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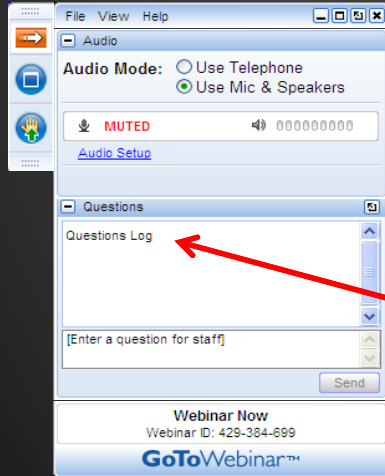
Green Infrastructure Maintenance - Case Studies in Program Development and Implementation

April 5th, 2017

1:00 PM - 3:00 PM ET



How to Participate Today



- Audio Modes
 - Listen using Mic & Speakers
 - Or, select "Use Telephone" and dial the conference (please remember long distance phone charges apply).
- Submit your questions using the Questions pane.
- A recording will be available for replay shortly after this webcast.



Today's Moderator



Dwayne Myers, P.E., D.WRE
CDM Smith



Today's Presentations

PWD's Green Stormwater Infrastructure Maintenance Program
Meg Malloy
Barbara Cushing

Green Infrastructure Manager for DC Water's DC Clean Rivers Project
Bethany Bezak, PE, LEED AP

Introduction to the National GI Certification Program (NGICP)
Stacy J. Passaro, P.E., BCEE



PWD's Green Stormwater Infrastructure Maintenance Program
Meg Malloy
Barbara Cushing

PHILADELPHIA WATER
EST. 1901

The slide features a background image of the Philadelphia skyline at dusk, with a bridge and water in the foreground. The Philadelphia Water logo is in the bottom left, and the Water Environment Federation logo is in the bottom right.

PHILADELPHIA WATER | Green City, Clean Waters
— DEPARTMENT —

A Sustainable Utility in support of a Sustainable City

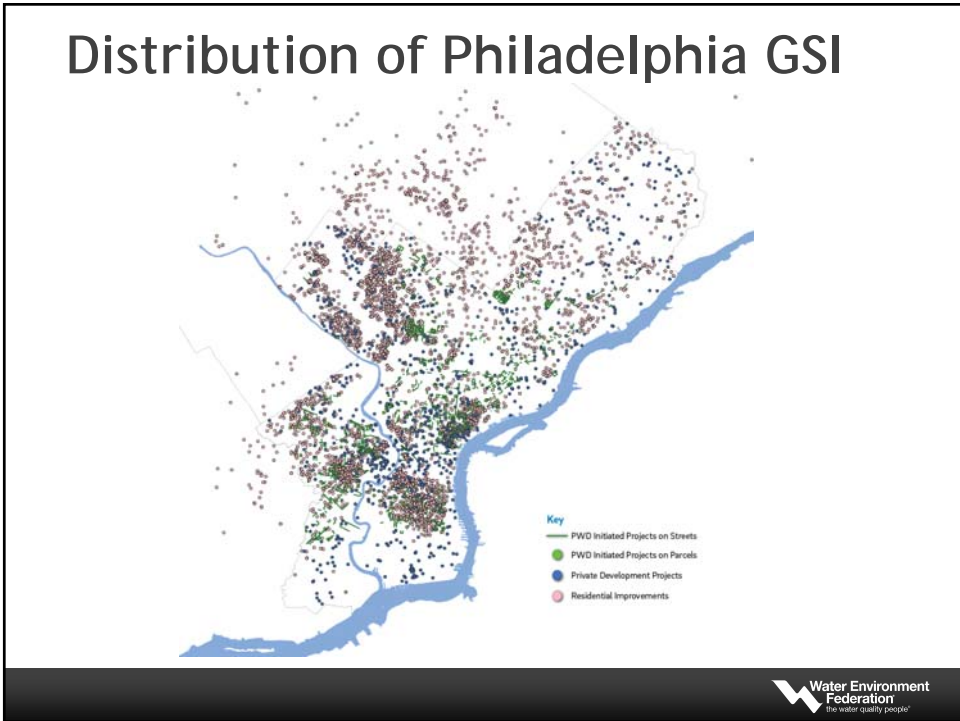
Drinking Water
1.73 million customers in Philadelphia, Bucks, Montgomery & Delaware Counties

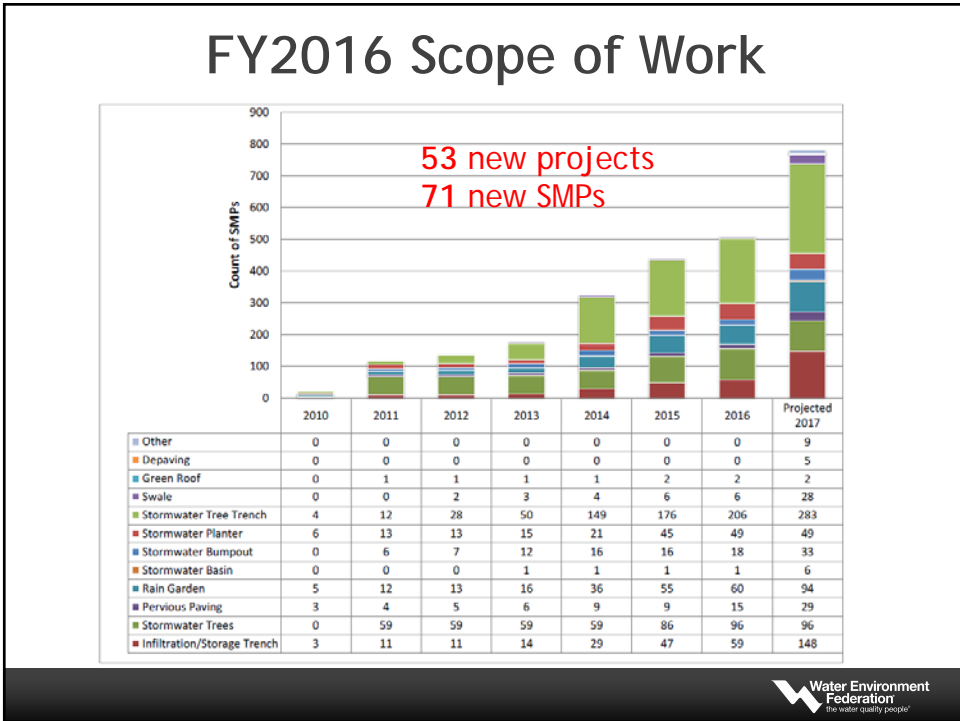
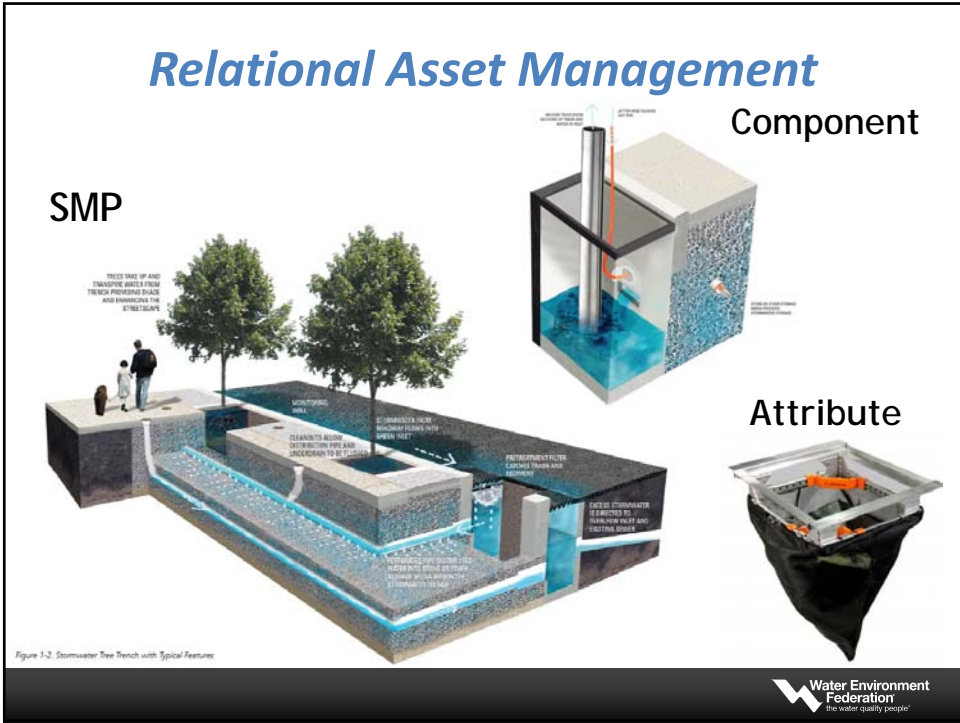
Wastewater
2.22 million customers in Philadelphia, Bucks, Montgomery & Delaware Counties

