment to re-connect floodplain. (Rosgen Priority 2)



2 Incised channel stabilization to store modern sediment. (Rosgen Priority 3)



3 Raise streambed to store modern sediment and tie into modern terrace. (Rosgen Priority 1)

Leatherman's Run

- Initiated 2012, T201380204
- Approximately 640 foot length
- DelDOT owned land adjacent to I-95
- Includes protection of two exposed sanitary crossings
- Construction completed Fall 2016.
- Construction Bid $616,000
- Actual Cost $903,000 (due to sewer issues)
- 6.4 effective impervious acres removed (No BANCS info) — 19.2 EIA
- $129,000 / EIA removed

Before

After

After

Varlano Park

- Initiated 2013, T201480206
- Approximately 250 foot length
- DelDOT outfall from a subdivision into a New Castle County Park
- 48" diameter pipe with a 29 acre drainage area
- Scour pool 4' deep with 12' high banks to a 4' to 7' high incised channel.
- Average sediment load of 32 cy/yr
- Construction completed Fall 2018
- Construction cost $583,120
- 12.9 effective impervious acres removed
- $47,600 / EIA removed

Before

After

After

After

After

After

DELAWARE DEPARTMENT OF TRANSPORTATION

MAKING STRIDES TO IMPROVE WATER QUALITY