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Alternatives to Porous Pavement and Maintenance Considerations

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Mark Mittag, P.E.
Mark.Mittag@ch2m.com

Green Infrastructure Drivers

- Since 1999, with strong endorsement by the EPA, green infrastructure has been the trend in Local/State stormwater regulation and design manuals
- LEED New Construction Credit 6.1 requires stormwater volume control,
  - LID linked to approximately 10 LEED credits
- Combined Sewer Overflow (CSO) control
- Chesapeake Bay, Puget Sound, San Francisco Bay, other critical waters
- And others (e.g., Impaired waters, grant programs)
- Incentives – environment, sustainability, community benefits, reduced liability, cost-effective
- **Proposed EPA Federal Stormwater Rules!!**

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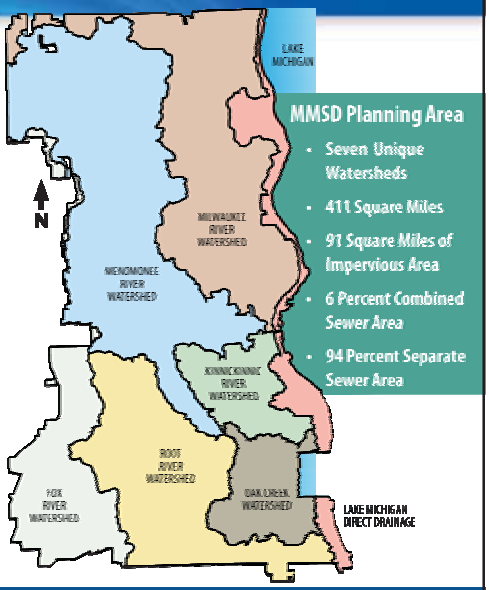
MMSD Permit Requires Green Infrastructure

- Permit requires 1 million gallons new GI annually
- First permit in the country with a green infrastructure requirement in the body of the permit



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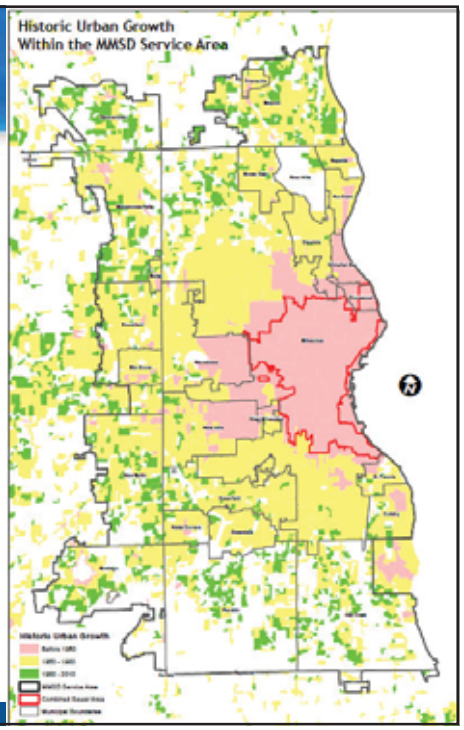
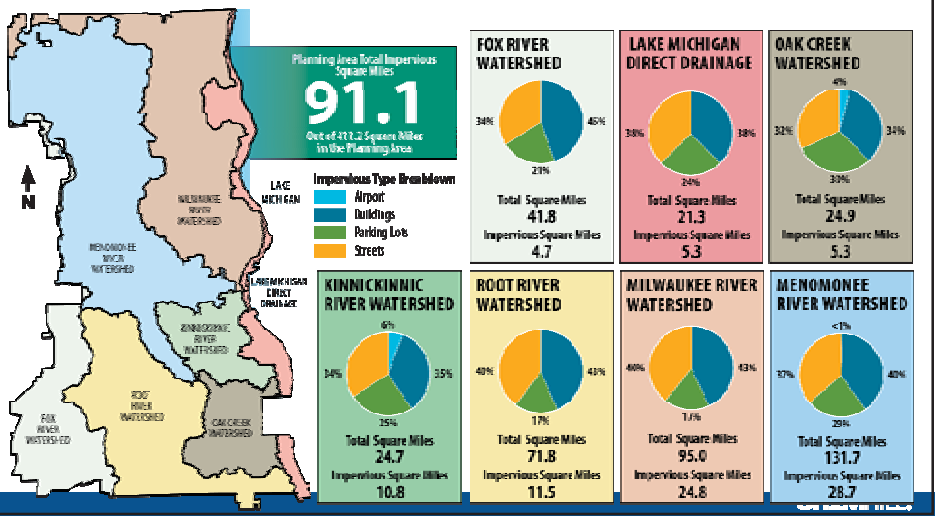
Historical Urban Growth

