In-Situ Soil in Bioretentions

Better, Faster, and More Cost-Effective

SEPTEMBER 3, 2026 1 PM - 3 PM (1-2pm hybrid and 2-3pm in person training)

Conventional bioretention retrofit practices often rely on extensive excavation, soil disposal, bioengineered soil media, and underdrain systems. These components increase project costs, carbon footprint, timelines, and long-term maintenance demands while reducing the water quality and water quantity benefits. In contrast, in-situ bioretention is a way of working with nature in the design and construction of bioretention systems to make them more effective and lower cost. The “In-situ” soil approach reduces construction costs by 50% and maintenance costs by 25 to 40%. Most sites can benefit from using this approach over conventional practices.

You’ll learn when this approach is feasible, the benefits it provides, and how to apply it in your next project.

Thanks for joining!

If you need assistance, use chat or email, Anabel Kadri at akadri@cbtrust.org

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MARYLAND CB TRUST Protect the Chesapeake & Coastal Bays

A BRIDGING COMMUNITY EDMONSTON MARYLAND EST. 1924

ENGINEERS PLANNERS SCIENTISTS ECOSITE, INC. Ecologically Sustainable Design

COASTAL RESOURCES INC. Ecological Consultants

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About the Chesapeake Bay Trust

The Chesapeake Bay Trust is a nonprofit grantmaking organization dedicated to improving the Chesapeake, Coastal Bays, and Youghiogheny watersheds. Our mission is to restore and protect our natural resources by focusing on three core objectives: environmental education, community outreach, and on-the-ground restoration.

Each year, the Trust awards millions of dollars in grants to support healthier local communities and a cleaner environment. We engage more than 250,000 individuals annually who are making a positive impact on our waterways and the natural resources of our region.

We believe that empowering people to take action is the key to protecting forests, streams, rivers, bays, wildlife, and more—right in their own communities.

In-Situ Soil in Bioretentions

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Learning Objectives: This session will explore how working with existing soils and native plants can cut costs and improve stormwater management. You will learn when this approach is feasible, the benefits it provides, and how to apply it in your next project.

Speakers:

Rodney Barnes, Town of Edmonston (Town Manager)
Mike Clar, P.E., Ecosite, Inc. (Principal Engineer and Owner)
Katie Scott, P.E., Coastal Resources, Inc. (Senior Water Resources Engineer)
Host & Emcee – Sadie Drescher, Chesapeake Bay Trust (Vice President of Programs for Restoration)

Edmonston is a Green Community!

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Town Administrator Rod Barnes

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IN-SITU BIORETENTION WORKGROUP DISCUSSION

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Questions to be addressed:

- Eligibility of In-situ approach in Bioretention
- Opportunities for implementation
- Restrictions on use
- Best practices for sharing concept with workshop attendees/grantees
- Risks with the approach

In-situ bioretention facility @ QA Co. BOE

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BACKGROUND

- Bioretention developed in 1993 in PG County, MD (Clar, 1993)
- Has become one of the most widely used BMP in US
- Has become identified as a preferred site practice for green building design and LEEDS certification
- Original concept consists of excavating existing soils and replacing with either natural or artificial “soil media”.
- There are many situations where the existing soils may not need to be totally removed but instead can be augmented in-situ to provide a more sustainable and low cost approach to bioretention

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What is In-situ Bioretention:

- An improved ecologically sustainable approach to bioretention practice
- Reduces construction costs by 50% or more which enables grant funds to build more practices and treat more area
- Provides greater runoff volume control

OBSTACLES TO IN-SITU DESIGN

- Regulatory agencies (State, County, tons) do not have guidance for this practice
- Sadly, I may currently be one of the few practitioners & source of guidance
- In-situ bioretention, based on ecological engineering & landscape ecology, is on the leading front of current technology. This technology is very new and we have much to learn
- 2 approaches:
  1. Many in-situ practices disturb < 5,000 sf and are exempt from SWM control (May still need E&S plan)
  2. Partner with local regulatory agency and create a demo project (i.e, Trust campus & City of Annapolis)

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Eligibility of In-situ approach in Bioretention

TYPES OF BIORETENTION FACILITIES

- Bioretention – stormwater filter (MDE 2000)
- Micro-bioretention – ESD BMP (MDE 2009)
- Landscape Infiltration – ESD BMP (MDE 2009)
- Rain garden? – ESG BMP – (MDE 2009)

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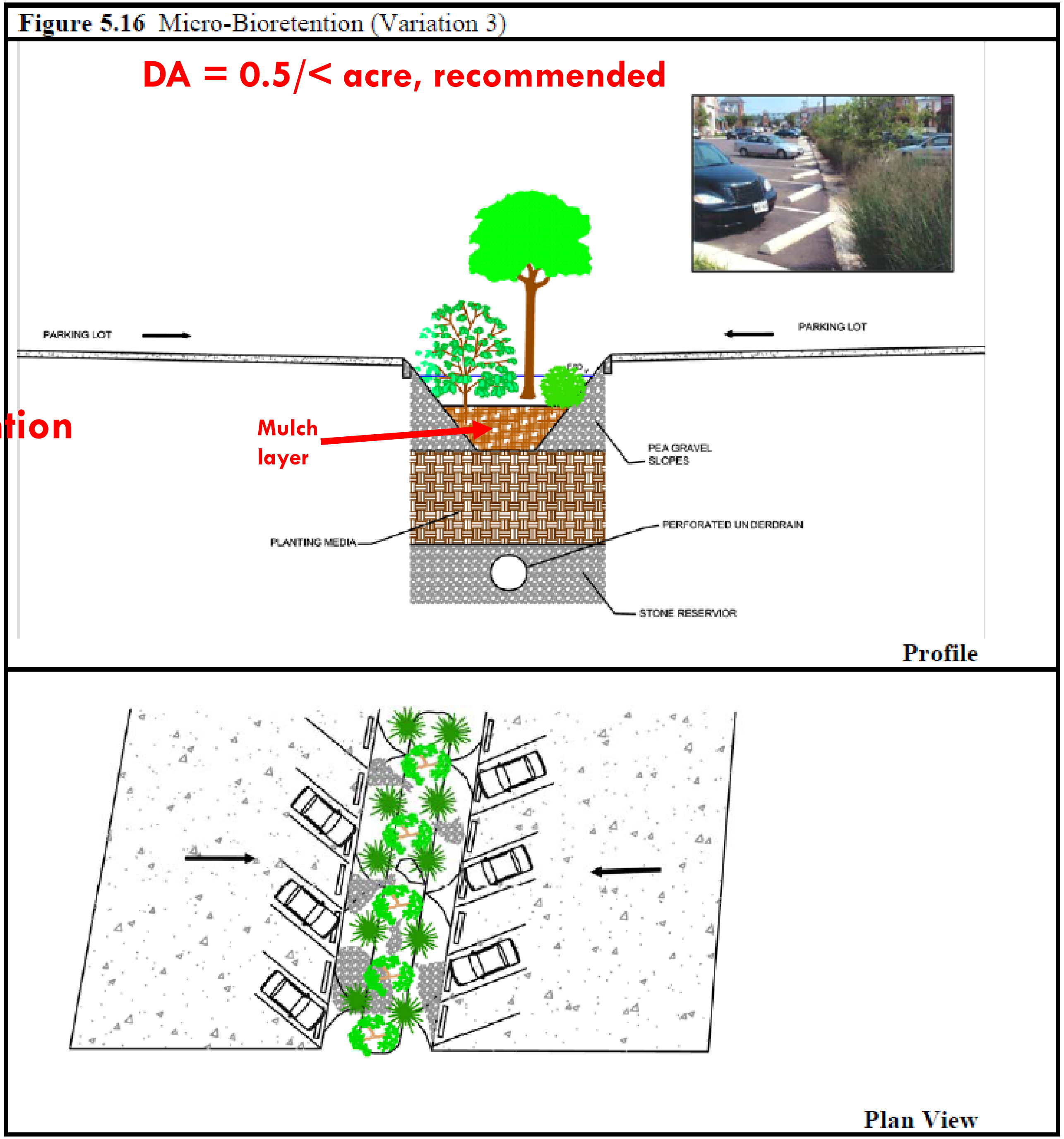
DESIGN GUIDANCE

Design Criteria. In general, the in-situ bioretention facility design must conform to the guidelines provided in MDE 2000 bioretention & MDE 2009 micro-bioretention guidance.

- ❖ Guidance is provided on the following design parameters:
  - allowable ponding depth,
  - minimum width and length parameters,
  - depth and type of soil/filter media,
  - design of bioretention as infiltration practices,
  - selection of appropriate plant material

Micro-bioretention
In-situ most frequently
used with Micro-nioretention



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KEY POINTS

- ✓ ESD practice, allows infiltration, but use of underdrain limits infiltration
- ✓ Limits DA to 0.5 acre (MDE has not provided science basis for this value which appears too limiting. 1 acre is more reasonable)
- ✓ Typically requires excavation & disposal of 4 – 6 ft of existing soil
- ✓ Also requires import of planting media "bioretention planting soil"
- ✓ Recommends use of underdrain which is expensive and makes practice underground detention
- ✓ Also uses geotextiles which tend to clog
- ✓ Introduces use of organic compost (35-40%), but provides no science to back this value which appears too high
- ✓ NOTE: In-situ only requires 10% organic matter by volume, not weight.

