

Construction of Infiltration Practices



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Types of Infiltration Practices

Infiltration Basins & Trenches

Subsurface Infiltration

Bioretention

Porous Pavement / Pavers



Steps for Successful Infiltration

Testing



Steps for Successful Infiltration

Testing

Design

3.06.2 Post Construction Stormwater BMP Standards and Specifications

March 2013



Steps for Successful Infiltration

Testing

Design

Construction



Construction of Infiltration Systems



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Delaware's Sediment and Stormwater Management Program

Delaware's Sediment and Stormwater Management program operates within the Division of Watershed Stewardship's [Drainage and Stormwater Section](#). The program employs a comprehensive approach to sediment control (both during and after construction) and stormwater management that includes monitoring of stormwater quantity and water quality control. Program responsibilities include:

- Sediment control and inspection during construction
- Post-construction inspection of permanent stormwater facilities
- Stormwater quantity and water quality control
- Education/training relating to stormwater

Delaware Sediment and Stormwater Regulations

- [Sediment and Stormwater Regulations - current](#)
- [Technical Document](#)

• **Technical Document Public Notices**
DNREC does not intend to use the TGD (Technical Document) as a regulation that has the force and effect of law and which may be enforced as such. Instead, the TGD is an interpretive or advisory document that the Department will use to administer the regulations, and which will provide greater detail and explanation for the public. The TGD considers various types of stormwater and sediment plans that may be employed under the regulation, and shows how applicants can obtain approval through the use of an offset and other solutions to different and difficult stormwater and sediment management scenarios.

- [Designer Training](#)
- [FAQ](#)
- [Interim Guidance Policy](#)
- [Stormwater Assessment Study GIS Web App](#)
 - Some layers from the SAS GIS Web App are available for download from the [Delaware Geospatial Data Exchange](#)
- [Sediment and Stormwater Regulations Development](#)

Current Month's Sediment and Stormwater Listserv

[Sign up for the Sediment and Stormwater Listserv](#)

[List of Delegated Agencies](#)

Laws, Regulations, and Policies

- [Sediment & Stormwater Law](#)
- [Sediment & Stormwater Regulations](#) - projects prior to 1/1/14
- [Plan Review Policy](#)
- [Construction Review Policy](#)
- [Turbid Discharge Policy for Best Available Technology \(BAT\)](#)
- [Enforcement Policy](#)
- [CCR Policy for State & Federal Projects](#)
- [Pond Code 378 for Urban Stormwater Management Ponds](#)

Certification Information

Applications

- [Application for Plan Approval](#)
- [Minor Land Disturbing Activity Application](#) - grandfathered projects
- [Utility Construction Application](#) - grandfathered projects
- [Certified Construction Reviewer Application](#)

Checklists - grandfathered projects

- [Sediment & Stormwater Plan Review Checklist](#)
- [Minimum Submittal Requirements for SWM Conceptual Plan](#)
- [Minimum Submittal Requirements for Pond Construction Plan](#)





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Drainage & Stormwater Section

Sediment & Stormwater Technical Document

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This series of articles has been assembled as a technical document to support revisions to the Delaware Sediment and Stormwater Regulations. The articles and appendices contain information, policies, procedures, checklists and examples to assist the regulated community in complying with the sediment and stormwater regulations. Revisions or updates to the Technical Document require public notice. All public notices are included on the [Technical Document Public Notices](#) webpage.

[Article 1. Sediment and Stormwater Program Background](#)

[Article 2. Policies and Procedures](#)

- [2.05.1 Variance Request Form](#) (fillable pdf)
- [2.05.2 Variance Request Form - Expired Plans](#) (fillable pdf)

[Article 3. Plan Review and Approval](#)

