

GSI– Full Circle with Lessons Learned



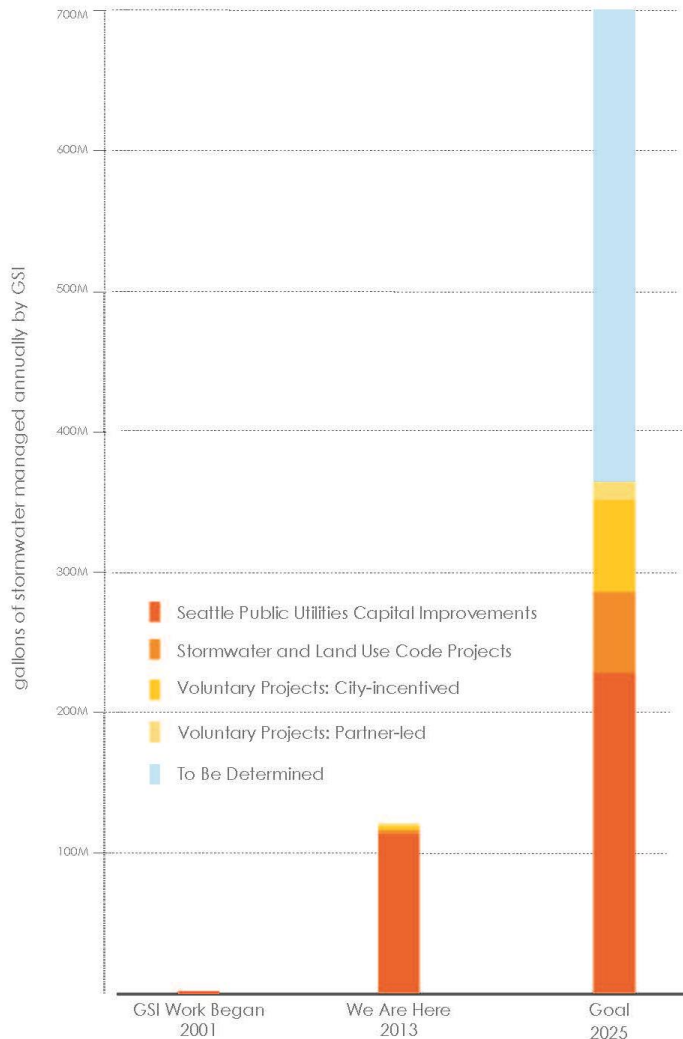
Agenda

- Seattle's GSI
- O&M Tool Kit +
- Lessons Learned
- Final Acceptance
- Asset Management
- In the Works



Policy + Program Development

Seattle Green Stormwater Infrastructure
2025 Goal: Manage 700M gallons Annually



- In July 2013, City Council unanimously passed Resolution 31549:
- GSI should be relied upon to manage stormwater wherever possible
- Target to manage 700MG annually with GSI by 2025

Existing and Forecasted GSI in ROW



- Existing
- 180K sq ft
- \$650K budget
- Forecast 2020
- 500K sq ft
- \$1.3M approved for O&M

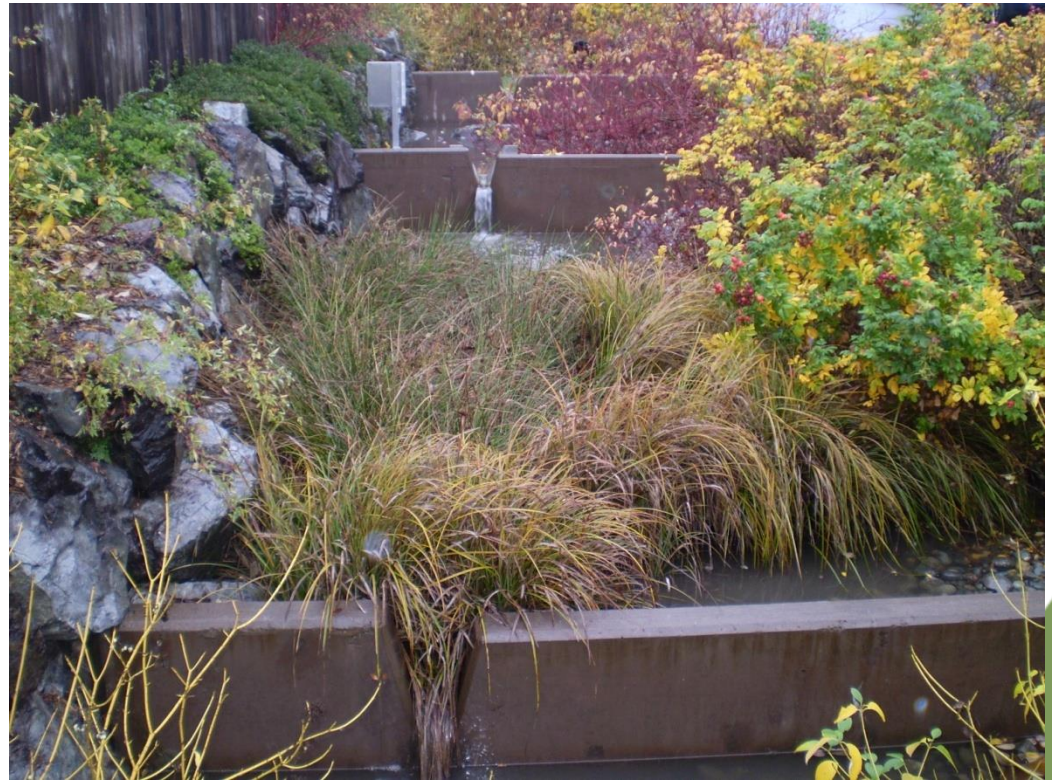
Maintenance \$\$

- Total \$\$ = Vegetation + Hardscape
- Vegetation: 0- 3 yrs
 - \$2.21
 - *Watering method and frequency increase cost up to 4X*
- Established Vegetation: 4+
 - SPU cost: \$1.66
 - 25% reduction
- Hardscape = \$0.31 per sq. ft.