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Table B.4.1 Materials Specifications for Micro-Bioretention, Rain Gardens & Landscape Infiltration-

Material	Specification	Size	Notes
Plantings	see Appendix A, Table A.4	n/a	plantings are site-specific
Planting soil [2' to 4' deep]	loamy sand (60 - 65%) & compost (35 – 40%) or sandy loam (30%), coarse sand (30%) & compost (40%)	n/a	USDA soil types loamy sand or sandy loam; clay content < 5%
Organic content	Min. 10% by dry weight (ASTM D 2974)		
Mulch	shredded hardwood		aged 6 months, minimum; no pine or wood chips
Pea gravel diaphragm	pea gravel: ASTM-D-448	NO. 8 OR NO. 9 (1/8" TO 3/8")	
Curtain drain	ornamental stone: washed cobbles	stone: 2" to 5"	
Geotextile		n/a	PE Type 1 nonwoven
Gravel (underdrains and infiltration berms)	AASHTO M-43	NO. 57 OR NO. 6 AGGREGATE (3/8" to 3/4")	
Underdrain piping	F 758, Type PS 28 or AASHTO M-278	4" to 6" rigid schedule 40 PVC or SDR35	Slotted or perforated pipe; 3/8" perf. @ 6" on center, 4 holes per row; minimum of 3" of gravel over pipes; not necessary underneath pipes. Perforated pipe shall be wrapped with ¼-inch galvanized hardware cloth
Poured in place concrete (if required)	MSHA Mix No. 3; f'_c = 3500 psi @ 28 days, normal weight, air-entrained; reinforcing to meet ASTM-615-60	n/a	on-site testing of poured-in-place concrete required: 28 day strength and slump test; all concrete design (cast-in-place or pre-cast) *not using previously approved State or local standards* requires design drawings sealed and approved by a professional structural engineer licensed in the State of Maryland - design to include meeting ACI Code 350.R/89; vertical loading [H-10 or H-20]; allowable horizontal loading (based on soil pressures); and analysis of potential cracking
Sand	AASHTO-M-6 or ASTM-C-33	0.02" to 0.04"	Sand substitutions such as Diabase and Graystone (AASHTO) #10 are not acceptable. No calcium carbonated or dolomitic sand substitutions are acceptable. No "rock dust" can be used for sand.

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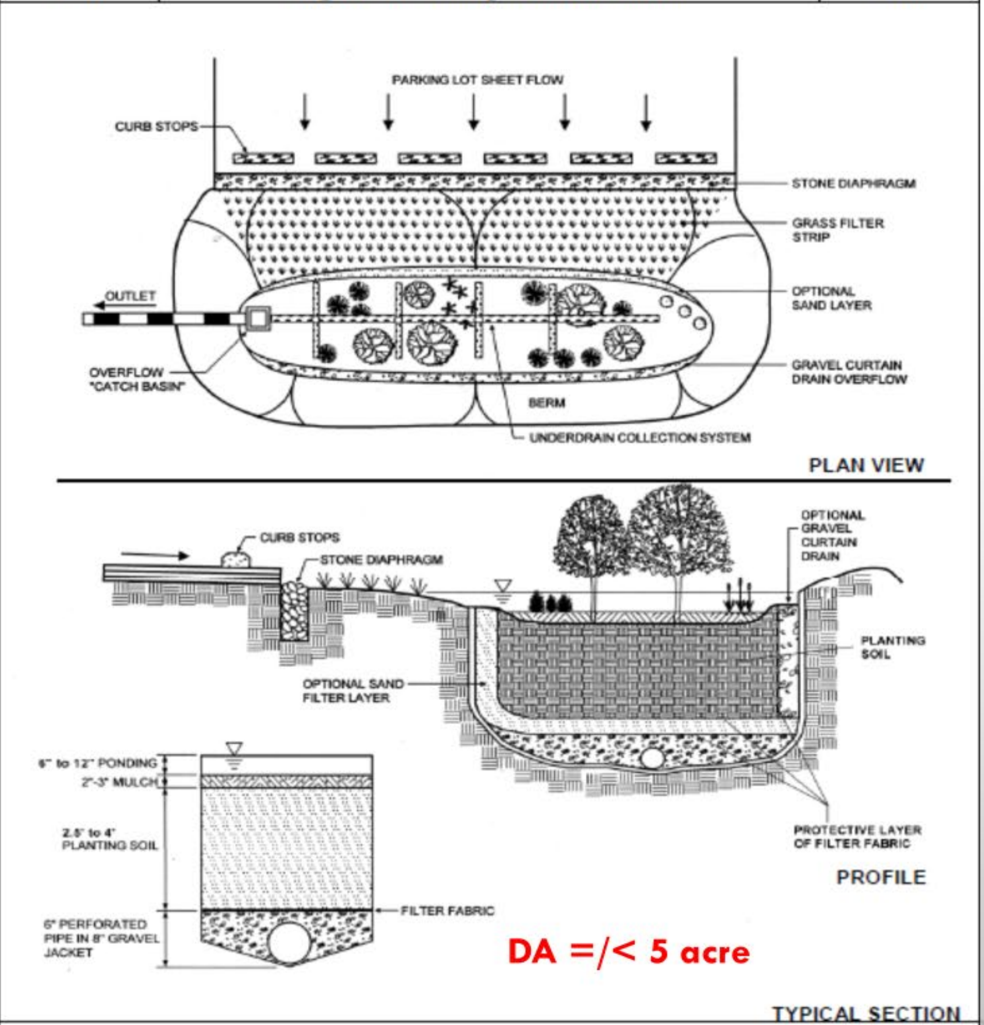
OTHER DESIGN CONSTRAINTS

- ✓ Practice required to capture and store at least 75%of ESDv
  For 0.5ac this value is 1288 c.f.
- ✓ Surface area (Af) must be at least 2% of DA
  For 0.5 ac DA this is 436 sf
- ✓ Surface ponding depth of 12 in or less
- ✓ Media filter depth of 24 to 48 in required.
  The excavation and import of media are major cost items
- ✓ Limiting excavation depth and mixing of organic material may require agency approval
- ✓ If used as infiltration system must be 48 in above groundwater level

Bioretention Stormwater filter (MDE – 2000)

F-6	Figure 3.17 Example of Bioretention	F-6



Bioretention combines open space with stormwater treatment.

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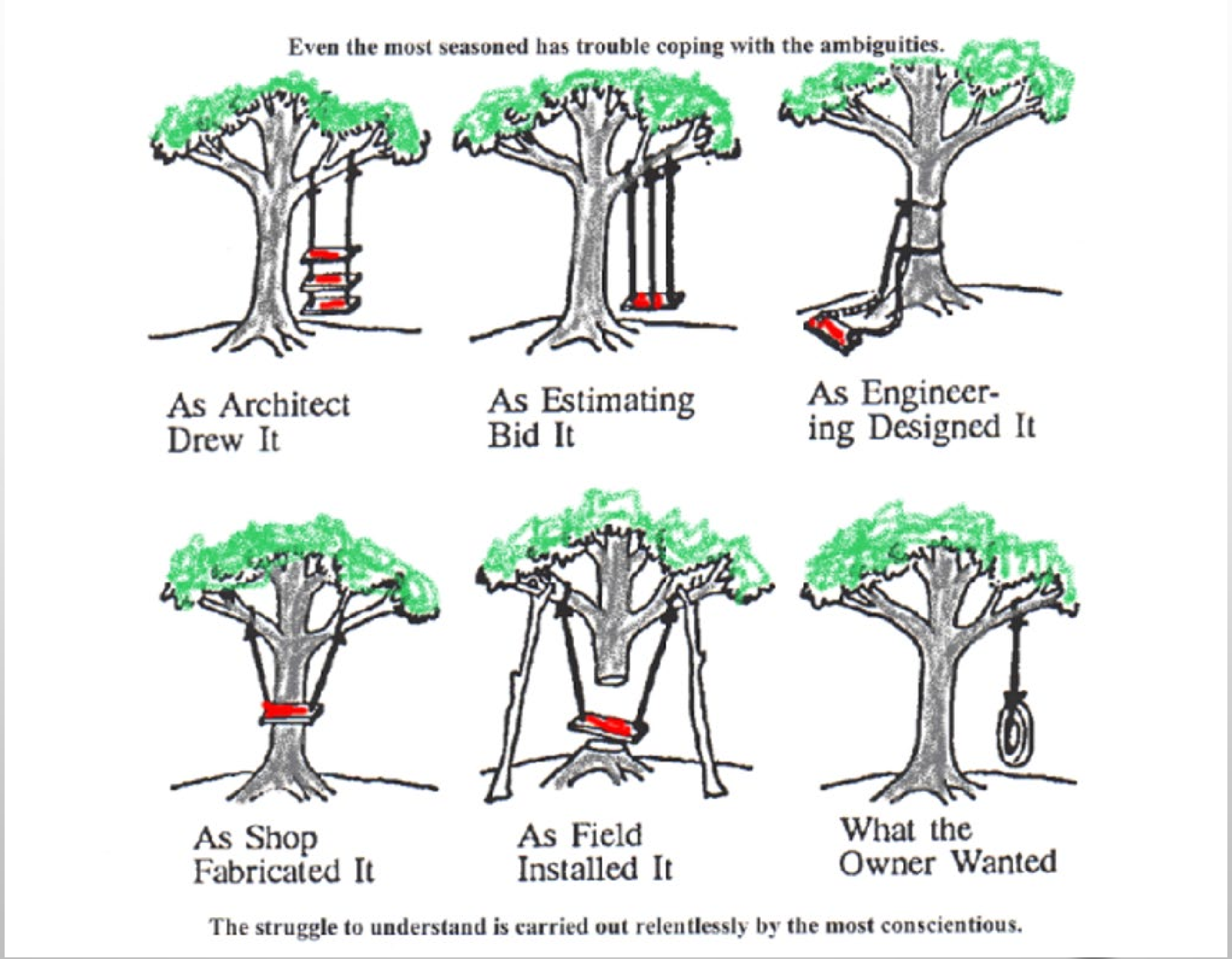

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KEY POINTS

- ✓ Treats practice as a stormwater filter
- ✓ Allows DA of up to 5 acres (MDE has not provided science basis for this value which can be all impervious surface
- ✓ Typically requires excavation & disposal of 4 – 6 ft of existing soil
- ✓ Also requires import of "bioretention planting soil"
- ✓ Does not encourage infiltration
- ✓ Recommends use of underdrain which is expensive and makes practice underground detention

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KEY POINTS

Adequate pretreatment for bioretention systems (F-6) is provided when all of the following are provided:

- (a) 20’ grass filter strip below a level spreader or optional sand filter layer,
- (b)gravel diaphragm and (c) a mulch layer.

