O&M and Green: Best Practices for Green Infrastructure Operations and Maintenance

Tuesday, January 7th, 2014
1:00 – 2:30pm EST

Speakers:
Karen Sands, Milwaukee Metropolitan Sewerage District (MMSD)
Bill Hunt, Professor and Extension Specialist, NC State University

Sponsored by U.S. EPA Office of Wastewater Management

Logistics

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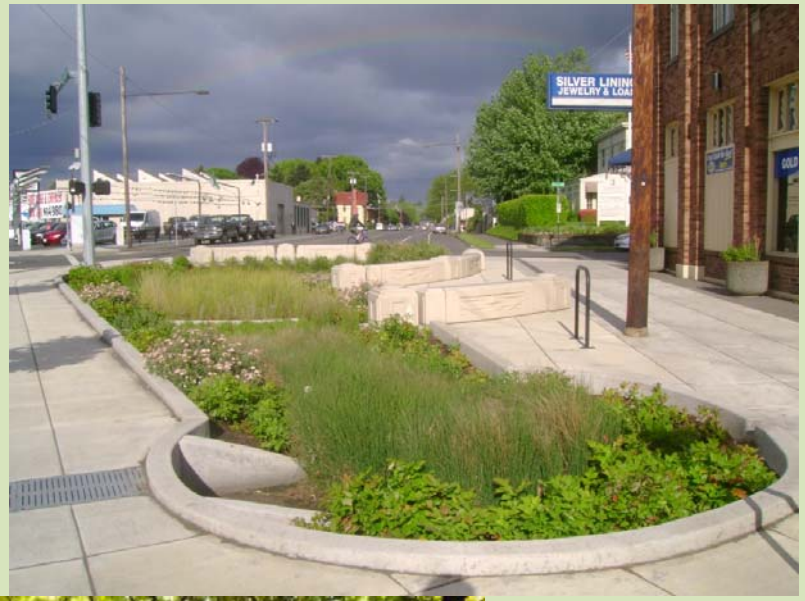
  - Call GoToWebinar support number [800 263-6317], and give conference ID# 959089816

Webcast Agenda

- **Speaker introduction**
- **Karen Sands**, Milwaukee Metropolitan Sewerage District (MMSD)
  - MMSD's evolving approach to maintaining green infrastructure investment
- **Bill Hunt,** Professor and Extension Specialist, NC State University
  - Basic strategies to maintain green infrastructure performance over time
- **Q&A session**



O&M and Green:
Best Practices for Green Infrastructure Operations and Maintenance

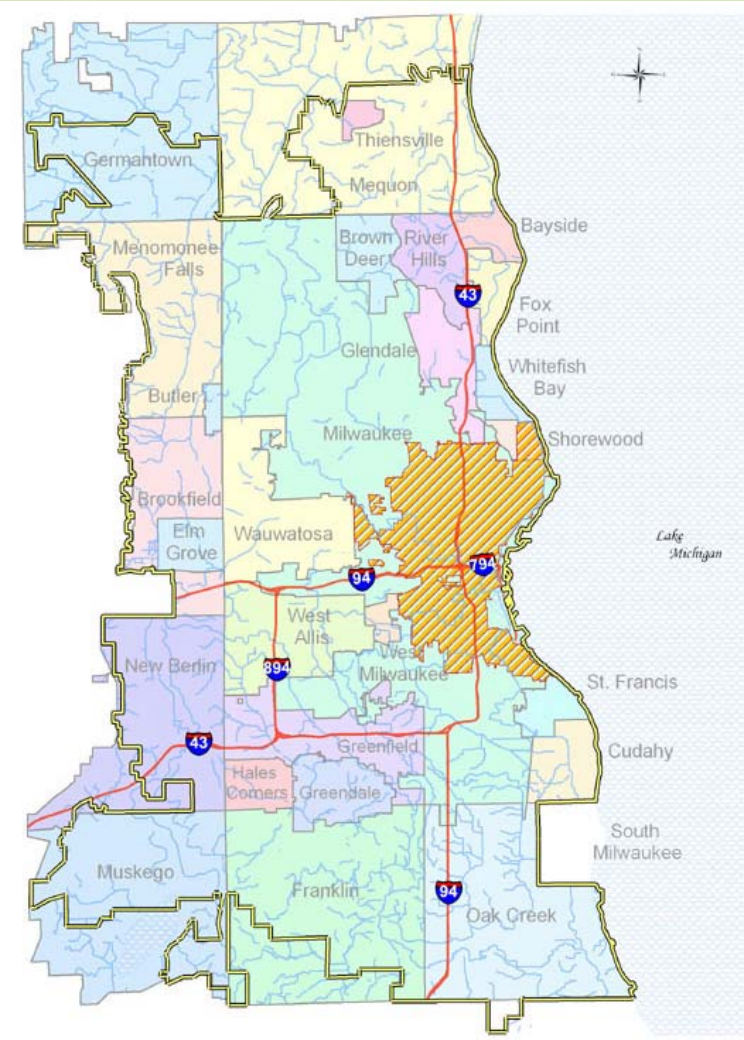
Maintaining the Rain (in Milwaukee) that Stays Mainly on the Plain

Karen L. Sands, AICP
Manager of Sustainability
Milwaukee Metropolitan Sewerage District