O&M Tool Kit

- Updated O&M Manual for use in the ROW
- Restoration Guidelines
- Design guidance tools
- Standards development
- Checklists
- Key Performance Indicators



Defining a *Failure*

- Define failure for all assets
- Minimal maintenance acceptable for a functioning swale
- Clearly identify when and what to retrofit
- Planting pallet- not working for facility
- Ponding – localized evidence in swale, entire swale, facility, underdrain, UIC



Living with living SW assets - adjacent



- Spraying for “weed” control
- Adding yard waste and debris
- Construction destruction
- Filling with mulch
- Planting vegetables

-Restoration and Repair Manual
-Homeowners Guide
-Education and Outreach



**Two points: community involvement
Aesthetics**

Maintenance can be overwhelming









Acceptable? Still functions



- **Invasive**
- **Aesthetically unpleasing**
- **Neighborhood nuisance**

Policies and standards

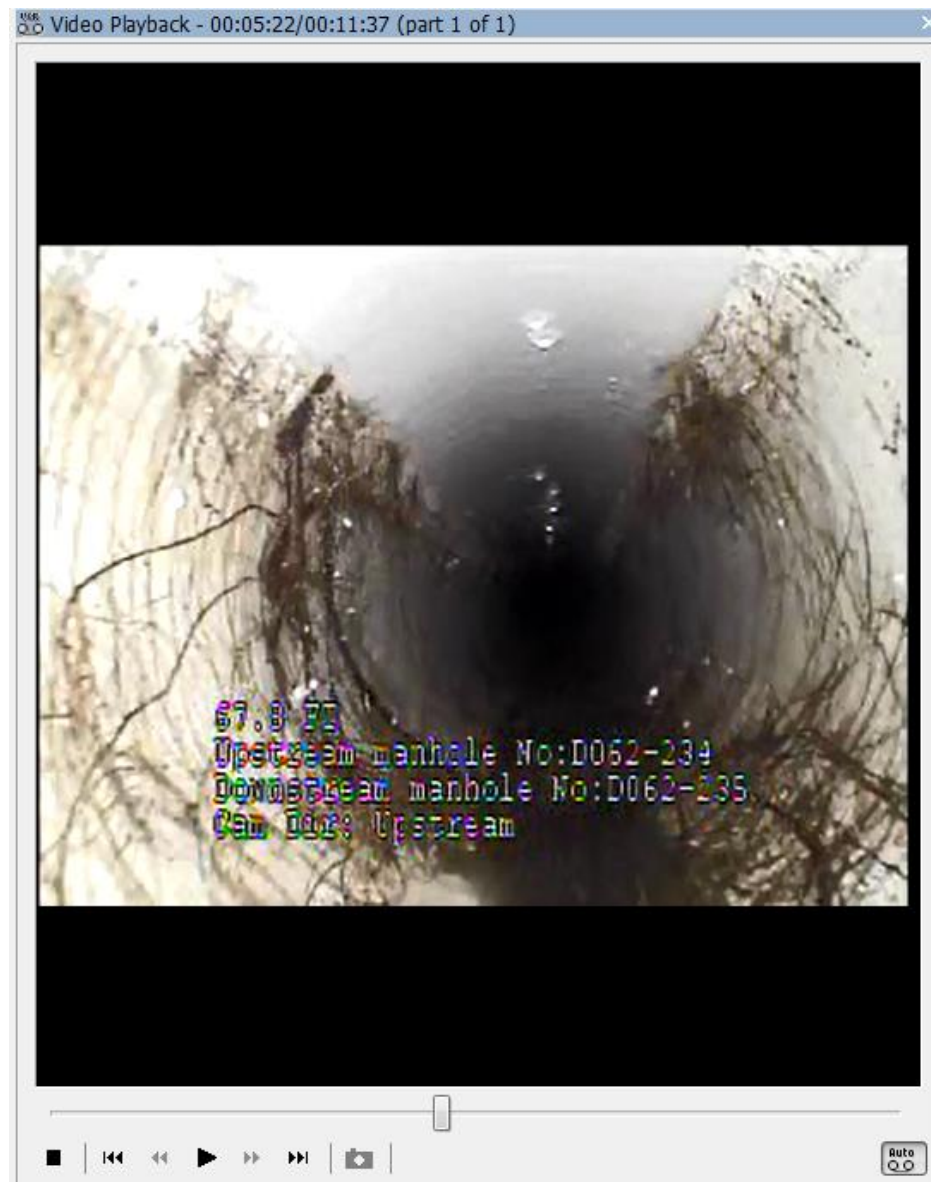


- SPU committed resources
- SPU will maintain GSI in the ROW
- Homeowners guidance booklet in development

- Design changes to low growing planting pallet
- Aesthetics - sticky



Underdrains



Solutions

- Inspection
- Pipe material change
- Modified aggregate wrap
- Hinged cap
- Two-way clean Out
- Time and \$\$





- **Safety**
- **Accessibility for crew**
- **ADA**

- **Right plant for right place**
- **Simplified plant pallet**
- **Maintenance access**



Sidewalks and Trees

- Ensure existing rules or programmatic plans identify acceptable levels of service for key community assets
- Walkability
- Plant pallet
- Planting setbacks
- Plants/trees reach full potential
- Tree responsibility and communication
 - Adjacent management for potential limbs or leaf litter
 - Power company for line interference
 - Traffic for line of site
 - Utility for mains