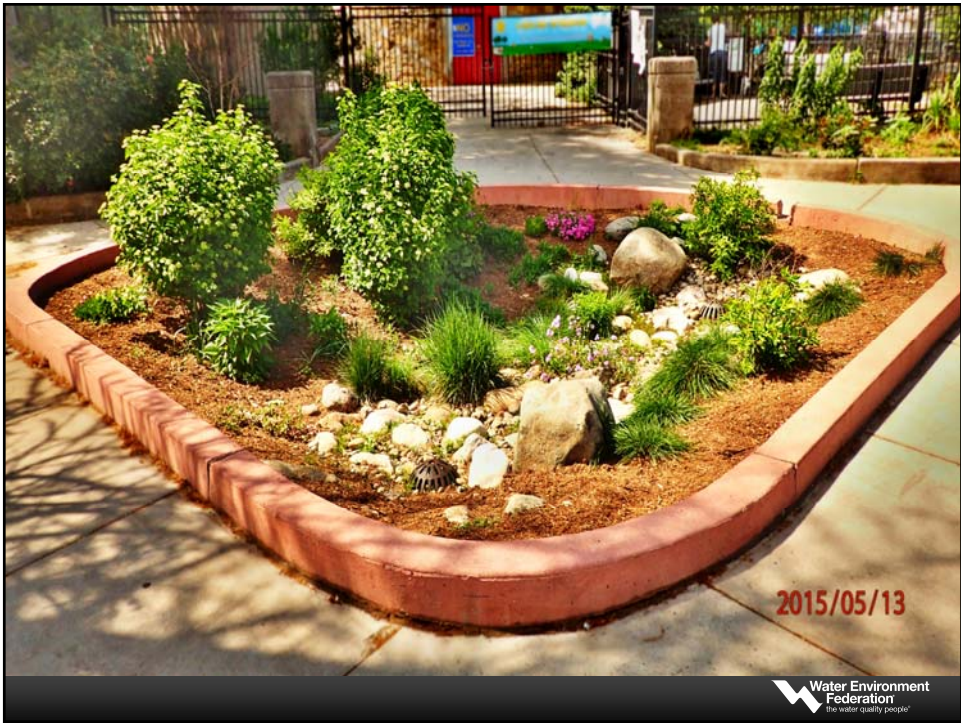
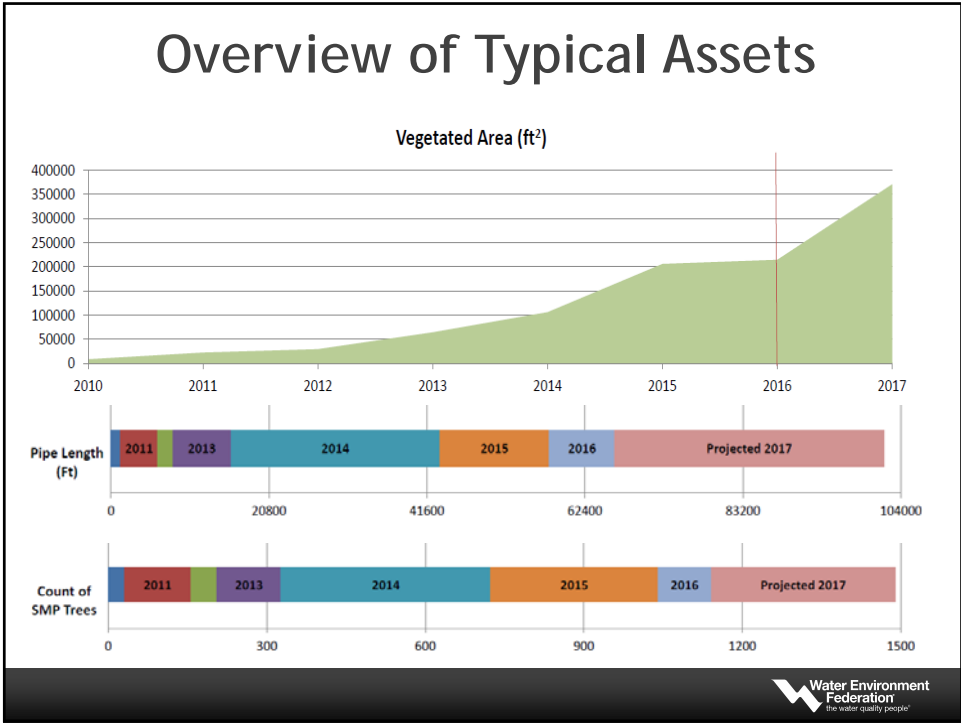
Stormwater
Philadelphia City/County only

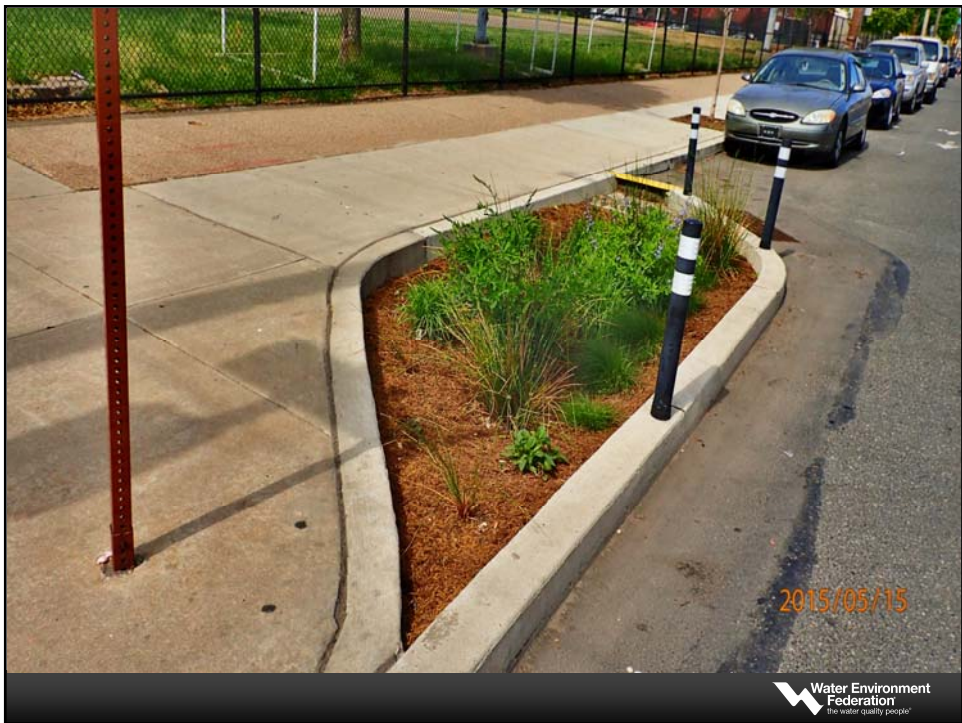
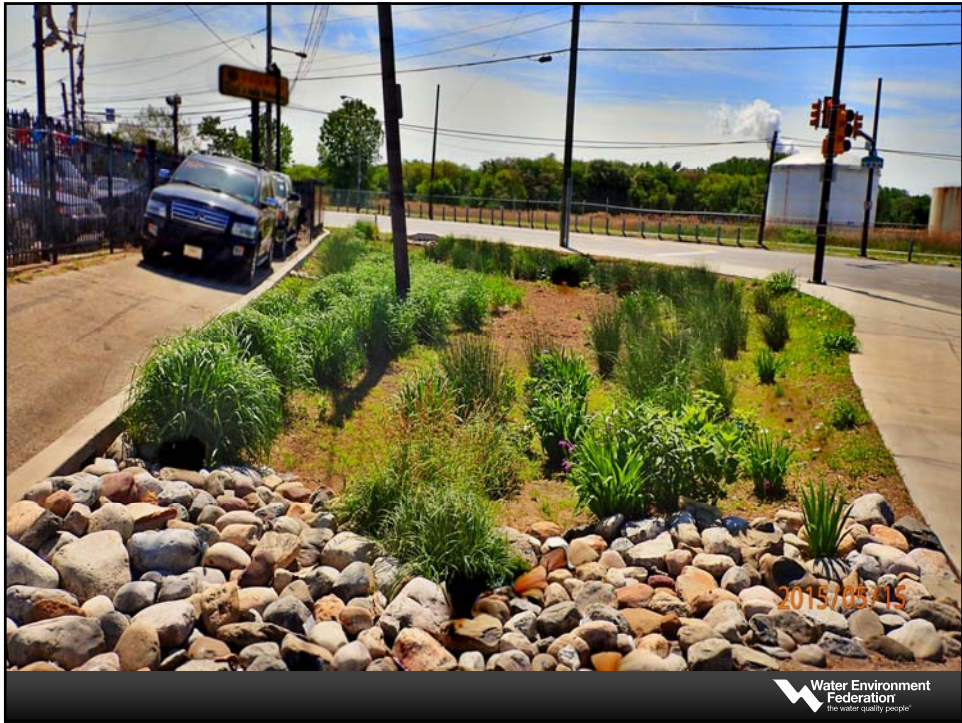