Bioretention systems (F-6) shall consist of the following treatment components:

- *A 2½ to 4 foot deep planting soil bed,*
- *a surface mulch layer, and*
- *a 12" deep surface ponding area.*

The required filter bed area (*Af*) is computed using the following equation:

Af = (WQv) (df) / [(*k*) (*hf* + *df*) (*tf*)]

where:

Af = Surface area of filter bed (ft2)

WQv = water quality volume (ft3)

df = filter bed depth (ft)

k = coefficient of permeability of filter media (ft/day)

hf = average height of water above filter bed (ft)

tf = design filter bed drain time (days)*

*1.67 days is recommended maximum for sand filters, 2.0 days for bioretention*foot deep planting soil bed, a surface mulch layer, and a 12" deep surface ponding area.*

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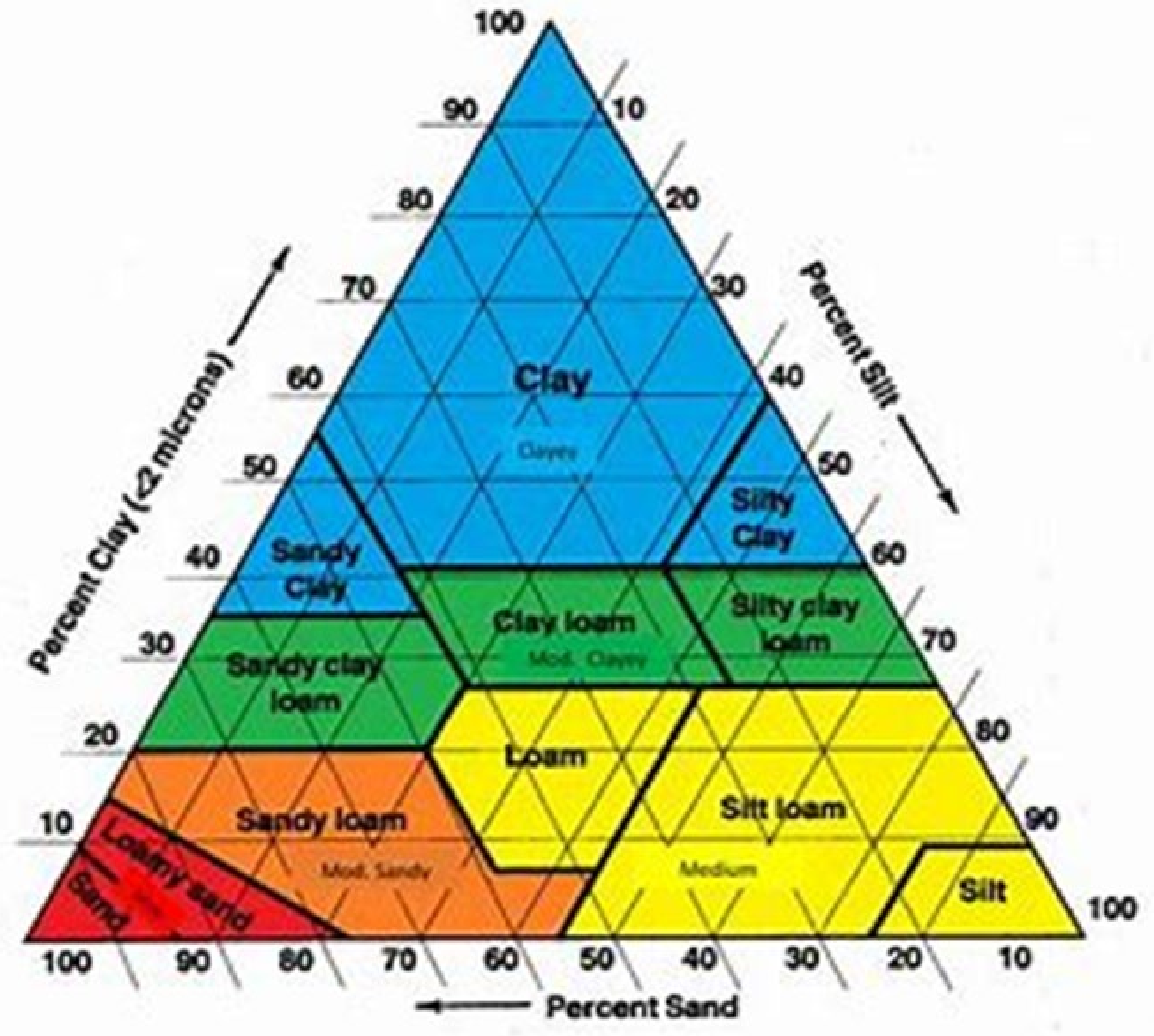
Table B.3.2 Materials Specifications for Bioretention

Material	Specification	Size	Notes
Plantings	see Appendix A, Table A.4	n/a	plantings are site-specific
planting soil [2.5' to 4' deep]	sand 35 - 60% silt 30 - 55% clay 10 - 25%	n/a	USDA soil types loamy sand, sandy loam or loam
mulch	shredded hardwood		aged 6 months, minimum
pea gravel diaphragm and curtain drain	pea gravel: ASTM-D-448 ornamental stone: washed cobbles	pea gravel: No. 6 stone: 2" to 5"	
geotextile	Class "C" - apparent opening size (ASTM-D-4751), grab tensile strength (ASTM-D-4632), puncture resistance (ASTM-D-4833)	n/a	for use as necessary beneath underdrains only
underdrain gravel	AASHTO M-43	0.375" to 0.75"	
underdrain piping	F 758, Type PS 28 or AASHTO M-278	4" to 6" rigid schedule 40 PVC or SDR35	3/8" perf. @ 6" on center, 4 holes per row; minimum of 3" of gravel over pipes; not necessary underneath pipes
poured in place concrete (if required)	MSHA Mix No. 3; f'_c = 3500 psi @ 28 days, normal weight, air-entrained; reinforcing to meet ASTM-615-60	n/a	on-site testing of poured-in-place concrete required: 28 day strength and slump test; all concrete design (cast-in-place or pre-cast) *not using previously approved State or local standards* requires design drawings sealed and approved by a professional structural engineer licensed in the State of Maryland - design to include meeting ACI Code 350.R/89; vertical loading [H-10 or H-20]; allowable horizontal loading (based on soil pressures); and analysis of potential cracking
sand [1' deep]	AASHTO-M-6 or ASTM-C-33	0.02" to 0.04"	Sand substitutions such as Diabase and Graystone #10 are not acceptable. No calcium carbonated or dolomitic sand substitutions are acceptable. No "rock dust" can be used for sand.



Percent Clay (<2 microns)
Percent Silt
Percent Sand
Clay
Clayey
Silty Clay
Sandy Clay
Clay loam
Mod. Clayey
Silty clay loam
Sandy clay loam
Loam
Silt loam
Medium
Silt
Sandy loam
Mod. Sandy
Loamy sand
Sand

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Table 1. Maximum Allowable Ponding and Storage Depths (Inches)

Soil Texture	Hydrologic Soil Group	F* (in/hr)	Max Allowable Ponding Time (hrs)			Max Allowable Storage Time (hrs)			Remarks
			24	48	72	24	48	72	
Sand	A	8.27	198	397	595	496	992	1489	
Loamy Sand	A	2.41	58	116	174	145	290	434	
Sandy Loam	B	1.02	24	49	73	61	122	183	
Loam	B	0.52	13	25	37	31	62	93	
Silt Loam	C	0.27	6	13	19	16	32	49	
Sandy Clay Loam	C	0.17	4	8	12	10	20	31	
Clay Loam	D	0.09	2	4	6	5	11	16	Ponding depth limited
Silty Clay Loam	D	0.06	1.4	3	4	4	7	11	"
Sandy Clay	D	0.05	1.2	2.4	4	3	6	9	"
Silty Clay	D	0.04	0.96	1.92	3	2	6	7	"
Clay	D	0.02	0.48	0.96	1.44	1	2	4	"

F* is the saturated hydraulic conductivity rate as reported by Rawls, Brakensiek and Saxton, 1982 (See Table 2)

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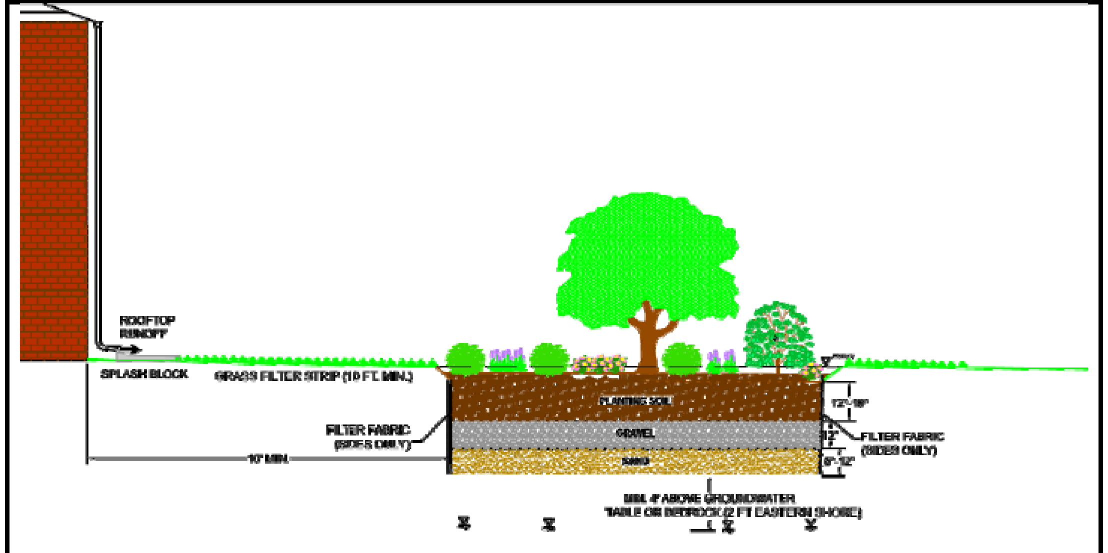
- Landscape Infiltration