- Prior to 1950
- Prior to 1980
- Since 1980
- Implications for green infrastructure strategies



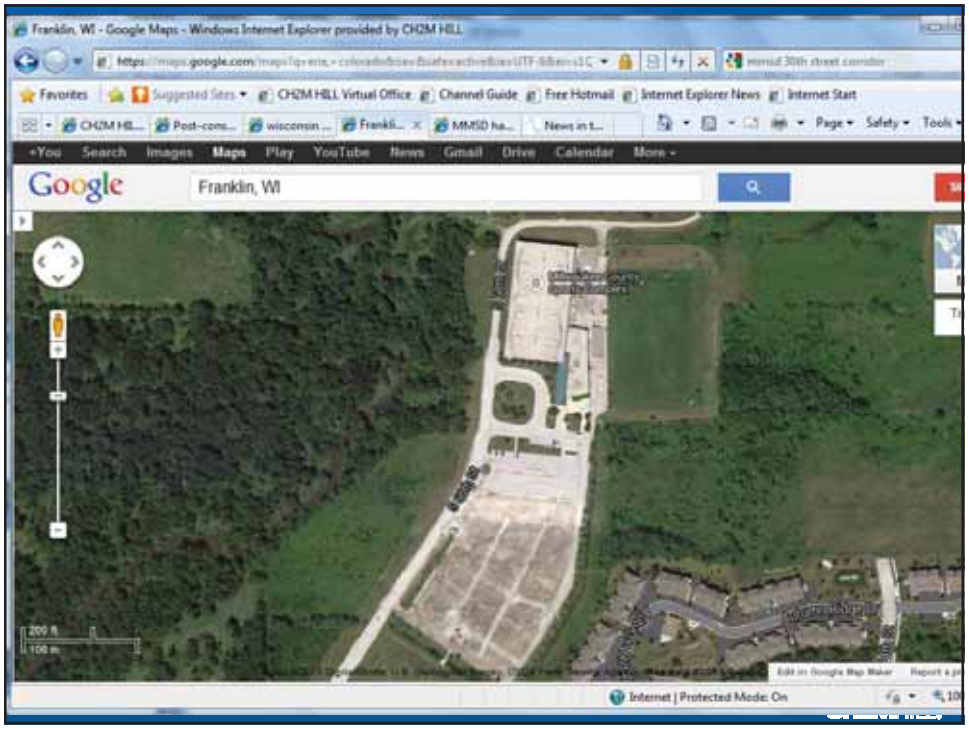
Understand Watershed Differences

- Watershed-specific conditions guide GI portfolio



Land Use Drives Green Infrastructure Strategy Selection

- Amount of area
- Constraints to implementation
  - Steep slopes
  - Depth to groundwater/bedrock
  - Parcels with limited area



City of Milwaukee 2014 Street CIP Example Evaluations

- West Roosevelt Drive between 60th Street and 37th Street
  - Typical median boulevard
- South 71st Street between Montana and Kinnickinnic River Parkway
  - Typical residential street
- East Michigan Street between Water Street and Lincoln Memorial Drive
  - High urban example