Inspection Processes and Protocols/Contractor Education









Successful liner installation

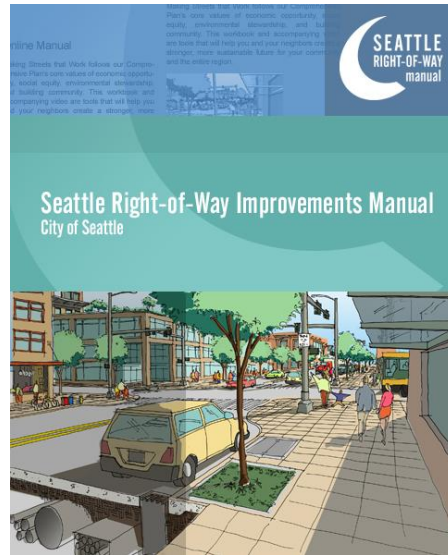


Improvements

- Construction inspection performed by EOR, LA, and or Geotech
- Designation of special inspector(s)
- General duties and responsibilities of inspectors
- Required project information form captures information for GIS/GTE

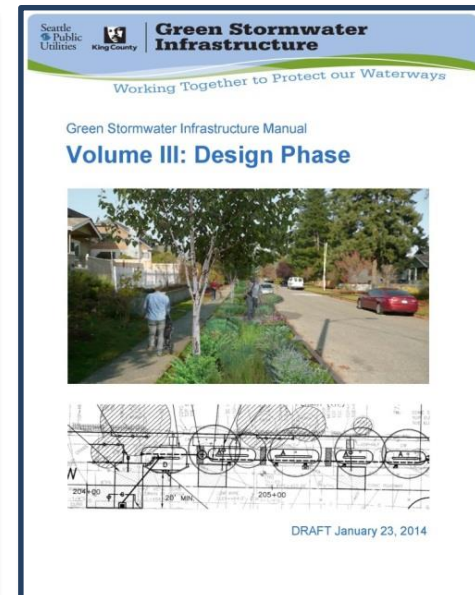
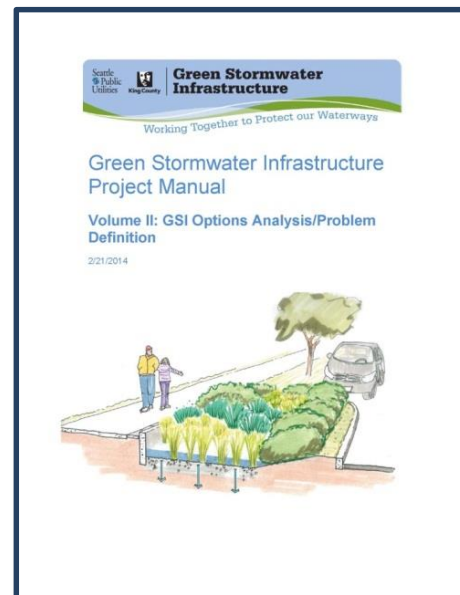


Be Clear on what is allowable



Public & Private Projects Guidance and Codes

Utility Lead Retrofit / Capital Improvement Projects Manuals



SPU Practice Changes

- GSI Design Phase
Asset checklist
 - Non-standard elements require approval early in design process
 - Identifies in design potential long term cost issues of non standard elements



- 
- A photograph of a lush, green garden bed. The foreground is filled with various green plants, including some with large, heart-shaped leaves and others with smaller, more delicate foliage. A black pipe is visible in the background, partially obscured by the plants. The overall scene is a dense, healthy garden.
- Planting season
 - Plants available
 - Interim?



•Street Edge

- Parking
- Access to vehicle
- Erosion control
- Vegetation/bushes

- Rock?
- Vegetation/ground cover?
 - sheet flow
- Mulch?







Street edge parking?
Erosion
Compaction



- Inlets
 - Water getting to swale
- Vegetation set backs
- Sediment/mulch elevations



- Leaf litter
 - Keep
 - SPU
 - Remove

In the works

- Voluntary rain gardens in the ROW
 - Client assistance memo
 - 2 years and counting
 - Enforcement
 - Restoration
- Vertical Walls
 - Acceptable O&M
 - Inspection
 - Low risk
 - High cost
 - In Vol R.G
- Infiltration
 - Shallow
 - Deep



Questions?

Drena Donofrio, P.E.

GSI O&M Asset Manager

www.seattle.gov/util/greeninfrastructure



City of Seattle
Seattle Public Utilities

Ray Hoffman, Director

Briefing on:

*DC Water's DC Clean Rivers Project
Drivers for Long-term Success: Green Infrastructure Asset
Management*

Briefing for:

National Green Infrastructure Learning Lab

Agenda

- Overview of the DC Clean Rivers Project
- Drivers for Long-term Success: GI Asset Management
- Questions