Figure 5.11 Landscape Infiltration



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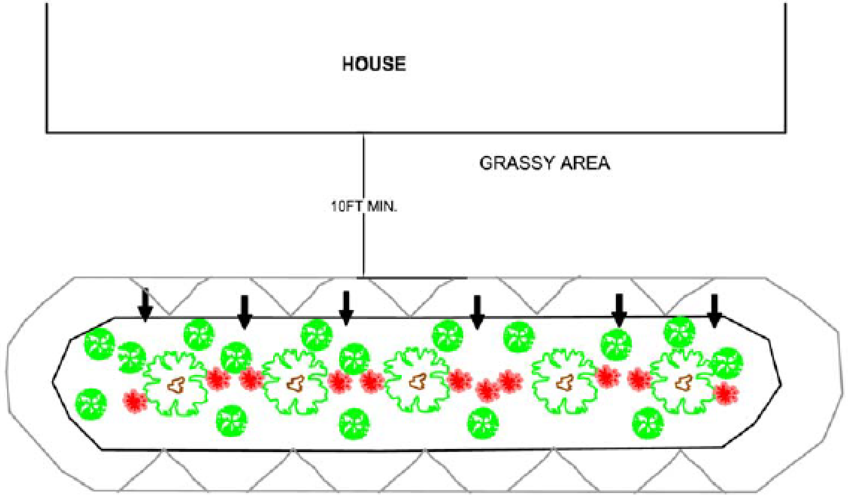

Plan View

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❖ Landscape Infiltration –ESD BMP (MDE 2009) Notes

- Similar to Micro-bioretention
- Recommended for A & B soils
- Encourages infiltration
- Still requires excavation and disposal of approx. 3 feet of exiting soil which is questionable given presence of A & B soils
- Uses Appendix B.4, above, for material specifications for the sand, gravel, and planting soil media.

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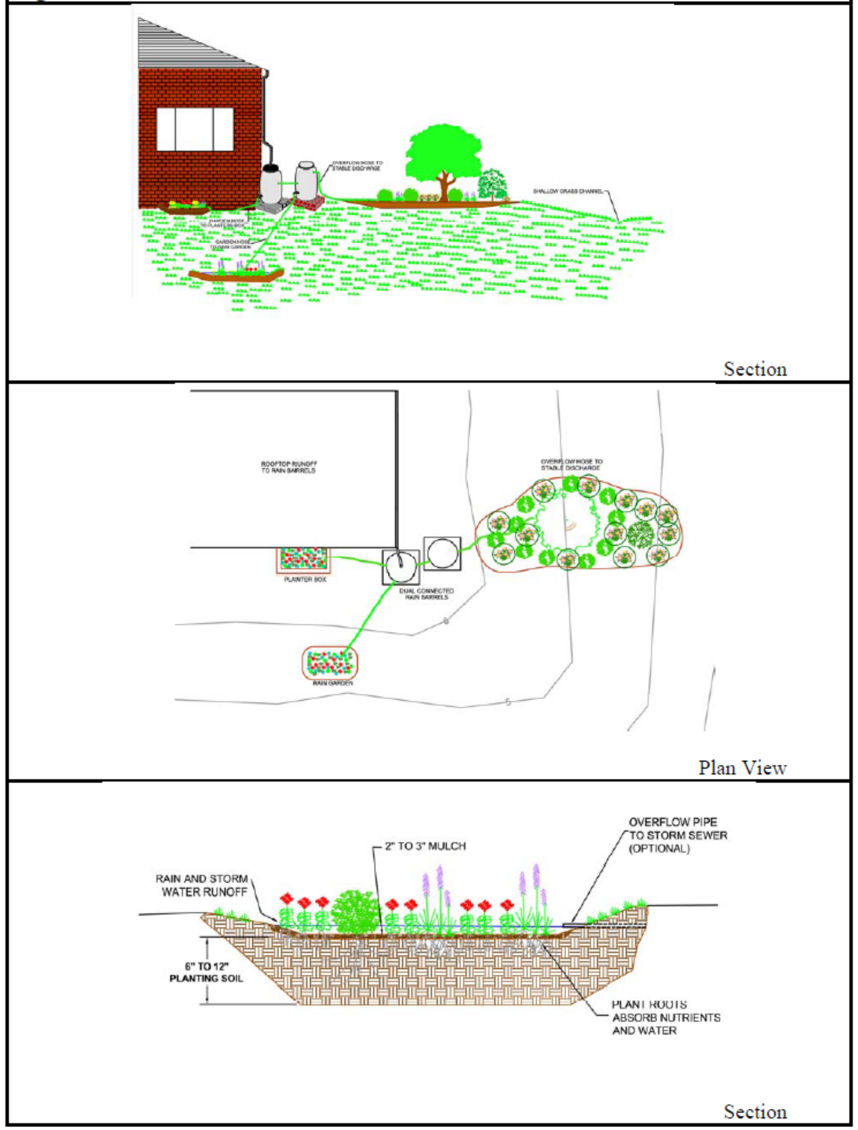
- Rain garden –
- ESD BMP –
- (MDE 2009)

Figure 5.17 Rain Garden



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❖ Rain Garden –ESD BMP (MDE 2009) Specifications

Excavated rain gardens work best where HSG A and B are prevalent. In areas of HSG C and D, at-grade applications or soil amendments should be considered.

- *A minimum six to twelve-inch layer of planting soil shall be provided.*
- *A mulch layer two to three inches deep shall be applied to the planting soil to maintain soil moisture and to prevent premature clogging.*
- *The planting soil and mulch shall conform to the specifications found in Appendix B.4.*

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In-Situ Variance with Traditional Bioretention

- Main variance is depth and type of soil/filter media
- MDE is aware of the In-situ approach but has not yet provided formal approval
- Best approach is to meet with local permitting agency and request permission to use as a demonstration project
- Many local permitting agency are interested in supporting improved design approaches.
- CBT campus design can be used as a reference

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GOUIN IN-SITU APPROACH

- The porosity of compacted soils and clay soils can be improved considerably by incorporating organic matter deeply into the soil.
- Soil compaction is often the primary cause of plant failures in landscapes. The roots of plants cannot penetrate soils with greater than 85% compaction. Thus, if roots cannot grow, plants cannot survive and thrive.
- The best source of organic matter is mature compost. Mature compost is not only rich in plant nutrients and humic acid but contains high concentration of lignins which resist decomposition.
- Because the nutrients exist as organics, the bodies of micro-organisms, they are released slowly through a process known as mineralization.
- The humic and fulvic acids in the compost assist in granulating clay particles while the lignins in the compost reduce the bulk density of soils and have a wicking action on gravitational and capillary waters.

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GOUIN IN-SITU APPROACH

METHOD

- First, test soil to determine if liming materials are needed to adjust the pH and to provide additional calcium
- The liming materials are applied first followed by an equivalent of 50 dry tons of mature compost per acre over the area to be treated.
- Fifty dry tons is equivalent to approximately 4 cubic yards per 1,000 sq. ft.
- The soil should not be tilled unless it is dry
- The amendments should be rototilled into the soil as deeply as possible, a minimum of six inches. Immediately following tilling, sub-soil using a chisel sub-soiler adjusted to penetrate the soil a minimum of (14") or deeper.
- Sub-soil at (18" - 20") intervals traveling across the slope. Next sub-soil up and down the slope at the same depth and spacing.
- Next apply 25 dry tons of compost per acre, (2 c.y. per 1,000 sq. ft.) over the sub-soiled area and rototill again in preparation for planting.

DESIGN QUESTIONS

- What to do if a site contains good natural soils such as those included in the specifications.
- Situation where we are excavating and removing perfectly good natural soils such as sand loams, loamy sands or loams and replacing these soils with manufactured media is in conflict with sustainability criteria
- In these situations recommend using in-situ bioretention design approach which consists of excavating the bioretention site area for the required ponding depth, mixing 3-4 inches of well-aged organic material such as composted leaf mulch, or double shredded pine fines, and planting the vegetation.
- This approach will meet the new design objective of simplicity of design, high life cycle and low construction and maintenance costs. (i.e. ecological engineering & landscape ecology)

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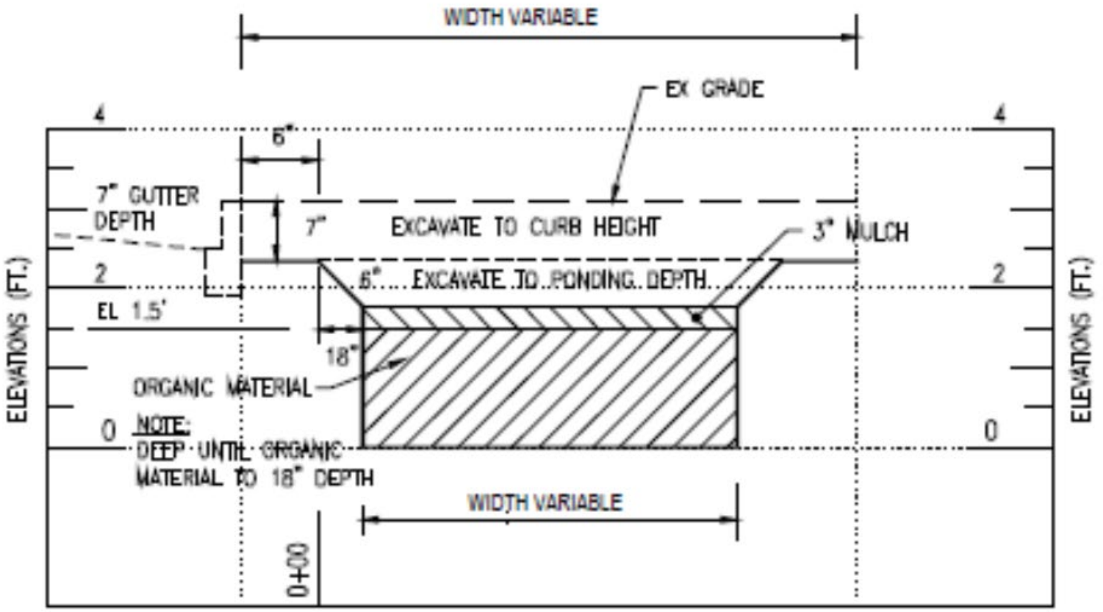
In-situ Design Method

- Surface ponding depth of 6 inches or less.
- Allow 3” for organic material
- Allow 3-6 “ for soil expansion
- Deep tilm 18 – 24” depth

Rain garden should be located in full to partial sun, at least two feet above the seasonal high water table and be 12 - 18 inches deep.