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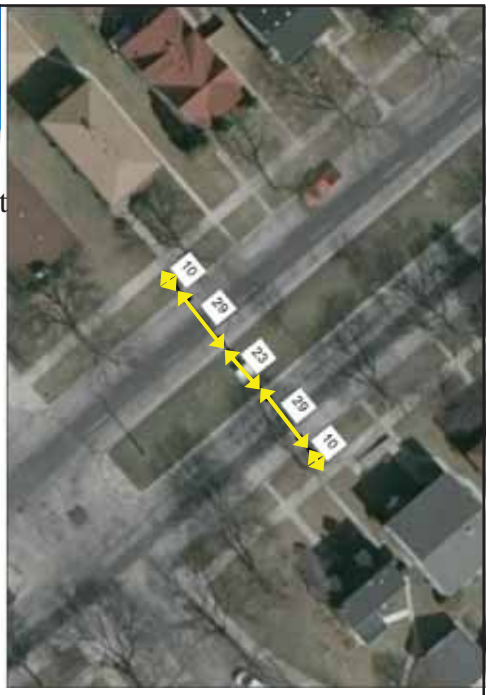
West Roosevelt Drive Dimensions

Median Width = 23 feet
Road Width = 29 feet x 2 feet = 58 feet
Terrace Width = 10 feet
Project Length = 8,850 feet

Green Street Opportunities:

- Median Bioretention
- Terrace Bioretention
- Open Space Bioretention
- Porous Pavement
- Tree Trench

Considerations:
Reconstruction versus Repaving



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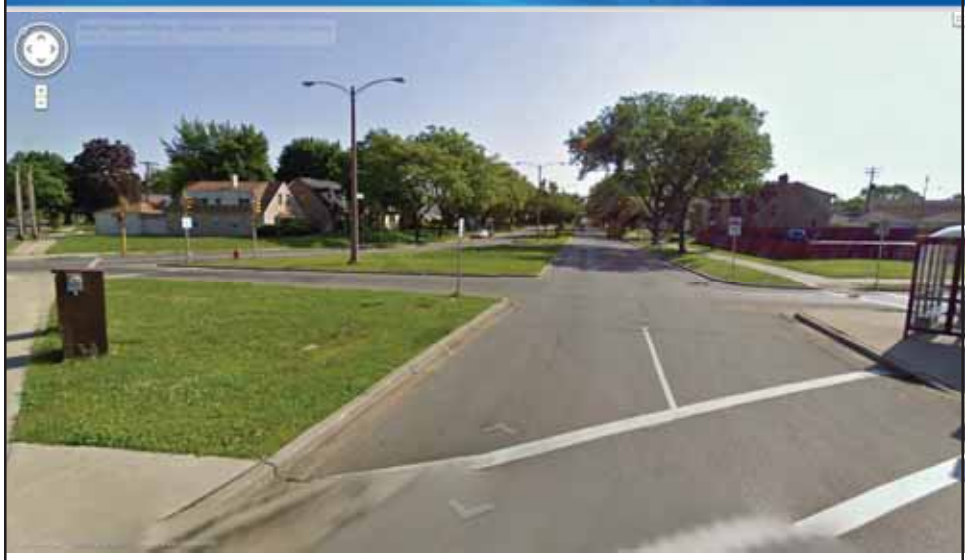
West Roosevelt and 60th Street View



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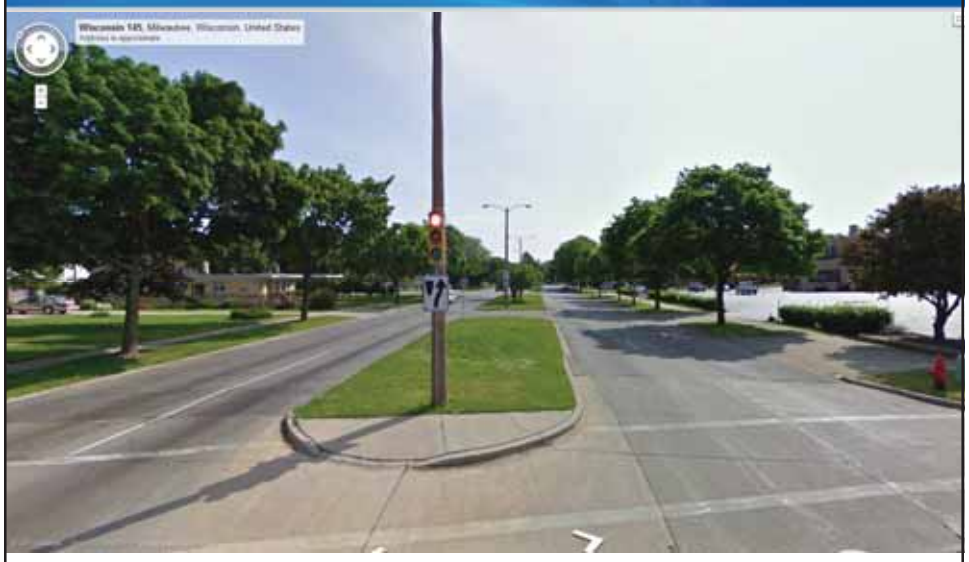
West Roosevelt and Fond du Lac Street View