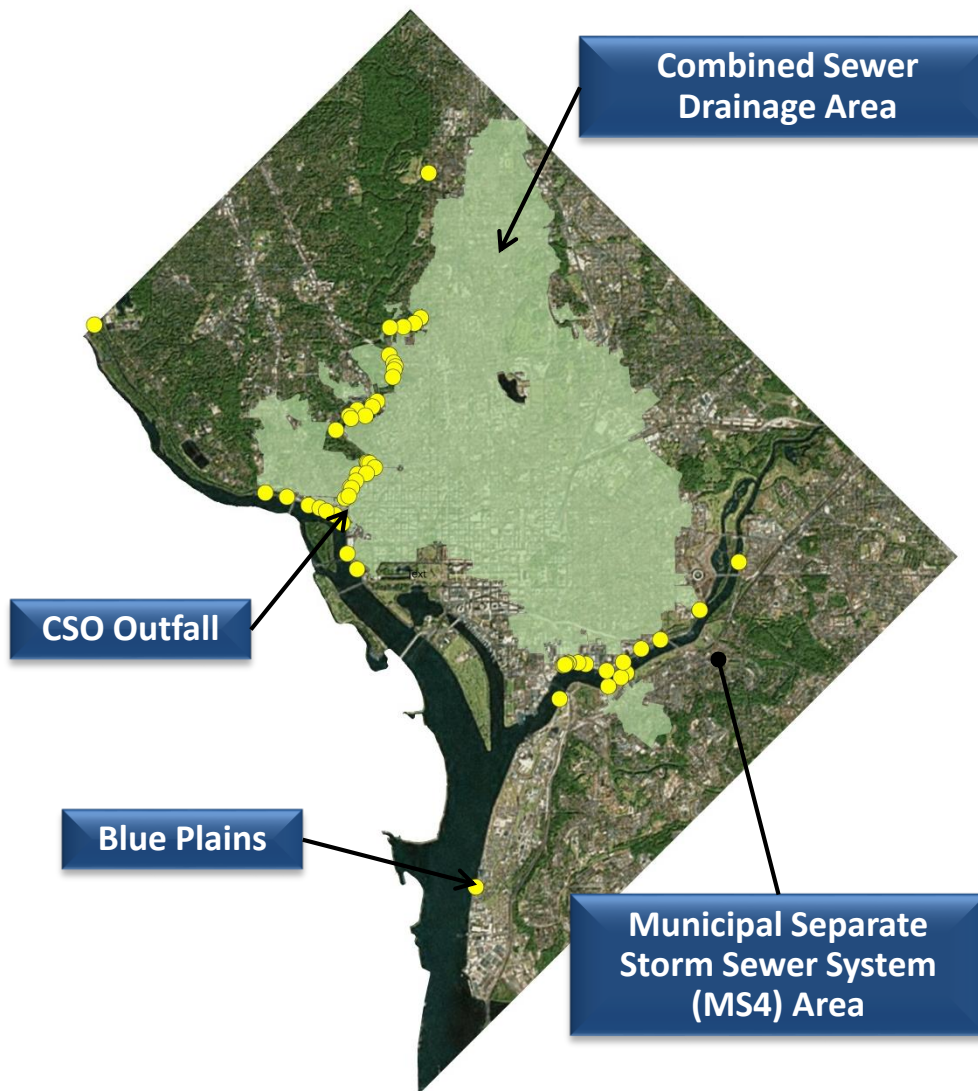
OVERVIEW OF THE DC CLEAN RIVERS PROJECT



Pilot Green Roof Maintenance
Training Program

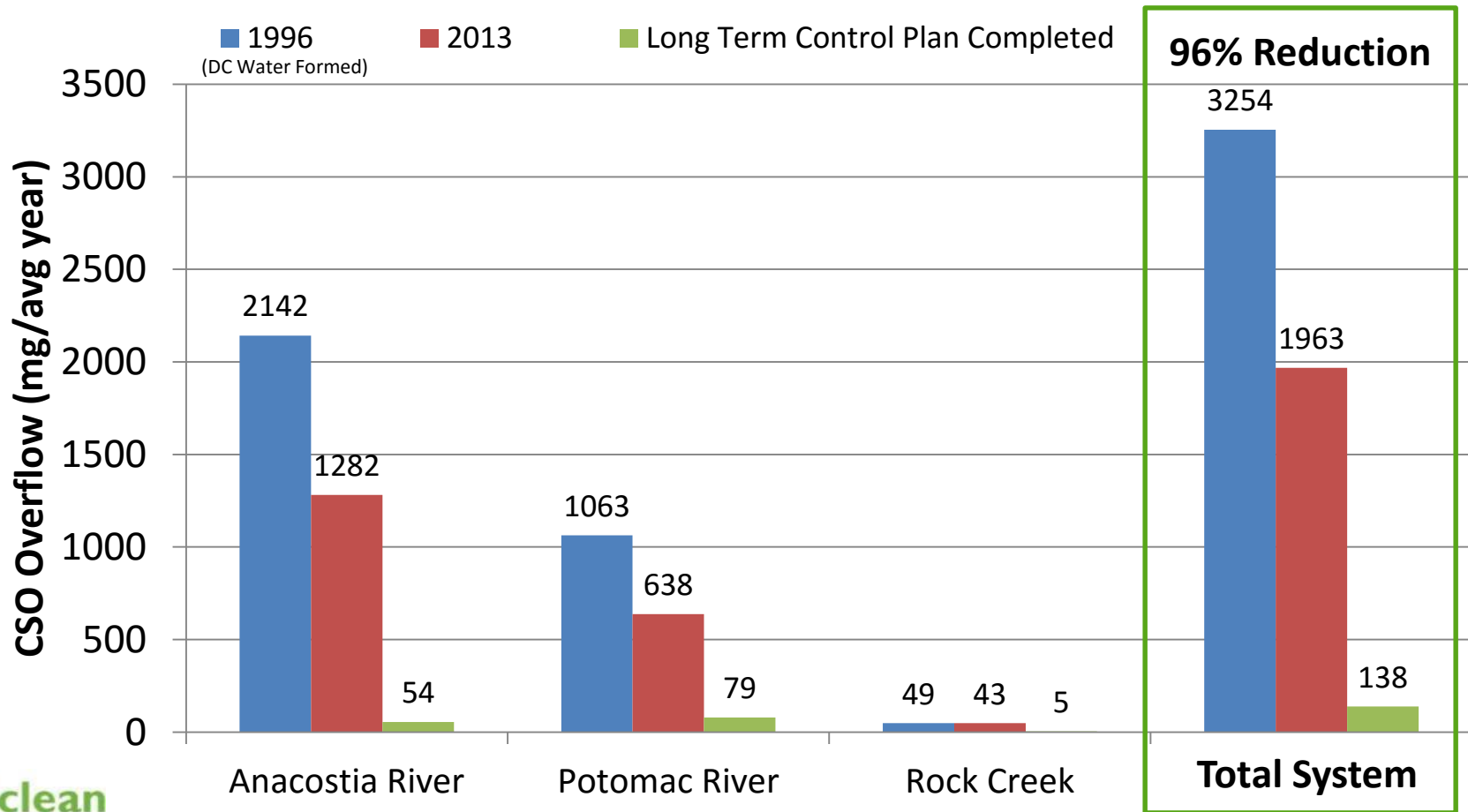


DC Water's DC Clean Rivers Project: Where are Combined Sewers Located?

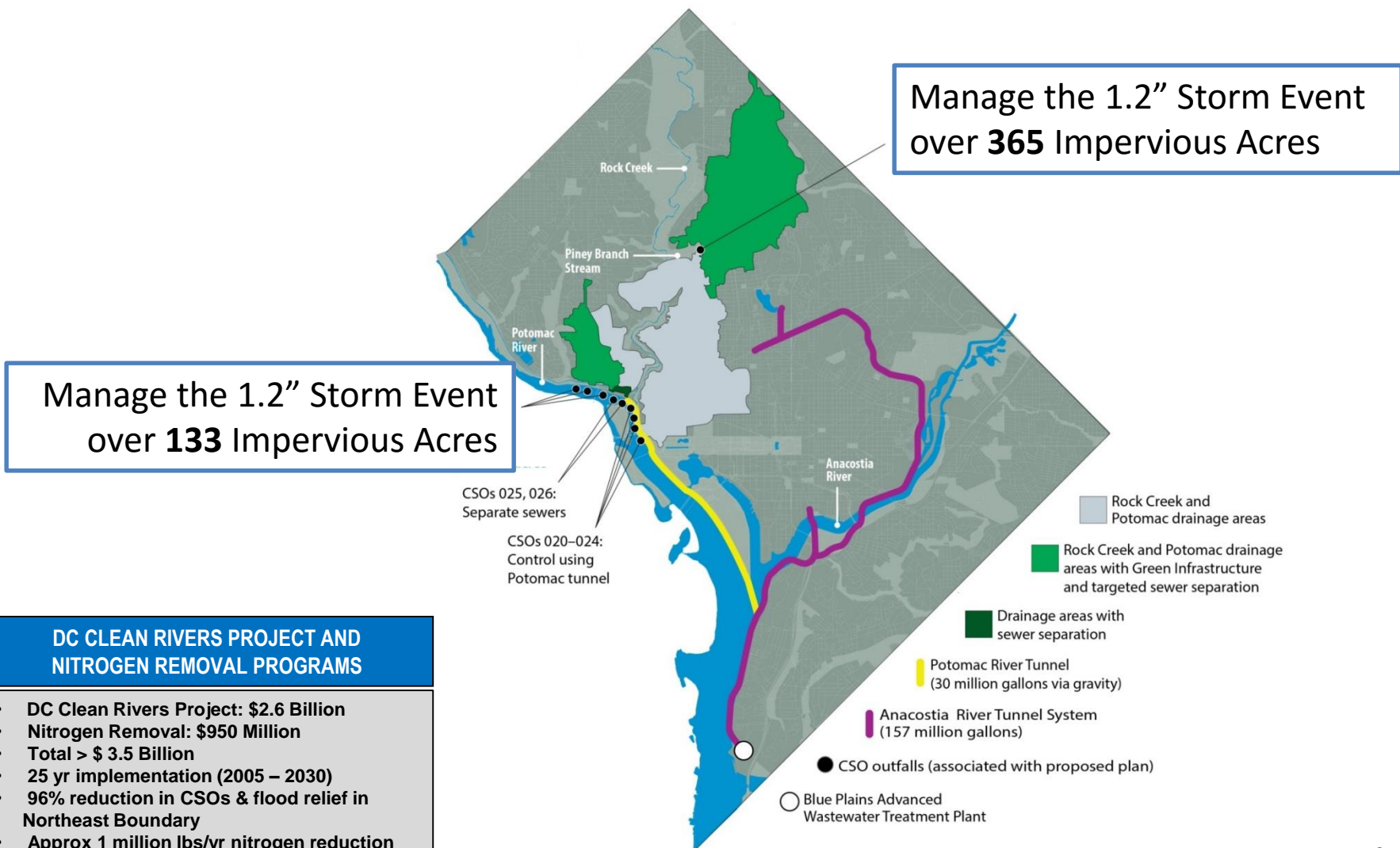


- 1/3 area is combined (12,478 acres)
- 47 Active CSO outfalls
 - 13 to Anacostia
 - 10 to Potomac
 - 24 to Rock Creek
- Three receiving waters
 - Anacostia River
 - Potomac River
 - Rock Creek

DC Water's DC Clean Rivers Project: Magnitude of the Problem, DC Water's Solution