- [3.01 Project Types](#)
 - [3.01.1 Standard Plan Applications](#)
- [3.02 Plan Review Process - Detailed Plans](#)
 - [3.02.1.5 Example Project Application Package "Broadkill Estates"](#)
 - [3.02.2.7 Example Preliminary Sediment and Stormwater Plan Submittal Package](#)
 - [Appx. 3.02.2.7.1 Residential](#)
 - [Appx. 3.02.2.7.2 Commercial](#)
 - [Appx. 3.02.2.7.3 Institutional](#)
 - [Appx. 3.02.2.7.4 Redevelopment](#)
- [3.03 Construction Site Stormwater Management](#)
- [3.04 Post Construction Stormwater Management](#)
 - [3.04.4 DURMM v.2 Spreadsheet](#) **NOTE:** Please save a copy of this file to your computer before using it.
 - [3.04.5 DURMM v.2 Quick Start Guide](#)
 - [3.04.6 DURMM v.2 User Guide](#)
- [3.05 General Plan Requirements](#)
 - [3.05.2 Example Plan Cover Sheet](#) **NOTE:** Please save a copy of this file to your computer before using it.
- [3.06 Sediment and Stormwater BMP Standards and Specifications](#)
 - [3.06.1 Delaware Erosion and Sediment Control Handbook](#)
 - [3.06.2 Post Construction Stormwater BMP Standards and Specifications](#)



[Article 4. Construction Review and Compliance](#)

- [4.01.2 BMP Construction Checklists](#)

[Article 5. Maintenance of Permanent Stormwater Management Systems](#)

- [5.01.3 Maintenance Review Checklists](#)



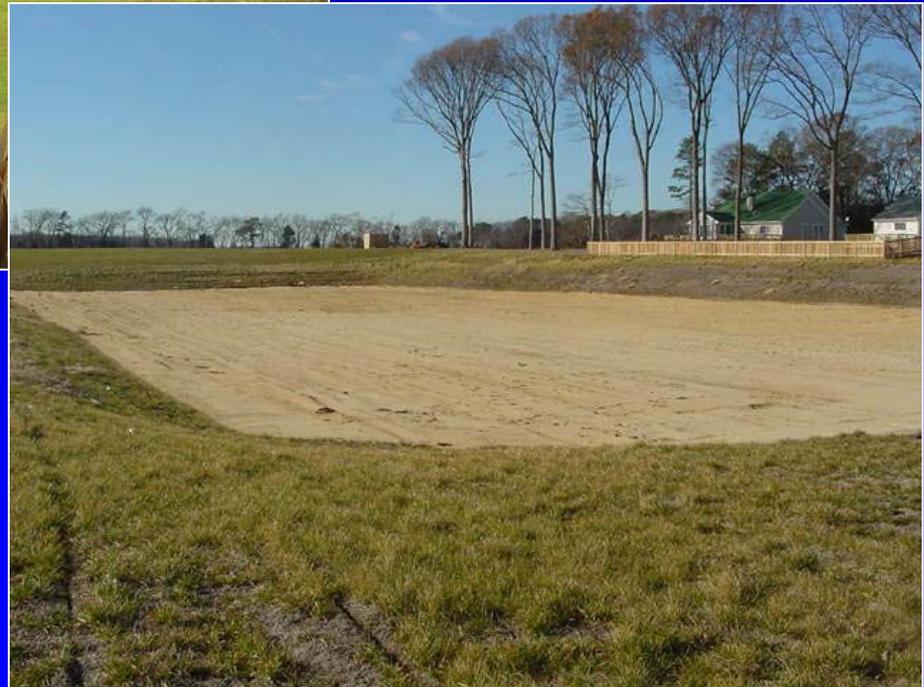
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BMP Construction Checklists

- [Infiltration](#)
- [Bioretention](#)
- [Permeable Pavement Systems](#)
- [Vegetated Roofs](#)
- [Rainwater Harvesting](#)
- [Rooftop Disconnection](#)
- [Vegetated Channels](#)
- [Sheet Flow to Filter Strip or Open Space](#)
- [Dry Detention](#)
- [Underground Detention](#)
- [Filtering Systems](#)
- [Constructed Wetlands](#)
- [Wet Ponds](#)

Infiltration Basins



Infiltration Basins

- Minimize Compaction During Construction



Infiltration Basins

- Minimize Compaction During Construction
- Can be Used as a Sediment Trap
 - Leave 12” + high
 - Excavate after drainage area is stabilized



Sediment Accumulation





Infiltration Basins

- Minimize Compaction During Construction
- Can be Used as a Sediment Trap
 - Leave 12” + high
 - Excavate after drainage area is stabilized
- Stabilize Side Slopes
 - Use minimum topsoil on pond bottom