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71st Street

- Residential area
- Grass terrace
- No median
- Good existing tree canopy cover

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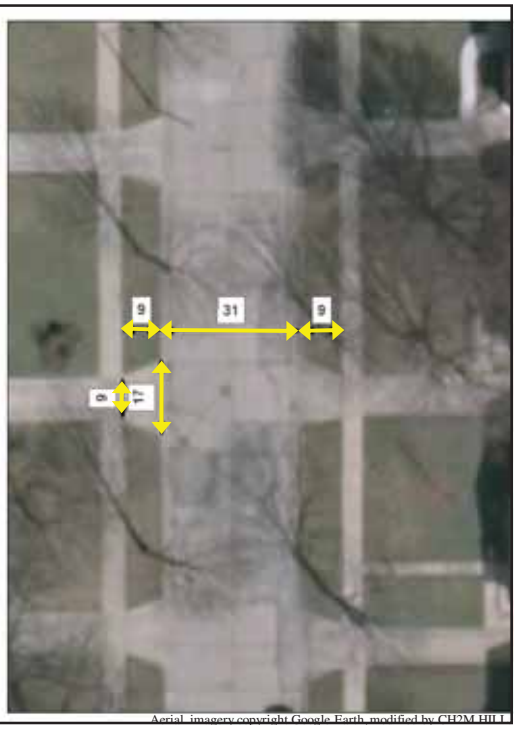
71st Street Dimensions

Median Width = none
Road Width = 31 feet
Terrace Width = 9 feet
Project Length = 1,100 feet

Green Street Opportunities:

- Terrace Bioretention
- Porous Pavement
- Tree Trench
- Open Space Bioretention



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71st Street

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71st Street Looking south from Montana 02/21/2013

Michigan Street—Water Street to Lincoln Memorial Drive

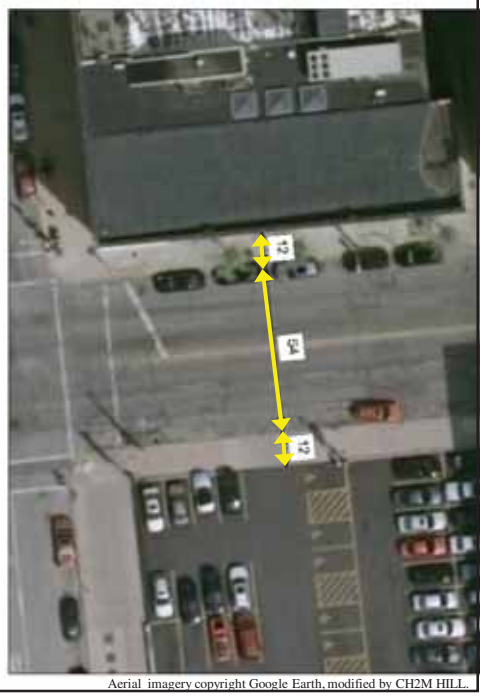
- Central business district
- Full terrace sidewalk,
- High traffic area
- Some off-street open space

Michigan Street Dimensions

Median Width = none
Road Width = 54 feet
Terrace Width = 12 feet
Project Length = 3,000 feet

Green Street Opportunities:

- Tree Trench
- Porous Pavement Parking Lane
- Planter Boxes instead of Terrace Bioretention
- Open Space Bioretention