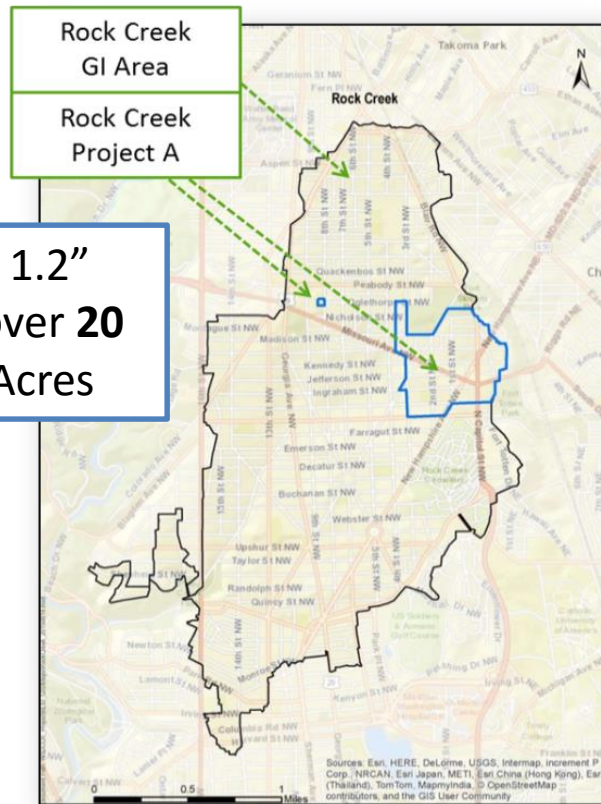


DC Water's DC Clean Rivers Project: Updated Long Term Control Plan

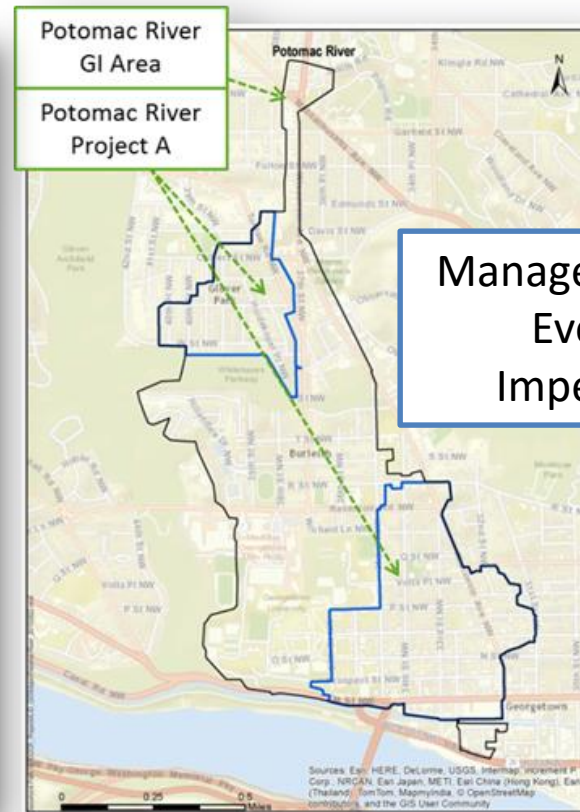


DC Water's DC Clean Rivers Project: Identification of the First GI Contracts

- Rock Creek Project A / Potomac River Project A



Rock Creek GI Project Area



Potomac River GI Project Area

DRIVERS FOR LONG-TERM SUCCESS: GREEN INFRASTRUCTURE ASSET MANAGEMENT



Pilot Green Roof Maintenance Training Program



Managing Assets for Long-term Success: Existing National Knowledge on GI Maintenance

- 2013 Survey of GI Programs on:
 - Maintenance program staffing roles and responsibilities;
 - Maintenance activities and the necessary frequencies;
 - Administrative and maintenance crew staffing needs;
 - Maintenance activity and GI project condition logging and tracking; and
 - Maintenance program costs.

Surveyed Programs
Metropolitan Sewer District of Greater Cincinnati
Kansas City Water Services Department
Montgomery County's Department of Environmental Protection
New York City Department of Environmental Protection
Philadelphia Water Department – GSI Maintenance Group
Onondaga County Department of Water Environment Protection
City of Portland's Bureau of Environmental Services
Seattle Public Utilities

Managing Assets for Long-term Success: Existing National Knowledge Takeaways

- Make asset management a forethought, not an afterthought
- Have a vision for where you're going with your asset management program, but be flexible with how you get there

Surveyed Programs
Metropolitan Sewer District of Greater Cincinnati
Kansas City Water Services Department
Montgomery County's Department of Environmental Protection
New York City Department of Environmental Protection
Philadelphia Water Department – GSI Maintenance Group
Onondaga County Department of Water Environment Protection
City of Portland's Bureau of Environmental Services
Seattle Public Utilities

Managing Assets for Long-term Success: Design First with Maintenance in Mind

Considerations:

- Cost and time stem from both travel and maintenance activities
- Initial learning curve for crews
- Simpler designs and consistent design minimize complexity

Current Programmatic Design Goals:

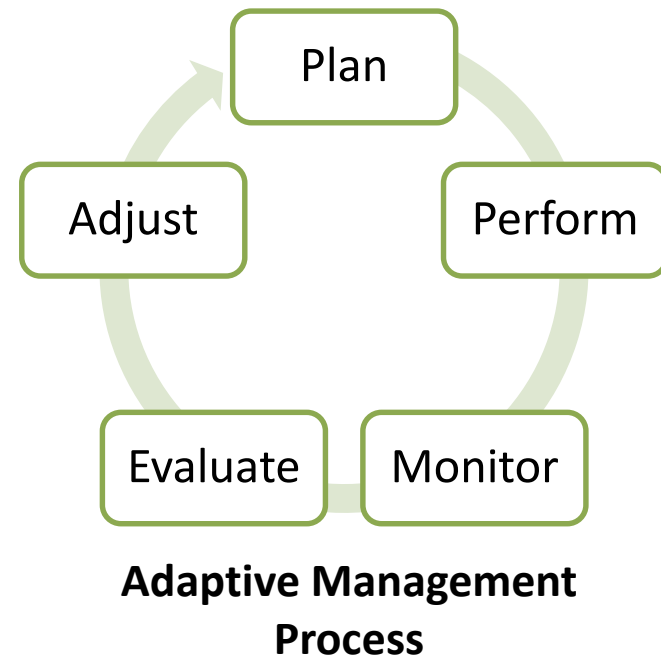
- Concentrate siting of GI practices
- Standardize GI practices
 - Layouts and Sizing
 - Materials
 - Planting plans
- Consider crew needs
 - Site access
 - Tools

