Chesapeake Bay
Stormwater Training Partnership

# A Visual Guide to Assessing, Inspection and Maintaining LID Practices

# Welcome to the Webcast

- To Ask a Question
  - Submit your question in the chat box located to the left of the slides. We will answer as many as possible during Q&A.
- To Answer a Poll Question
  - Simply select the preferred option. For those viewing this session alongside several colleagues, respond in a manner that represents your organization as a whole.
- We ARE Recording this Session
  - All comments and questions will be recorded and included in the archives. We will notify you as soon as the recording and related resources are loaded on the web.
- We Appreciate Your Feedback
  - Fill out our evaluations – our funders need to hear it!

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Alliance for the Chesapeake Bay

# Today's Agenda

1. Maintenance Matters Now: The Changing World of BMP Inspection
2. The Visual Indicators Approach to Inspecting and Maintaining Stormwater BMPs
3. Coming Soon! Visual indicators for other LID practices and ponds

# Poll Question #1

How many people are watching with you today?

- Just me
- 2-5 people
- 6-10 people
- > 10 people

# Poll Question #2

Tell us a little about yourselves…who are you representing today?

- Local government
- Private sector
- Regulatory agency
- Non-profit
- Academia
- Other…*tell us in the chat box*

# Poll Question #3

What is your role in the inspection, maintenance or verification of BMPs?

- Inspection
- Maintenance
- Verification
- Some combination of the above
- Manage BMP inventory
- Responsible for implementing MS4 permit
- Something else…tell us in the chat box!

# Speaker Info

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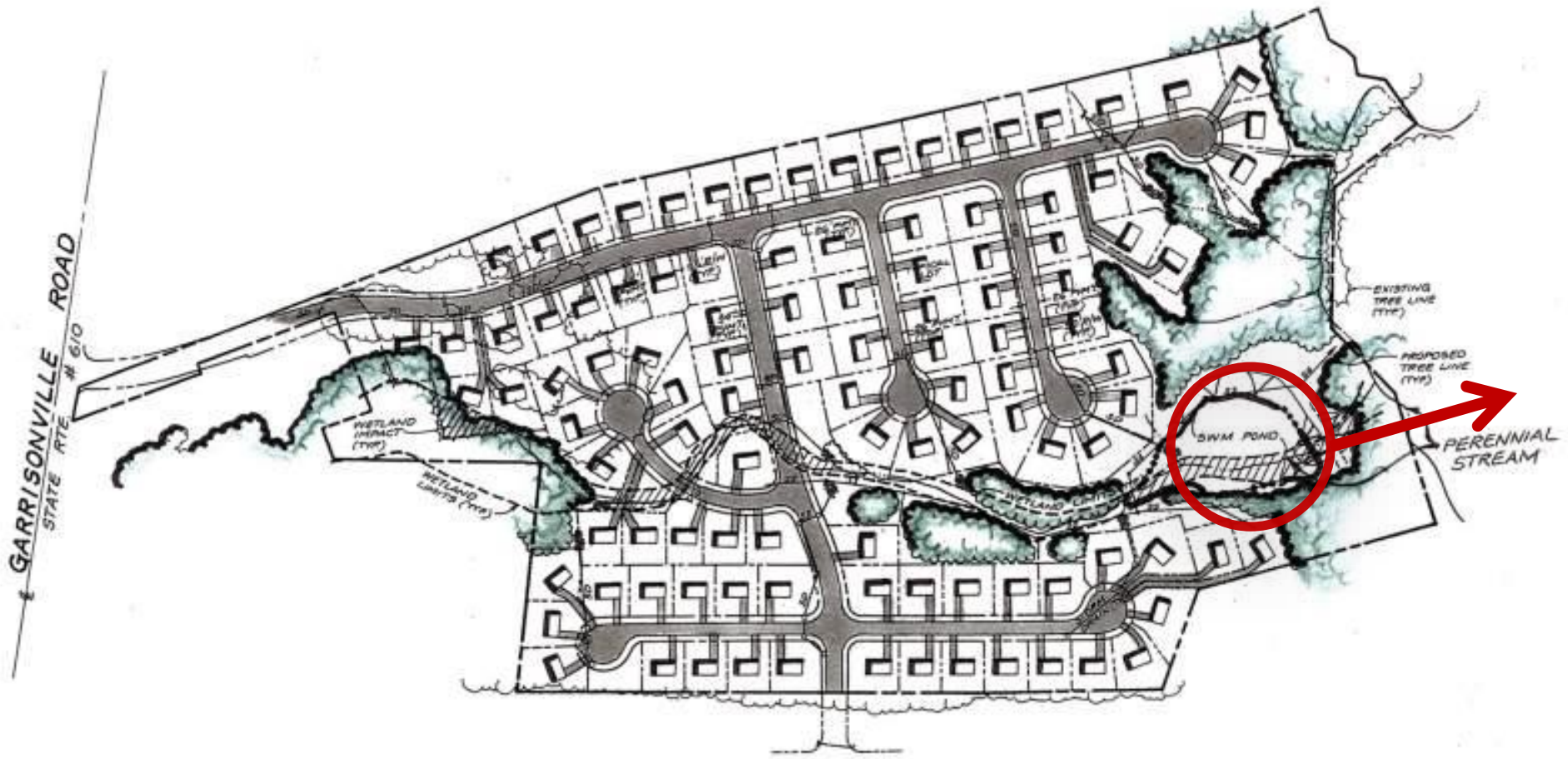
# Maintenance Matters Now ! The Changing World of BMP Inspection

MS4 Maintenance Requirements, Legacy BMPs, BMP Verification and the Bay TMDL

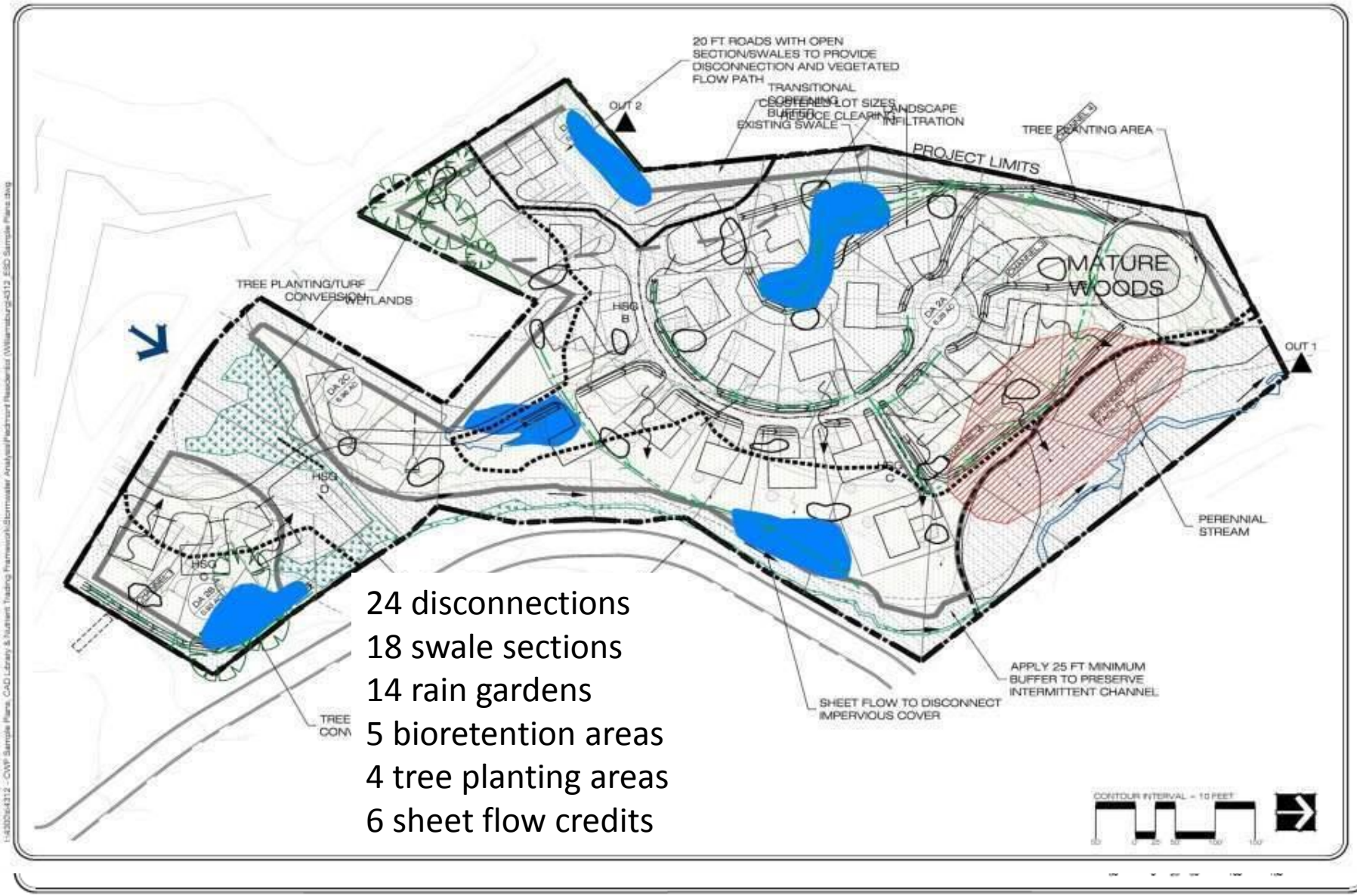

BMP Performance Is Inextricably Linked To Maintenance (which is not very sexy)

