

The City of Philadelphia's Green Stormwater Infrastructure Maintenance Program and Maintenance Manual Development

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5/15/14





GREEN CITY, CLEAN WATERS

The City of Philadelphia's Program for Combined Sewer Overflow Control
\$2.4 Billion Investment over the next 25 years

Green Stormwater Infrastructure

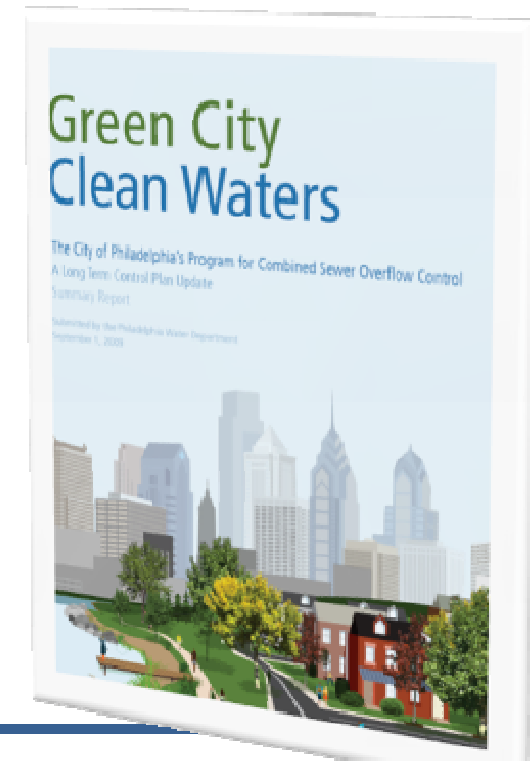
\$1.67 Billion

Traditional Infrastructure

\$345M

Adaptive Management

\$420M





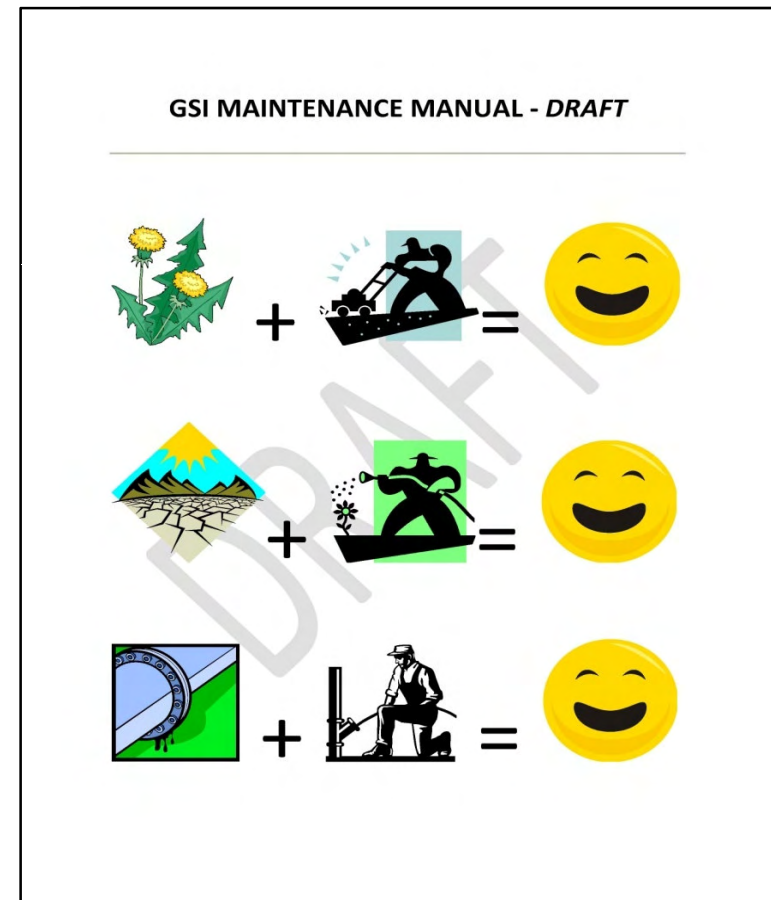
Maintenance Manual Development

PA DEP Compliance

- Maintenance Manual Process Plan
- Maintenance Manual (CO&A Deliverable)