06/14/2007

Infiltration Trenches



Infiltration Trenches

- Minimize Compaction During Excavation



Infiltration Trenches

- Minimize Compaction During Excavation
- Use Correct Filter Fabric





Infiltration Trenches

- Minimize Compaction During Excavation
- Use Correct Filter Fabric
- Use Clean Washed Stone



Infiltration Trenches

- Minimize Compaction During Excavation
- Use Correct Filter Fabric
- Use Clean Washed Stone
- Provide Observation Port

Observation Port



Infiltration Trenches

- Minimize Compaction During Excavation
- Use Correct Filter Fabric
- Use Clean Washed Stone
- Observation Well
- Stabilize Drainage Area Prior to Discharge to Infiltration Trench
 - Suspended Solids Filter

Stabilize Contributing Area & Provide Suspended Solids Filter



Subsurface Infiltration Systems

Infiltration Galleries



Subsurface Infiltration Systems

Dry Wells



Subsurface Infiltration Systems

Acceptable Vehicle Loads



TABLE 1 – Maximum Allowable Axle Loads for Wheeled Vehicles at Various Cover Depths

Fill Depth (in. over chamber)	Max. Axle Load (lbs)
6	8,000
12	16,000
18 with pavement	32,000
24+ without pavement	32,000

NOTE: 36" of cover over the chambers is required for full dump truck travel and dumping. See instruction number 4 on page 7.

TABLE 2 – Maximum Allowable Ground Pressures for Various Vehicle Track Widths and Fill Depths

Fill Depth (in. over chamber)	Track Width (in.)	Max. Ground Pressure (PSF)*
6	12	1070
	18	900
	24	800
	30	750
12	12	1540
	18	1190
	24	1010
	30	910
18	12	2010
	18	1480
	24	1220
	30	1060
	36	950

* Ground pressure is vehicle operating weight divided by total truck contact area for both tracks. Call StormTech at 1-888-892-2694 or visit www.stormtech.com for examples of allowable tracked vehicles.

Acceptable Geotextiles

TABLE 3 – Some Suitable Geotextiles

Manufacturer	AASHTO M288 Class 2 Non-Woven*	AASHTO M288 Class 1 Woven**
Amoco Fabrics and Fibers (Part of BP)	ProPex 4506, ProPex 4508, ProPex 4551, ProPex 4552, ProPex 4553	ProPex 2006, ProPex 2016, ProPex 2004
Belton Industries	—	Beltech 315 Style 883
Carthage Mills	FX-60HS, FX-80HS	FX-66
Contech Const. Products	C-70NW	—
GSE Lining Technology	NW6, NW8	—
Maccaferri	MacTex MX245, MacTex MX275	—
Mirafi Const. Products	Mirafi 160N, Mirafi 180N	Mirafi 600X, Filterweave 403, Filterweave 404, Geolon HP570, Geolon HP665, Geolon HP770
Pavco - Armanco	NT 3000, NT 4000	TR 4000
SI Geosolutions	Geotex 601, Geotex 601	Geotex 315ST
TNS Advanced Tech.	R 060, R070, R 080, R100	M 403
US Fabrics	US 205NW-C	US 315
Webtec	TeraTex N06, TeraTex N08	TeraTex HD

*AASHTO M288 Class 2 Non-Woven Geotextile Application: 1. Separation layer between angular stone cover and fill to prevent fines intrusion. 2. Filter layer over the chambers of the StormTech Isolator™ Row to prevent fines migration out of row while maintaining adequate hydraulic flows.

**AASHTO M288 Class 1 Woven Geotextile Application: Stabilization layer for the angular stone foundation of the StormTech Isolator™ Row to prevent scouring of the stone base during the JetVac maintenance procedure, modest hydraulic flows maintained.