# The Old BMP Inspection Model Has to Be Modified

One big pond



# The New “Many-BMP” Maintenance Model



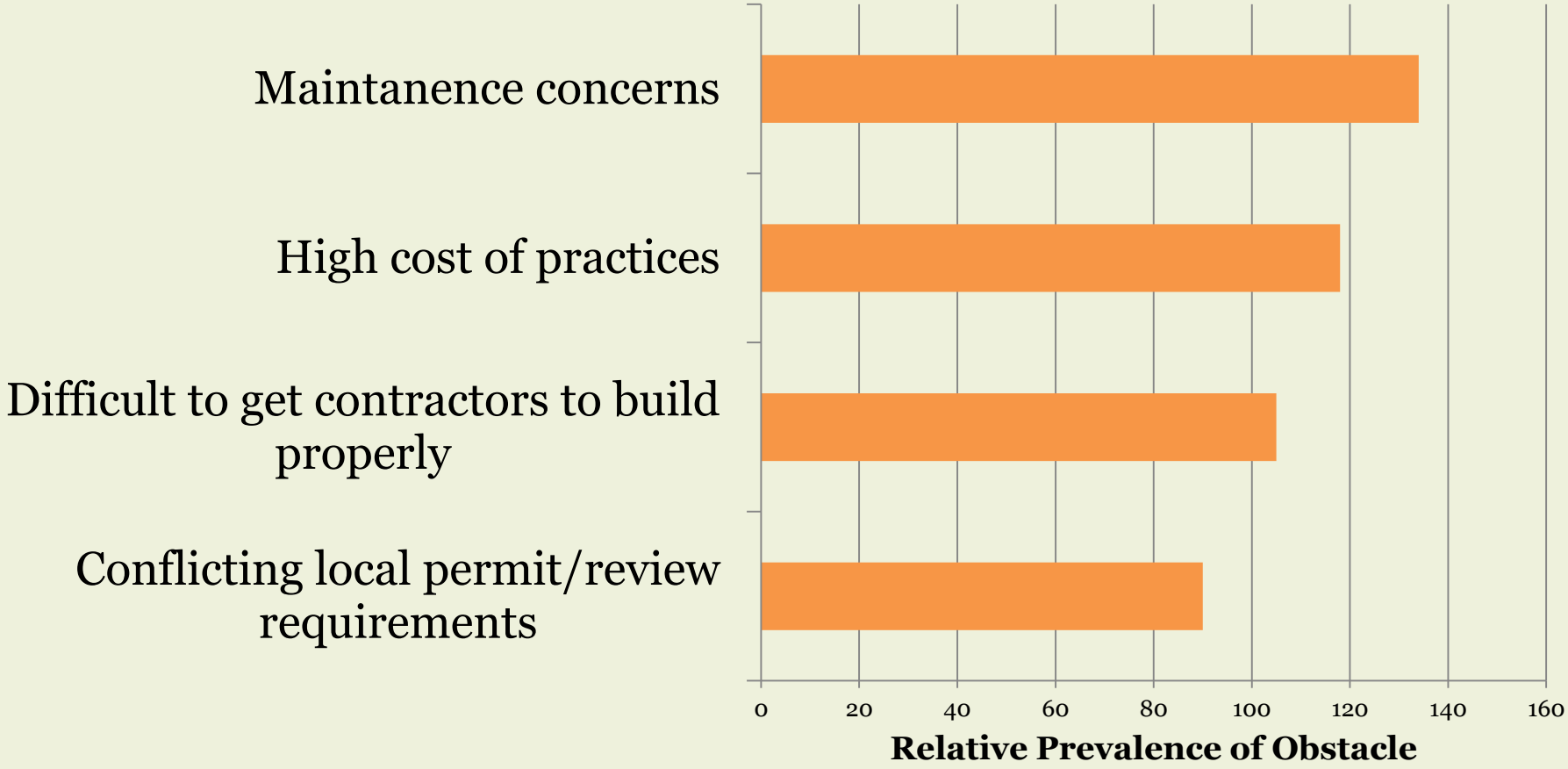

24 disconnections
18 swale sections
14 rain gardens
5 bioretention areas
4 tree planting areas
6 sheet flow credits

# The Challenge We Face

- A lot more practices to deal with
- More prescriptive MS4 requirements for ongoing maintenance inspection
- New BMP reporting, tracking and reporting requirements for TMDL
- Limited staff resources

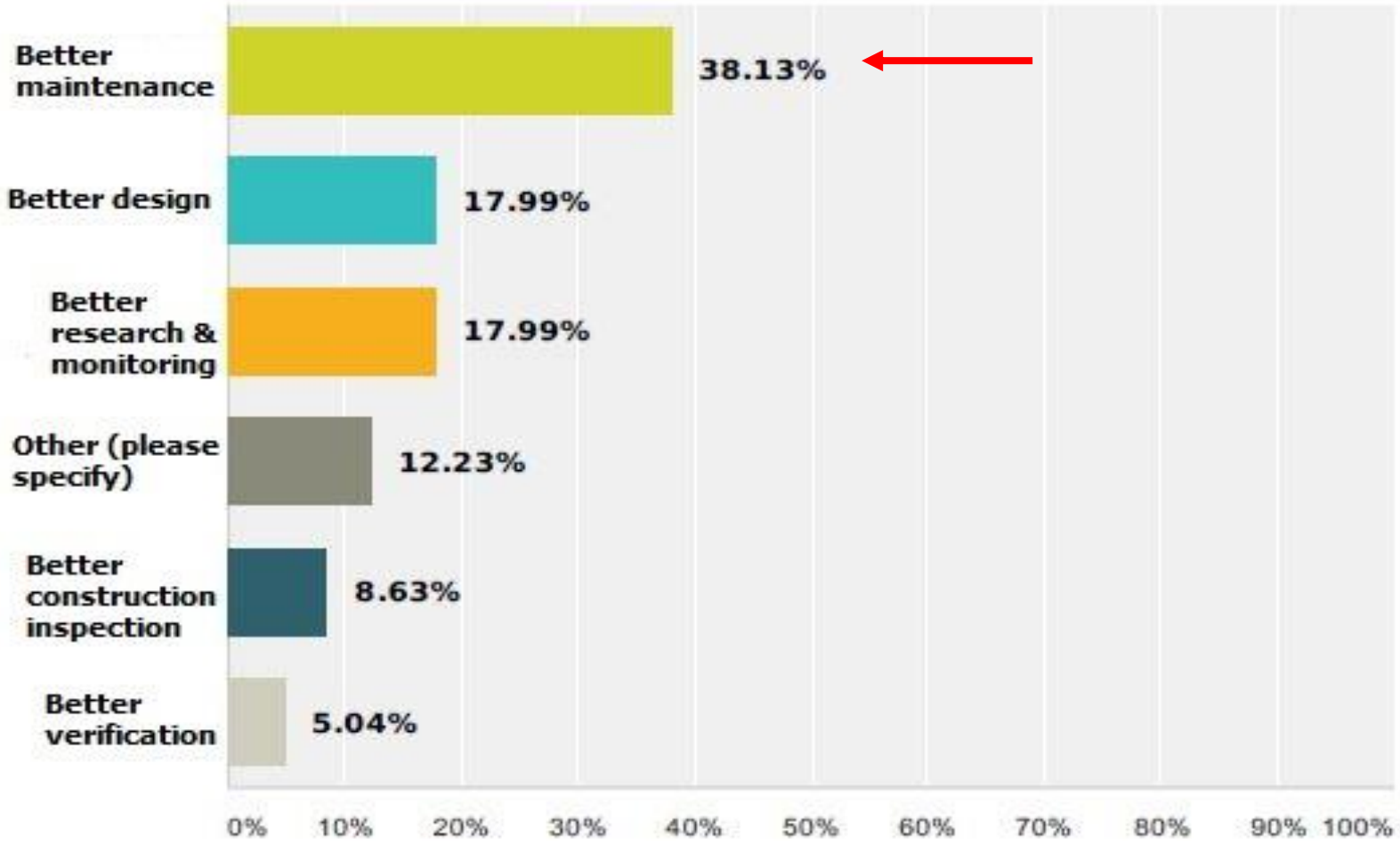
# 2014 CSN Network Survey

**Q18 Biggest Obstacles in Using Low Impact Development**



# Q19 Where do you feel the biggest water quality improvements can be achieved in the future with stormwater BMPs?

Answered: 139 Skipped: 105



# How to inspect our Legacy BMPs ?

| Thirty Years of BMPs. The BMP Inventory in a Maryland County (2006) | | | |
|---|---|---|---|
| *Potentially High Performers* | | *Known Low Performers* | |
| Bioretention/Dry Swales | 49 | Underground Detention | 270 |
| Sand Filters | 279 | Dry Ponds | 528 |
| Wet pond | 212 | Oil Grit Separators | 805 |
| Pond Wetland | 98 | Proprietary Practices | 239 |
| Infiltration Basin | 58 | Flow Splitter | 321 |
| Infiltration Trench | 459 | Other (plunge pools) | 30 |
| | | Grand Total | **3350** |