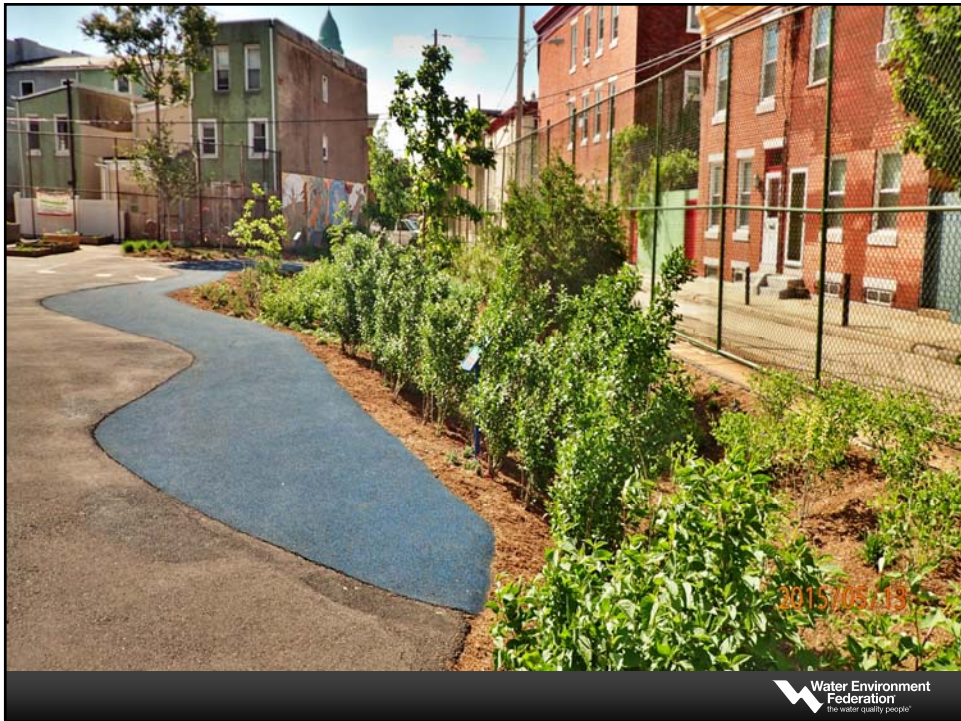
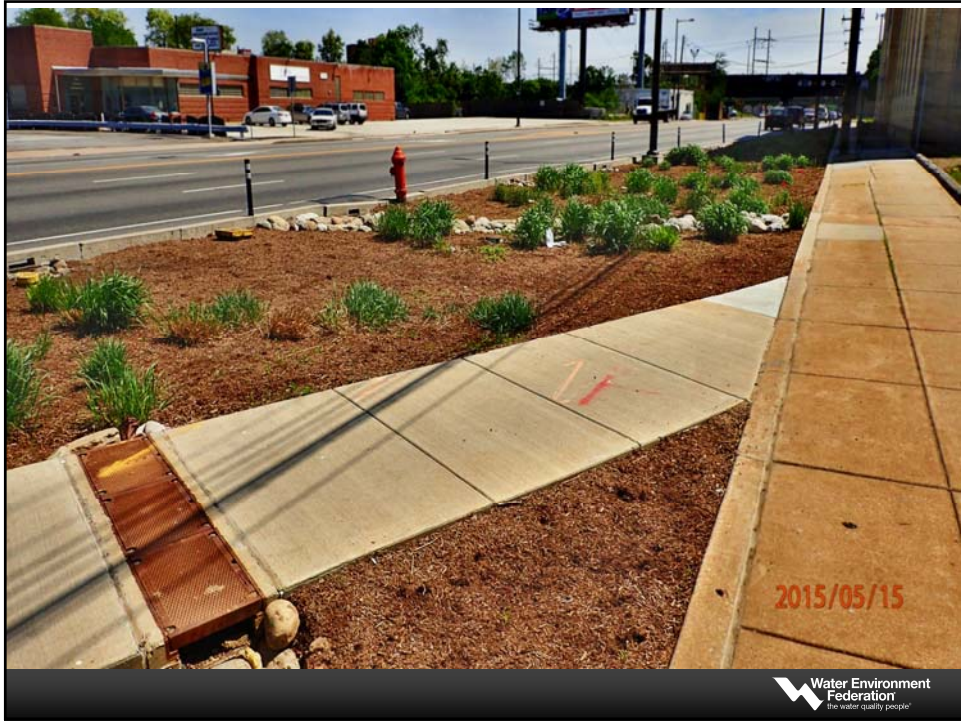
Water Environment Federation
the water quality people