Managing Assets for Long-term Success: DC Water Maintenance Program Goals

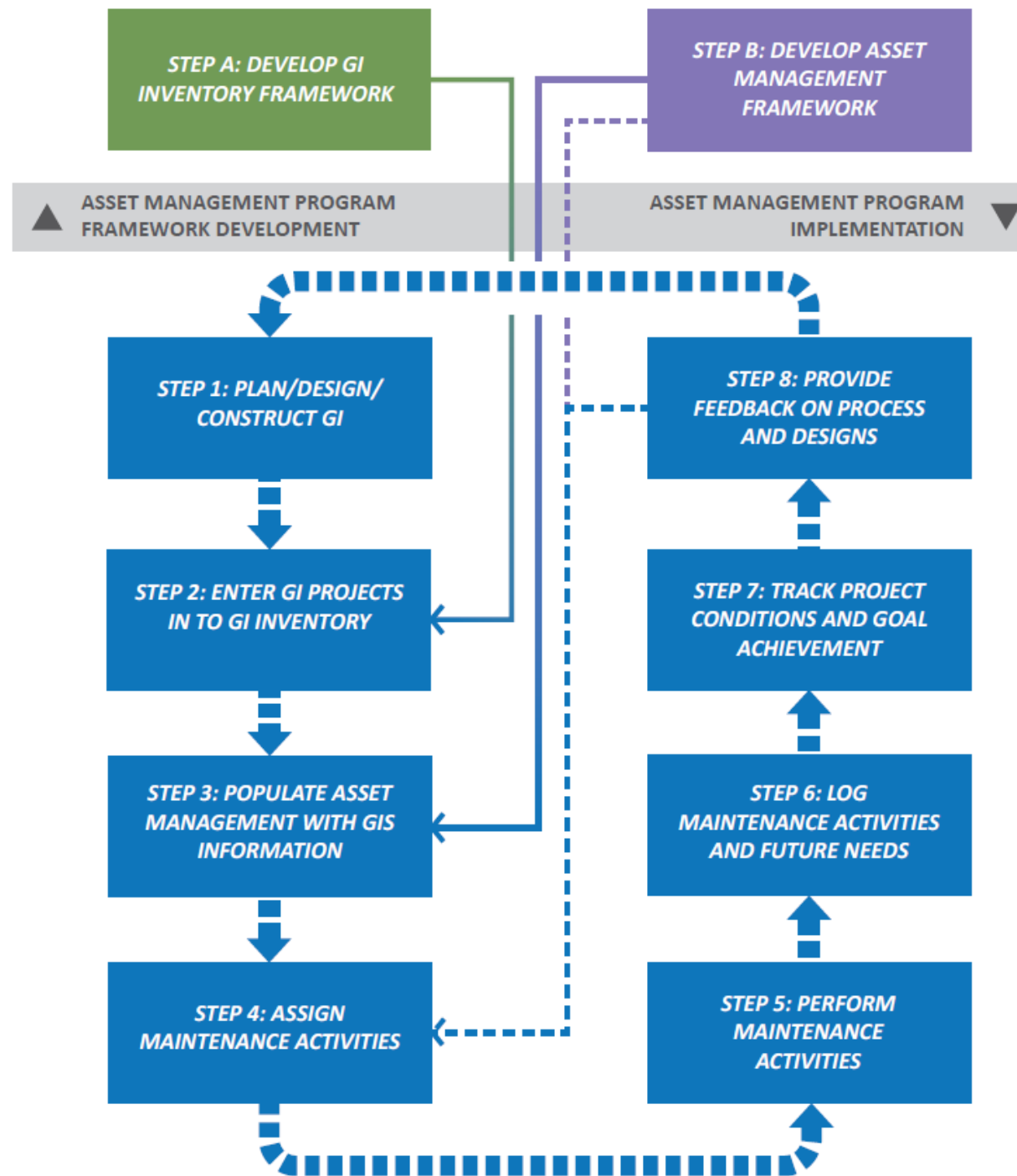
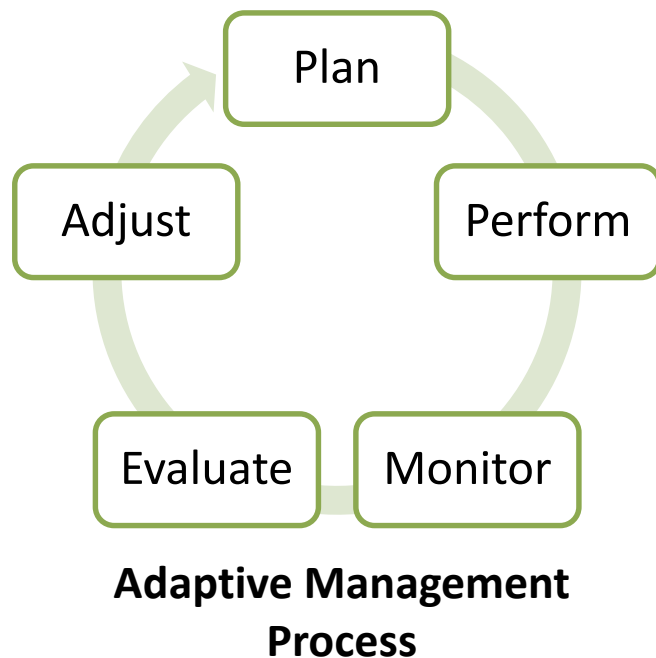
- DCCR's Green Infrastructure Maintenance Program goals:
 - Function
 - Ensure GI function to meet performance requirements.
 - Safety
 - Ensure public and maintenance crew safety.
 - Aesthetics
 - Ensure GI maintains the original project aesthetic goal.