Extensive Development and Testing

- Equipment
- Procedures
- Personnel





Core Programmatic Admin Tasks FY11 -12

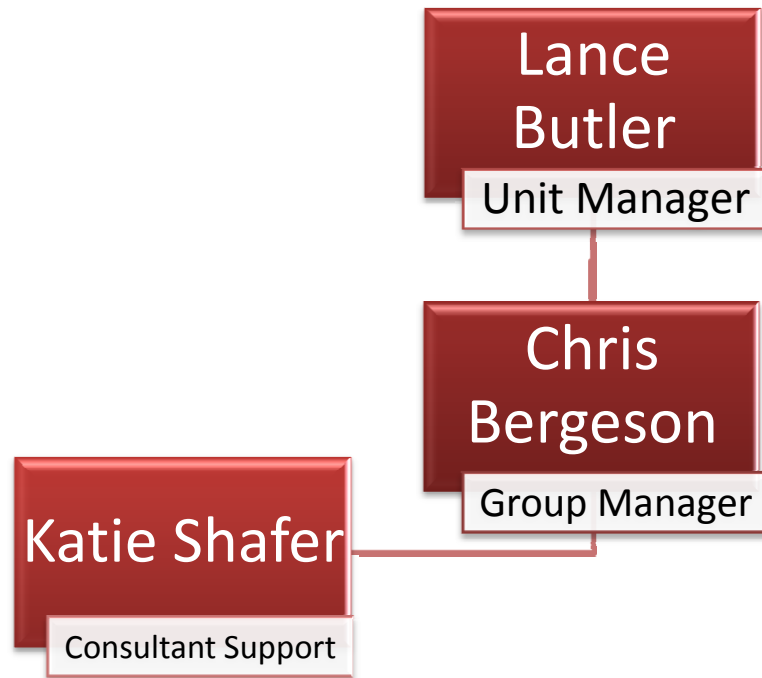
Program Development

Personnel and Equipment
Protocol Development

Contract Management

Intra-Departmental Coordination

- GIS → Ground-truthing
- Construction → Feedback
- Planning and Design → Feedback





Core Programmatic Field Tasks FY11-12

Surface

- Field Testing Inspection Protocols
- Field Testing Maintenance Protocols

Subsurface

- Field Testing Inspection Protocols
- Field Testing Maintenance Protocols



Surface Maintenance Challenges

•System Stressors

- sedimentation
- heat
- drought
- invasive species
- non-target species

•Urban stressors

- road salts
- vandalism
- cars
- rodents & pets?





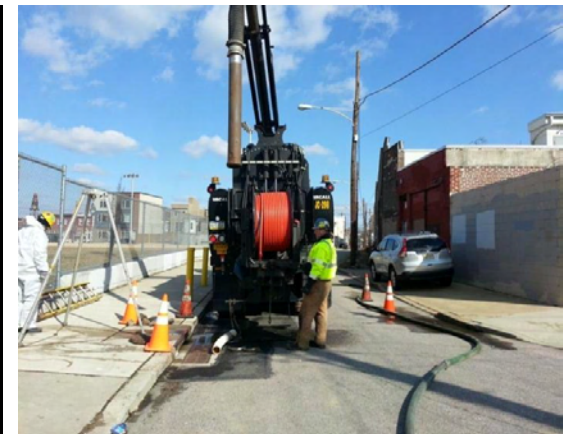
Subsurface Maintenance Challenges

•Urban Stressors

- trash/debris
- South Philly
- bus routes

•Maintenance Scheduling

- access
- wet weather events
- schools





Core Programmatic Admin Tasks FY13 -14

Program Development

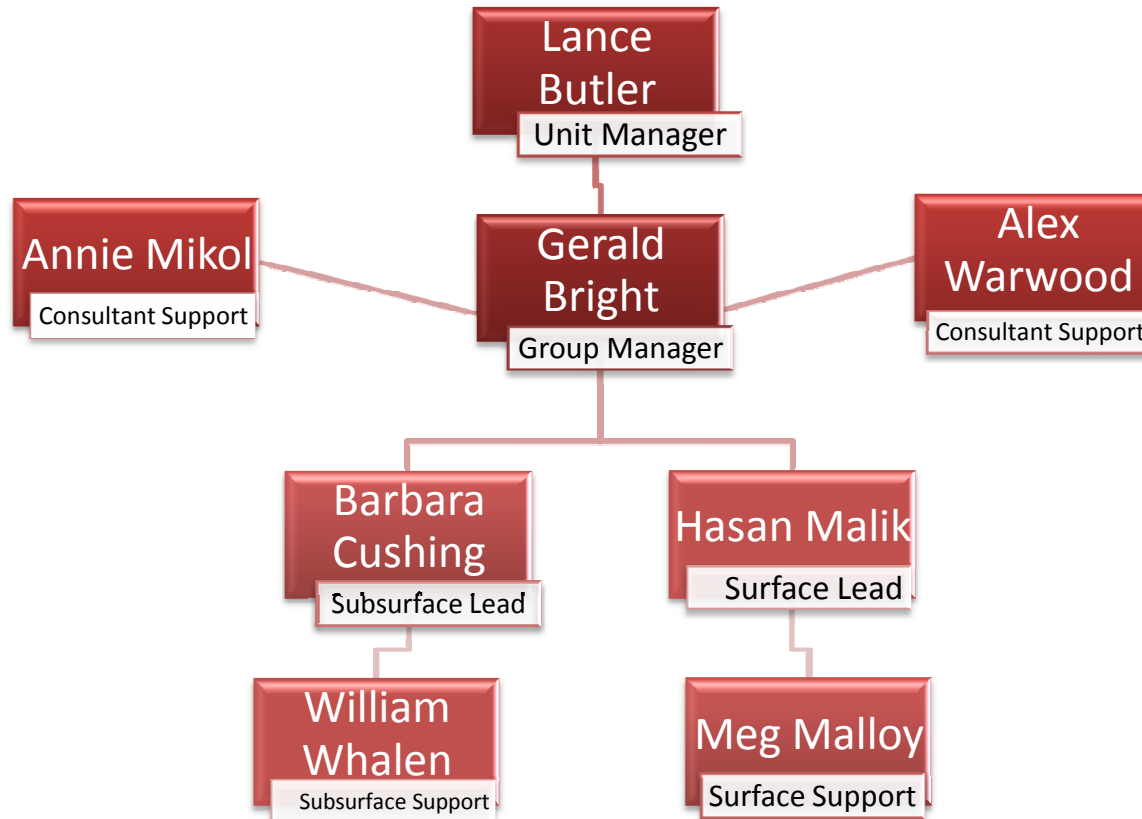
- Personnel and Equipment
- Project Inventory
- Asset Management
- District-Based Regime
- Work-order Management