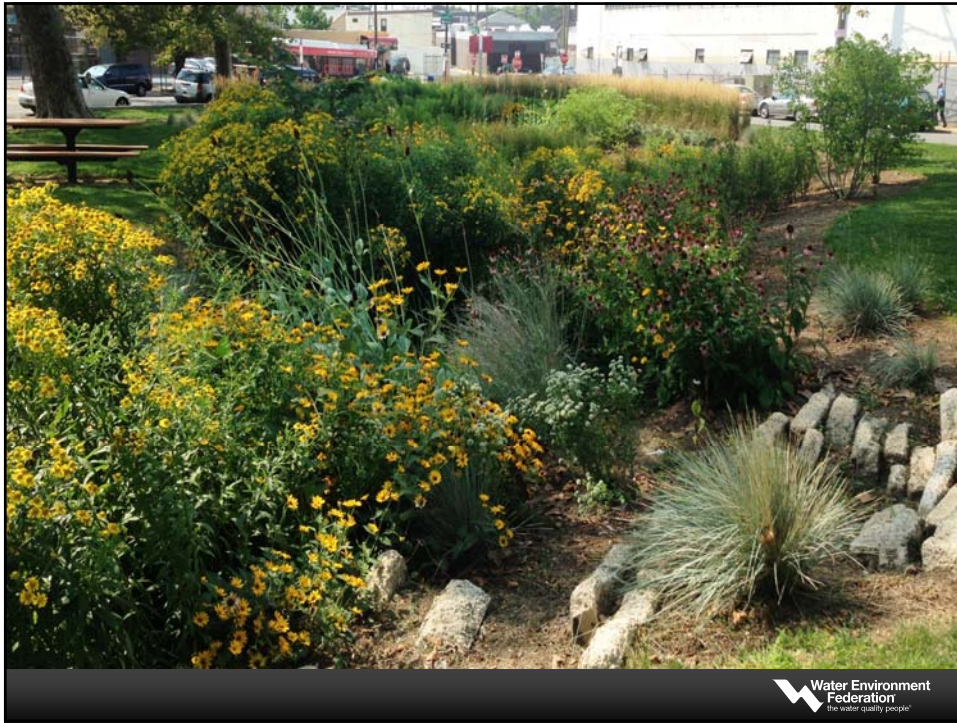












Surface vs. Subsurface

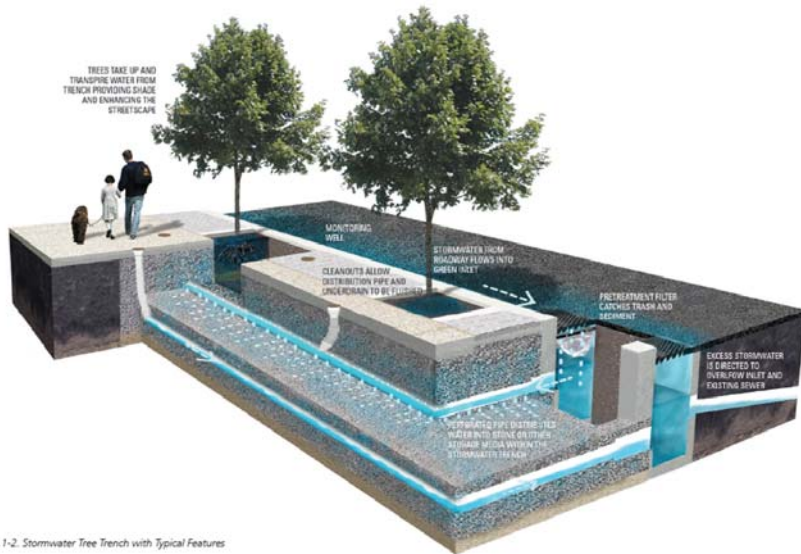
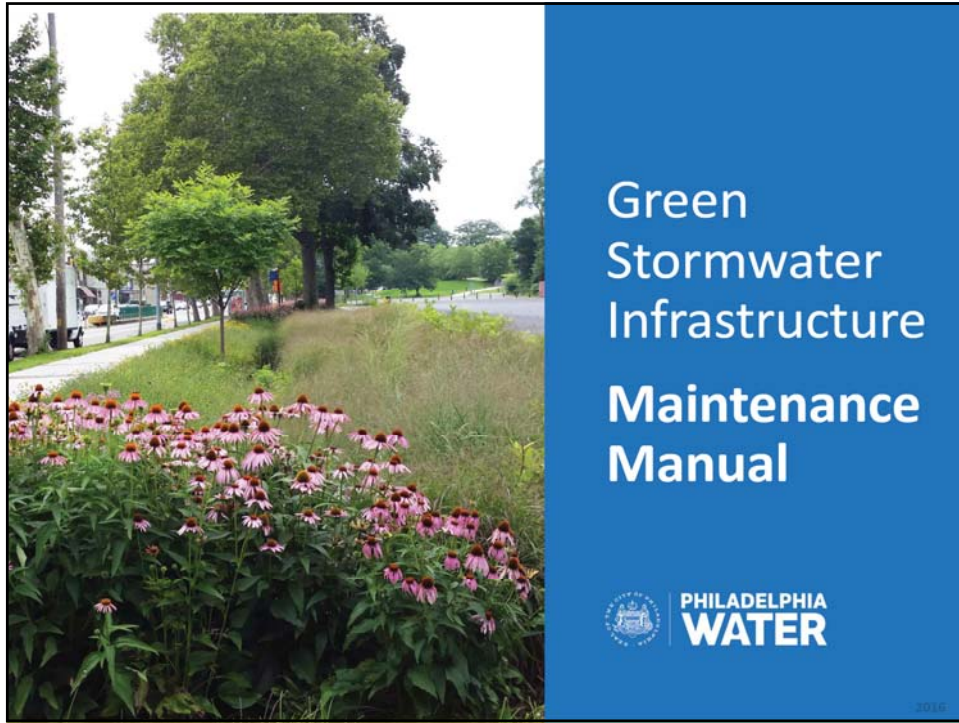


Figure 1-2. Stormwater Tree Trench with Typical Features






GSIMN's Plant ID Guide

GREEN STORMWATER INFRASTRUCTURE
MAINTENANCE
SHRUB & HERBACEOUS
PLANT IDENTIFICATION GUIDE
PHILADELPHIA
WATER

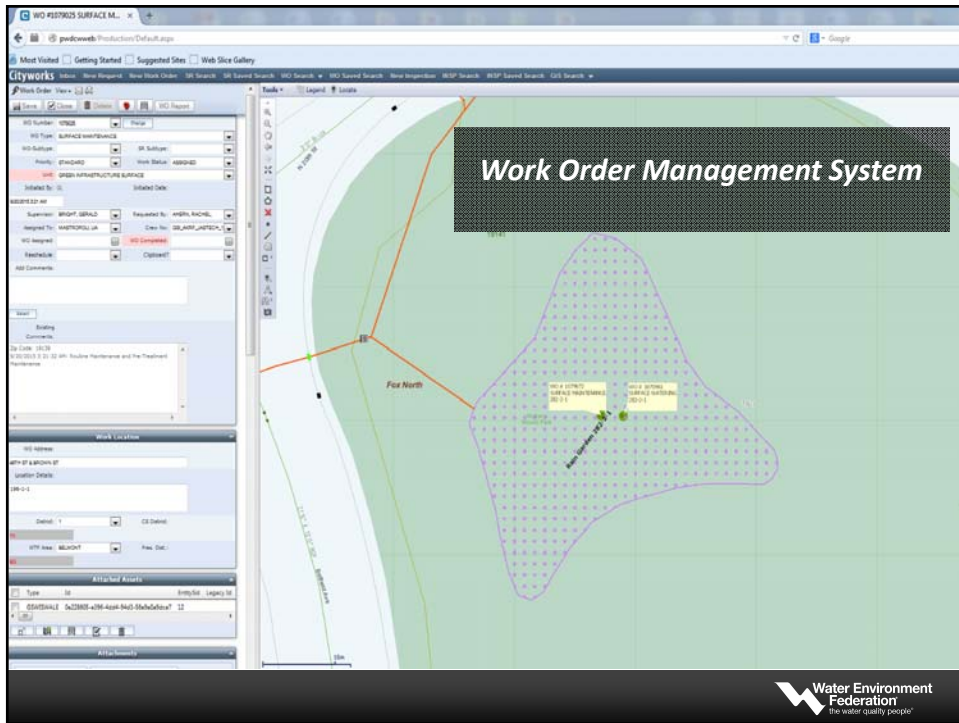
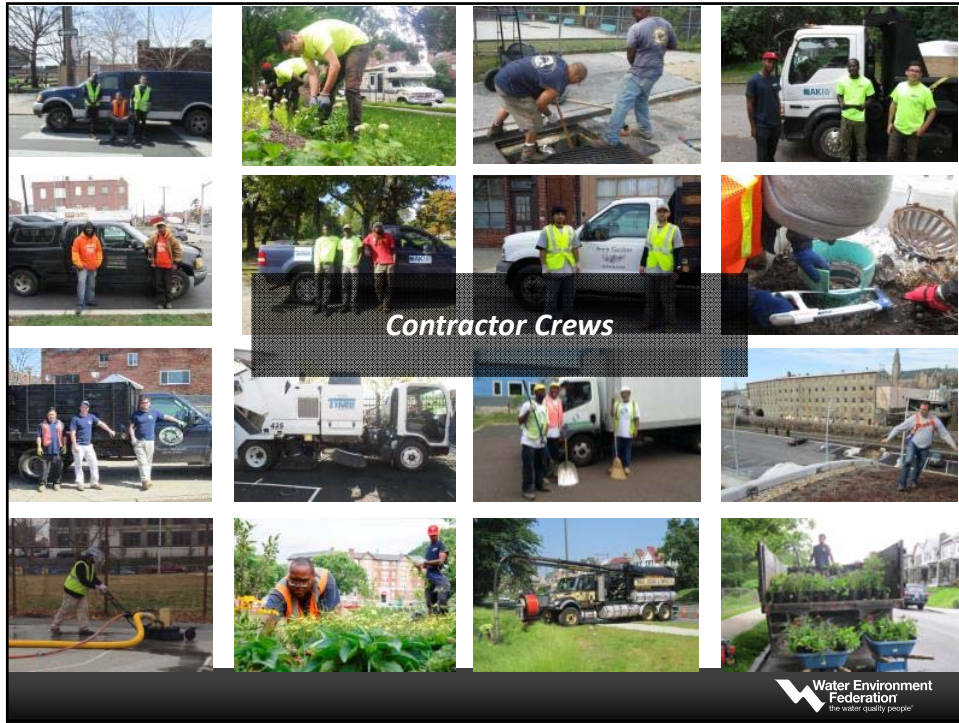
ADONICAEAE / Viburnum