# Higher Public Expectations

- New stormwater fees
- Higher level of service expected, but has not really been defined
- Limited homeowner knowledge about purpose of stormwater practices
- Public notices nuisances, not performance
- Public education and outreach

# The Bay Pollution Diet

# Urban BMP Verification

- BMP Verification a priority for all sectors in the Chesapeake Bay Program
- Urban Stormwater Workgroup adopted its verification protocol in February 2014
- States will implement them thru their existing MS4 BMP reporting efforts

# Performance Verification

Ensure BMP still exists and is providing the pollutant removal it was designed to achieve or if it requires major restoration

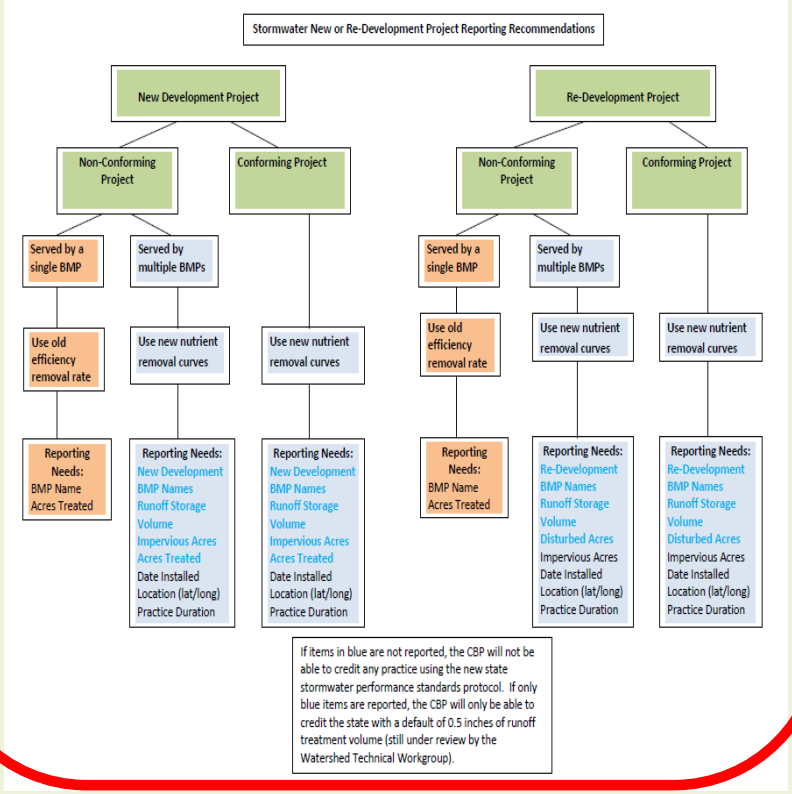
MS-4 Permit/ Bay TMDL

Once every 9 -10 years

Trained evaluator

Facility BMP Inventory

State BMP Reporting for Bay TMDL




Each BMP has unique items that must be reported to get credit in the TMDL

Requires that MS4s and the 7 states have a tracking capability for individual BMPs

BMPs have a fixed duration for credit, which can only be extended based on field verification

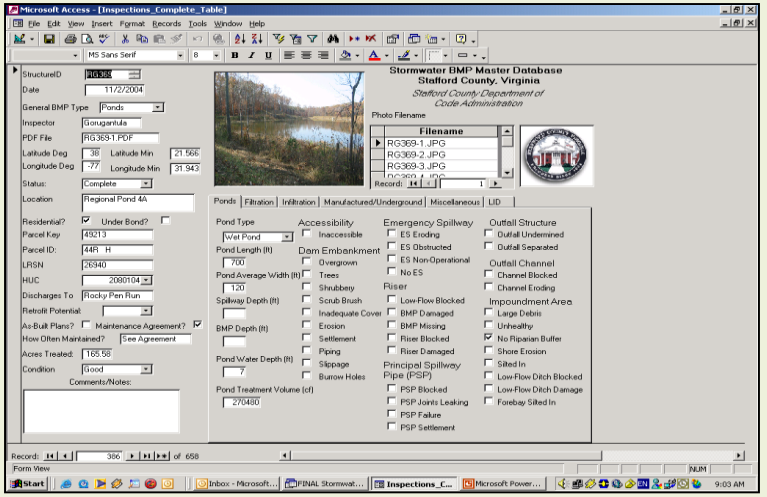
# New requirements are expected increase total inspector workload

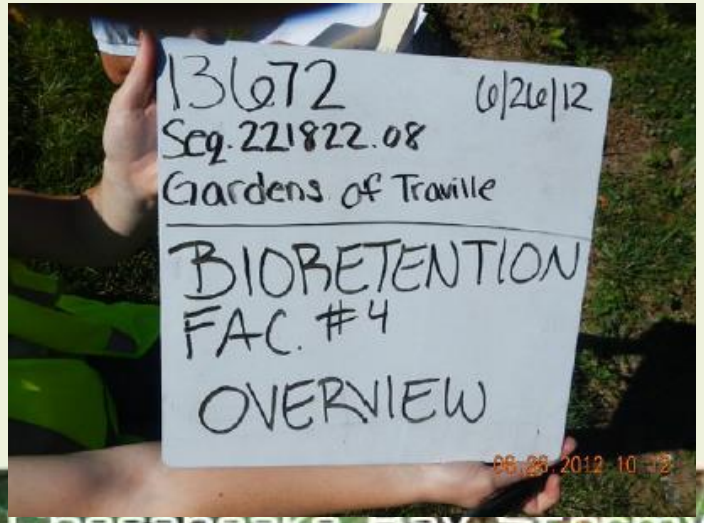
- MS4 requirements to inspect local BMPs
- Need to evaluate older BMPs for retrofit potential
- CBP TMDL BMP performance verification
- Shift to more distributed LID practices as stormwater regs are implemented
- Need for tighter inspection during practice construction
- Forensic BMP investigations to fix failed BMPs
- Verifying Homeowner BMPs

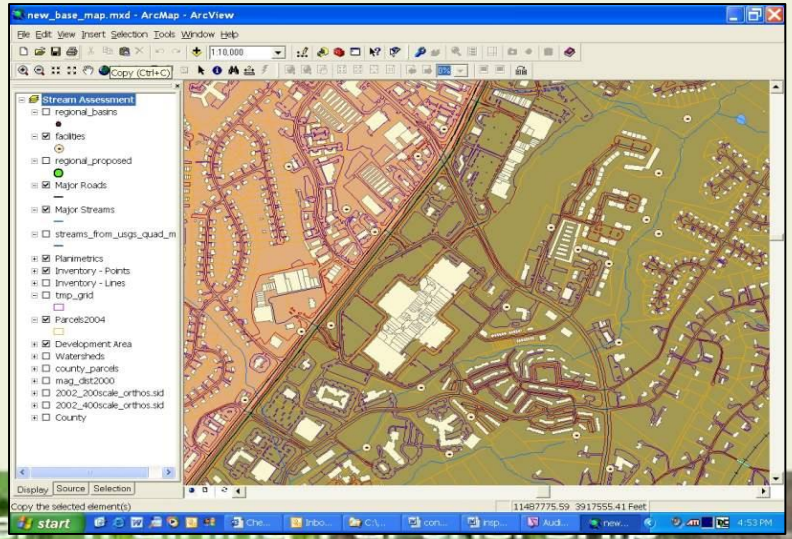
# Need to sharply reduce the time for most routine inspections

- Use rapid visual indicators
- Dump the long checklists
- Pass the good facilities quickly and move on
- Flag the bad or failing practices for a more intensive investigation