Agenda

- MMSD Overview
- MMSD Green Infrastructure (GI) Programs
- MMSD GI O&M
  - Past
  - Current
  - Future

Milwaukee Metropolitan Sewerage District



- We Serve:
  - 1.1 Million Customers
  - 28 Municipalities
  - 411 Square Miles
- Using Grey Infrastructure:
  - Collector Sewers/MIS
  - 2 Water Reclamation Facilities
  - 521 MG Tunnel Storage
- To Protect the Environment:
  - Convey/Store/Reclaim Wastewater
  - Manage Flooding
  - Much More…

Green Infrastructure

- Public Education
  - "Every Drop Counts" Campaign
  - www.h2ocapture.com
- Greenseams® Property Acquisitions
- Lake MI Rain Gardens Initiative
- Rain Barrel Sales
- Partnership Funding (Green/Sustainable Infrastructure)
- Green Roof Program
- Green Streets Program

O&M: Green vs. Grey

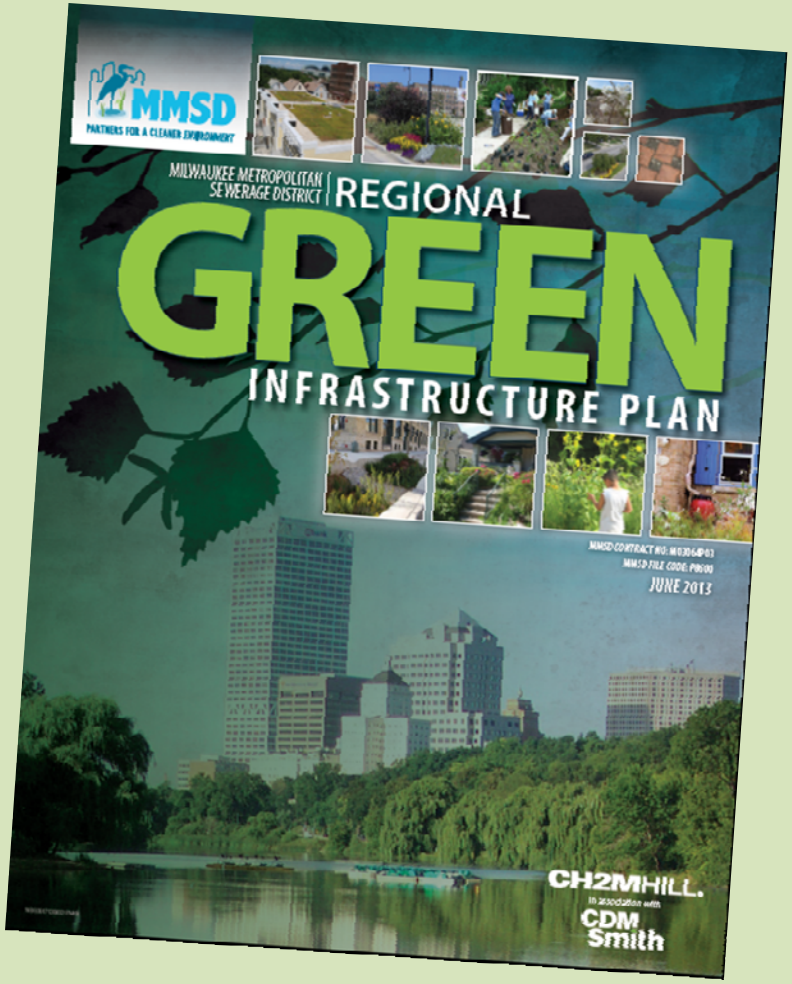
GI Maintenance

Our Interest in Green Infrastructure

- Reduce stormwater volumes we convey, store and treat
- Protect receiving water quality

…in order to comply with our discharge permit

MMSD's Regional Green Infrastructure Plan



- Implement the MMSD 2035 Vision
- Help prioritize green infrastructure funding decisions
- Provide input for the next facilities plan
- Logically implement WPDES green infrastructure goals

MMSD's Green Infrastructure Program Structure

- Green Infrastructure Definition: 10 strategies
- Greenseams®
- New: soil amendments

Capital vs. O&M Funding

Capital:

- Greenways
- Porous pavement
- Green alleys, streets and parking lots
- Lg cisterns
- Bio-retention
- Wetlands

O&M:

- Green roofs
- Rain barrels/sm cisterns
- Rain gardens
- Native landscaping
- Trees*

MMSD GI O&M Past

- Initially: nothing
- Mid 2000s: maintenance plans

MMSD's Green Infrastructure Permit Requirement

- "…must ensure that green infrastructure practices/control measures are put in place and maintained in the MMSD service area."
- "Any green infrastructure practices/control measures that are put in place to fulfill the retention capacity requirement must be maintained during the term of this permit."