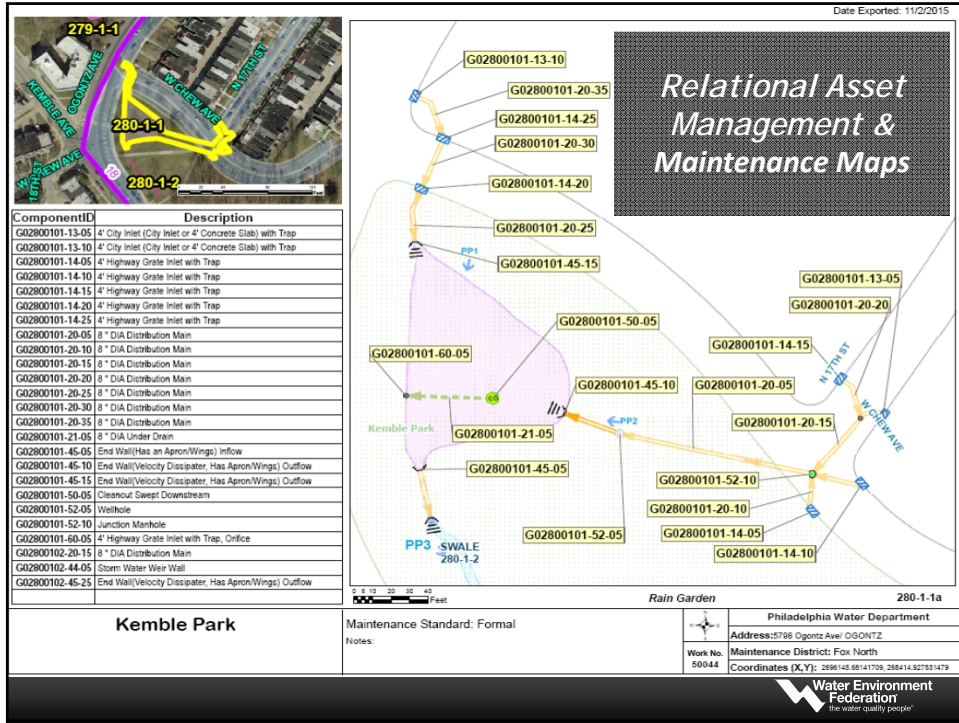
Viburnum nudum* var. *cassinoides
(Withered Viburnum, Blue Haw)
5-6' Tall (up to 12')
Blooms Early Summer

- Leaf: Football or egg to oblong (to 3 1/2" long); Nearly smooth with scales; Teeth rounded and widely spaced
- Flowers: White flowers (3/16" across) in flat-topped clusters (cymes 2-5" wide) in spring
- Fruit: Green fruit (5/16" long) turns pink to red to blue to black in fall, provide winter interest
- Fall Color: Vary: yellow, orange-red, dull crimson, and purple
- Problems: Occasional insect pests include aphids, borers, nematodes, scale and thrips. Occasional disease problems include anthracnose, leaf spots and powdery mildew.
- Maintenance: Prune in late fall or early spring

13





Routine Surface Maintenance



Routine Subsurface Maintenance



Porous Pavement Maintenance



Porous Pavement Winter Maintenance



Aesthetic Maintenance



Partnership With PowerCorps_PHL

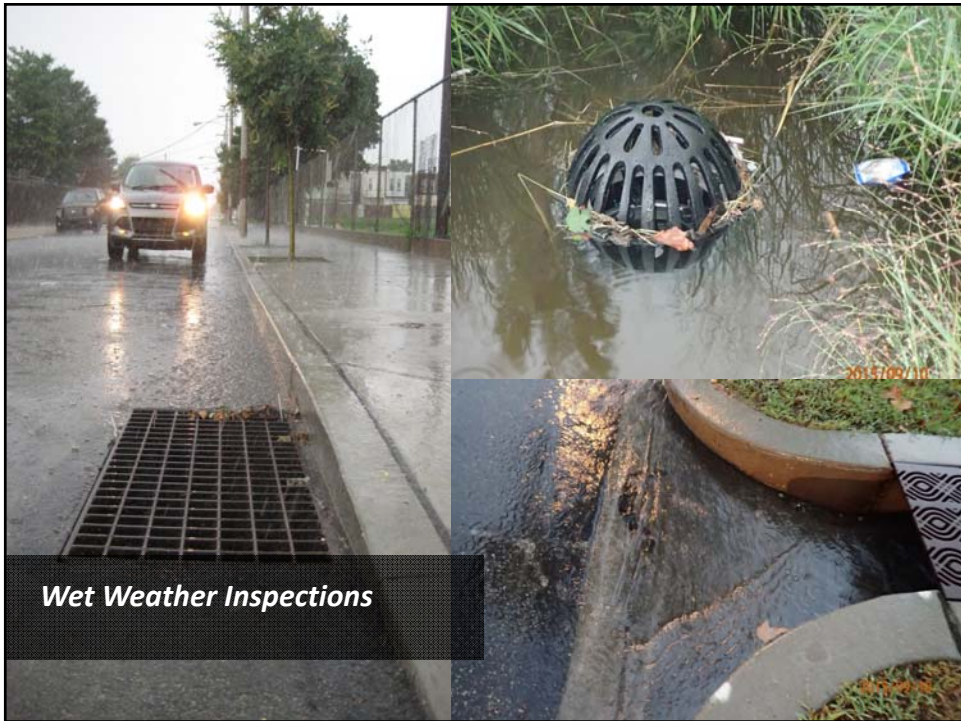


"In-House" Reactive Maintenance: GSI Maintenance Apprentices



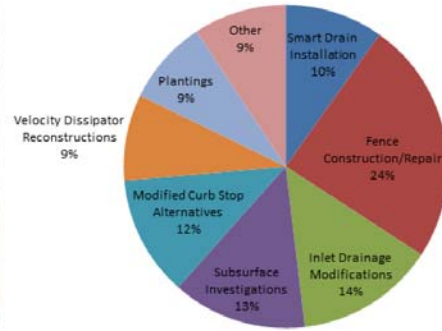
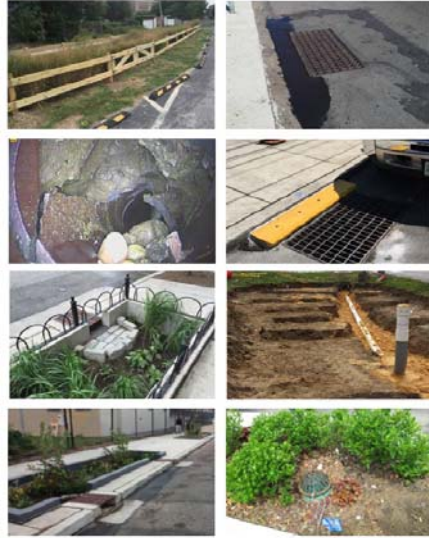


Dry Weather Inspections



Wet Weather Inspections

On-Call Additional Maintenance



Landscape Public Works Contract



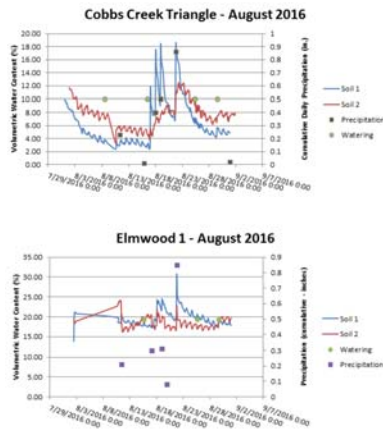
- Landscaping Public Works Contract (50153) started in March 2016
- Planting, seeding, mulching, and fencing for all capitol projects
- GSIMN completed site inspections
- GSI Unit to assist in FY 2018



Photopoints?



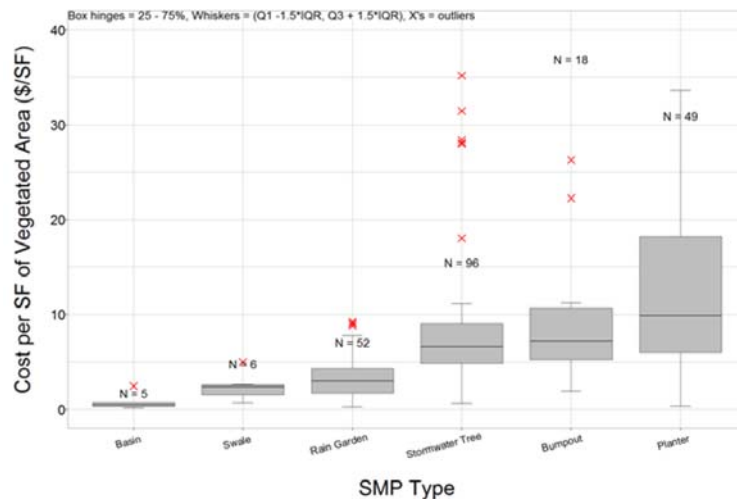
Soil Moisture Sensor Study



- Watering is a large annual cost
- Improving predictions of watering needs can save costs
- 9 moisture monitoring units at 4 GSI sites
- Results: Moisture is highly variable, depending on soil type and sensor location
- Recommend to continue in FY 2017-18 season