# Need to integrate technology throughout each step of the inspection process



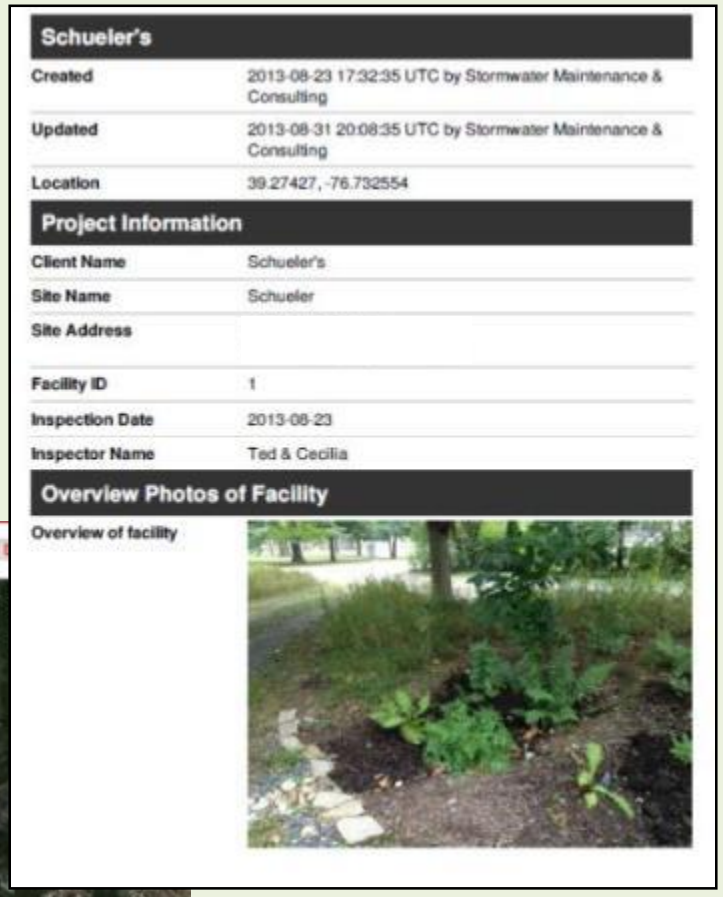




Chesapeake Bay Stormwate

# Inspection App

- Online tracking
- Upload photos directly from phone/tablet
- Creates PDF report
- Available for trial period





http://fulcrumapp.com/apps/bioretention-illustrated/

# Expand the Inspection Work Force

- Summer BMP field crews
- Landscape maintenance crews
- Erosion and sediment control inspectors
- Third party or private sector inspection
- Homeowner BMP auditors
- Self-reporting inspections for some BMPs
- Forensic BMP investigators and project cost estimators

# While enforcement is an essential backstop, most problems stem from owner ignorance

Most of the owners you will be dealing with won't have much understanding of:

- What and where the practices are
- Why they are needed
- How they function
- How they should be maintained

Think of yourself as a stormwater extension agent!

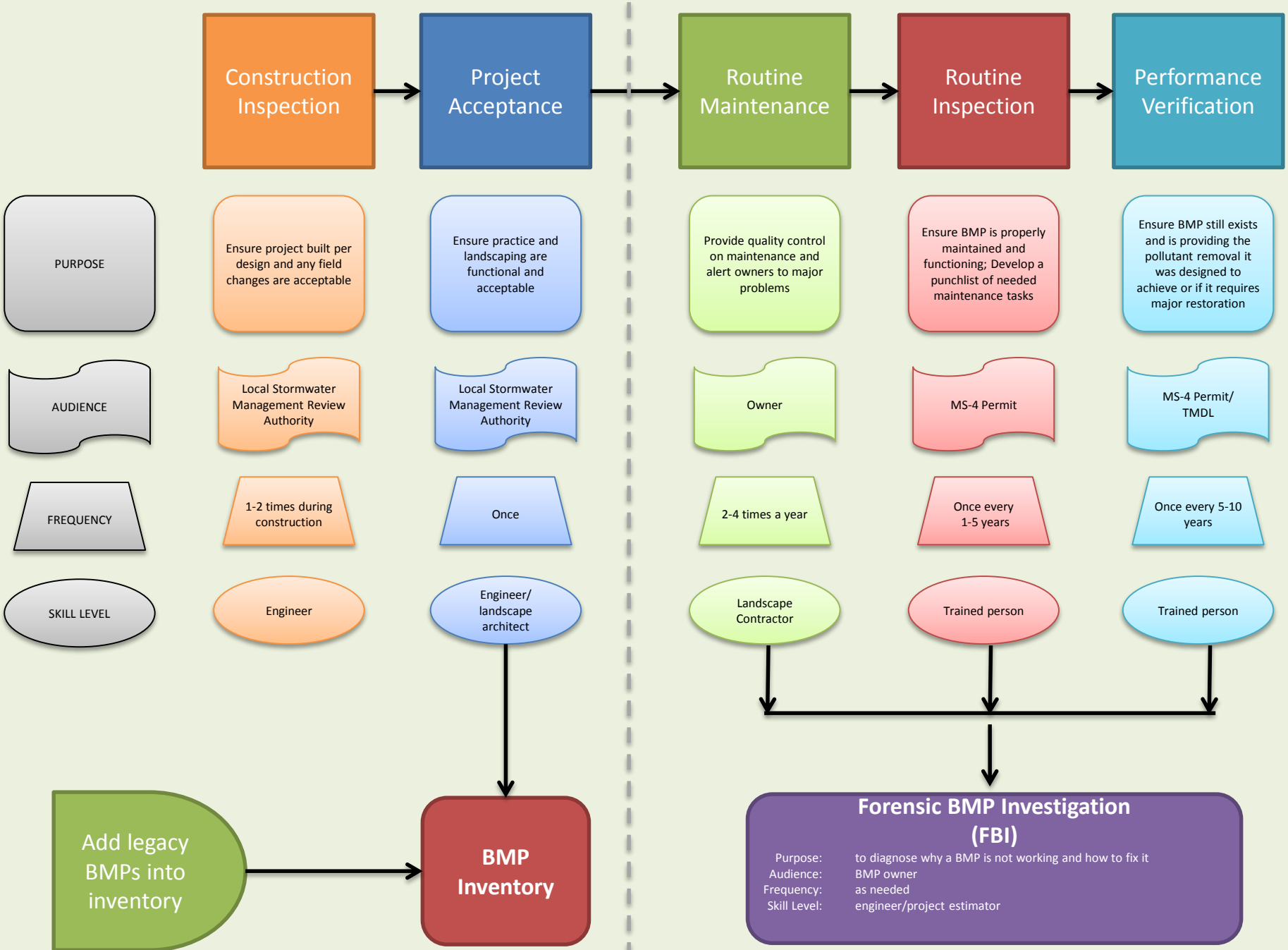
# Questions

# 2. Visual Indicator Approach

# Visual Indicator Approach

- Use of simple visual indicators in order to conduct rapid investigations of BMPs
- Employing this approach during routine maintenance, inspections and performance verifications
- Results in a punch list of actions to be taken to maintain functionality of the BMP
- More severe cases trigger a more in depth investigation into the problem

# Visual Inspection Framework



# Visual Indicators

Goal: To evaluate the stormwater BMP in 10 minutes or less

How: Follow a prescribed sequence to assess the performance and functionality of BMP by using numeric triggers to grade each visual indicator from score of Pass, Minor, Moderate or Severe

Result: Use of a tablet tool to develop a punch-list of tasks to follow-up on to bring the BMP up to speed

Limit the use of expensive engineer time for the limited inspections where the are really needed

# Routine Regulatory Inspection

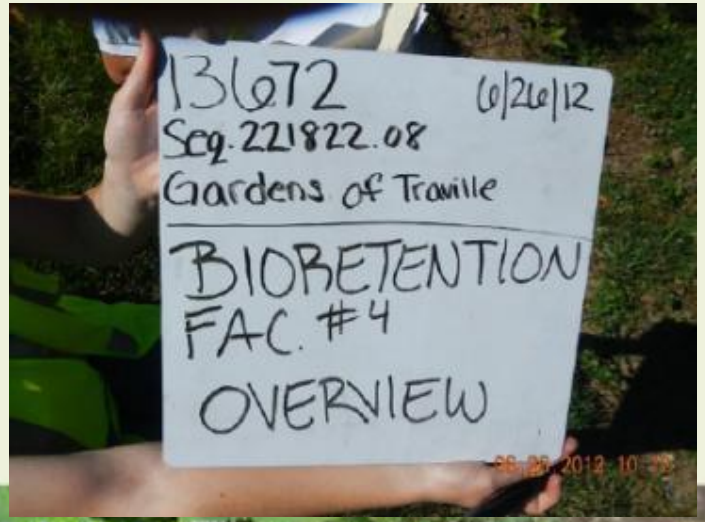
| | |
|---|---|
| PURPOSE | Ensure BMP is properly maintained and functioning; Develop a punch list of needed maintenance tasks |
| AUTHORITY | MS-4 Permit |
| FREQUENCY | Once ever 1-5 years |
| SKILL LEVEL | Trained person |

Tool:
Visual Indicators

NOTE:
Method should be used to quickly evaluate practice during each routine maintenance visit as well

# Field Investigations

- Take photos, measurements, notes
- Use of a dry erase board and a camera to rapidly document the inspection and note observations on a tablet
- Carry simple tools to inspect facilities from ground surface and perform minor maintenance tasks



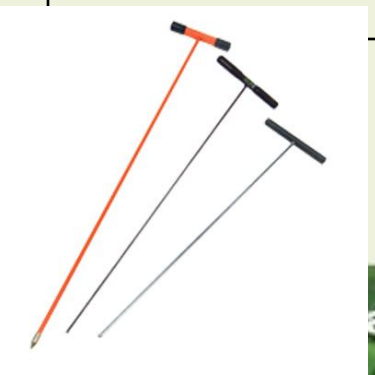
# Equipment

## Equipment

- White board
- Manhole pick
- Digital Camera
- Dip-sticks (sediment)
- Tablet/smart phone with app
- Various tools for opening observation wells (wrenches etc.)
- Shovel, rake
- Measuring tape
- Soil auger
- Plant ID sheet
- Authorization letter

**Optional items:**

- As-builts/site plans
- Safety vests
- Bug spray
- Flashlight
- Six pack of beer



# Using Bioretention as a Case Study…

Warning !