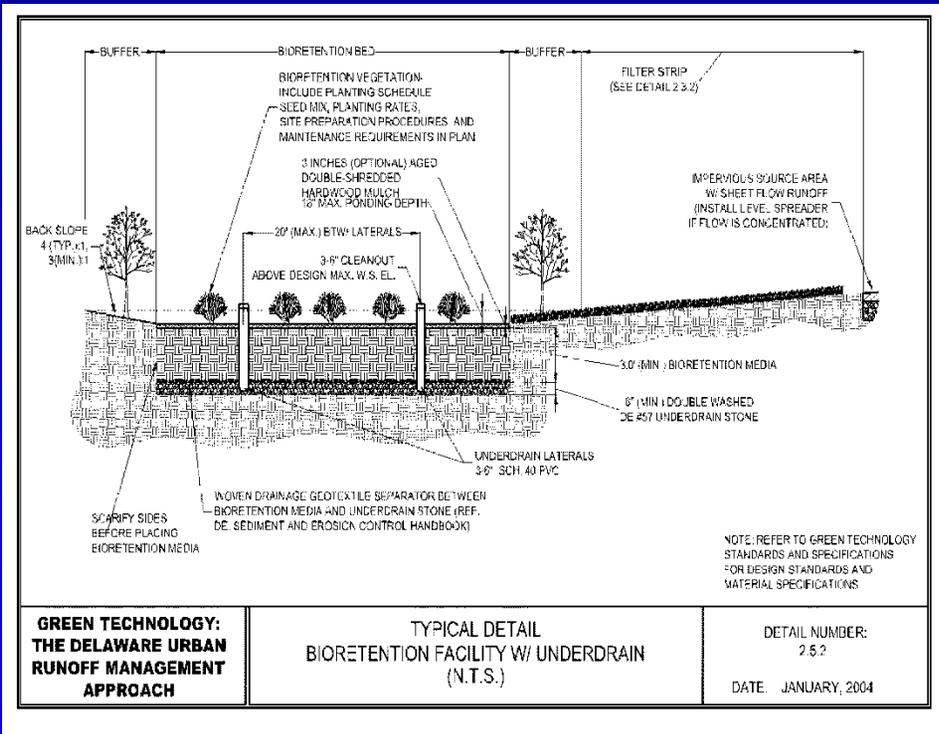
- Follow manufacturer's recommendations!
- Check Sequence of Construction for manufacturer's field review prior to backfilling

Bioretention



Bioretention

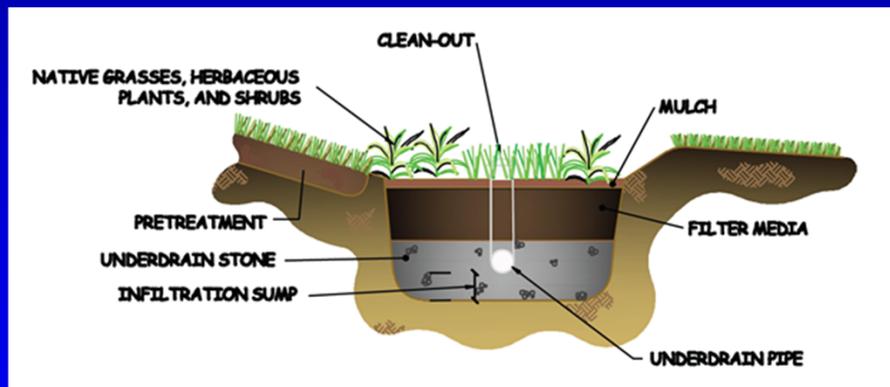
Typical Section (Grandfathered Plans)



- 2"-3" mulch (optional)
- Min. 3' planting soil
- Woven geotextile;
≥ 110 gpm
- Underdrain layer
 - 4"-6" pipe
 - 6"-8" DE #57 double-washed stone

Bioretention

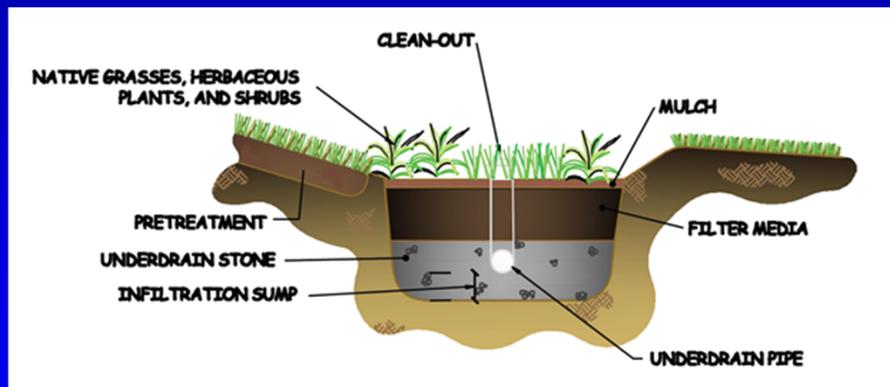
Typical Section *NEW!*



- Underdrain layer
 - 4”-6” **cgp**
 - 2’ ~~DE #57~~ rice gravel (1/4” stone) sump