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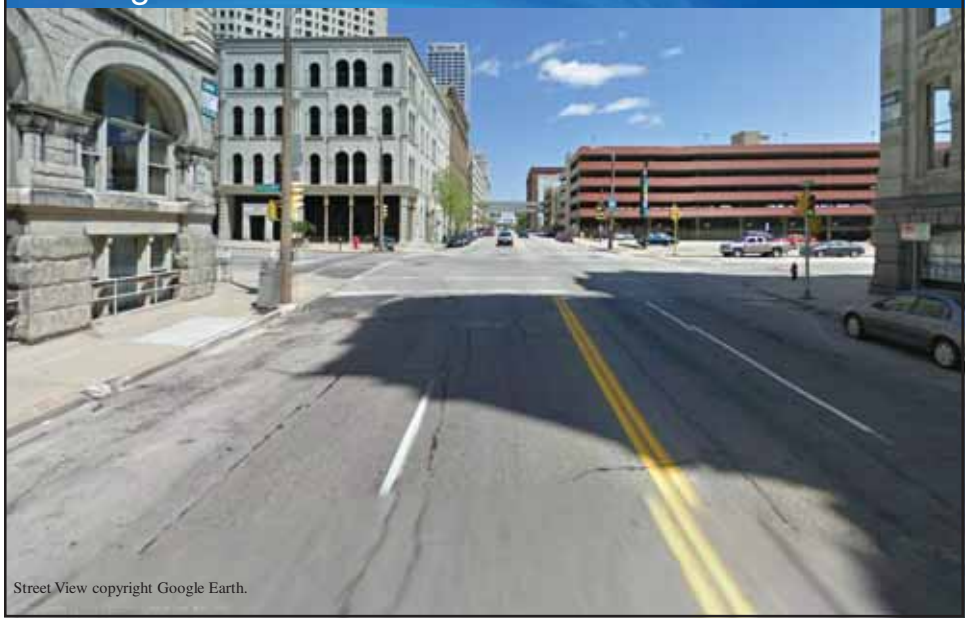
Michigan Street



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Michigan Street

Michigan

Looking east on Michigan near Water Street

Regional Resource

- H2OCapture.com

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Why is Maintenance Important?

- Ensure long term performance of Green Stormwater Assets
- Protect capital investments
- Meet regulatory requirements
- Public health issues
- Public/community perceptions

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So… when should I start thinking about maintenance?

At the start of design!

(if not earlier)

Maintenance: From Grey to Green

- Typically relies less on heavy equipment and confined entry and more on hand work
- Vegetation establishment and maintenance critical
- Routine maintenance of porous materials
- Routine maintenance of pretreatment devices (i.e. inlet filters)
- Highly visible systems and structures require routine maintenance for public perception
- **Some overlap with maintenance that is already taking place!**

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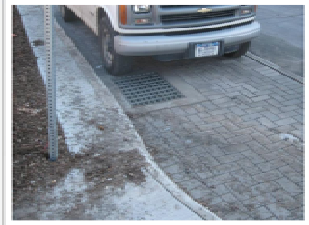
Porous Pavements: General Maintenance

- Clean inlets; clean-outs twice per year
- Vacuum semi-annually
- Power-wash only if needed
- Maintain adjacent landscaping/planting beds
- Winter maintenance considerations



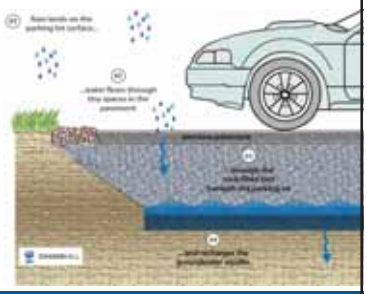


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TABLE 1
Sweeper Equipment Comparison Metrics