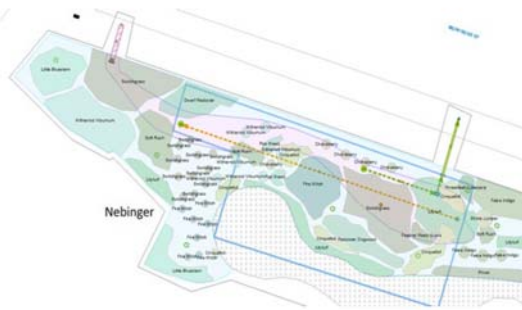
Surface Maintenance Cost Analysis



Costs per Area (as Vegetated Footprint) by SMP



Vegetation Study



- Mapped 100 “soft” sites with species
- Identified 1,233 unique target species
- A range of 2-45 species per SMP



Bethany Bezak, PE, LEED AP

- Green Infrastructure Manager for DC Water’s DC Clean Rivers Project



Incorporating Adaptive Management into Maintenance

Bethany Bezak
DC Clean Rivers Project



Agenda

- Overview of DC Water's DC Clean Rivers Project (DCCR)
- DCCR's GI Asset Management and Maintenance Program
- Adaptive Management Examples
- Green Infrastructure, Green Jobs



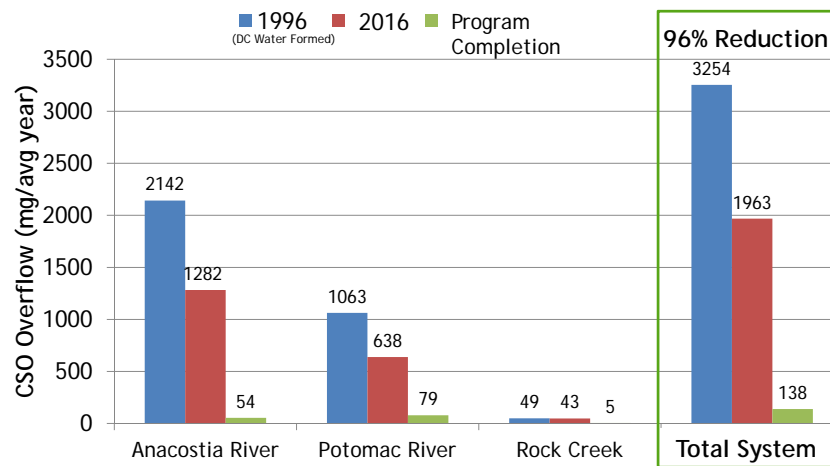
Combined Sewer System in Washington, D.C.



- Combined Sewer System Covers 1/3 of the District (12,478 acres)
- 47 Active CSO outfalls
 - 13 to Anacostia
 - 10 to Potomac
 - 24 to Rock Creek
- Three receiving waters
 - Anacostia River
 - Potomac River
 - Rock Creek



Magnitude of the Problem and DC Water's Solution



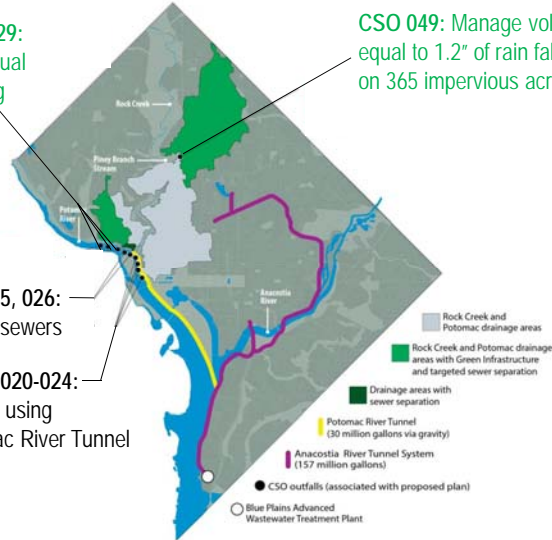
DC Clean Rivers Project Scope

CSO's 027, 028, 029:
Manage volume equal to 1.2" of rain falling on 133 impervious acres

CSO 049: Manage volume equal to 1.2" of rain falling on 365 impervious acres

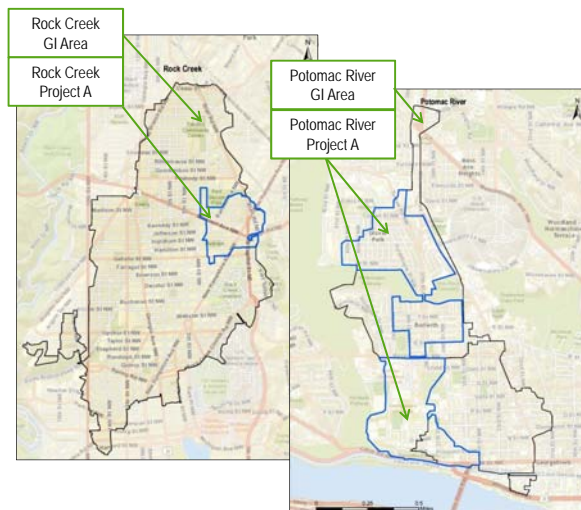
CSO's 025, 026:
Separate sewers

CSO's 020-024:
Control using Potomac River Tunnel

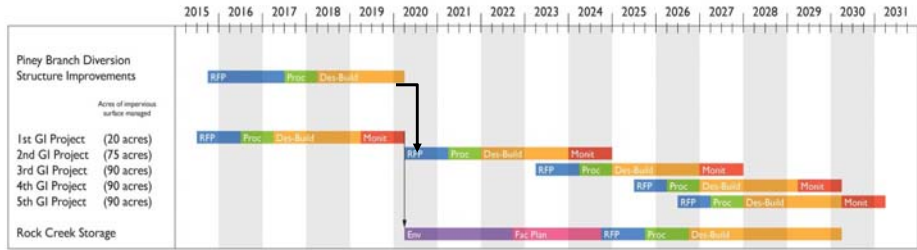


GI Volume Management Requirements

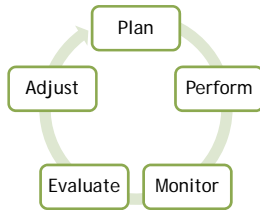
- Consent Decree requires DC Water to construct 5 projects in Rock Creek and 3 projects in the Potomac River
- Volume Requirement: Manage 1.2" of runoff from 500± impervious acres total
- Deadlines for first project in each sewershed:
 - Rock Creek Project A: Place in Operation 3/30/19
 - Potomac River Project A: Place in Operation 6/23/19



Adaptive Management Process for GI Implementation



Rock Creek Sewershed Projects' Schedule



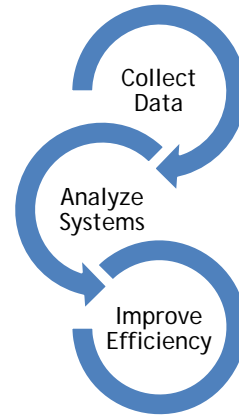
Adaptive Management Process

- Amended Consent Decree - phased GI implementation into multiple projects
- DCCR will incorporate lessons learned on design, construction, maintenance, etc. as projects are built



Asset Management and Maintenance Goals

- GI maintenance will be required via NPDES permit.
- Long-term, DCCR must improve the **cost-effectiveness** of maintenance while ensuring GI's:
 - Function and performance
 - Safety to the public
 - Aesthetics

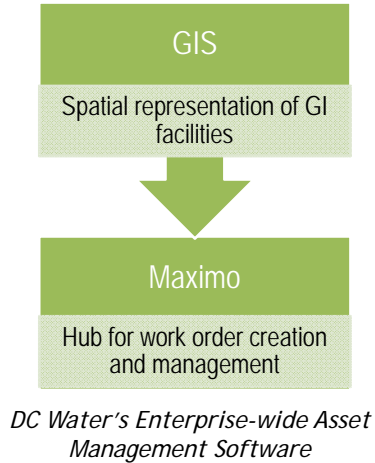


Data collection must be in real-time to improve long-term maintenance efficiencies



DC Water's Enterprise-wide Asset Management

- DC Water currently operates and maintains water and sewer infrastructure, which includes:
 - 1,350 miles of water pipes and 1,900 miles of sewers,
 - 4 water and 9 wastewater pumping stations, and
 - A 384 MGD wastewater treatment.
- DC Water's Asset Management Program used across all departments uses a combination of GIS and Maximo

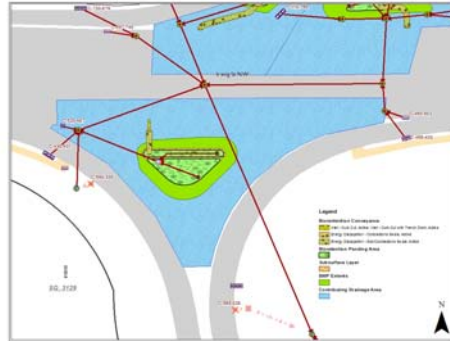


Considerations to Achieve Asset Management Goals

- Defining the data to collect
- Determining the mechanism to collect data
- Enforcing the contractor's completion of data collection

DCCR's Defined Data

- Representation within GIS
 - Inlets/energy dissipation
 - Surface layer(s)
 - Subsurface layers (if different than surface)
 - Cleanouts and observation wells
 - Underdrains
- Data to be input
 - General information, i.e. Contract number
 - Practice definition, i.e. planter bioretention
 - Warranty end date
 - Mixes and depths for permeable pavement and/or bioretention soil media



Example of Bioretention in GIS



Mechanism for Data Collection

User-Friendliness

Software's Robustness

- DCCR is using mobile program because too much data is needed to be captured to allow paper forms or data input after maintenance to be effective
- Any mobile solution for DCCR must be:
 - Easy to pick up and use for expected contractors in the near-term
 - Be compatible with DC Water's software for the long-term
- DCCR's mobile application development to-date includes:
 - Gaining an understanding of DC Water's wider asset management program,
 - Defining the data to collect, and
 - Evaluating software and hardware available for use.