Bioretention

Typical Section *NEW!*

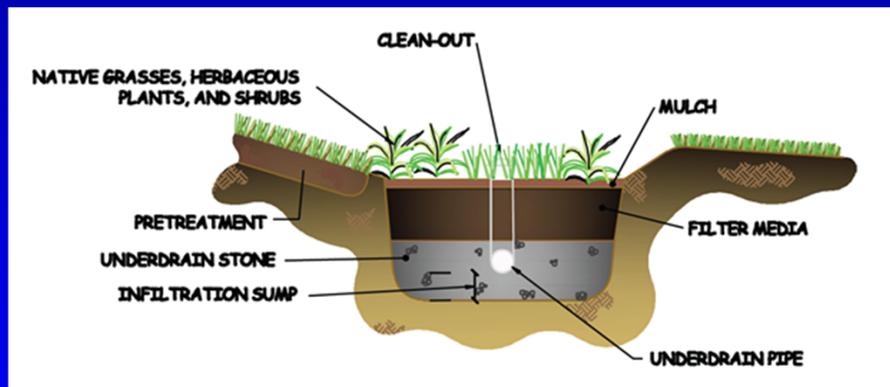


- ~~Woven geotextile;~~
 ~~≥ 110 gpm~~

- Underdrain layer
 - 4”-6” *cpp*
 - 2’ ~~DE #57~~ rice gravel (1/4”) sump

Bioretention

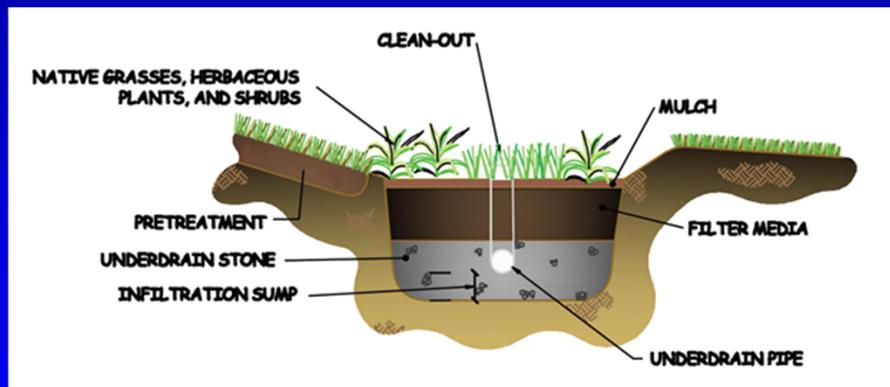
Typical Section *NEW!*



- Min. 3' 2' planting soil
- ~~Woven geotextile;~~
~~≥ 110 gpm~~
- Underdrain layer
 - 4"-6" cpp
 - 2' ~~DE #57~~ rice gravel (1/4") sump

Bioretention

Typical Section *NEW!*



- 2"-3" mulch (*optional*)
- Min. 3' 2' planting soil
- ~~Woven geotextile;~~
~~≥ 110 gpm~~
- Underdrain layer
 - 4"-6" *cpp*
 - 2' ~~DE #57~~ rice gravel (1/4") sump

Bioretention

Material Specifications: Sand



- ASTM C-33 concrete sand
- Clean, washed
- Fineness modulus of 2.75 or greater

Bioretention

Material Specifications: Mulch



- Free of dirt & debris
- Triple shredded hardwood
- Single shredded may be used as top dressing

Bioretention

Material Specifications: Peat Moss



- Virgin sphagnum peat moss
- Typically must be imported from Canada

Bioretention

*Material Specifications: **Compost***



- Yard/Food Waste
- Aged
- **STA Certified**



US Composting
Council

Bioretention

Material Specifications: **Compost**

BMP Standards and Specifications Appendix 3 - Compost Material Properties

Appendix 3. Compost Material Properties

This specification shall apply for all applications where compost is used as or within a stormwater best management practice.