This may be the last pretty bioretention area you see for the next 30 minutes

# Bioretention

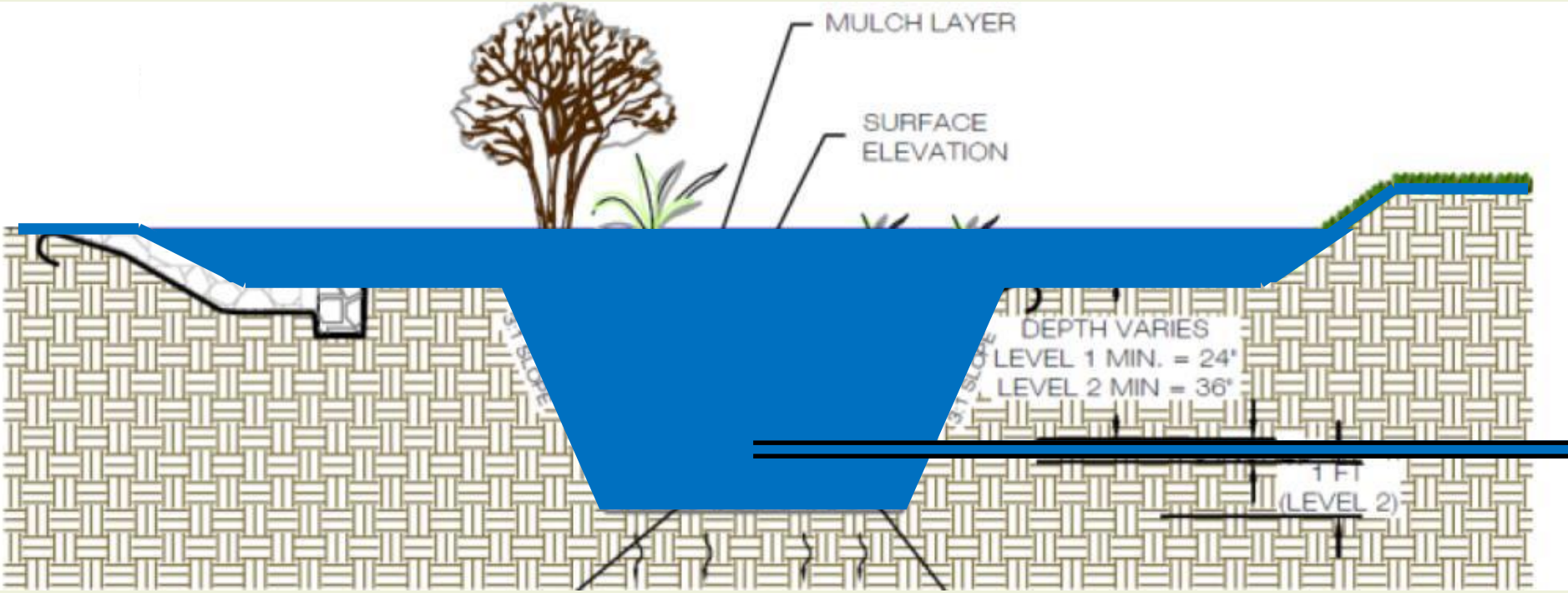
**Bioretention**

**Water Quality Swale**

**Urban Bioretention**

**Residential Rain Garden**

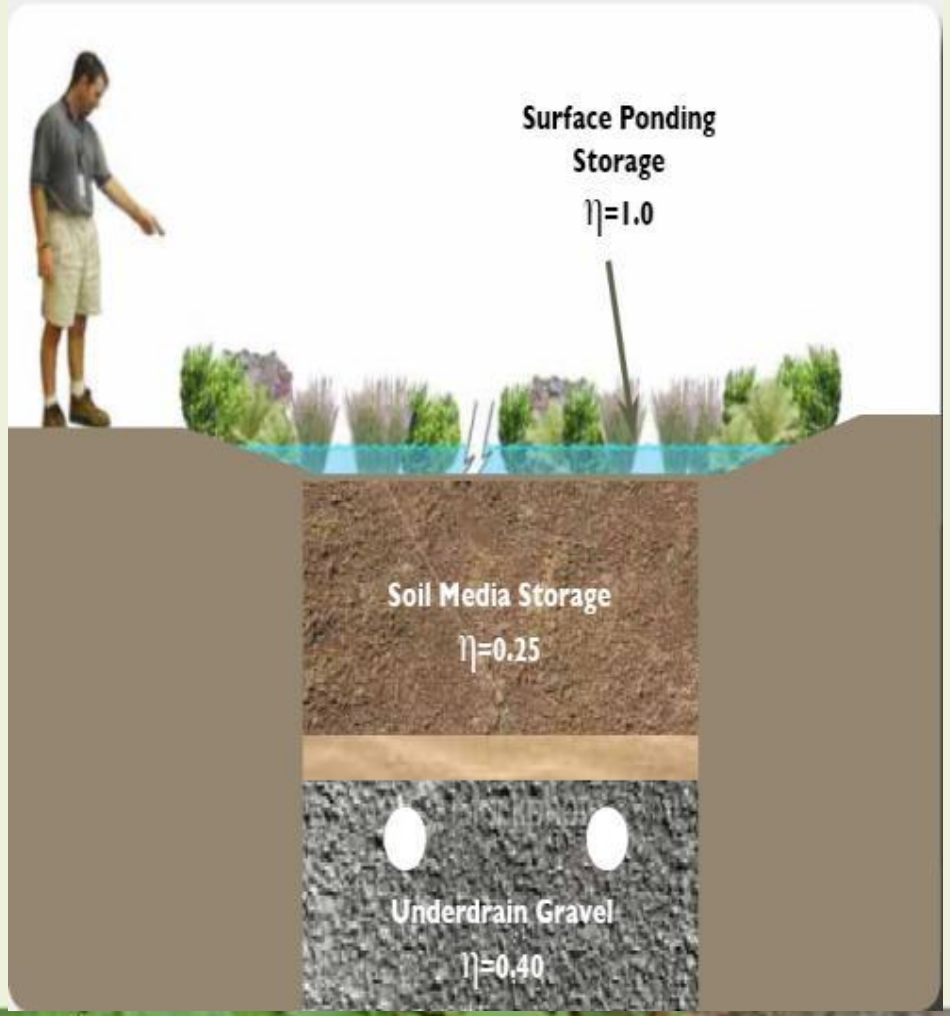
# Bioretention: How it Works




Runoff flows into a bioretention facility and temporarily ponds. Water then slowly filters through the filter bed and either is collected by the underdrain and sent to the storm sewer system or infiltrates into the surrounding area.

