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

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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

An expert

Some experience through

Extensive knowledge
called in for advice
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
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 Enginee

- Bill Lord
  - Horticulturalist
  - Entomologist
The Examination
Coastal Relief
NC State Certified Specialist

MOISTURE OPERATION

ACTION REPORT

Expiration Date

Dimensions: 200’ X 140’

Jacksonville N.C.

Entry Time: __4:20___ am

Method Of Treatment: (check)

- Sand filter
- Sedimentation
- Infiltration Basin

Classification:

Inspectors Signature: Timothy B. [Redacted]
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

**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 # 6890). 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 preventative maintenance for:
  – PICP
  – Pervious Concrete
  – Pervious Asphalt

• May not work for Restorative Maintenance
Most Powerful Sweeper: The Vac Truck

Potential for Restorative Maintenance
Vacuum Sweeper Results
Gravel Loss: A problem?
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

<table>
<thead>
<tr>
<th>Lawngrass</th>
<th>Height after Mowing (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermudagrass</td>
<td>3/4 to 1 1/2</td>
</tr>
<tr>
<td>Zoysiaagrass</td>
<td>3/4 to 1 1/2</td>
</tr>
<tr>
<td>Centipedegrass</td>
<td>1 to 1 1/2</td>
</tr>
<tr>
<td>Kentucky bluegrass, fine fescue, or perennial ryegrass</td>
<td>1 1/2 to 2 1/2</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>2 1/2 to 3 1/2</td>
</tr>
</tbody>
</table>

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
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

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For questions about EPA’s Green Infrastructure Webcast Series:

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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