TYPICAL RAIN GARDEN (FLOW THROUGH)

NO UNDER DRAIN

SCALEHORIZ. 1" = 2'
VERT. 1" = 2'

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DESIGN QUESTIONS

- Are there soils that are not suited for In-situ?
- Still developing this data, but so far these soil types have been identified;
  - Hydric soils with high water tables (use wetland BMPs)
  - Heavy clays subject to slippage failure
    - Marlboro clay
    - Christiana clay
    - Howell clay
  - Sallow soils underlain by rock
  - Soils contaminated with toxics

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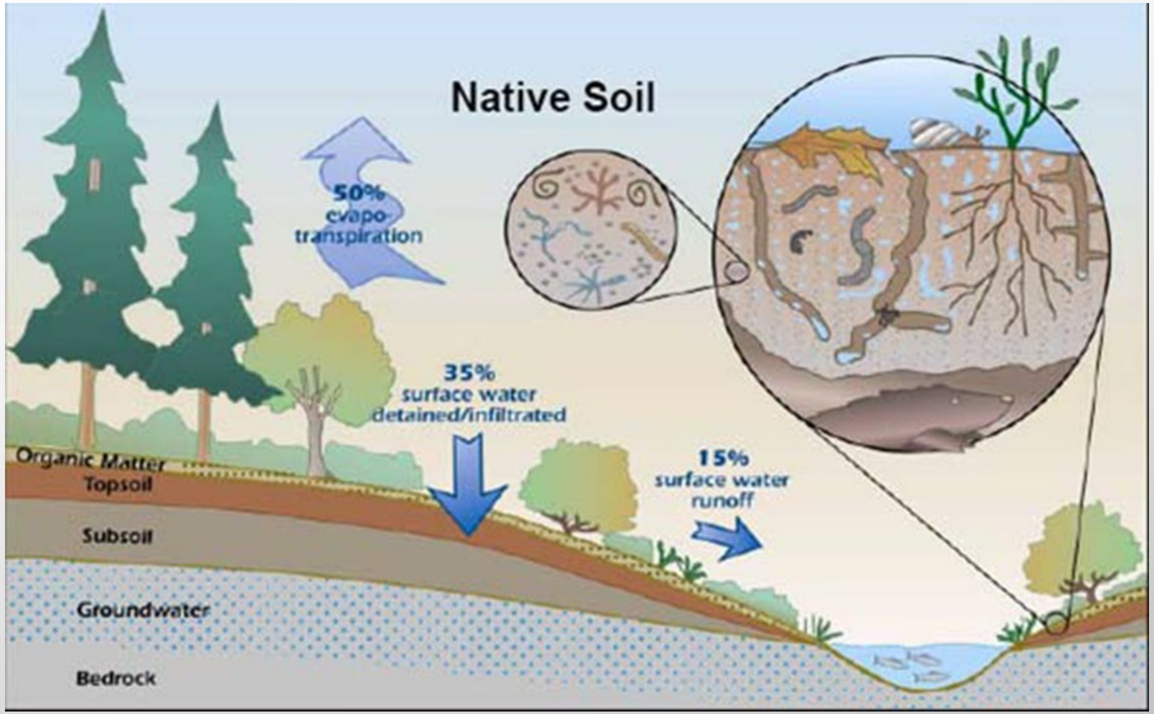
Why Use In-situ Bioretention:

- Use Ecological engineering & Landscape Ecology principles
- Provide high rates of water infiltration and retention
- Minimize surface water runoff and erosion
- Trap sediments, heavy metals and excess nutrients, and biodegrade chemical contaminants
- Encourage vigorous protective vegetative cover
- Support beneficial soil life that fight pests and disease and supply plant nutrients, reducing need for fertilizers and pesticides that may contaminate receiving waters



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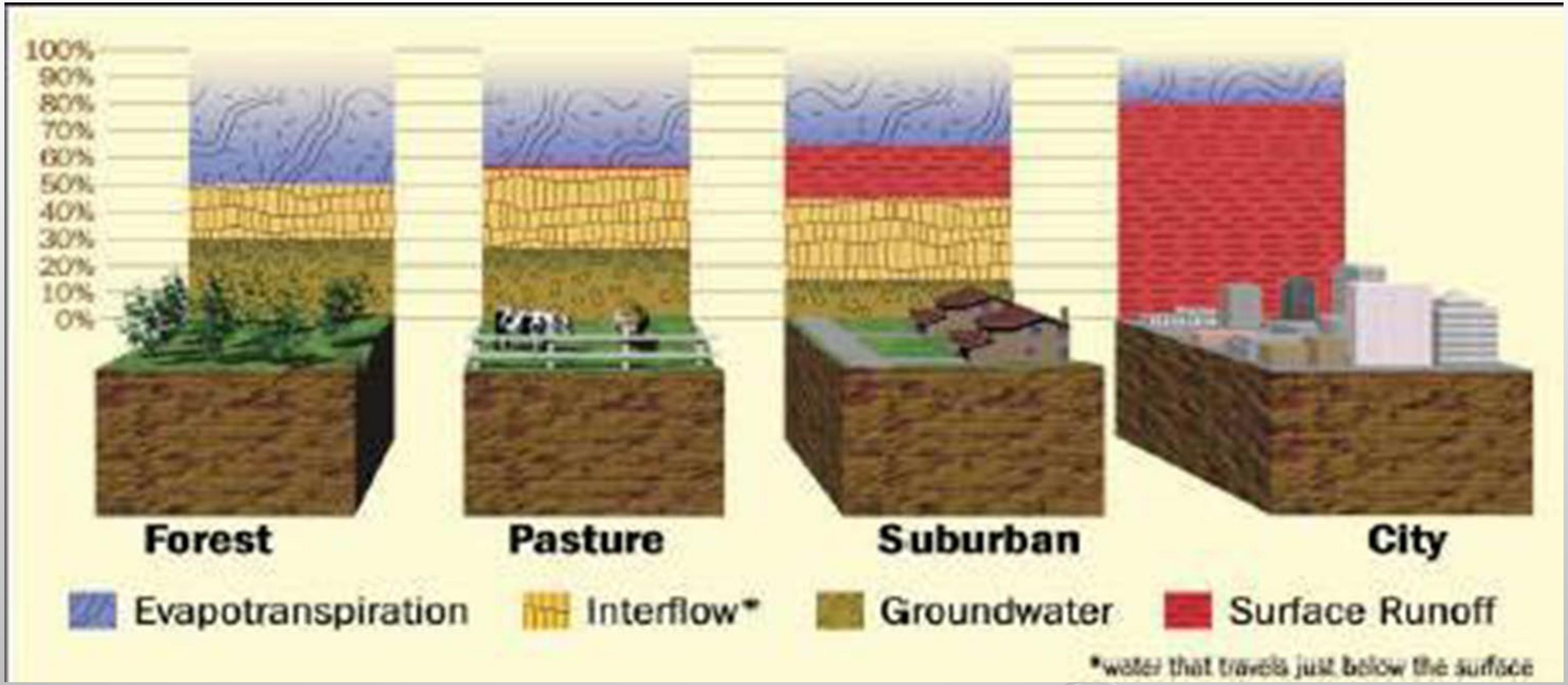
How to get suburban and city sites to function like a forested soil



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- Ayres (2009) reported that measured F rates at sites (10), greatly exceeded (> 3x) the F rate expected based on soil texture alone (Rawls,1982), presumably because of biological activity in the soil which maintains soil structure infiltration rate

- Additional field testing required to verify

- How can we use this knowledge to improve design and ease restrictions on soil types

Note: Site BP with F rate of 0.2"/hr

Table 2: Measured vs predicted infiltration rates at bioretention cells measured by Ayers (2009)

Site name	Soil	Predicted infiltration rate based on Rawls et al 1982 (inches per hour)	Measured infiltration rate (inches per hour)	Age at time of measuring infiltration rate
BP	53% sand, 23.5 % silt, 23.4% clay	0.2	3.15	7 years
NWHS	51.4% sand, 34.2 % silt, 14.4% clay	0.6	2.165	5 years
LRH	46.4% sand, 33.3% silt, 20.3% clay	0.5	3.15	10 years

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DESIGN GUIDANCE

Frequent design Modifications (Bells & Whistles)

- under-drains,
- manufactured filter media (Bioretention soils),
- chimney drains,
- various combinations of gravel jackets.

❖ Some of these modifications are worthwhile while others have the potential to undermine the intent of the original design.