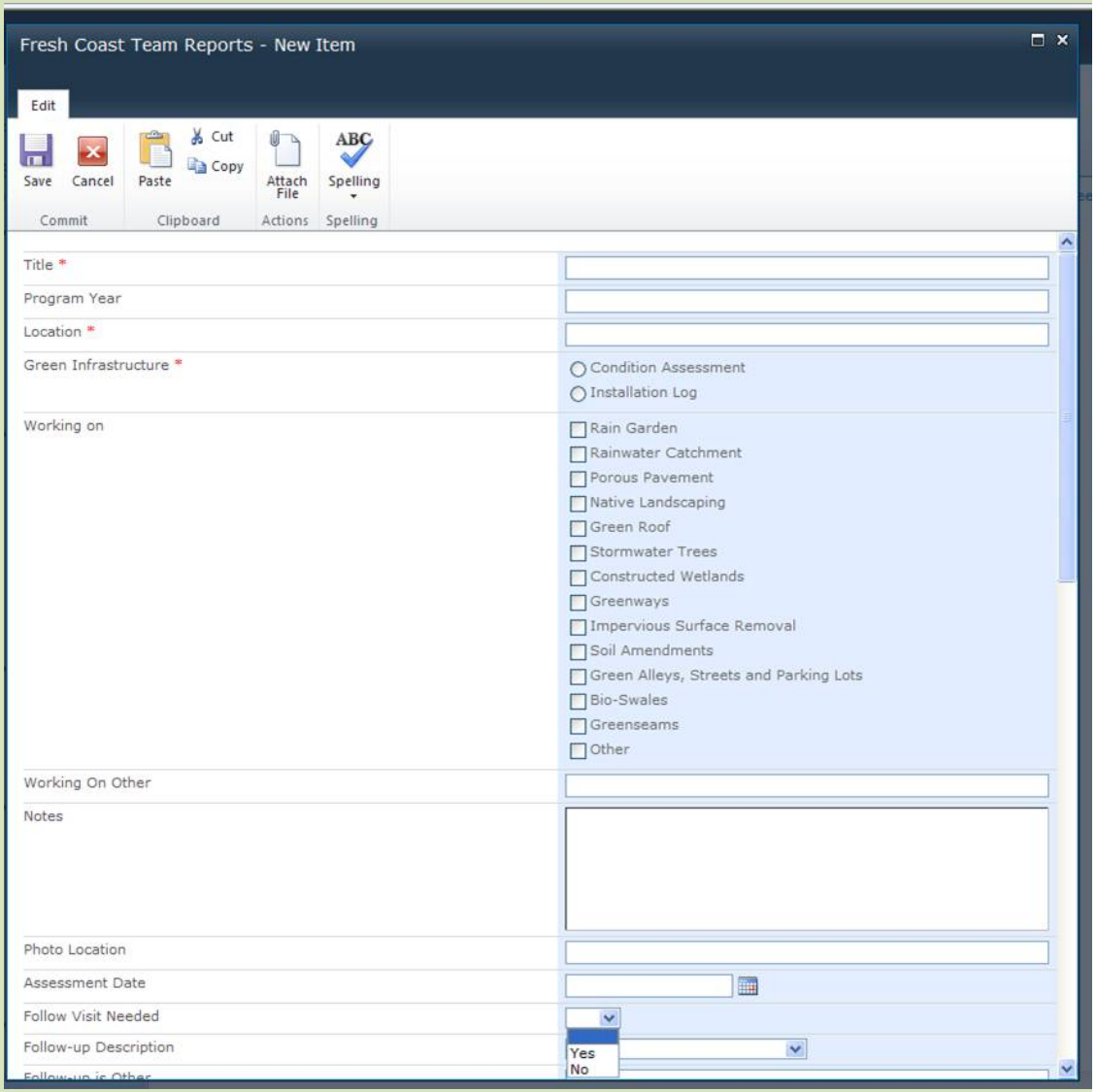
Capital Projects: Conservation Easement

O&M Projects: Souped Up Maintenance Requirement

1. Reports
2. O&M

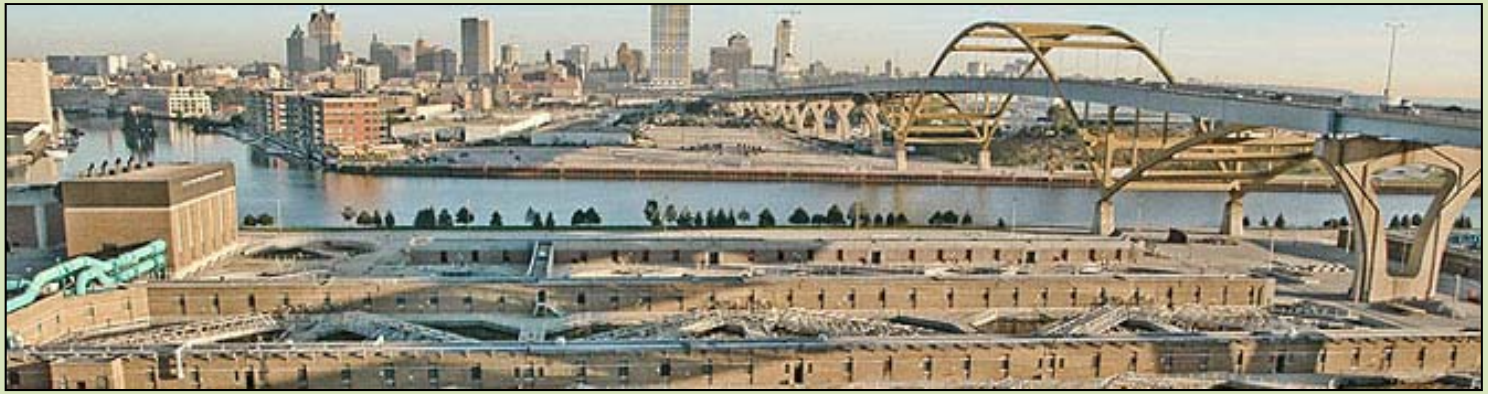
Condition Assessment Forms

- SharePoint based
- Pictures attached
- Interns
- Challenges
- Future Actions



Note: this is one of three assessment form pages

Milwaukee-area Municipal Practices



MMSD O&M Future:

- Condition assessments/inspections
- Veolia Water project
- High-road employment opportunities

MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

Maintaining Green Infrastructure Practices

Bill Hunt, Ph.D., PE

Professor & Extension Specialist

NC State Univ.