Table 3.1: Compost Material Properties

Parameter	Range	Testing Method
Particle Size	For Amendments: 100% pass through a 1/2" screen For Compost Logs: 99% pass through a 2" screen; max. 40% pass through a 3/8" screen	TMECC 2.02-B
pH	6.0-8.0	TMECC 4.11
Manufactured Inert Material	<1% dry weight basis	TMECC 3.08-A
Organic Matter	35-95% dry weight basis	TMECC 5.07-A
Soluble Salt Concentration	≤ 6.0 mmhos/cm	TMECC 4.10-A
Carbon to Nitrogen Ratio (C:N)	≤ 25:1	
Stability (Carbon Dioxide evolution rate)	≤ 2 C / unit VS / day	TMECC 5.08-B
Maturity (seed emergence and seedling vigor)	>90% relative to positive control	TMECC 5.05-A
Trace Metals	"Pass"	
Dry Bulk Density	12.5-25 lb/cu.ft.	
Moisture content	40-50%	

Compost Specifications

Compost used to fulfill regulatory requirements shall meet the criteria set forth in the separate Specifications for Compost. In addition, it must be provided by a member of the U.S. Composting Seal of Testing Assurance (STA) program.

The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STA Program Compost Technical Data Sheet (See Table 14.3).

03/2013

3.06.2.A-3-1

- Yard/Food Waste
- Aged
- **STA Certified**
- Appendix 3
 - Spec for compost used in **all ESC & SWM practices**

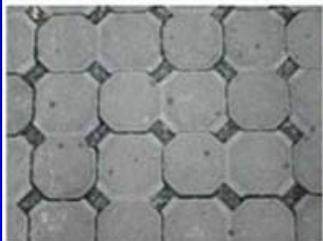
Bioretention

*Material Specifications: Biosoil-14 **NEW!***



- Volumetric quantities
 - **60%** concrete sand
 - **30%** triple shredded hardwood mulch
 - **10% aged, certified compost**
- Drum mixed batch
- DNREC approved supplier

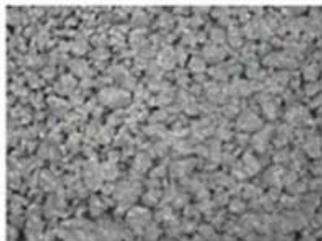
Porous Pavements



Permeable Interlocking Concrete Pavers (PICP)



Concrete Grid Pavers (CGP) "Turfstone"



Porous Concrete (PC)



Porous Asphalt (PA)



Plastic Turf Reinforcing Grids (PTRG)