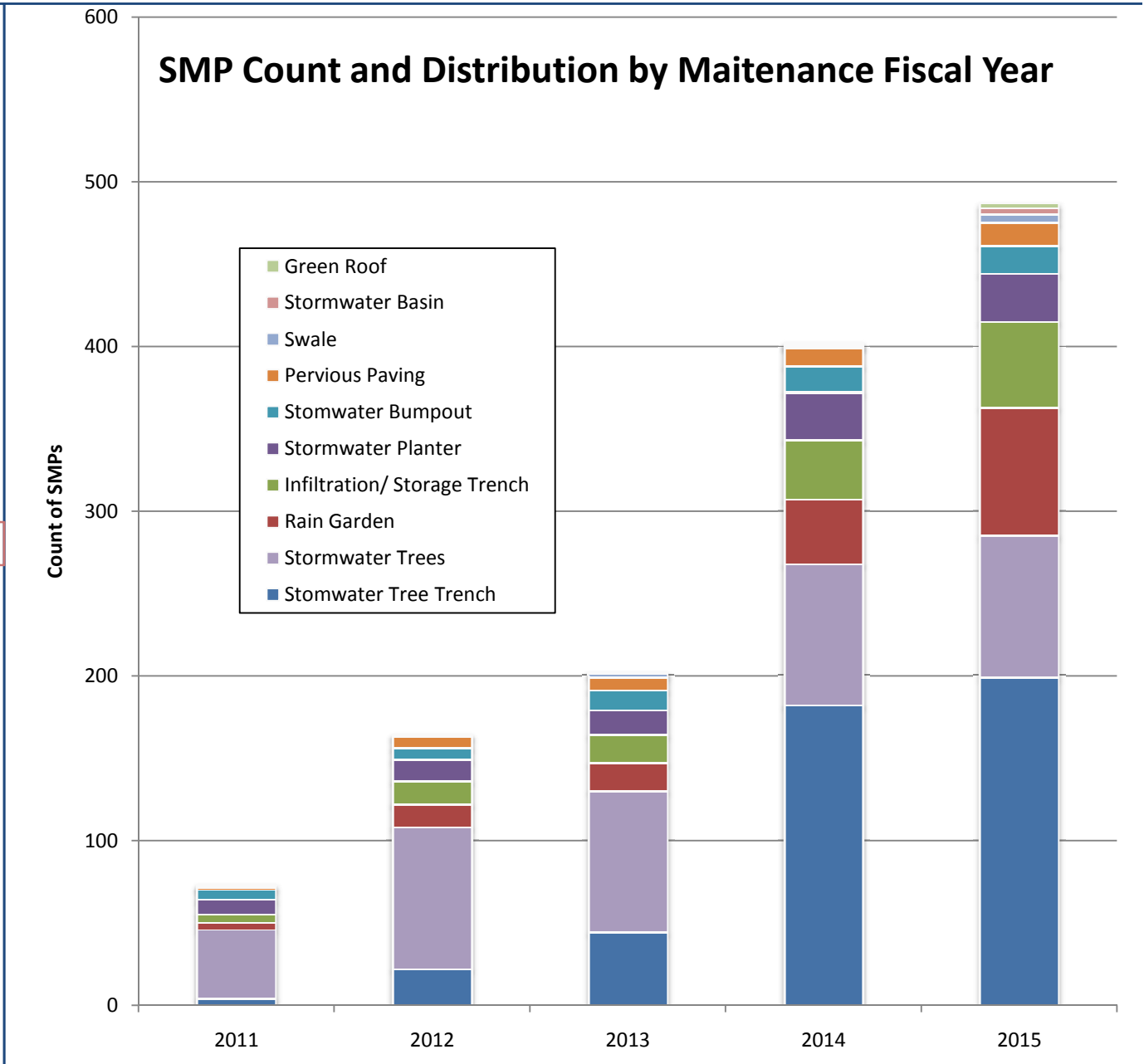
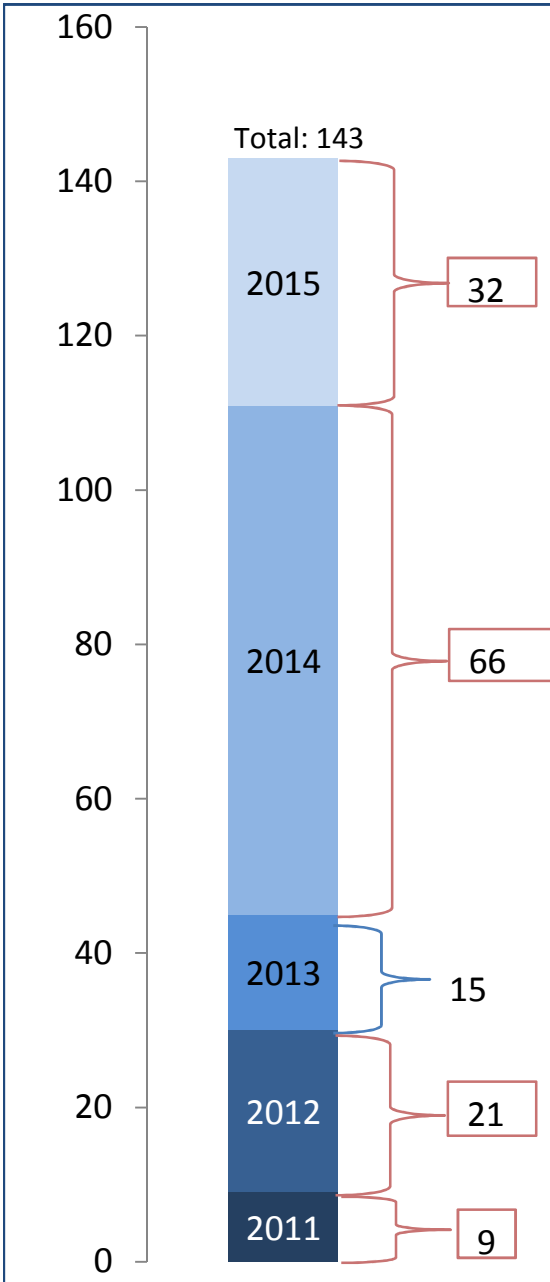
Intra-Departmental Coordination