About your Instructor

- Bill Hunt, PE, Ph.D.
- Professor & Extension Specialist
- NC State University
- Design, Construct, Monitor, and Maintain SCMs
- Proud father of 4

What We Saw:
Cary Stormwater BMPs (2007)

- Approximately 425 BMPs in Cary
- According to one of Cary's inspectors: Timothy Grady, RLA:
- 95% of BMPs failed initial inspection as they require repairs
- Most repairs are maintenance related: (1) erosion & clogging, (2) trash/ rubbish, (3) unwanted trees/ vegetation

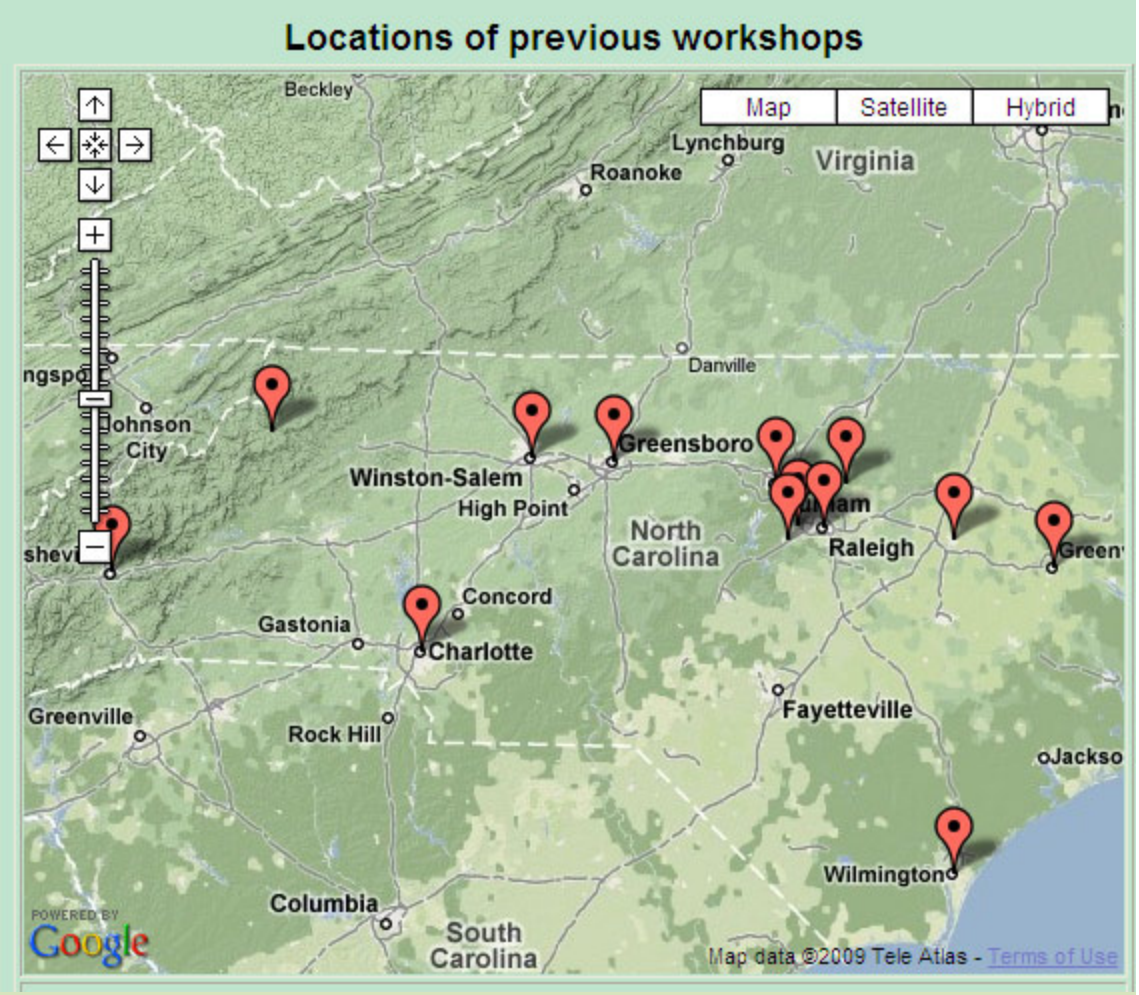
Enter the…BMP Inspection & Maintenance Certification

Who offers this Certification?

- NC State University Cooperative Extension Service
- Muni's and Counties can choose to Adopt it
  - Several Have

How Popular is the Certification?