Flexible Concrete Mat



Concrete Grid Slab



Plastic Geocells

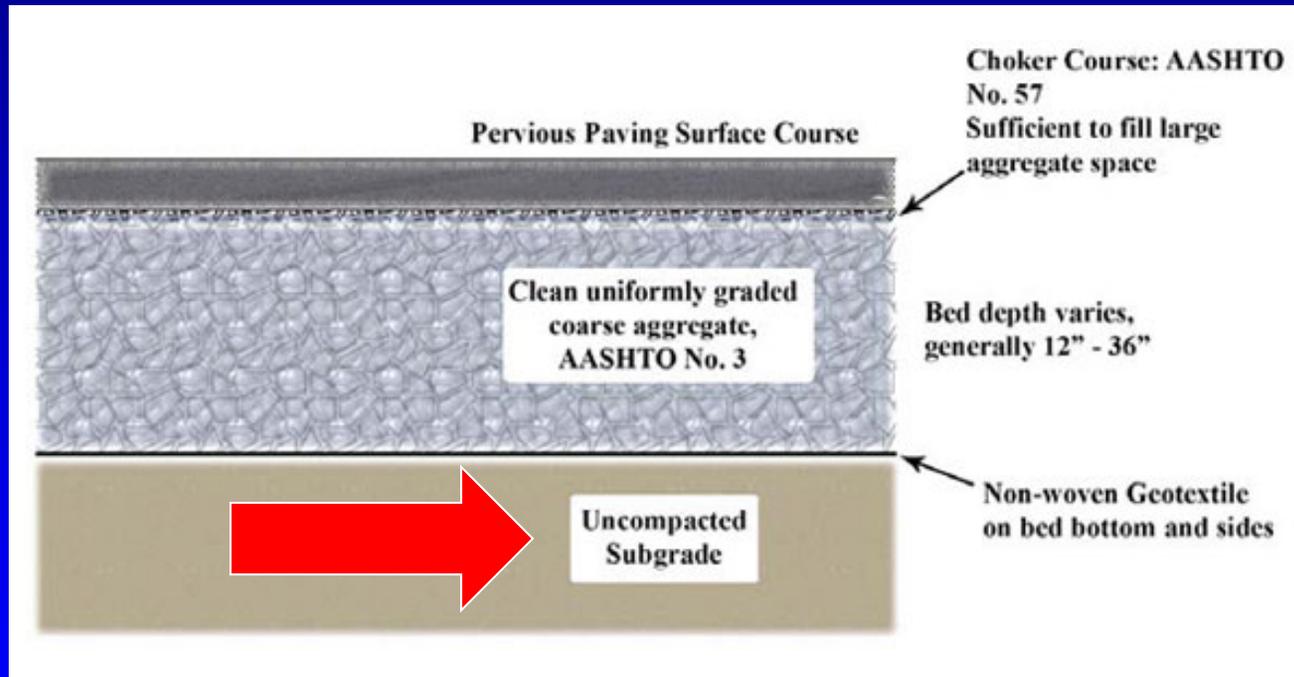


Concrete Grid Paving Units

Porous Pavement

- Low traffic areas
- Good underlying soils
- Open-graded asphalt
 - no fine aggregate
 - 16% voids versus 3-5% voids
- Gravel bedding