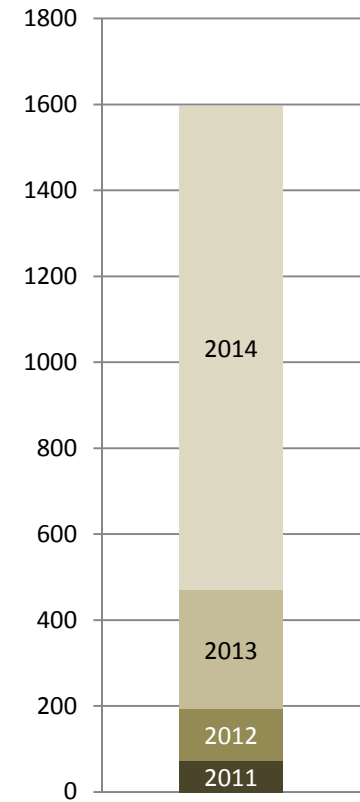
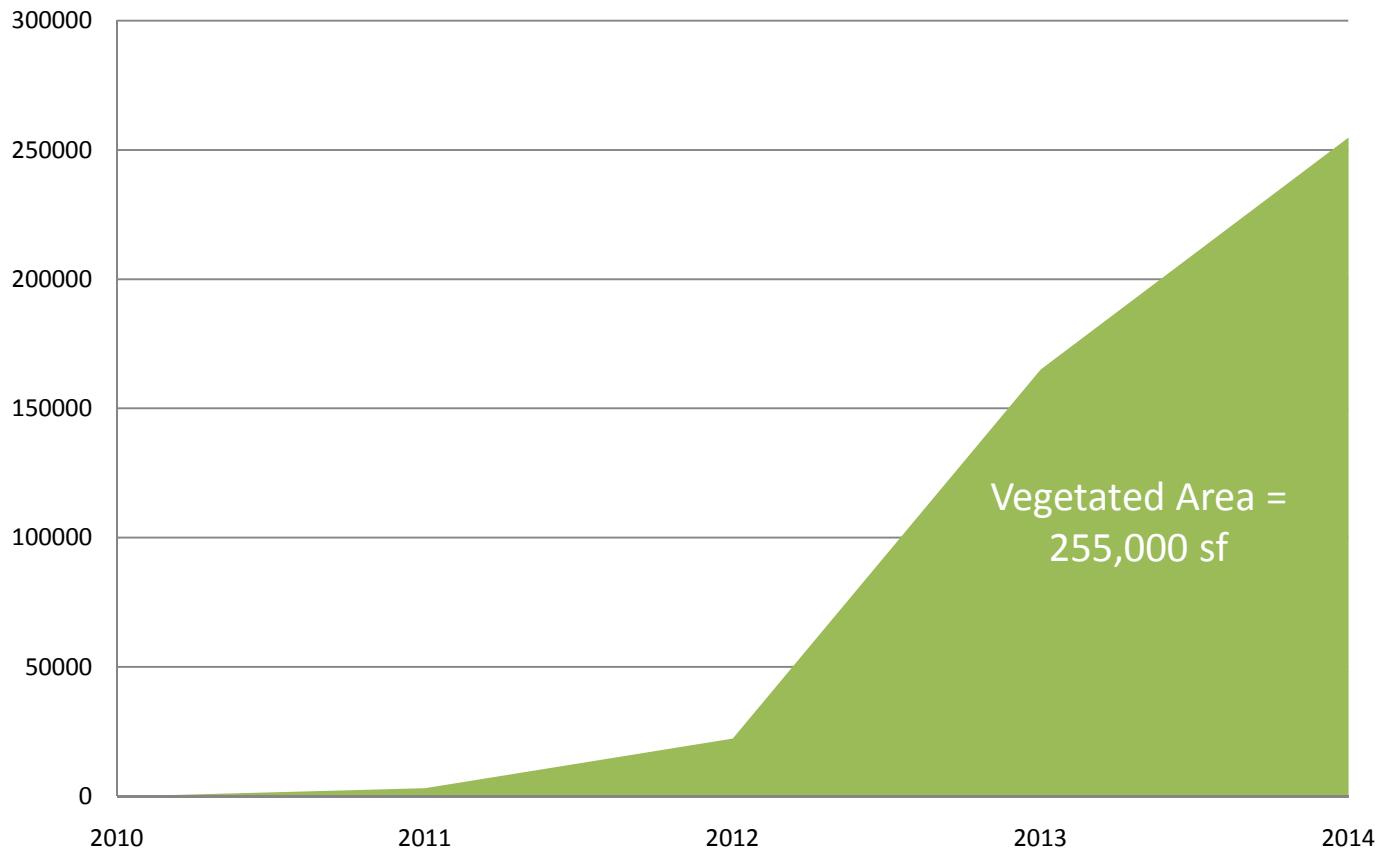
- GIS → Verification; Workflows/Network; Components DBase
- Construction → PLAR; Planting Demo; Inspector's Guide
- Design → Design Reviews (30%,70%); Feedback