Existing System Understanding

Software Evaluation

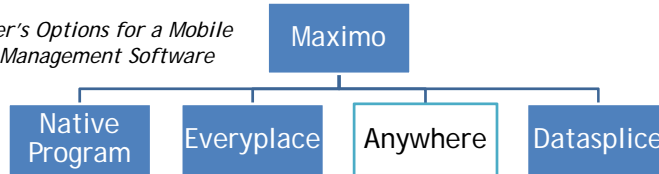
Hardware Evaluation

Mobile Application Development Process



Evaluation of Mobile Software App

DC Water's Options for a Mobile Asset Management Software

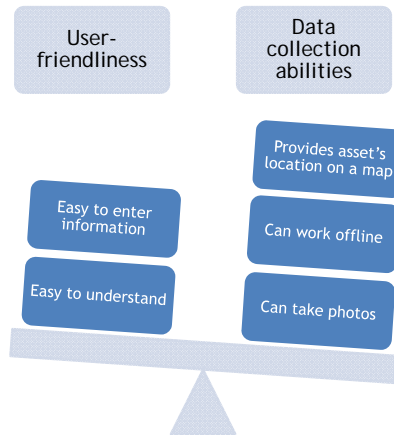


- DCCR initially chose Maximo Anywhere to pilot among other programs based on:
 - Cost (startup and operating)
 - User experience/training needs
 - Customization needs vs. 'out-of-the-box' features
 - Coordination with IT to get up and running
 - Ability to work without internet
 - Hardware needs
 - Server needs
 - Ability to take pictures
 - Ability to be enterprise-wide solution



User Testing Maximo Anywhere

- Maximo Anywhere determined to meet data collecting requirements.
- DCCR evaluated ways to improve the usability for a less-experienced Maximo user, included:
 - The information presented/the order of the information
 - Size of buttons
 - The speed of clicking through features
 - The fields available for selection



Mobile applications must balance software's data collection abilities with user-friendliness



Evaluation of Hardware for Mobile App



Toughbooks

- IT-recommended
- Little customization
- Limited mobility
- Expensive (\$5,000)



Tablets

- Customization required
- Greater mobility
- Moderate Cost



Smartphones

- Most customization
- Greatest mobility
- Small viewport
- Least cost


Other considerations:

1. OS Compatibility
2. OS-specific customization
3. Organization's IT security policies (i.e. contractor's cannot provide own devices)

Tablets selected due to balance between mobility and customization needs



Examples of Maximo Anywhere



Work Order Details

START Work Order | COMPLETE Work Order

WO # 15-444434 | Description: PLANNED Maintenance for Green Asset AR0011

Asset: AR0011 | 445499 | GREEN Aracosta River INFILTRATION OPENWEA

Work Type: PM

Tasks: 0

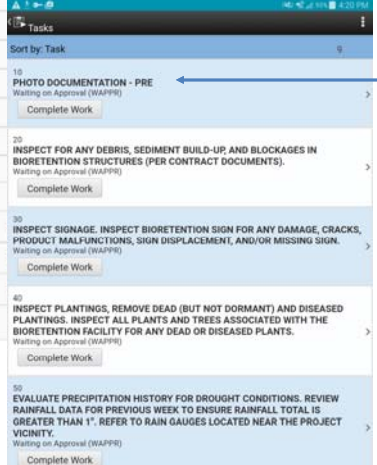
Specifications: 0

Attachments: 0

Actual Labor: 0

Actual Materials: 0

Work Log: 0



Tasks

Sort by: Task

10 PHOTO DOCUMENTATION - PRE
Waiting on Approval (WAPPR)

20 INSPECT FOR ANY DEBRIS, SEDIMENT BUILD-UP AND BLOCKAGES IN BIORETENTION STRUCTURES (PER CONTRACT DOCUMENTS).
Waiting on Approval (WAPPR)

30 INSPECT SIGNAGE, INSPECT BIORETENTION SIGN FOR ANY DAMAGE, CRACKS, PRODUCT MALFUNCTIONS, SIGN DISPLACEMENT, AND/OR MISSING SIGN.
Waiting on Approval (WAPPR)

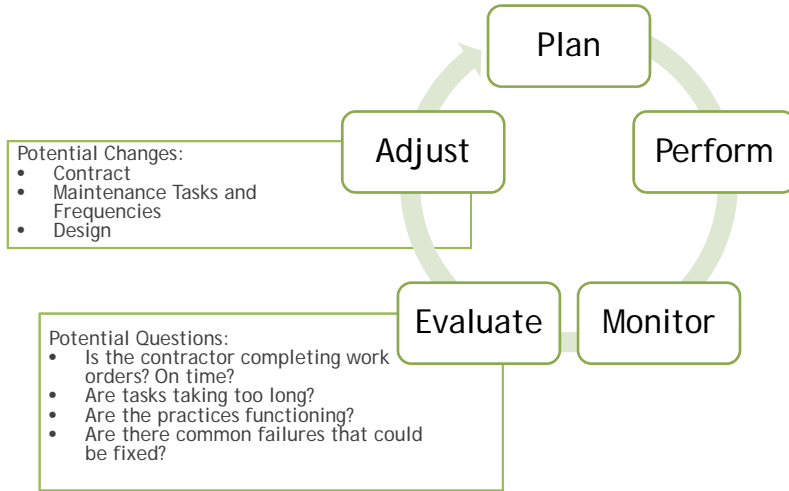
40 INSPECT PLANTINGS, REMOVE DEAD (BUT NOT DORMANT) AND DISEASED PLANTINGS. INSPECT ALL PLANTS AND TREES ASSOCIATED WITH THE BIORETENTION FACILITY FOR ANY DEAD OR DISEASED PLANTS.
Waiting on Approval (WAPPR)

50 EVALUATE PRECIPITATION HISTORY FOR DROUGHT CONDITIONS. REVIEW RAINFALL DATA FOR PREVIOUS WEEK TO ENSURE RAINFALL TOTAL IS GREATER THAN 1". REFER TO RAIN GAUGES LOCATED NEAR THE PROJECT VICINITY.
Waiting on Approval (WAPPR)

Task



Incorporating Adaptive Management into Planning



Examples of DCCR's Adaptive Management Changes

- Contract
 - Defined period to complete maintenance, i.e. "Between the 7th and 15th day of every month"
 - Payment contingent upon completed work order
- Maintenance Tasks and Frequencies
 - Multiple "as-needed" vacuum tasks to allow additional maintenance during fall, dependent on when leaves fall
- Design
 - Incorporation of a catch basin-type inlet into bioretention to centralize

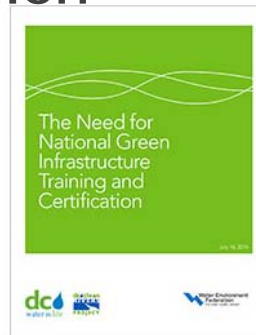
Green Infrastructure, Green Jobs

- Skilled workforce is critical to performance of GI
 - Knowledge across full lifecycle of GI - Construction, Inspection, Maintenance
- Green jobs is important component to realizing Triple Bottom Line benefits
- Strong focus in DC and other communities
- DC Water formalized commitment via DC Water/District 'Green Jobs MOA' (available at dcwater.com/green)



Need for GI Certification

- Creating a National Certification establishes a long term pathway for living wage jobs across the United States
- No national certification program exists for GI construction and maintenance
- GI and stormwater controls are becoming more common and grow substantially
- GI maintenance is increasingly required in many NPDES permits
- There is a need to establish minimum standards and assure workers have skill sets required for GI to be effective over long term
- DC Water and WEF partnered to establish the National Green Infrastructure Certification Program





Stacy J. Passaro, P.E., BCEE

NGICP Program Manager

Office Number: (301) 829-5163

spassaro@wef.org



Introduction to the National GI Certification Program (NGICP)



What is NGICP?