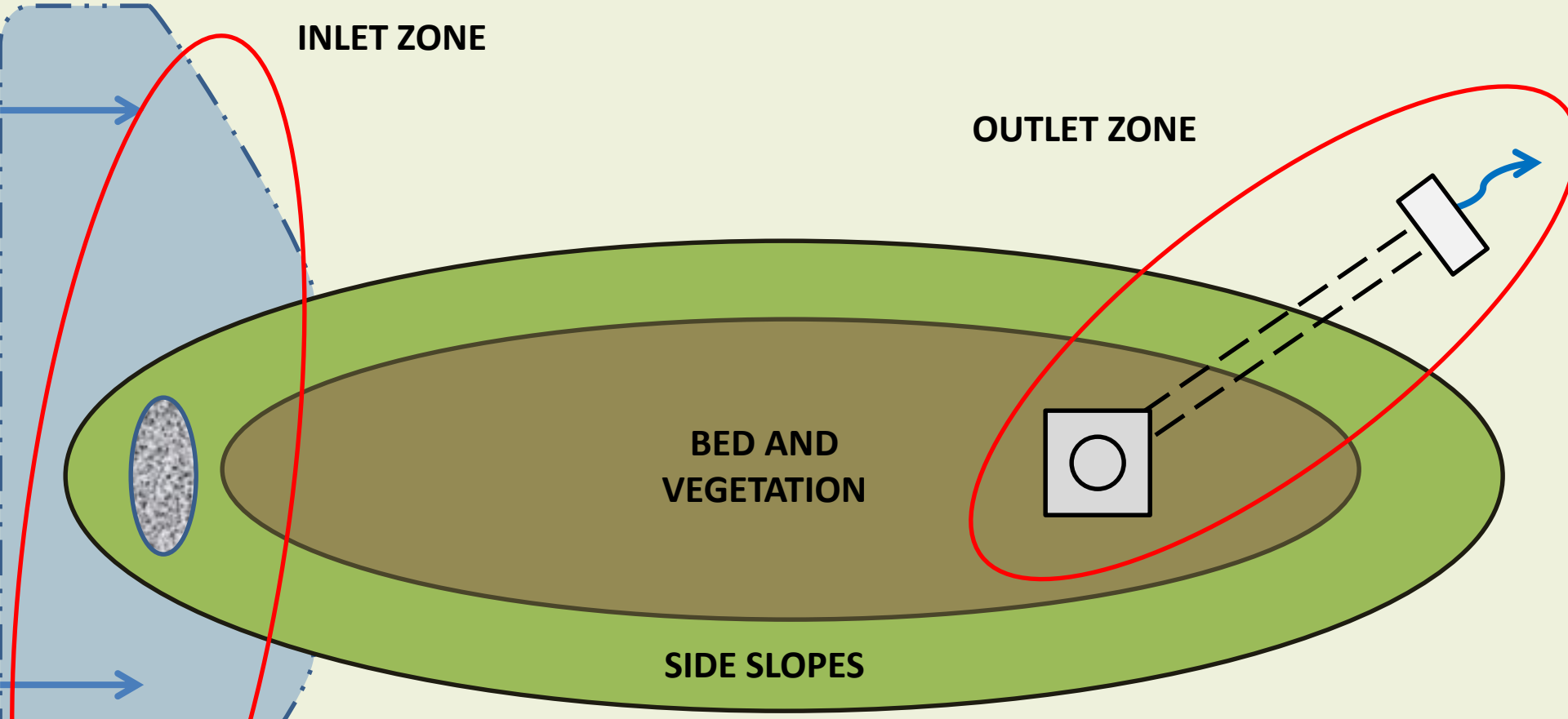
# Key Parts of Bioretention

- Ponding area
- Filter media
- Pea gravel
- Overflow
- Vegetation
- Optional:
  - Underdrain + stone
  - Infiltration sump



# Visual Indicator Approach for Bioretention

# Bioretention from above



# Visual Indicators Sequence

| No. | Zone | INDICATOR | |
|---|---|---|---|
| 1 | Inlet | Inlet Obstruction | |
| 2 | Inlet | Erosion at Inlet | INLET ZONE |
| 3 | Inlet | Pretreatment | |
| 4 | Inlet | Structural Integrity, Safety Features | |
| 5 | Perimeter | Surface Area | |
| 6 | Perimeter | Side slope Erosion | PERIMETER ZONE |
| 7 | Perimeter | Ponding Volume | |
| 8 | Bed | Bed Sinking | |
| 9 | Bed | Sediment Caking | |
| 10 | Bed | Standing Water | |
| 11 | Bed | Ponding Depth | BED ZONE |
| 12 | Bed | Mulch Depth/Condition | |
| 13 | Bed | Trash | |
| 14 | Bed | Bed Erosion | |
| 15 | Vegetation | Vegetative Cover | |
| 16 | Vegetation | Vegetative Condition | VEGETATION ZONE |
| 17 | Vegetation | Vegetative Maintenance | |
| 18 | Outlet | Outlets, Underdrains, Overflows | OUTLET ZONE |

# Forensic BMP Investigation
# FBI

Purpose: to diagnose why a BMP is not working and how to fix it

Audience: BMP owner

Frequency: as warranted by field inspection

Skill Level: engineer/project estimator

Indicate what needs to be checked by private BMP owner in a letter on non-compliance