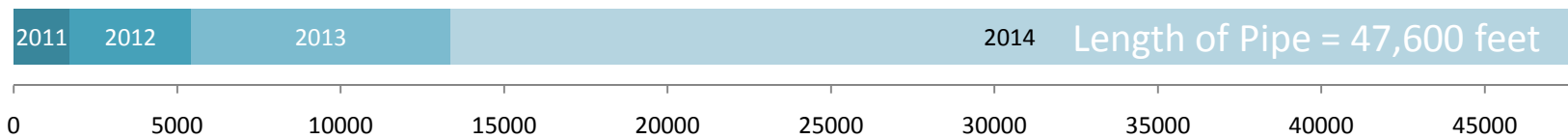
Core Programmatic Admin Tasks FY13 -14







Number of Trees = 1600





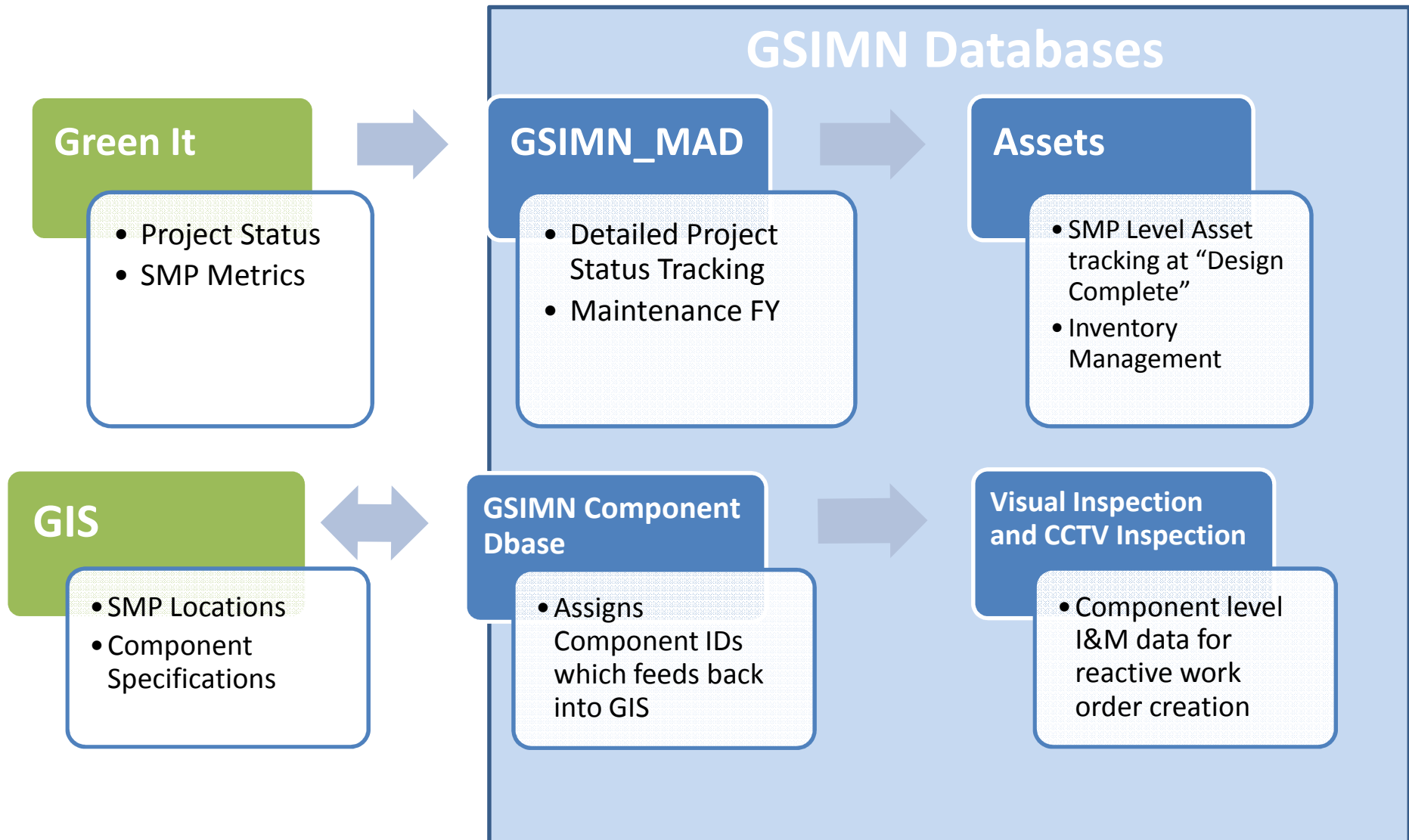
Core Programmatic Admin Tasks FY13 -14

Program Development

- Personnel and Equipment
- Project Inventory
- Asset Management
- District-Based Regime
- Work-order Management