- As of 18Nov13, >2000 people had been certified
- Over 43 classes offered, most sell out



Success… Across State Borders

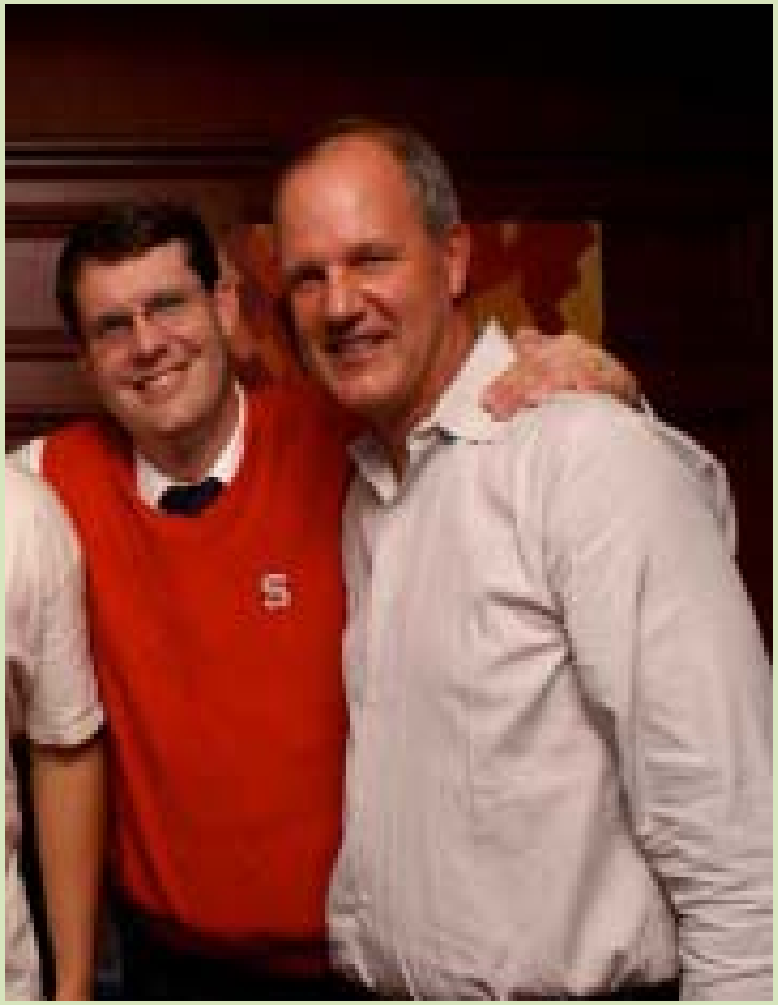
- I&M program has been offered in
- California (3X), Georgia (2X), Illinois, Tennessee, Minnesota

  New Zealand (2X), Australia, and Singapore

Course Content

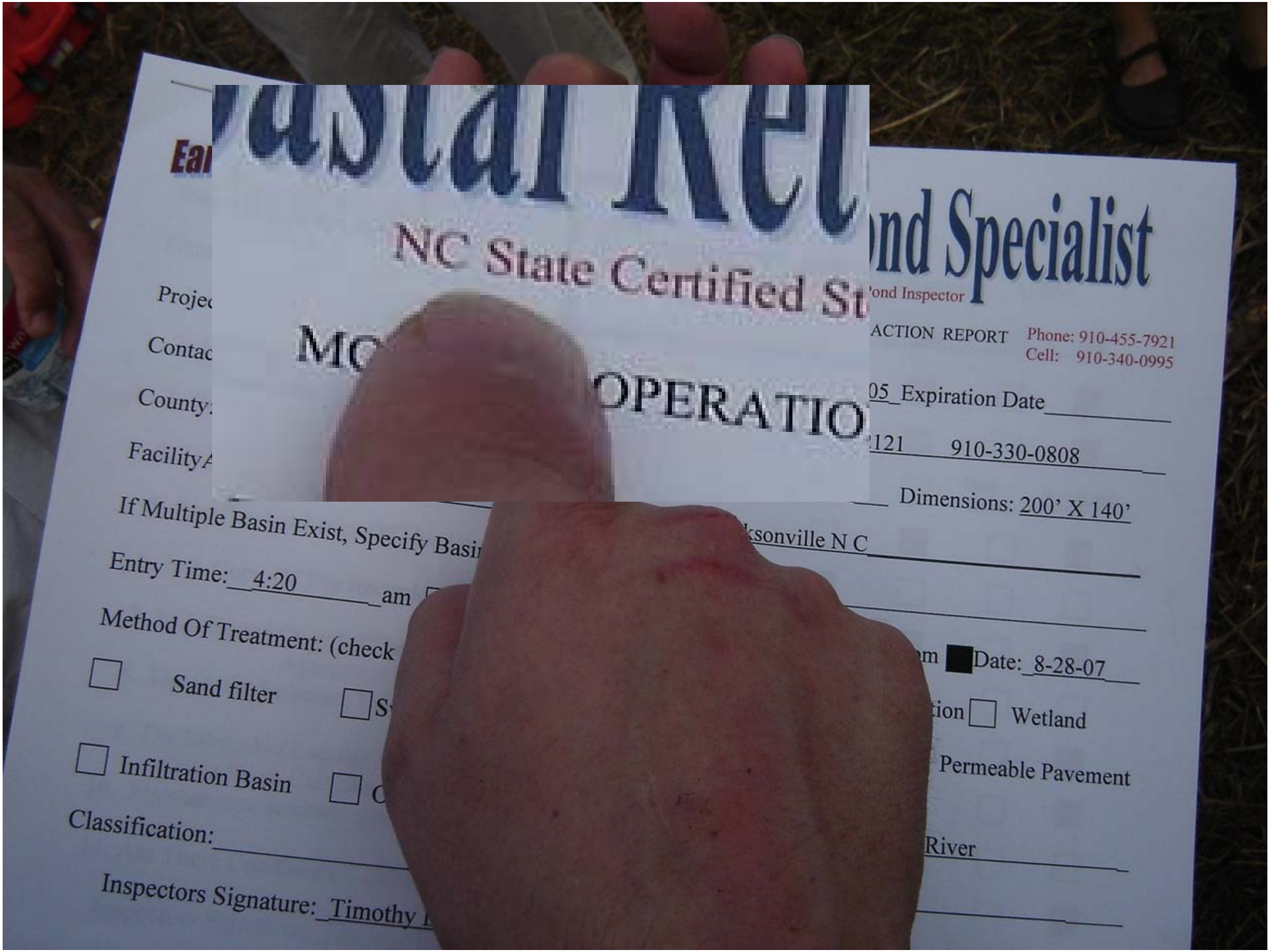
- 1.75 days
- 12 modules
- Emphasis on basics
- Modules are changed to emphasize concepts commonly missed on exams