Make/Model	Type	Size (LxWxH)	Cleaning Width	Approx. Cleaning Time for 1 acre[a]	Suction (Water Column)	Noise Level[d]	Approx. New Cost
Elgin Whirlwind	Pure Vacuum [Large-driven]	21 feet x 8 feet x 10.5 feet	32 inches	96 min.	68 inches	83 dB	$220,000
Tymco 600 Air Sweeper	Regenerative [Large-driven]	22.5 feet x 8 feet x 10 feet	87 inches	36 min.	Not available	72 dB	$200,000
Tennant ALTV 4300	Pure Vacuum [Sidewalk]	8.5 feet x 4 feet x 7 feet	46 inches[b]	66 min.	Not available	Not available	$30,000
Tennant Green Machine 636	Pure Vacuum [Intermediate]	11.5 feet x 4.5 feet x 6.5 feet	47 inches	69 min.	Not available	Not available	$100,000
Elgin Pelican[e]	Mechanical Sweeper	16 feet x 8.5 feet x 10 feet	120 inches[c]	27 min.	Not applicable	Not available	$135,000

[a] Assumes a 1-acre area, at 5 miles per hour sweeping speed without stopping, hand labor, or other tasks.
[b] While the pickup width is 46 inches, the vacuum suction hose for the pickup rack is only 8 inches.
[c] Including two side broom attachments. Main broom is 66 inches wide.
[d] Average of decibels at left, right, front, and rear of unit at a distance of 50 feet.
[e] Not recommended for porous pavement maintenance.
NA = Information not available.

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Photos
(courtesy of each equipment manufacturer)

Elgin Whirlwind

Tennent Green Machine 636

Tennant ALTV 4300

Tymco 600

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Lessons from the LID / GI School of Hard Knocks

- "This is porous what?" (i.e. institutional memory can be fleeting; signage helps!)
- "What are those weeds doing in my rain garden?" (i.e., native bioretention plants can look like weeds)
- "Yep, I just mowed the whole site" (including those "rain pits" over there)
- "Just throw it in that swampy thing" (i.e. rain gardens collect trash)

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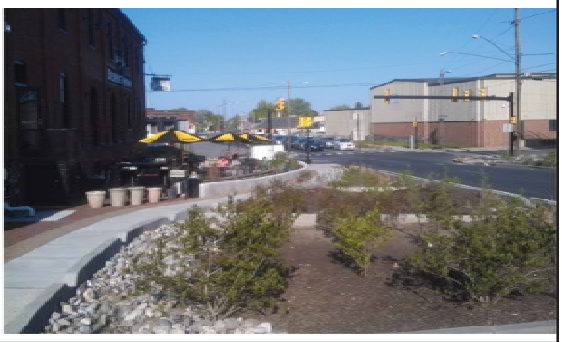
Overcoming Poor Public Awareness of GI

- Tours and workshops raise public awareness about GI practices and maintenance
- GI program branding with fact sheets, websites and videos
- Establish volunteer maintenance programs



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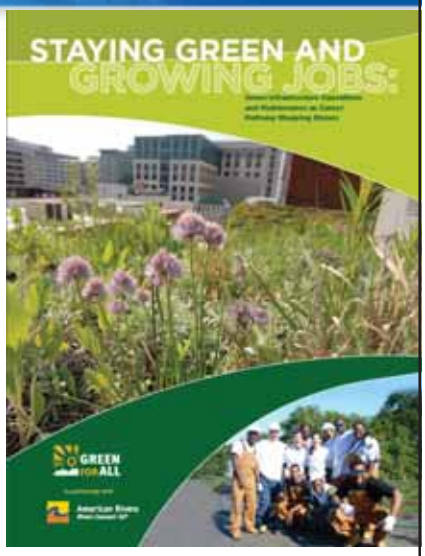
Linking Green Infrastructure Maintenance to Green Jobs

- Highly visible vegetative GI practices make them more likely to be maintained
- Requires workforce with new skills
- Create long term permanent jobs
- Specially trained professionals for inspections
- Opportunity to create entry level positions to disadvantaged youth



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More Information

- Staying Green: Strategies to Improve Operations and Maintainance of Green Infrastructure in the Chesapeake Bay Watershed, American Rivers (2013)
- NC State University Cooperative Extension BMP Inspection & Maintenance Certification: http://www.bae.ncsu.edu/topic/bmp-im/overview.html
- The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure, US EPA (2013) http://water.epa.gov/grants_funding/cwsrf/upload/Green-Infrastructure-OM-Report.pdf

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Discussion

- Mark Mittag
  (414) 847-0536
  Mark.Mittag@ch2m.com

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