#1

# Inlet Obstruction

INLET ZONE


Good condition


Remove sediment, debris


Removal of sediment, obstruction


Sediment staining = entry problem

#1

# Severe Inlet Obstruction

**Severe accumulation of sediment, debris**


**Locate source, mitigate**
**Evaluate the need for enhanced pretreatment**
**Design remediation**

#2

# Erosion @ the Inlet

INLET ZONE


Good condition


Stabilize inlet


Disperse flow, investigate cause

#2

# Severe Inlet Erosion

FBI

**Evaluate inflow protection measure**
**Repair erosion**

#3

# Pretreatment

INLET ZONE


Free of sediment/debris


Remove accumulated sand/sediment


Remove accumulated


Locate source, mitigate

#4

# Structural Integrity

INLET ZONE

**Pass**


**Good condition**

**Moderate**


**Reinforcement needed immediately**

#4

# Structural Integrity

**Problems with adjacent curbs, pavement**

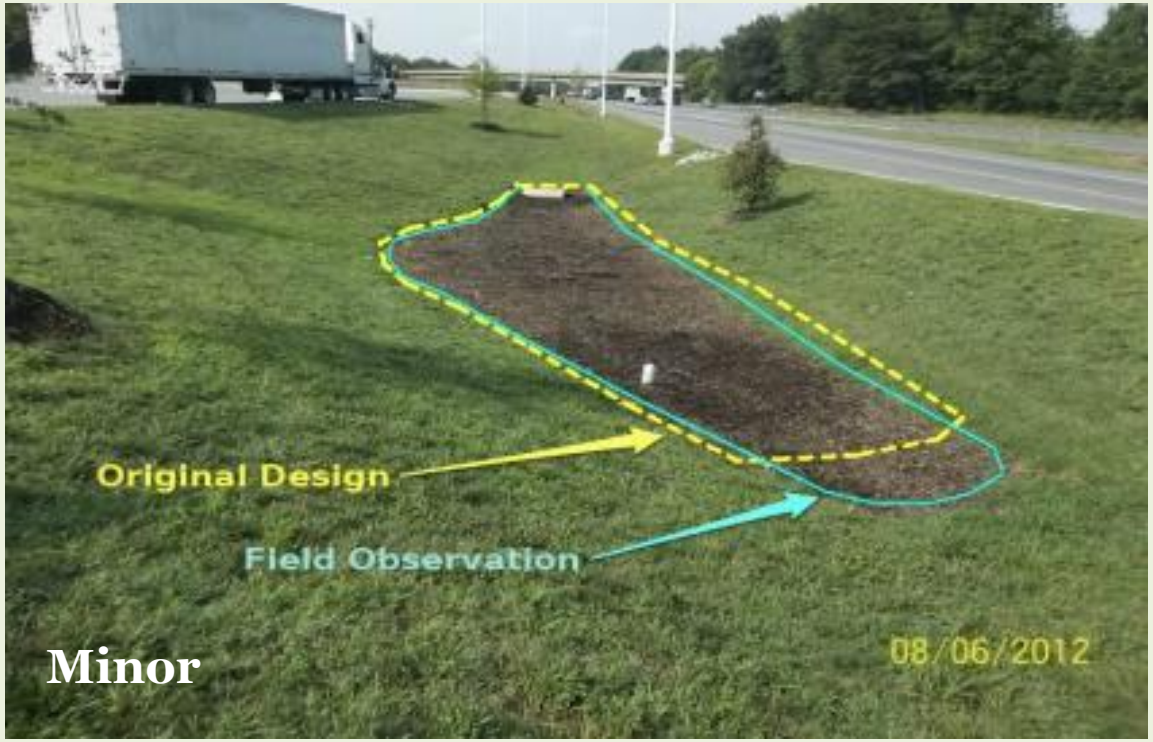

**Design repair**

#5

# Surface Area

PERIMETER ZONE

**Does the surface area match the design?**




**Minor**

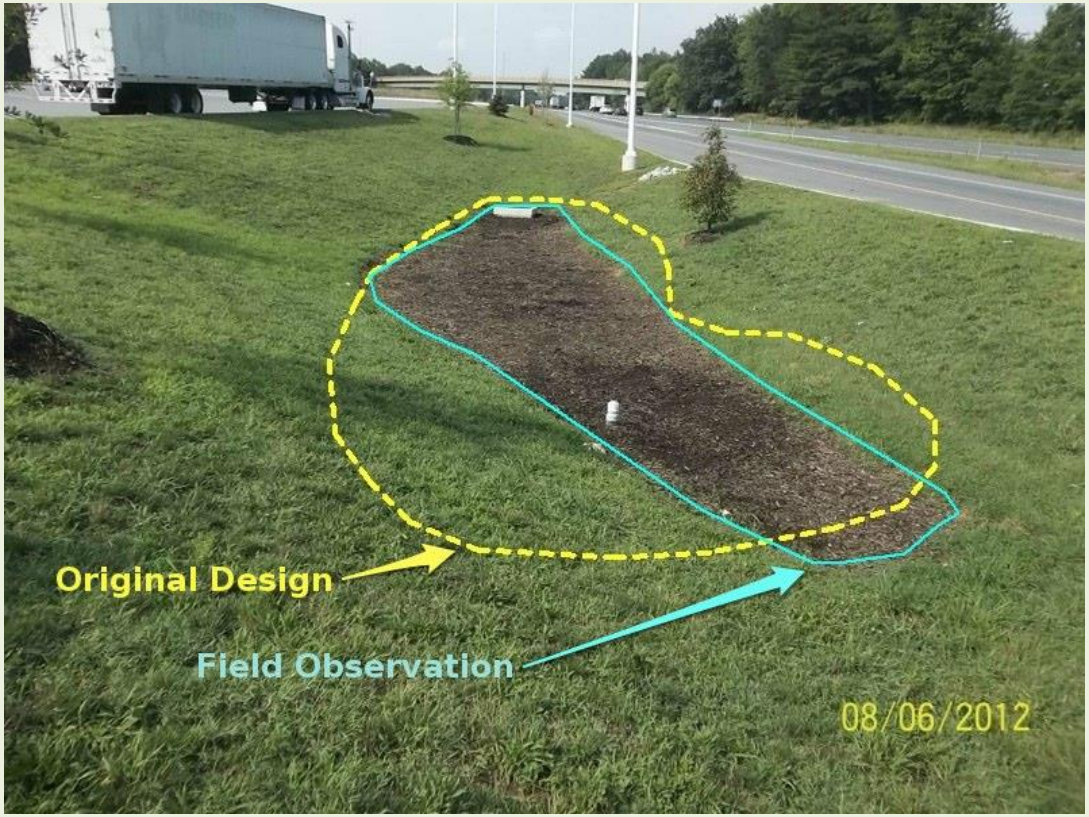
| | |
|---|---|
| Minor | 5% different from design |
| Moderate | 10% different from design |
| Severe | > 25% different from design |

Severe

#5

# Severe Design Departures
# Surface Area

A greater than 25% departure from the design assumptions for surface area, storage, ponding depth or CDA




FBI

**Proceed to Topographic Survey**

#6

# Side slope erosion

PERIMETER ZONE

Pass


Good condition

Spot re-seeding

Minor

Moderate

Vegetative stabilization needed

#6

# Severe Side Slope Erosion



FBI

**Evaluate topsoil and vegetation**
**Design erosion repair**

#7

# Ponding Volume

PERIMETER ZONE

**Pass**

**Water flows through entire facility**

**Minor**

**Some short circuiting occurring, mound up outlet**

**Moderate**

**Short circuiting occurring, ineffective facility**

#7

# Severe Design Departures
# Ponding Volume

A greater than 25% departure from the design assumptions for surface area, storage, ponding depth or CDA