❖ In many instances these bells and whistles add substantially to either the material or construction cost and become a roadblock to the use of these practices

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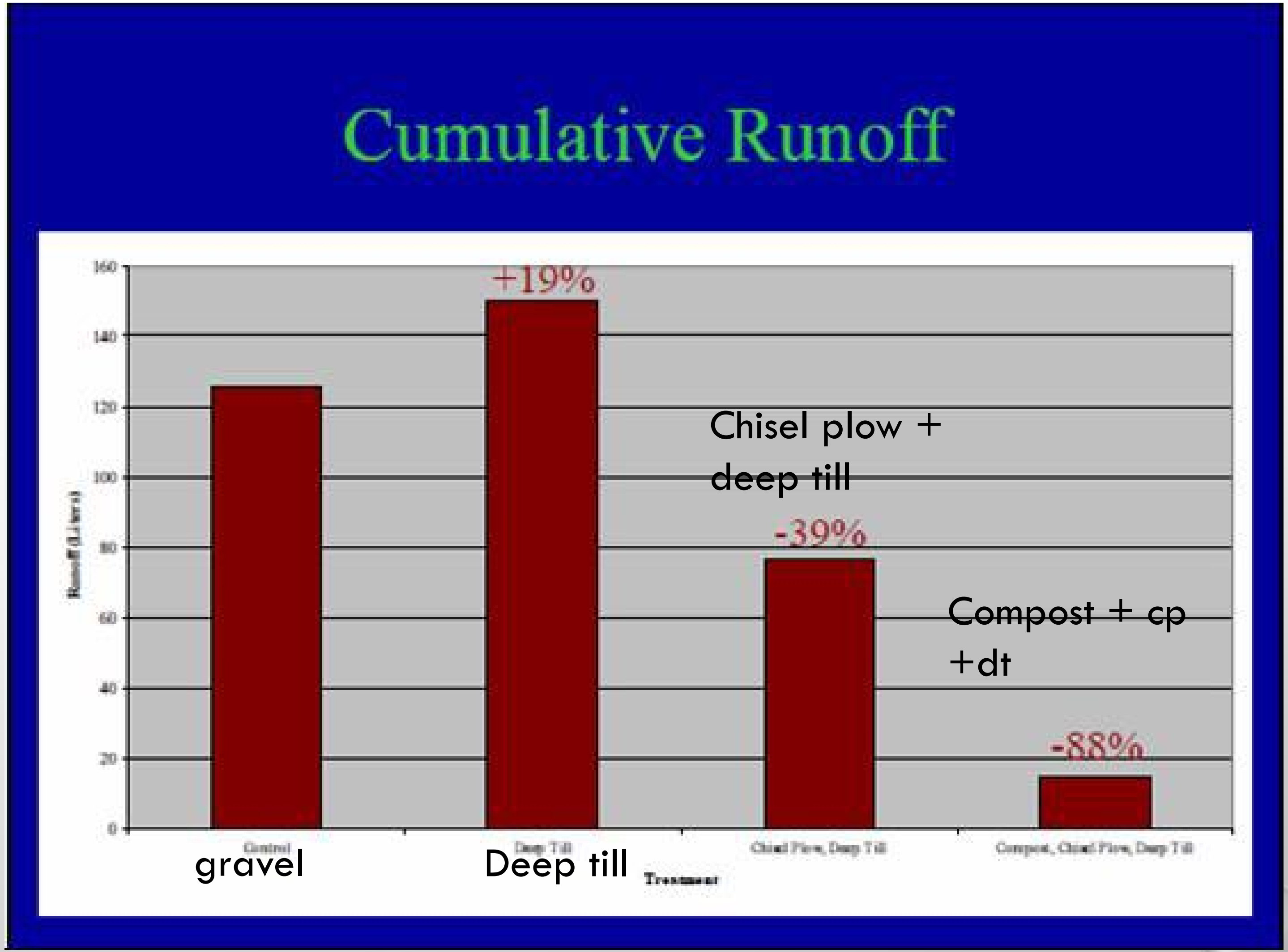
DESIGN QUESTIONS

- ❖ Moderately and Poorly Drained Soils.
  - What do we do on sites with moderately or poorly drained soils?
  - Do we excavate and replace with engineered bio-soils?
- ❖ Recent research such as illustrated in Figure 1 (Balousek, 2003) indicates that the infiltration properties of soils can be improved through physical treatment (i.e., ripping and soil chiseling), addition of organic materials and addition of native plant materials.
- ❖ Professor Frank Gouin, Dean, School of Horticulture, UMD gave us the approach to use.

- **Ongoing research such as illustrated in Figure 1 (Balousek, 2003) indicates that the infiltration properties of soils can be improved through physical treatment (i.e., ripping and soil chiseling), addition of organic materials and addition of native plant materials.**



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DESIGN CRITERIA:INFILTRATION RATES

- **Permeable Soils:**
  Native soils with K values =/> 0.52 "/hr, use field measured value (Note: Could improve)

- **Low Permeability Soils &Clays**
  When Gouin in-situ method is used, use default value of 0.52"/hr (Note: Also could improve)

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Determining Infiltration Rate

- Regulatory agencies typically establish infiltration testing methods
- Single ring and double ring test methods are most common
- For in-situ design, a mini-infiltrometer test is rapid and inexpensive (i.e. Turf-Tec International)

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TURF-TEC INTERNATIONAL INFILTRATION RINGS MONITORING RECORD

PERMEABLE ROAD PAVEMENT

PLACE: EDMONSTON, 47th AVE DATE: August 13, 2024
TIME: 11:15 am, 80^ EXACT LOCATION: 5202 47th AVE

Soil Type – SANDY Silt loam

PENETROMETER (COMPACTION) READINGS: ( ) %

MOISTURE SENSOR READINGS AT DIFFERENT LEVELS
MOISTURE AT 1" INCH LEVEL : ( ) % MOISTURE AT 2" INCH LEVEL : ( ) %
MOISTURE AT 3" INCH LEVEL : ( ) % MOISTURE AT 4" INCH LEVEL : ( )%

INFILTRATION RATE INFILTRATION RATE ACTUAL	CALCULATED
1 MINUTE : (0.07) INCHES X 60	= (4.2) INCHES PER HOUR
5 MINUTES : (0.1) INCHES X12	= (1.2) INCHES PER HOUR
15 MINUTES : (0.2) INCHES X 4	= (0.80) INCHES PER HOUR
30 MINUTES : (0.4) INCHES X 2	= (0.80) INCHES PER HOUR
60 MINUTES : (0.7) INCHES X 1	= (0.7) INCHES PER HOUR

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LANDSCAPING & PLANT MATERIALS

Landscaping Criteria. Landscaping is critical to the performance and function of an in-situ bioretention area; key planting parameters are summarized below.

- Dense vegetation (100% coverage)
- Native plant species a must.
- Vegetation should be selected based on hydric tolerance.
- Deep rooted native grasses a must
- A healthy mix of native perennials, minimum 3-species.
- A mixture of trees & or hardy shrubs & herbaceous materials recommended
- Signage must be provided identifying the facility to the public.

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LANDSCAPING & PLANT MATERIALS

- Many bioretention practices are placed in roadside urban areas which present very stressful conditions for plant materials
- We have very little data on which plants do best
- I would like to encourage joint research between CBT, MDE and UMD on plant performance
- Great research project for grad LA students

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MONITORING & MAINTENANCE

❖ Maintenance and Monitoring Criteria. In general the inspection guidelines for in-situ bioretention facilities provided in MDE manuals (200, 2007) should be followed. Key parameters and other unique criteria are summarized below.

- Inspect plants and structural components periodically (at least annually).
- Grasses shall be cut back in the spring before the emergence of new growth.
- Dead or diseased plant material shall be replaced.
- Remove sediment and clear debris from points of inflow.
- Replacement of mulch is not required where dense plant growth exists.
- Provide visual monitoring reports, from a registered professional, of the in-situ bioretention system semi-annually for 3-years.

NOTE: Document plants that have survived and thrive

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O & M PRACTICES

- Due to simplicity of design, in-situ practices have minimal O&M requirements and lower costs

MAINTENANCE SCHEDULE FOR RAIN GARDEN AREAS

DESCRIPTION	METHOD	FREQUENCY	TIME OF YEAR
SOIL Inspect and Repair Erosion	Visual	Annually until plant materials provide stable cover	Spring and Fall
ORGANIC LAYER Remulch as needed until plants provide adequate ground cover	By hand	Annually until plant materials provide stable cover	Spring
PLANTS Removal and replacement of all dead and diseased vegetation considered beyond treatment	See planting specifications Mechanical or by hand	Twice a year	Mar. 15 – Apr. 30 and Oct. 1 –Nov. 30 Varies; Depends on insect or disease infestation
Watering of plant material shall take place at the end of each day for fourteeen consecutive days after planting has been completed	By hand	Immediately after project completion	Whenever needed
Replace stakes after one year	By hand	Once a year	Only remove stakes in spring

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COST BENEFITS

- In-situ construction & O&M costs are approximately 25-40% of conventional bioretention costs
- Excavation and soil disposal: 2 feet —instead of 5 feet (60% reduction)
- Eliminate need to bring in man-made bioretention soils ($100/cy)
- Generally eliminate need for stone reservoir and under drains