Instructors



- Bill Hunt
  - Civil Engineer
  - Ag Enginner
- Bill Lord
  - Horticulturalist
  - Entomologist

The Examination


NC State Certified St
OPERATIO
ond Specialist
ond Inspector
ACTION REPORT
Phone: 910-455-7921
Cell: 910-340-0995
05 Expiration Date
121 910-330-0808
Dimensions: 200' X 140'
ksonville N C
Date: 8-28-07
Wetland
Permeable Pavement
River
Entry Time: 4:20 am
Method Of Treatment: (check
Sand filter
Infiltration Basin
Classification:
Inspectors Signature: Timothy

Has it worked?
Cary Stormwater BMPs (2007)

- Approximately 425 BMPs in Cary
- According to one of Cary's inspectors: Timothy Grady, RLA:
- 95% of BMPs failed initial inspection as they require repairs
- Most repairs are maintenance related: erosion, trash removal, tree removal

Has it Worked?
Cary BMPs… (now)

- ~ 95% pass, as owners better appreciate value of maintenance after investing in repairs…

For More Info on the BMP I&M Certification

- Google: BMP inspection NCSU

NCSU BMP Inspection and Maintenance Certification

Overview/Main | Certification Description | Upcoming Classes and Registration Information
Typical Agenda | Sample Powerpoint | Meet the Instructors | List of Certified Professionals

Why is Stormwater BMP Inspection and Maintenance Needed?

Communities across the State of North Carolina must manage rainfall that runs off roads, streets and parking lots. This runoff is called stormwater. To manage stormwater, many treatment devices, called BMPs, have been built. These devices include: wet retention ponds, bioretention areas, swales, stormwater wetlands, permeable pavement, rainwater harvesting systems, proprietary devices, and level spreaders. *BMPs must have annual, and sometimes more frequent, inspection and maintenance to perform as intended.* Maintenance includes hydrologic and water quality function, landscape functions, and consideration of impacts on human health and safety. Many communities across North Carolina are now requiring annual inspection, and if called for, maintenance of BMPs. BMPs are not managed as standard landscape features, as they are water quality treatment devices, and specialized training is needed to perform inspection and maintenance activities. BMP Inspection and Maintenance also presents a business opportunity for inspection by licensed professionals such as engineers and landscape architects, and maintenance by landscape and other green industry professionals. Those attending this course will:

- Understand stormwater, how it affects water quality, and regulations associated with it
- Understand stormwater management devices used in North Carolina and how they function
- Understand inspection and maintenance requirements of each stormwater practice

About the Training

This workshop offers 7 PDHs (professional development hours) for professional engineers and surveyors, as authorized by the NC Board of Examiners for Engineers and Surveyors. 10 CEUs are approved by the NC Board of Landscape Architects (Course # 6690). Other professionals may appeal to their respective boards to obtain professional education credits. All participants who pass an

Maintenance Objectives

- Safety
- Aesthetics
- Function
- "SAF"

Erosion, Sedimentation, & Clogging

Asphalt Generates Sediment

Other Asphalt Pollutants, too: hydrocarbons

Bioretention Sedimentation Case Study: Eroding Outparcel

Bioretention Sedimentation Case Study: Sediment in Bed

Bioretention Sedimentation Case Study: Excavating Sediment

Bioretention Sedimentation Case Study: Rebuilding Bed

7 years after repair

If not maintained, permeable pavement can become Impervious

Permeable Pavement Problems: Mud and Silt

Permeable Pavement Problems: Sediment

Unstable Catchment

Where does mud come from?