Porous Pavement



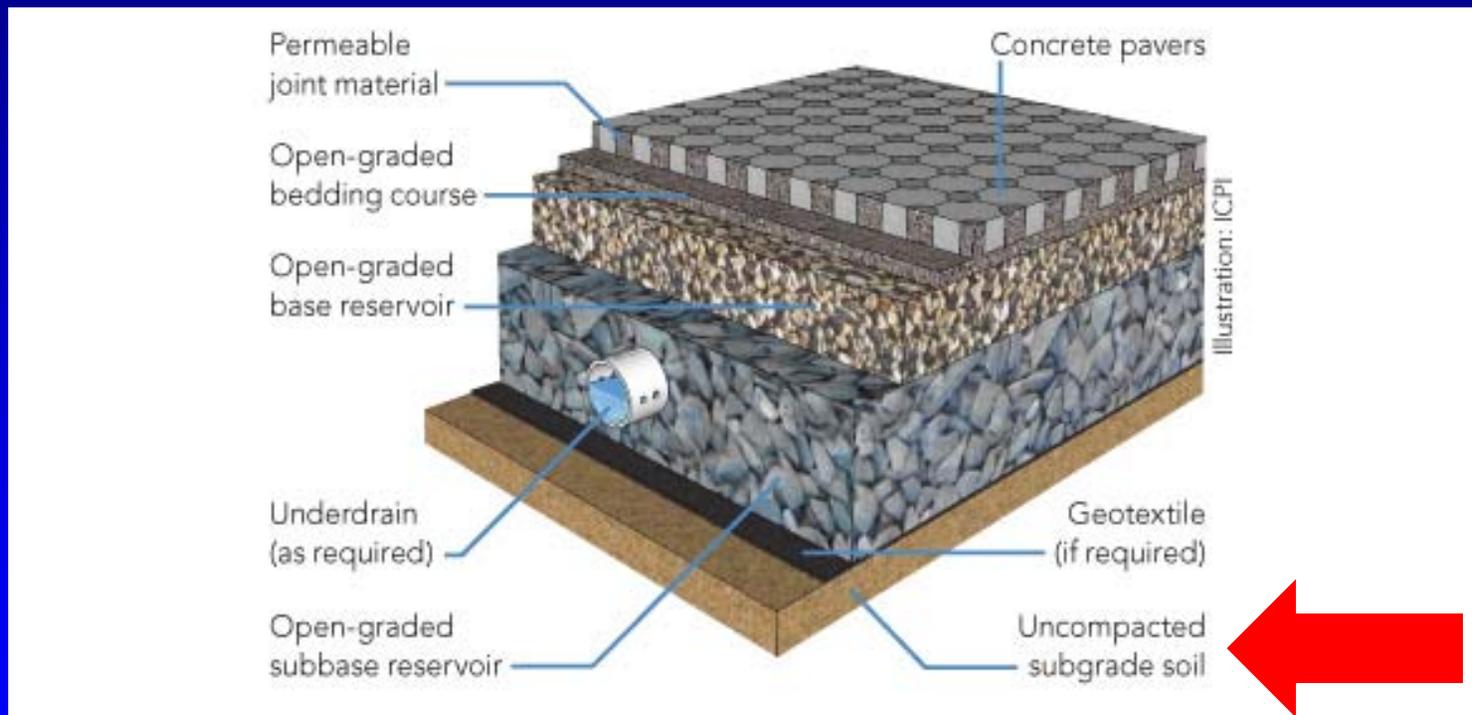
Grotto's Parking Lot Dewey Beach



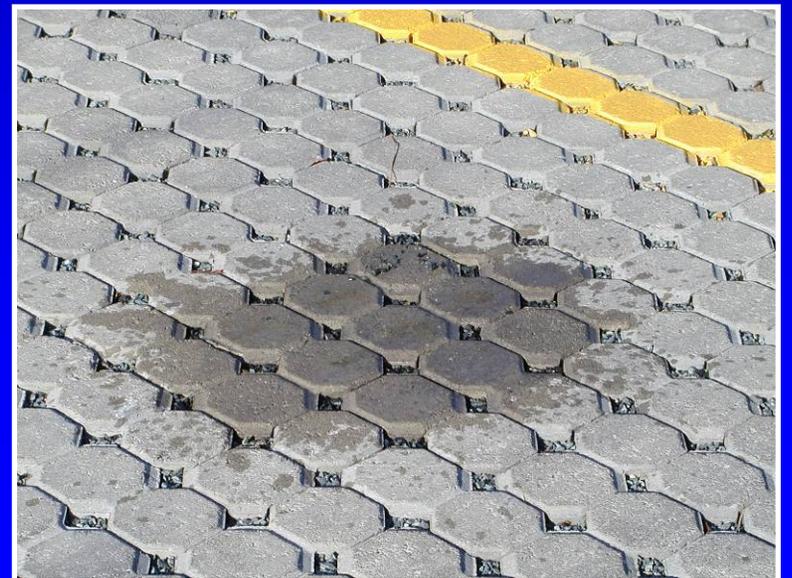
Pavers

- Good underlying soils
- Clean stone base
- Light traffic loadings
 - infrequent use
 - overflow parking

Pavers



Rehoboth Wal-Mart



Maintenance of Porous Pavement

- Divert offsite flows
- Vacuum with street sweeper
 - minimum 4 times per year
- High pressure washing

Infiltration Case Study

Lessons Learned

Infiltration Case Study

Approved Plan

SEQUENCE OF CONSTRUCTION

.
.
CONSTRUCT INITIAL GRADING OF BIORETENTION AREA AND AREA OF INFILTRATION FACILITY 1. TAKE CARE WHEN CONSTRUCTING STORMWATER FACILITIES. STORMWATER FACILITIES MUST **RETAIN A MINIMUM OF TWO (2) FEET OF EXISTING SOIL ABOVE THE BOTTOM ELEVATION** OF THE FACILITY IN ORDER TO BE DRIVEN ON BY STANDARD CONSTRUCTION EQUIPMENT. ONCE THE BOTTOM OF THE FACILITY HAS LESS THAN TWO (2) FEET OF SOIL ABOVE IT, **SPECIALIZED EQUIPMENT OR EXCAVATION METHODS SHALL BE USED AS SPECIFIED ON THE STORMWATER DETAIL SHEETS.....**

SEQUENCE OF CONSTRUCTION FOR INFILTRATION AREA

1. STAKE OUT FACILITY LOCATION. INSTALL SILT FENCE AROUND PERIMETER TO PROTECT FROM HEAVY EQUIPMENT.
2. AFTER ALL AREAS DRAINING TO THE FACILITY HAVE BEEN PERMANENTLY STABILIZED **EXCAVATE THE FACILITY FROM THE SIDES OF THE FACILITY** SO AS NOT TO COMPACT EXISTING SOIL.

Infiltration Case Study

Contractor's Remedy

June 2014









Infiltration Case Study

DNREC Final Inspection

July 2014





07/29/2014



Infiltration Case Study

*Revised Plan Based On
DNREC Recommendations*

November/December 2014

Pond #1



12/01/14



Pond #1

12/05/14

Pond #2



12/01/14



12/05/14

Pond #3



12/01/14



12/05/14



Questions?