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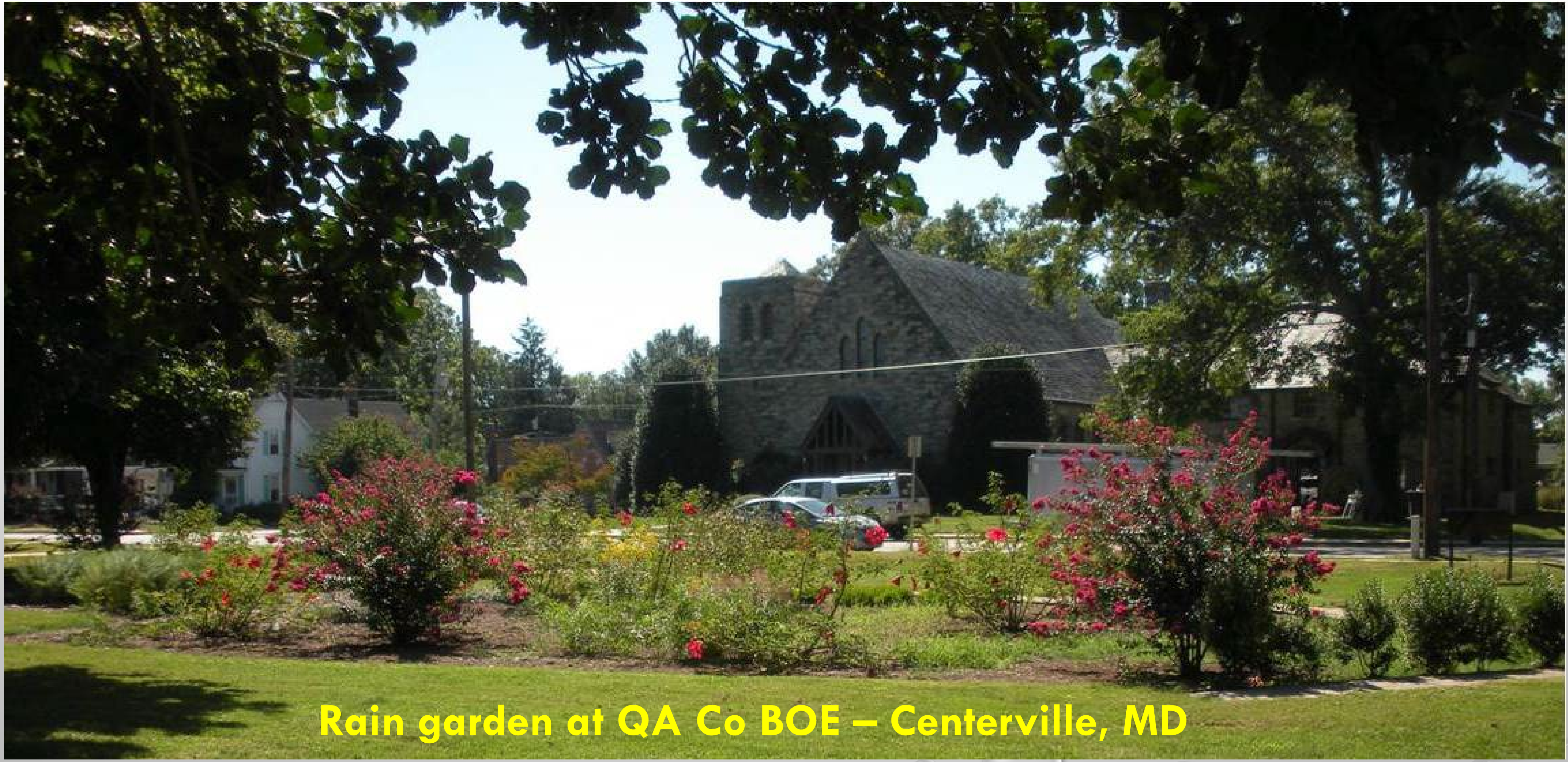

Rain garden at QA Co BOE – Centerville, MD

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❖ REFERENCES

Balousek, 2003
Clar, 1993
Clar, McCuen, 1983
Rawls, 1982
Ayres (2009
Gouin
MDE 200, 2005
Davis

In-Situ Rain Gardens

- Presented by Katie Scott, PE from Coastal Resources Inc.
- At Chesapeake Bay Trust campus in Eastport, MD

COASTAL RESOURCES INC.

- Annapolis, MD based, small, woman owned certified MBE/DBE environmental consulting firm
- 45 years experience providing environmental and engineering services to local and state agencies
- CRI has some of the most experienced environmental professionals in the area

Stormwater Management

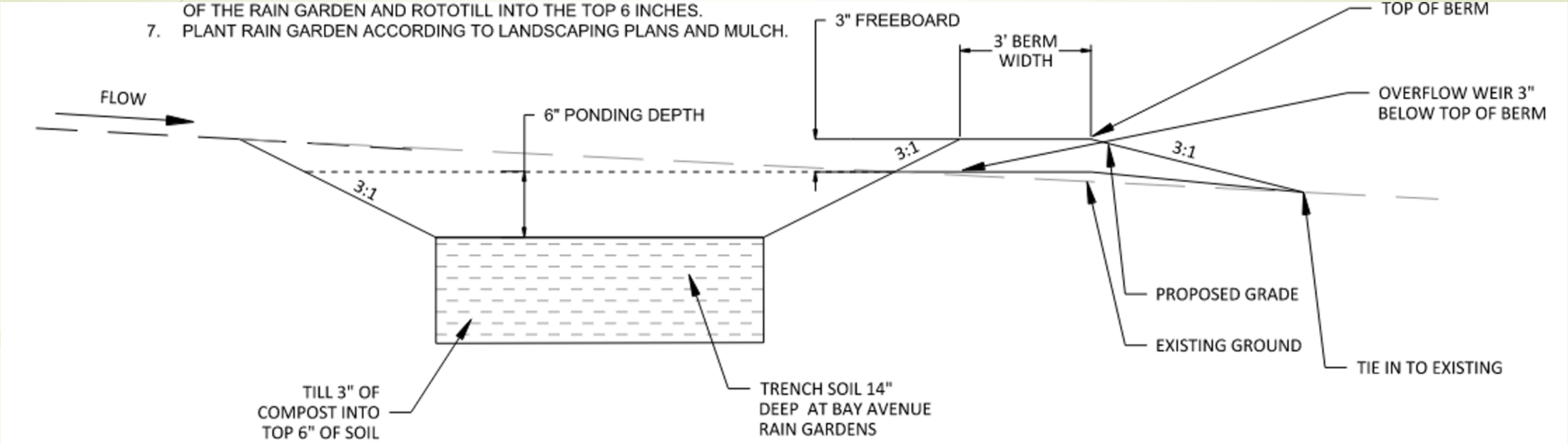
Overall Goal

- Capture stormwater where it falls rather than allow it to concentrate and cause erosion downstream.
- Solution: simplify the construction and maintenance to reduce costs

MDE Rain Garden Requirements

- Drainage area < 10,000 sf
- Soils: HSG A and B or if infiltration rate is > 1.02 in/hr
- Trenching 14" soil with 3" compost and lime and then adding 2" mulch on top should count as providing planting soil
- Minimum 6-12 in. planting soil can be provided with the native 'in-situ' soil on site.