- A national credential that is awarded after successful completion of an exam designed to verify that candidates possess the foundational knowledge and understanding to properly perform entry level field job tasks in constructing, inspecting and maintaining a variety of common GI practices



Objectives of NGICP

- Ensure that a skilled labor pool is available to construct, inspect and maintain GI facilities



- Support sustainable performance of GI practices
- Create perennial GI jobs that will pay a living wage to unemployed or underemployed local residents

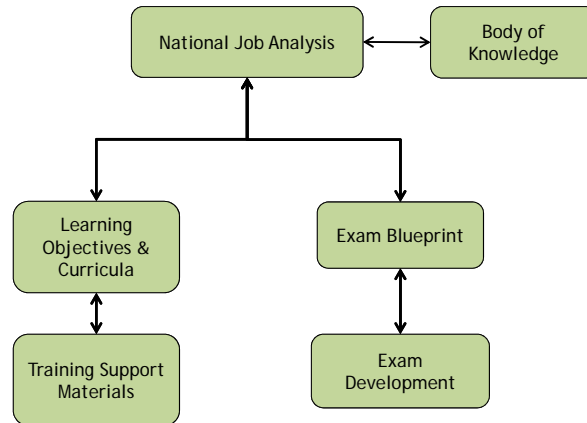
Eligibility Requirements

Candidates must have

- A high school diploma/ GED
- and*
- Recently participated in GI construction, inspection and maintenance training (minimum 35 hours combined classroom and field time)



Program Components



- NGICP developed in accordance with ANSI accreditation guidelines

Certification Council Members

- Geoff Brosseau, Executive Director of the California Stormwater Quality Association
- Jeanette Brown, Assistant Professor, Manhattan College
- Bart Jones, Principal at Barton Jones, LLC
- Sandra Ralston, Principal at Consensus, LLC
- Marsha Slaughter, Utilities Director for the City of Oklahoma
- Alan Vicory, Principal at Stantec
- Jennifer Wigal, Water Quality Program Manager at the Oregon Department of Environmental Quality
- Carlton Ray, Director, DC Water DC Clean Rivers Project, District of Columbia



Current NGICP Partners

- DC Water, Washington, D.C.
- Milwaukee Metropolitan Sewerage District (MMSD), Wisconsin
- Montgomery County, Maryland
- Kansas City Water Services Department, Missouri
- Fairfax County, Virginia
- City of Baltimore Department of Public Works, Maryland
- Louisville Metropolitan Sewer District, Kentucky
- San Francisco Public Utilities Commission, California
- Capital Region Water, Harrisburg, Pennsylvania
- Metropolitan Water Reclamation District of Greater Chicago, Illinois
- New Orleans Delegation, Louisiana
- Pittsburgh Water and Sewer Authority, Pittsburgh, Pennsylvania
- Metropolitan Sewer District of Greater Cincinnati, Cincinnati, Ohio
- Boston Water and Sewer Commission



Partners' Roles

- Participate in the Strategic Advisory Group
 - Help WEF develop a flexible program that meets a variety of needs
- Provide technical expertise for:
 - Job task analysis survey
 - Curriculum/training support material development
 - Exam development
 - Organize/provide training



Green Roof on DC Water's Fort Reno Reservoir



NGICP Development

- NGICP development kicked off January 2016
- Job task survey conducted May 2016
- Exam blueprint approved early summer 2016
- Program policies and procedures developed in summer/fall 2016
- Exam developed summer/fall 2016
- Curriculum and training support materials developed summer/fall 2016



NGICP Exam Blueprint



1. Watershed Fundamentals 6-10%
2. GI Practices 19-23%
3. GI Methods and Materials 50-54%
4. GI Functionality and Appearance 17-21%



Recommended Training Structure

	Actual or Approximate Number of Slides	Estimated Classroom Time (hrs)	Estimated Hands On or Field Time (hrs)
Module 1 - Introduction to Stormwater Management & Green Infrastructure	64	2.0	1
Module 2 - Materials Used in GI	71	2.0	0.5
Module 3 - Vegetation Used in GI	68	2.0	0.5
Module 4 - Safety in GI	62	1.0	0.5
Module 5 - GI Site Management	64	1.0	0.5
Module 6 - Bioretention	114	4.0	1.5
Module 7 - Permeable/Porous Pavements	100	3.0	1.0
Module 8 - Rainwater Harvesting	80	2.0	1.0
Module 9 - Green Roofs/Blue Roofs	100	3.0	1.5
Module 10 - Dry Wells	60	2.0	0.5
Module 11 - Stormwater Wetlands	100	3.0	0.5
Module 12 - Managing GI for Long-Term Performance	50	1.0	0.5



Bioretention



- Creates opportunities for:
 - Capture
 - Storage
 - Infiltration
 - Evapotranspiration

Permeable Pavements

- Allows for:
 - Capture
 - Storage
 - Infiltration



Rainwater Harvesting



- Cisterns and rain barrels achieve:
 - Capture
 - Storage
 - Potable water conservation



Green Roofs / Blue Roofs

- Achieve:
 - Capture
 - Storage
 - Evapotranspiration (green roofs)



Dry Wells



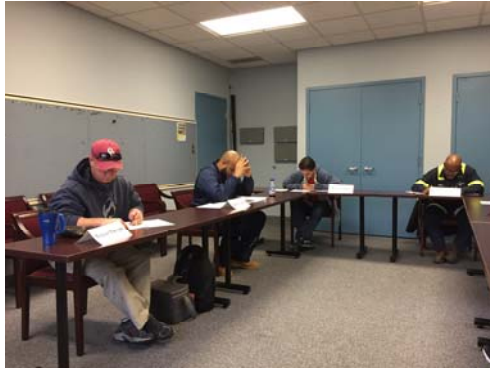
- Allows for:
 - Capture
 - Storage
 - Infiltration

Stormwater Wetlands

- Creates opportunities for:
 - Capture
 - Storage
 - Infiltration
 - Treatment
 - Evaporation
 - Transpiration



Inaugural Group of Certificants



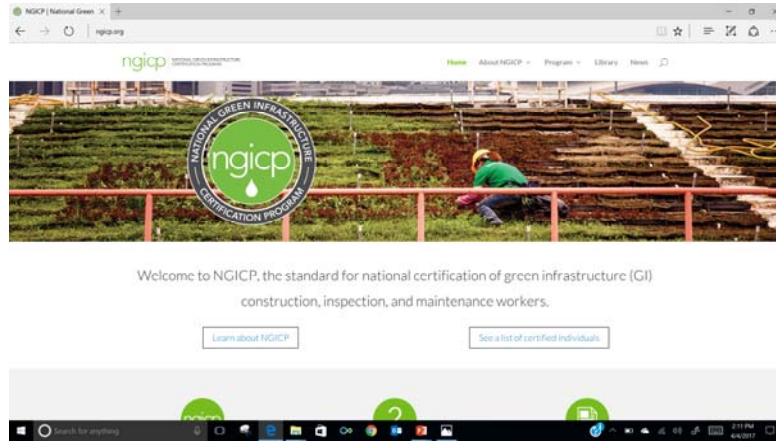
- First training conducted October/November 2016
- First exam administered December 13, 2016
- First round of NGICP Certifications awarded January 2017

Current Status

- Pilot year with partners - 2017
 - Spring training underway now
 - Exam on June 6, 2017
 - Fall training planned
 - Exam in early November 2017
- Business planning underway
- National rollout scheduled for early 2018

Additional Resources

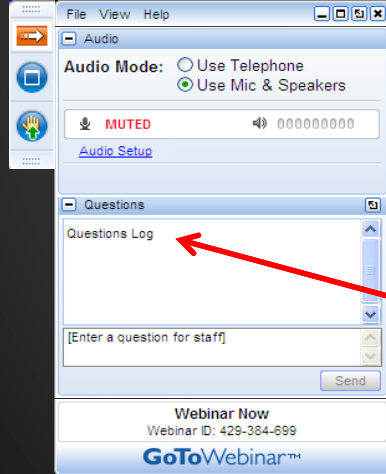
- www.ngicp.org



Supporting GI Maintenance Programs

- DC Water example

Questions?



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