Permeable Pavement Maintenance:

Clean the Catchment - Street Sweeper

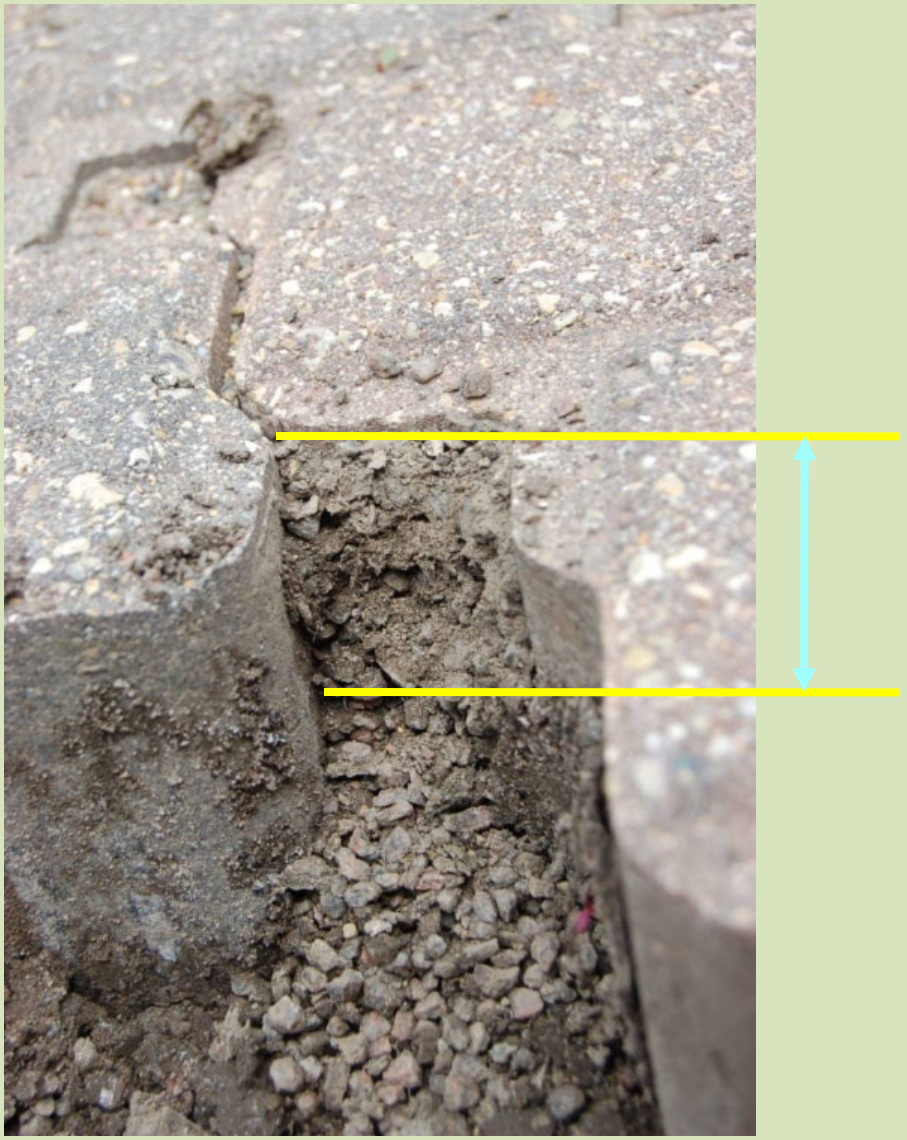
Permeable Pavement - Clean the Catchment: Blowing

Some of your Permeable Pavement will (nearly invariably) Clog

Permeable Pavement Clogging

Where does it happen?

The *Smutzdecke*!



Depth of Clogging Apparent

Different PP Systems Clog @ Different Locations

- PICP – Top 1.5 in
- CGP – Top ~0.5 in
- Pervious Concrete and Pervious Asphalt – Bottom of Cut (may be 4-8 from surface)

Though Specific Design Features have Impact

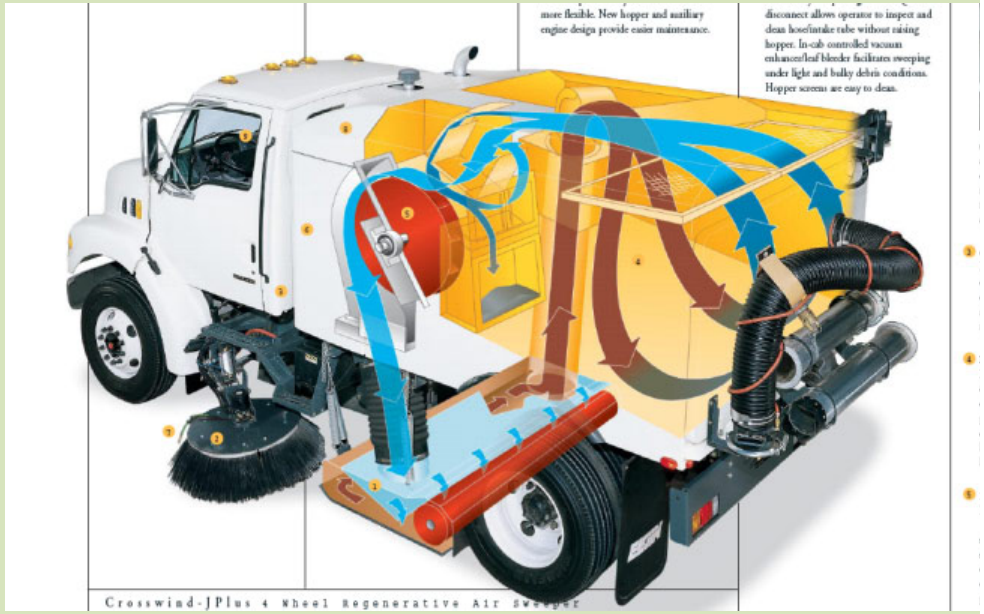
Purposefully embedded sand limits Smutzdecke depth