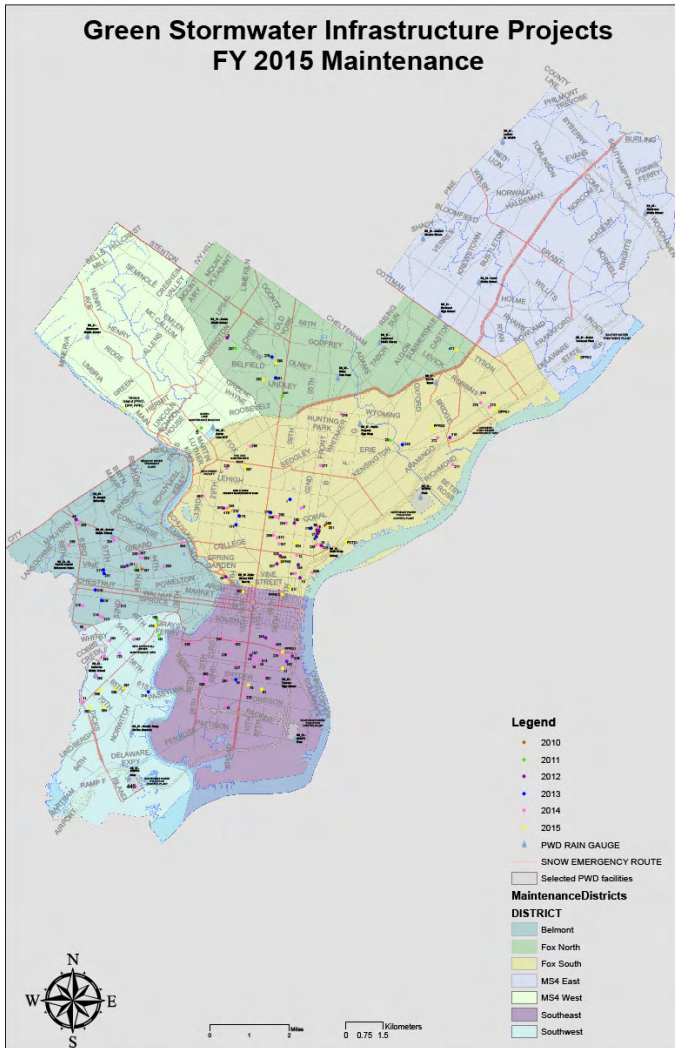
Intra-Departmental Coordination

- GIS → Verification; Workflows/Network; Components DBase
- Construction → PLAR; Planting Demo; Inspector's Guide
- Design → Design Reviews (30%,70%); Feedback





**Green Stormwater Infrastructure Projects
FY 2015 Maintenance**



Maintenance Districts

Belmont
 Fox St. North
 Fox St. South
 Southeast
 Southwest
 MS4 East
 MS4 West



Core Programmatic Field Tasks FY13-14

Surface

- Inspection (Dry/Wet)
- Pervious Paving
- Aesthetic Maintenance
- Tiered Approach
- Pretreatment Maintenance

Subsurface

- PWD CCTV Inspection
- Maintenance
- Pretreatment Maintenance

Reactive

- Pretreatment Maintenance
- Retrofits/Repairs



Aesthetic Maintenance



- 212 Task Orders Assigned
- 136 Work Orders
- Collected 3500 gallons of residential garbage, leaves/organic debris, and commercial/construction material
 - 575 gal. from Tree Trench and Stormwater Trees
 - 25 gal. from Stormwater Basins
 - 975 gal. from Rain Gardens
 - 1300 gal. from Stormwater Bumpouts
 - 525 gal. from Stormwater Planters
 - 100 gal. from Swales
- 41.75 hours on site conducting aesthetic maintenance





Subsurface I&M

Locating Utility Infrastructure Services (LUIS)

- EnviroSight Camera
- Hand Tools and Safety Equipment
- Sonde Locator

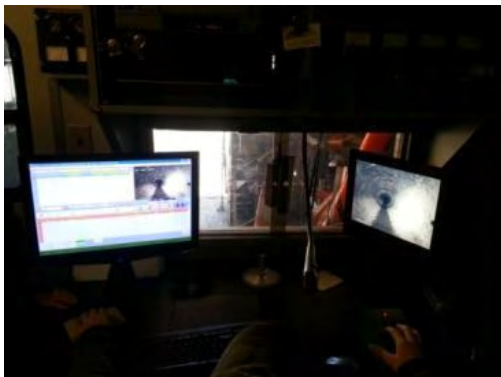




Subsurface I&M

Mobile Dredging and Pumping Co.