Managing Assets for Long-term Success: DC Water Asset Management Program Goals

- Manage GI projects and GI program adaptively over time
 - Log maintenance activity completion and issue identification in real time
 - Track project issues, conditions, and performance and identify mitigation tactics through adapting maintenance activities/frequencies and/or design
 - Improve efficiencies long term



Managing Assets for Long-term Success: Asset Management Program Process



Managing Assets for Long-term Success: Create Program Vision with Ability to Adapt

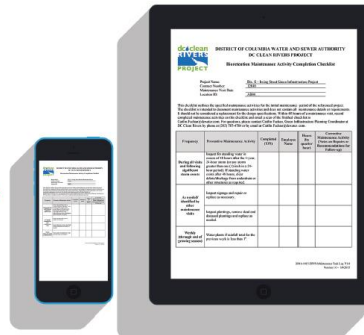
Work Order
Created and
Assigned to
Maintenance Crew

Crew Performs
Maintenance

Crew Logs
Maintenance in
Maximo

Previous Process	Email Request	Contractor Crews	Paper Forms
Updated Process	Automatically generated by Maximo	Maintenance Crews (Contractor/DC Water)	Handheld devices with a mobile application of Maximo

The image shows a paper checklist form from the District of Columbia Water and Sewer Authority. The form is titled 'Maintenance Activity Completion Checklist' and includes sections for project information, a checklist of maintenance activities, and a section for notes. The checklist has columns for 'Frequency', 'Description of Activity', 'Completion Date', 'Completion Status', and 'Notes'. The form is dated 2014-01-01 and is version 1.0.



Questions?

DC Water DC Clean Rivers Project

Caitlin Feehan, P.E., LEED AP

Green Infrastructure Planning
Coordinator

Email: Caitlin.Feehan@dcwater.com

Phone: 202-787-4784



More

- Erosion control during plant establishment (3yr)
- Tree canopy (leaf litter)
- Plant pallet (bushes shade swale bottom)
- Pest control
- Spill prevention and response
- Irrigation systems
- Crew and vegetation education
 - mulching
- underdrain cleaning learn space with caps=hinged?
- Nuisance vs. hazardous
- Feces/holding tanks
- Construction debris
- Illegal dumping
- Homeless encampments
- Pet waste
- Adjacent damage
 - Policies and edu.



Evolving Systems

- Work, work, work with field or contracting crews
- Update photos to continue refining doc.
- Document lessons learned
- Include BMP's



Updated O&M Manual for ROW

- Summary of Topics
 - Transition from construction and establishment
 - Operations: Defining parameters and resources
 - Bioretention surface maintenance
 - Structures and subsurface maintenance
 - Deep infiltration maintenance
 - Permeable pavement maintenance
 - Outsourcing and stewardship
 - Storm events
 - Inspection
 - Public engagement
 - Maintenance agreements



Example: Design Phase GSI ROW Checklist for O&M Asset Management to ensure consistency in approach as the program grows.

- A. Facility Footprint
- B. Inlets/Outlets/Pipes – Surface
- C. Inlets/Outlets/Pipes – Subsurface
- D. Vegetation
- E. Mulch
- F. Watering
- G. Deep Infiltration (over 6 feet)
- H. Permeable Pavement Facility
- I. Hardscape/Specialty Elements

FOR INTERNAL DISCUSSION PURPOSES

SPU/WTG GSI Program Management SPU #12-004
DRAFT Preliminary ROW GSI Components Checklist for O Assets
Date: May 5, 2014
SPU #12034



RIGHT OF WAY BASED GSI COMPONENT CHECKLIST FOR O&M ASSET MANAGEMENT

WORKING DRAFT 5-3-2014

This draft Bioretention focus -placeholders for others

Notes:

GSI Facility Asset / Component		CHECK		Asset or EQ# if available	NEW Type	ADDITIONAL INFO	APPROVED FOR USE		
		Is it defined in GSI Manual Vol V-Q&M? If no then go to NEW type column.	Meets SPU Standard?		Meets WTD Standard?	Tool, design, location, material etc	Reason for adding a new asset	Agency PM	O&M Mgr
▲ ▲ ▲ A. Facility Footprint ▲ ▲ ▲									
A1	Soils	COS Bioretention Mix							
		ECY Bioretention Mix							
		COS Mineral Aggregate Type 26							
		COS Mineral Aggregate Type 24							
		COS Mineral Aggregate Type 6 - sand							
A2	Check Dams	Rock							
A3	Weirs	Concrete							
		Wood or Composite							
		Boulder/stone							
		Segmental							
A4	Vertical Walls	Concrete							

Y:\2-en\project\1212034 SPU GSI PM Task 2 Tech Analysis\Support\GSI Manual\Vol V - O&M & Inspection\O&M Tables_Checklist\SPU_WTD GSI O&M Table DRAFT_Rev5ecaprt.xls

Page 1 of 9