In-Situ Rain Garden Detail

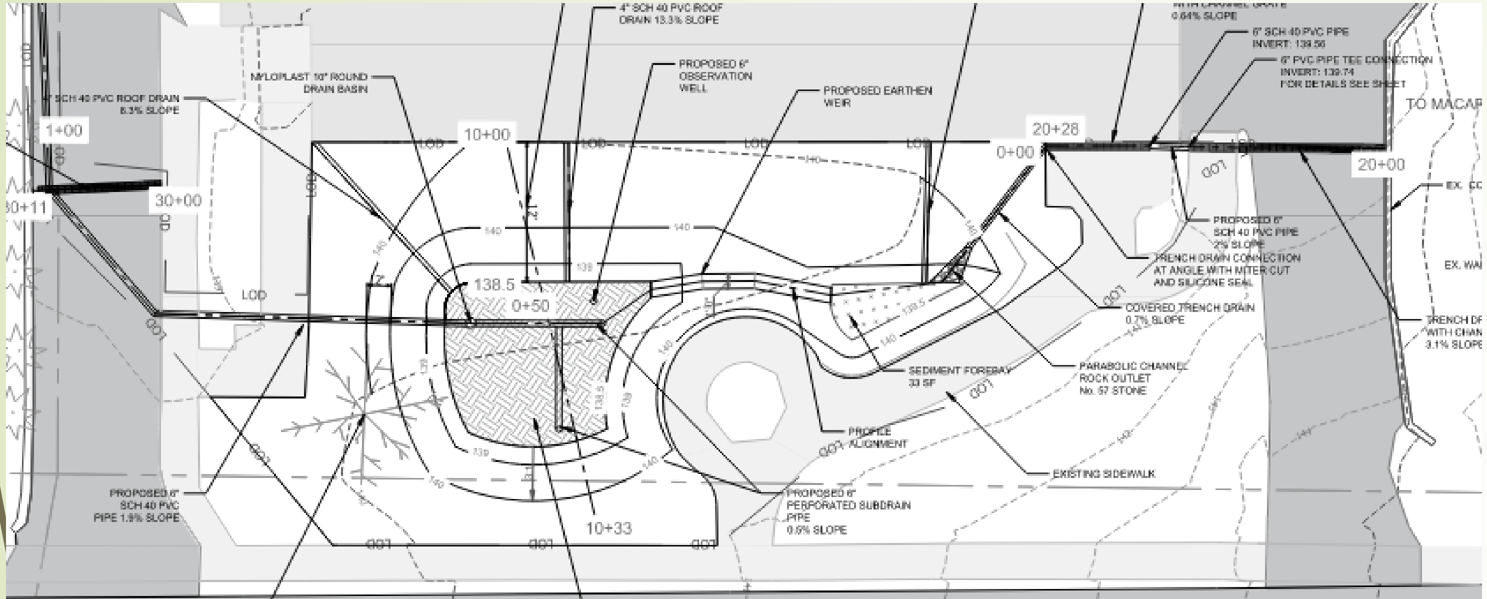


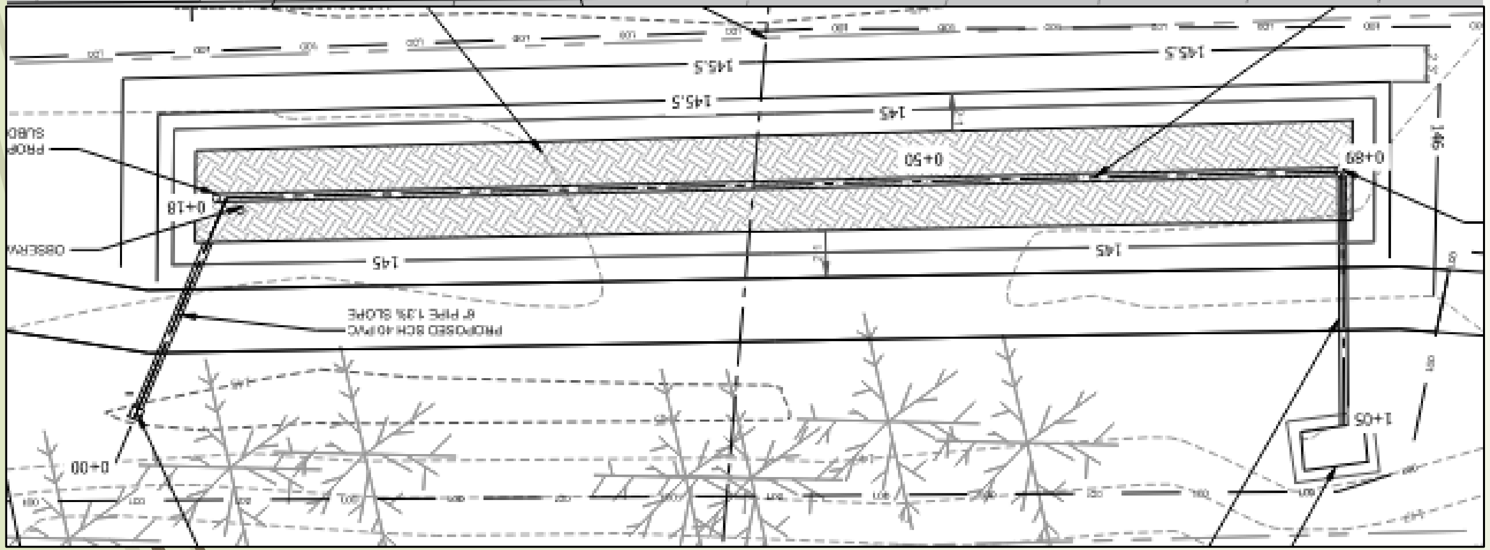
Soils Example

The Problem with Underdrains

- Infiltration needs to be slow to control nitrogen uptake therefore no underdrains should be used. (Robert Traver, Villanova, 4/16/15, CWEA Stormwater Spring Conference)
- No runoff reduction in bioswale due to hyper efficient underdrain. Underdrain responds quicker than overland.(Keith Eshleman, Appalachian Laboratory, 12/7/2018, MWMCC)

Underdrain Example



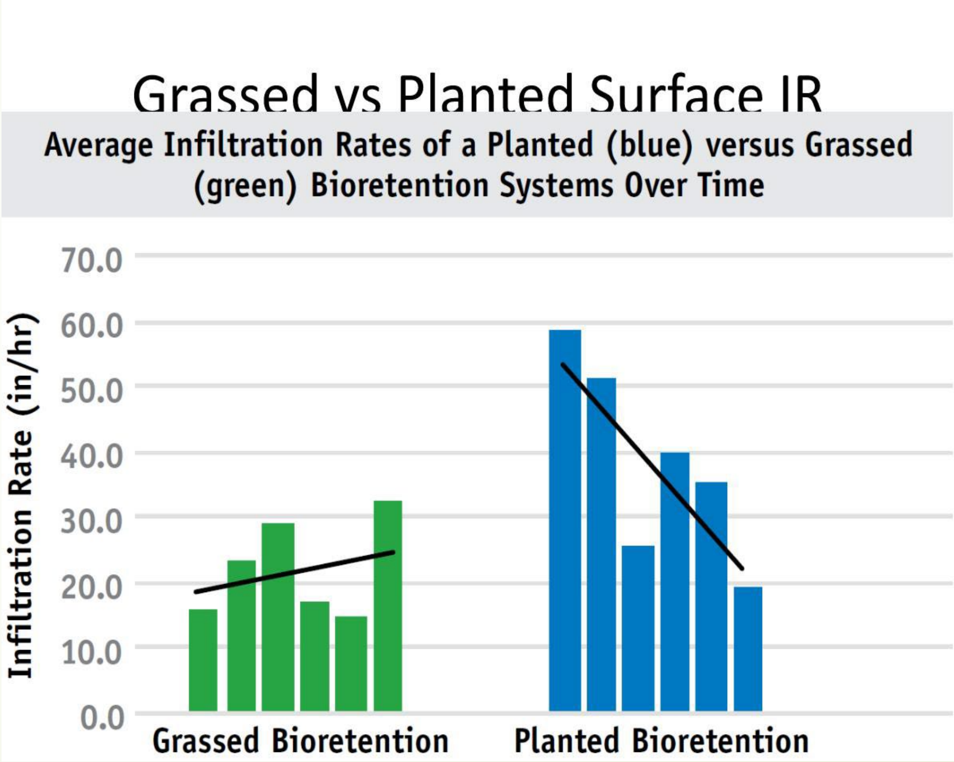


- Town Hall in Glen Echo, MD
- Trolley Park in Glen Echo, MD

Proposed in Glen Echo, MD

Maintenance: Simplified

- Turfgrass infiltrates as much as native plants after 5 years (James Houle, University of New Hampshire)
- If a homeowner wants native plants, they can choose to plant the rain garden with them.
- If stormwater infiltration is the goal, turfgrass is an acceptable ground cover. Fine fescue is a native grass.
- Maintenance may be easier for some homeowners depending on the plantings.



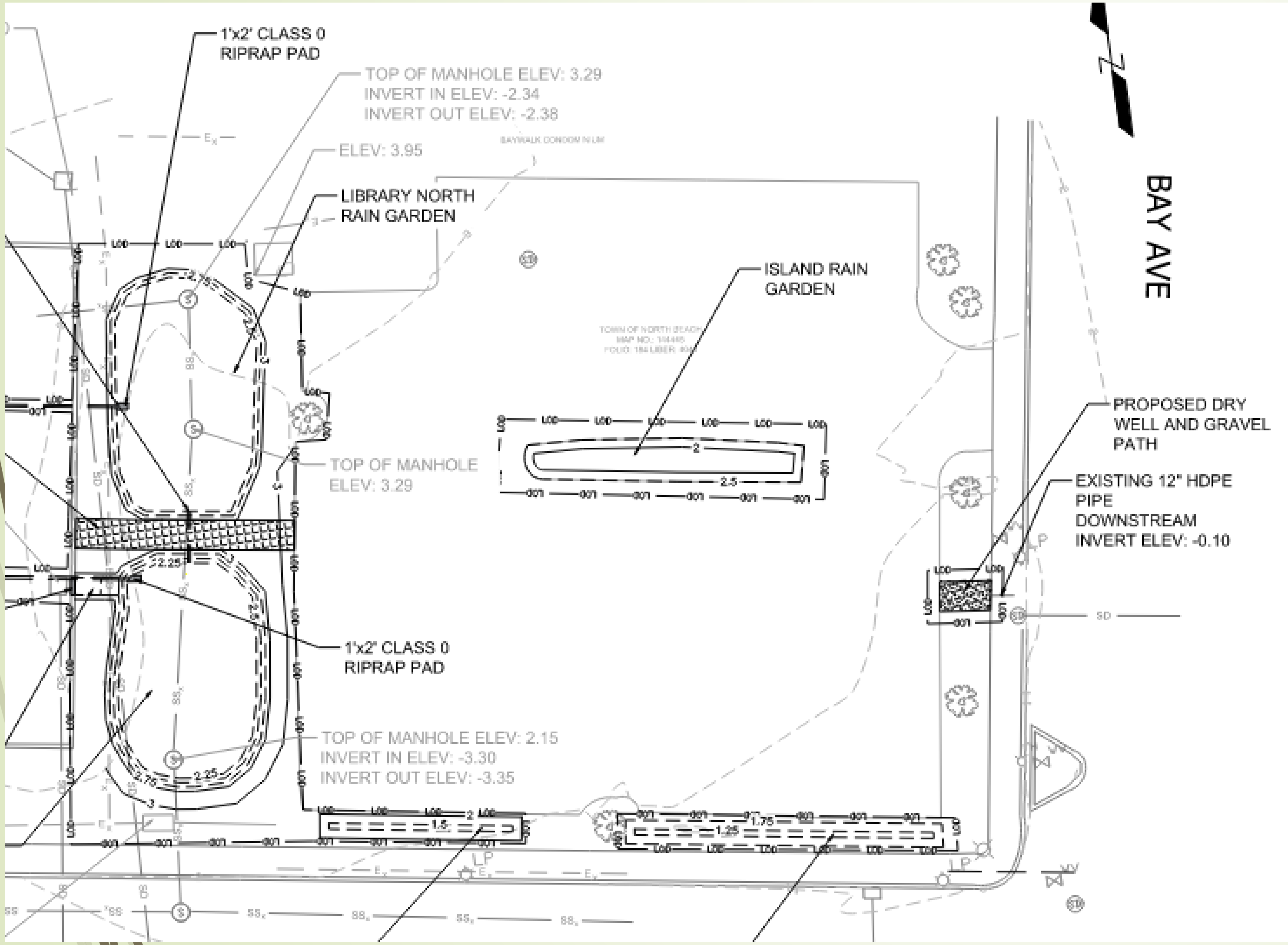
Maintenance Simplified Part 2

- Mulch only needs to be replaced as needed unless heavy metals are present. Both turfgrass and groundcovers will reduce the need for mulch.
- Coverage of plants is a better metric than number of plants. Move trees to the side of the garden to prevent shading. Groundcovers, plugs, turfgrass, and seedlings will allow for faster coverage. Grasses are good.(R. Traver)
- Simplify plant palette to 5 plants and interplant with groundcover (Heather Ambrose and David Alexander of Fairfax County). Plants include black-eyed Susan, swamp and butterfly milkweed, soft rush, and blue flag iris.

High Groundwater Table Solutions

- Town of North Beach has a high groundwater table of 2’ below surface.
- MDE bioretention in Chapter 3 requires 4’ distance
- Since this is only a rain garden, we kept a 1’ distance to high groundwater table.
- Plants uptake nitrogen; nitrogen is removed when plants are removed. (R. Traver)Therefore, nitrogen will not be conveyed to the water table if there is good plant coverage.

Compaction and Water Table Example



Proposed in North Beach, MD

- Area adjacent to Library
- Island Rain Garden existing

Conclusion

- Rain gardens are a great way to infiltrate runoff from impervious areas.
- Rain gardens can be a simple depression planted with turfgrass. Or they can be native plant pollinator gardens. Choose your own adventure.

Questions for our Speakers

- Raise hand (in person)
- Add to chat (online)