- Vactor Truck
- Nozzles/Brushes/Spray Gun
- Flexible Hose
- Crawler
- Confined Space Entry





Subsurface I&M

Defect Log Appendix

Customer: PWD	PWD Work Number	S-50032-G
GSI Maintenance and Monitoring	PWD Project Number	325
	Site Name	8th Street Tree Trench
	Site ID	25tt
	Element Start:	3001.6
	Element End:	1001.1
	Direction:	Downstream
	Material:	HDPE
	Diameter:	8"
	Usage:	Storm water
	Time and Date:	09/30/20 06-FEB-2013
Video Filename:	8" Street 130206_3001 Pre_0930A	
Notes:	Pre-inspection of component 3001	

Survey Observations - Operational and Maintenance Defects

<p>0:00 09/30/20 06-FEB-2013</p>	<p>1. At: 0.00 feet Component 3001</p> <p>Deposit Settlement (DSZ)</p> <p>Continuous Defect S01</p> <p>Remarks: Debris at the bottom of the clean out element Id. 3001.6 and element Id. 3001.5.</p>
<p>7:33 09/31/23 6-FEB-2013</p>	<p>2. At: 7.33 feet Component 3001</p> <p>Deposit Settlement (DSZ)</p> <p>Continuous Defect S02</p> <p>Remarks: Debris, trash and leaves. In element Id. 3001.5</p>



<p>38:56 13/13/40 6-FEB-2013</p>	<p>2. At: 38.58 feet Component 3001</p> <p>Roots Fine (RF)</p> <p>Continuous Defect S01</p> <p>Remarks: Roots entered the main body of the pipe in element Id. 3001.5</p>
<p>53:25 13/14/00 6-FEB-2013</p>	<p>3. At: 53.25 feet Component 3001</p> <p>Roots Fine (RF)</p> <p>Continuous Defect E01</p> <p>Remarks: Roots entered the main body of the pipe in element Id. 3001.5</p>