Permeable Pavement Maintenance: Sweeper/Vacuum Truck

Different Types of Sweepers for Different Types of Permeable Pavements:
Mechanical Sweeper vs. Regenerative Air Sweeper vs. Vacuum Sweeper

Preventative Maintenance

- Regenerative Air Street Sweeper good for <u>preventative</u> maintenance for:
  - PICP
  - Pervious Concrete
  - Pervious Asphalt
- May not work for <u>Restorative</u> Maintenance



Most Powerful Sweeper: The Vac Truck

Potential for Restorative Maintenance

Vacuum Sweeper Results


Gravel Loss
from Gaps is
not a universal
Maintenance
need

Filling gaps with gravel

Permeable Pavement Maintenance: Pressure Washing?

Mixed Results.

Pressure Washing: Mixed Results

- “Both sand and clay caused measurable clogging that was not reversible by pressure washing.”
- Coughlin et al. (2012). *J. Hydrol. Eng.*

Pressure Washing: Mixed Results

- “(1) Pressure washing and (2) pressure washing with power blowing… improved PC sidewalk infiltration… with and almost 200-fold increase observed… by combined pressure washing and power blowing”
- Dougherty et al. (2011). *J. Irrig & Drain Eng* (ASCE)

Must I Vac Sweep my entire lot?

Certain Areas Susceptible

- Landscape – Hardscape Interface
  - Overhanging Trees
- Impermeable Pavement – Permeable Pavement Interface
- Paths of “Dirty” Vehicles
- Snow Disposal

Vegetation Issues

Permeable Pavement Problems: Weeds and Moss

Grass growth is a sign of Sediment Accumulation

Permeable pavement weed control

- Systemic herbicides like Roundup™ - Preferred
- Flame weed killers – LP gas fueled – Be careful. Could ignite Concrete!
- Steaming

Grassed Permeable Pavement

You might have to mow it!

Permeable pavement weed control "dos and don'ts"

- Don't pull large weeds – can pull up pavers and fill gravel
- Do control weeds when they are small – if killed when large, dead weed biomass can clog pavement
- Some permeable pavements are meant to be vegetated – be careful

Plant Placement & Replacement in Bioretention

Dwarf Yaupon Holly in Saturated Soil

Gravel verges and grass filter strips = Treatment train

Damming by Vegetation?

Better By Design (70mm fall)

Mowing regimens?

Avoid scalping grass (Filter Strips & Swales)

Table 2. Guidelines for Mowing Heights

Lawngrass	Height after Mowing (inches)
Bermudagrass	3/4 to 1 1/2
Zoysiagrass	3/4 to 1 1/2
Centipedegrass	1 to 1 1/2
Kentucky bluegrass, fine fescue, or perennial ryegrass	1 1/2 to 2 1/2
Tall fescue	2 1/2 to 3 1/2

Remember: Height of Shoot Matches Depth of Root

Mowing – Important for Many SCMs

- Don’t Mow after rain/ soggy conditions
  - 0.50” Rain in Watershed could = 7” of Rain on SCM!!

What Mowing Can Prevent (Vegetated Filter Strip)

- 2 months old

What Mowing Can Prevent

- 13 months old

Reminder: Lots of nutrients in Runoff!

Fertilizer

- A one-time initial, slow-release fertilization may be OK
- Couple this with a soil test
- May need to lime for pH, too
- After that, let N+P in runoff do the work

By the way… a “no-no”


2004


2005


STOP


2004


STOP
2006

Bioretention Pruning

Bioretention Pruning

- Maintain lines-of-sight
- Allow sunlight into bed to kill pathogens
- Facilitate trash pick-up
- Safety issues

Costs

- Because much of this maintenance is landscape related, consider the MARGINAL cost
- E.Gg, the marginal bioretention maintenance cost versus standard landscaping was estimated to be 15%

Thank you for your time!

Speaker Contacts

Karen Sands, Milwaukee Metropolitan Sewerage District (MMSD)
KSands@mmsd.com | (414) 225-2123 |h2oCAPTURE.com

Bill Hunt, Professor and Extension Specialist, NC State University
bill_hunt@ncsu.edu | (919) 515-6751 | Google: "NCSU BMP I&M "

For questions about EPA's Green Infrastructure Webcast Series:

Eva Birk, ORISE Fellow, U.S. EPA Office of Wastewater Management
Birk.eva@epa.gov
(202) 564-3164

Emily Ashton, ORISE Fellow, U.S. EPA Office of Wastewater Management
Ashton.emily@epa.gov
(202) 564-3324

Next Webcast

Case Studies: Implementing Green Infrastructure under Enforcement Orders

Tuesday, March 4th, 2014

1:00 – 2:30pm EST

Information and registration will be posted at

http://water.epa.gov/infrastructure/greeninfrastructure/gi_training.cfm