FBI

**Design repair**

#8

# Sinking Filter Bed

BED ZONE


Even, flat bed


Mulch, media replacement


Mulch, media replacement

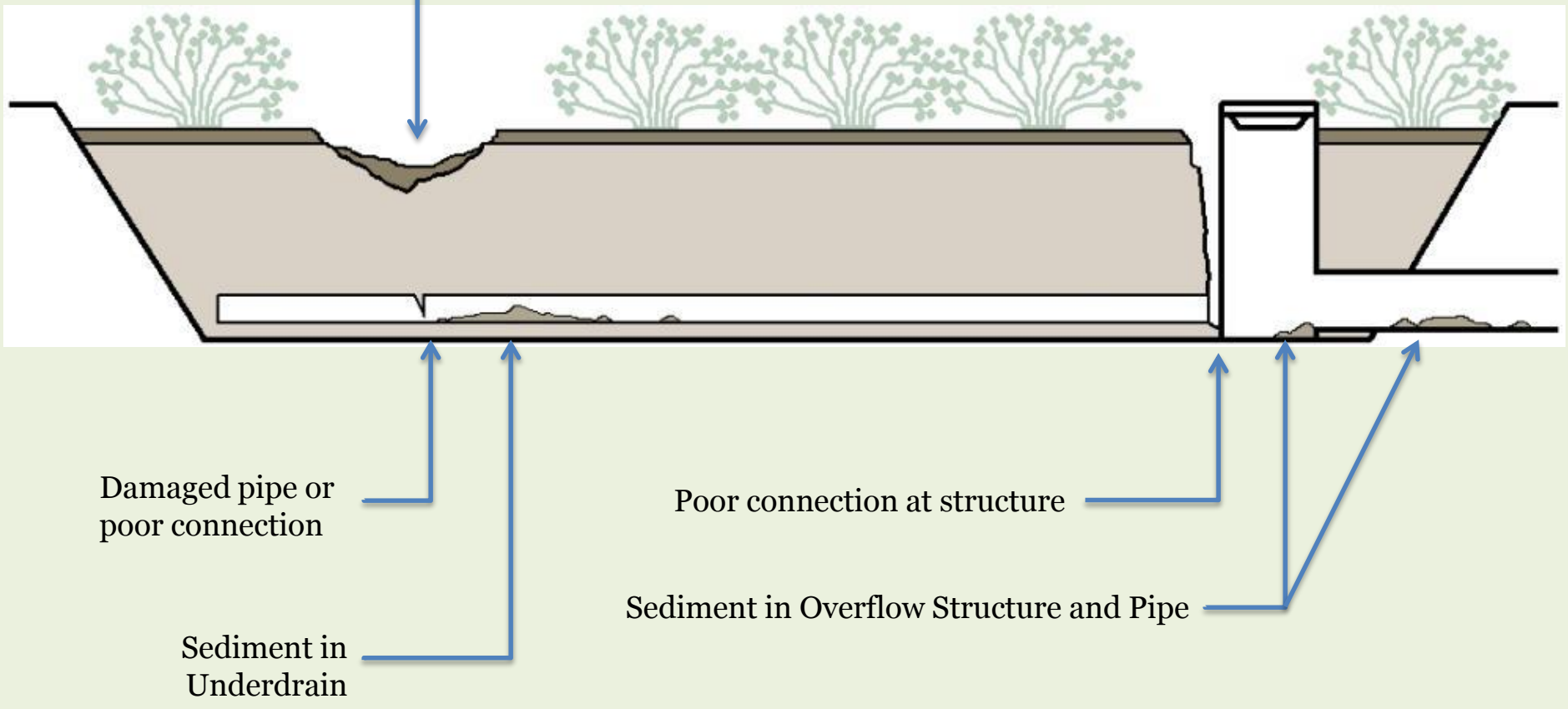

Check underdrain or outfalls for evidence of media migration

#8

# Severely Sinking Filter Bed


**Proceed to Test Excavation**

# Potential Causes of a Severely Sinking Filter Bed



#9

# Sediment Deposition/ Caking

BED ZONE

Pass

Good condition

Rake the cake

Minor

Moderate

**Remove sediment, check pretreatment, find and stabilize source in CDA**

#9

# Severe Caking and Sedimentation


**Determine Sediment Depth and its probable Source in the facility or its contributing drainage areas**

#10

# Standing Water

BED ZONE


None


Saturated soils


<3” of standing water after 72 hrs

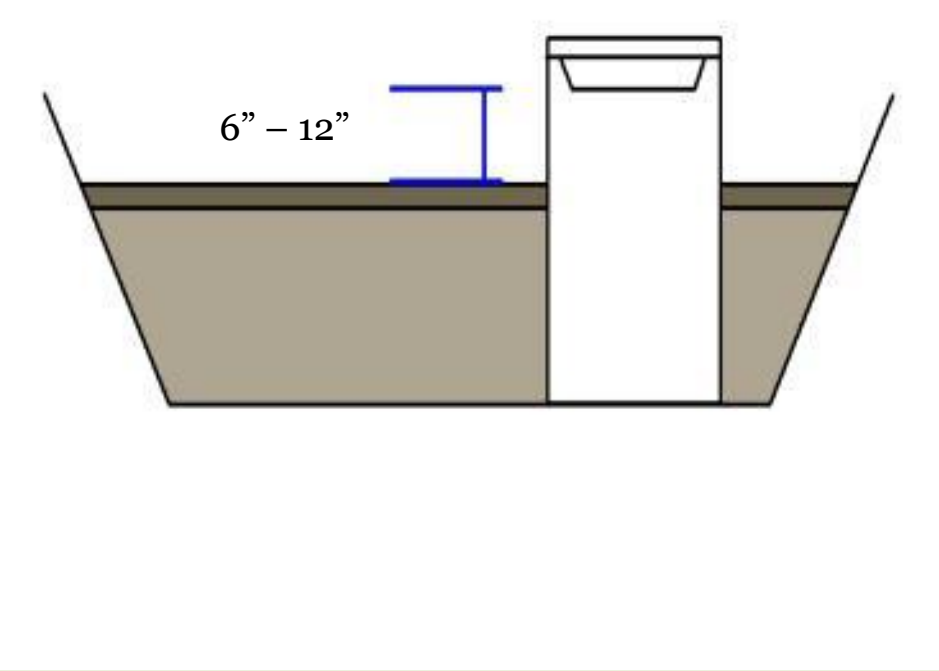

Proceed to pump down and test pit

#11

# Ponding Depth

BED ZONE

**Pass**

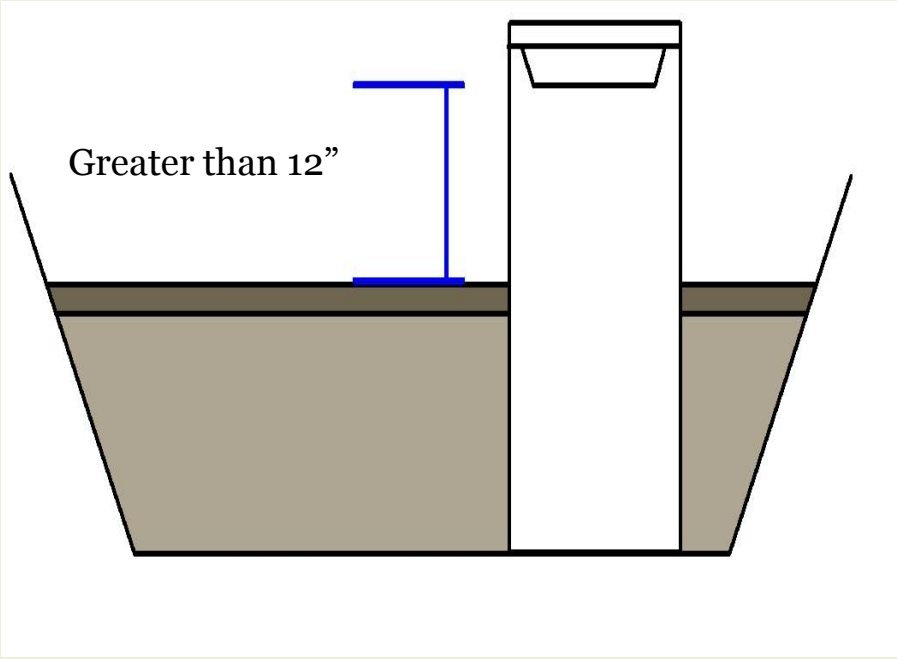



**Matches design**

#11

# Severe Design Departures
# Ponding Depth

A greater than 25% departure from the design assumptions for surface area, storage, ponding depth or CDA




**Topographic Survey & Adjust grade by removal or addition of mulch, and/or media**

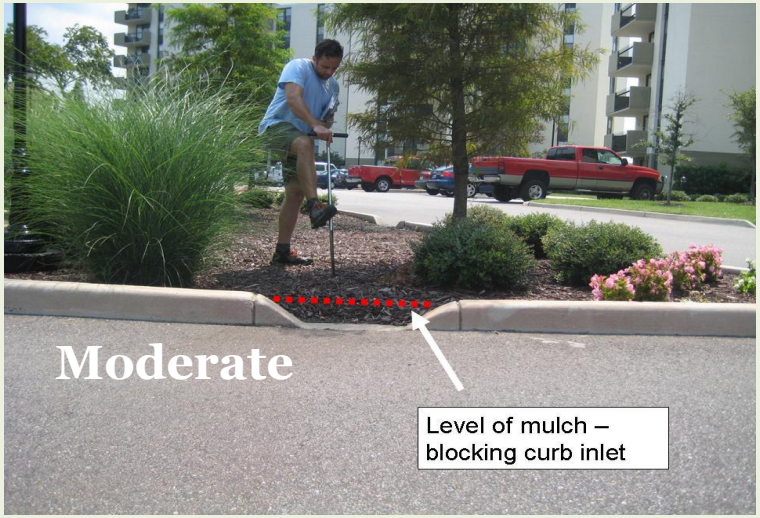
#12

# Mulch Depth, Condition

BED ZONE


Good condition


Replace mulch/Add ground cover





Remove mulch to design depth (2”-3”)

#13

# Trash

BED ZONE

**No trash**


**Trash**


**Remove trash**

#14

# Bed Erosion

BED ZONE


Good condition


Rake



**Disperse flow, rake, investigate the cause, evaluate pretreatment**

# Vegetation

VEGETATION ZONE

Vegetation is Different b/c…

- Vegetation changes over time
- Maintenance depends on landscaping regime

To assess: look at 3 different Visual Indicators:

- Vegetative Cover
- Vegetative Condition
- Vegetative Maintenance

# Dynamic Vegetation Management

Year 1

Year 3

Year 10

Original design plan should specify desired plant community through time

# Understand the desired landscaping objective




# Check Vegetation Indicators During Growing Season
# Depending on landscaping Regime, these are all in good shape

#15

# Vegetative Cover

VEGETATION ZONE

**Good cover**

**Few bare spots**

Tip: more mulch area exposed = more maintenance cost

**< 75% coverage**

Tip: Routinely split and replant Herbaceous material to reduce mulch area

#15

# Vegetative Cover

VEGETATION ZONE

**Severe**

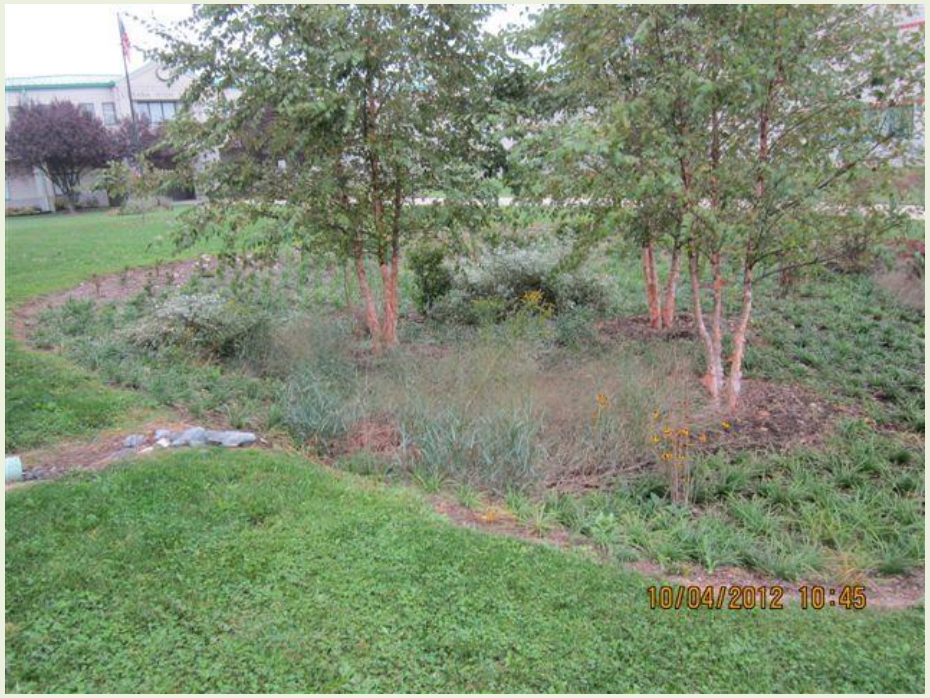
**Evaluate planting plan and replant**

#16

# Vegetative Condition

VEGETATION ZONE

**Plants alive and in good condition**




**Weeding needed**

#15-16

# Landscaping Detective Work

**< 35% coverage**

**Dead or Diseased Plants**

**Invasive Plants**

**Evaluate cause of plant failure (soils, species, design)**
**Do new planting plan (higher density or fast growing species)**

**Design and implement eradication plan, Evaluate remaining plants**
**Design new planting plan with higher density, Institute O & M Procedures**

#17

# Vegetative Maintenance

VEGETATION ZONE

**Well maintained**

**Tree removal needed**

**Maintenance needed!**

#18

# Underdrain

OUTLET ZONE

**Free of obstructions and debris**


**Sediment in underdrain**

Check for broken or missing caps


**Look for Bed Sinking**
**Do a test pit**

# Questions and Answers

# Visual Indicator Approach for Other LID Practices

# Webcast Resources

- Bioretention Illustrated: A Visual Guide for Constructing, Inspecting, Maintaining and Verifying the Bioretention Practice

- Final Recommended Guidance for Urban Stormwater BMP Verification

- Bioretention Illustrated App!

**www.chesapeakestormwater.net**

# Evaluation

*Please* take a few moments to answer our 6 question survey to help us better serve your needs in our webcast series.

https://www.surveymonkey.com/r/Bioretention-Illustrated-2016

We use this information to report it to assess our work, your needs and to report it to our funders for future webcasts !