Subsurface I&M





Reactive Maintenance



BEFORE





GSI Maintenance Manual Format

Table of Contents

Division 1 – Introduction

1.1 Introduction

1.2 Stormwater Management Practices*

1.2.1 SMPs In Practice By PWD

1.2.2 SMPs In Limited Practice Or Not Yet In Practice By PWD



GSI Maintenance Manual Format

Table of Contents

Division 2 – Maintenance Tasks

2.1 Surface Structural Maintenance

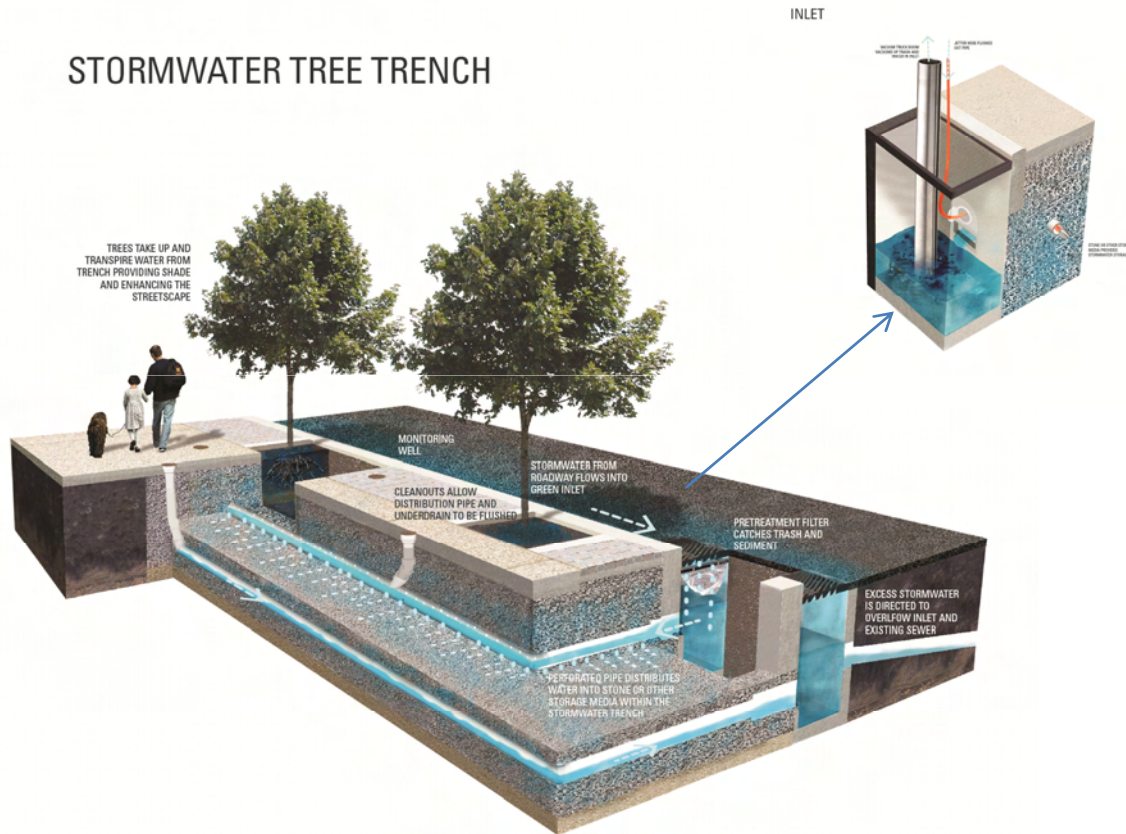
2.2 Vegetation Maintenance

2.3 Subsurface Maintenance

2.4 Waste Disposal and Decanting



STORMWATER TREE TRENCH



Surface Maintenance

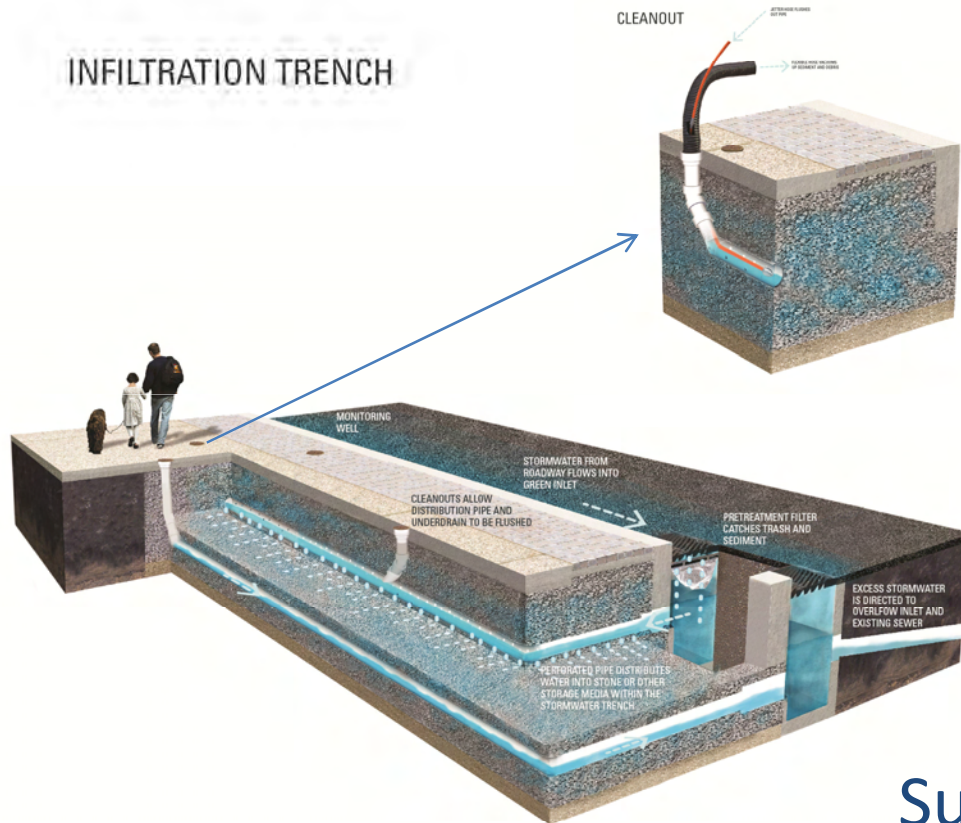
- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize SMP
- Remove non-target/invasive vegetation
- Apply mulch
- Prune trees
- Water trees

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures



INFILTRATION TRENCH



Surface Maintenance

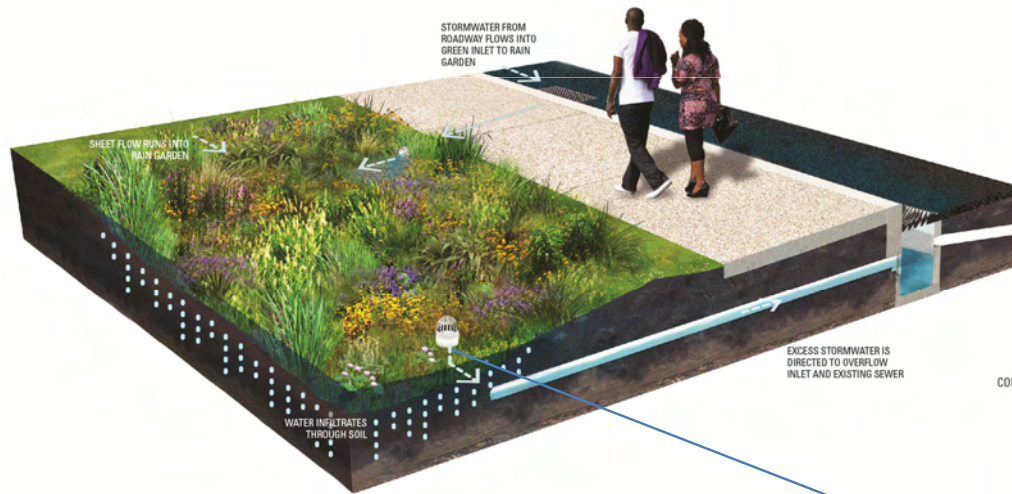
- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize SMP

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures



RAIN GARDEN

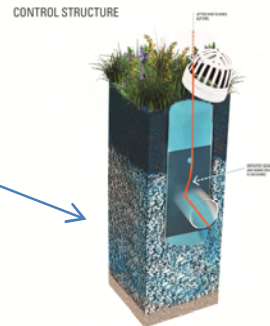


Surface Maintenance

- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize
- Apply mulch
- Remove non-target/invasive vegetation
- Cut back target perennials
- Mow turf and meadow areas
- Prune trees and shrubs
- Water trees, herbaceous vegetation and shrubs

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures





STORMWATER BUMPOUT



Surface Maintenance

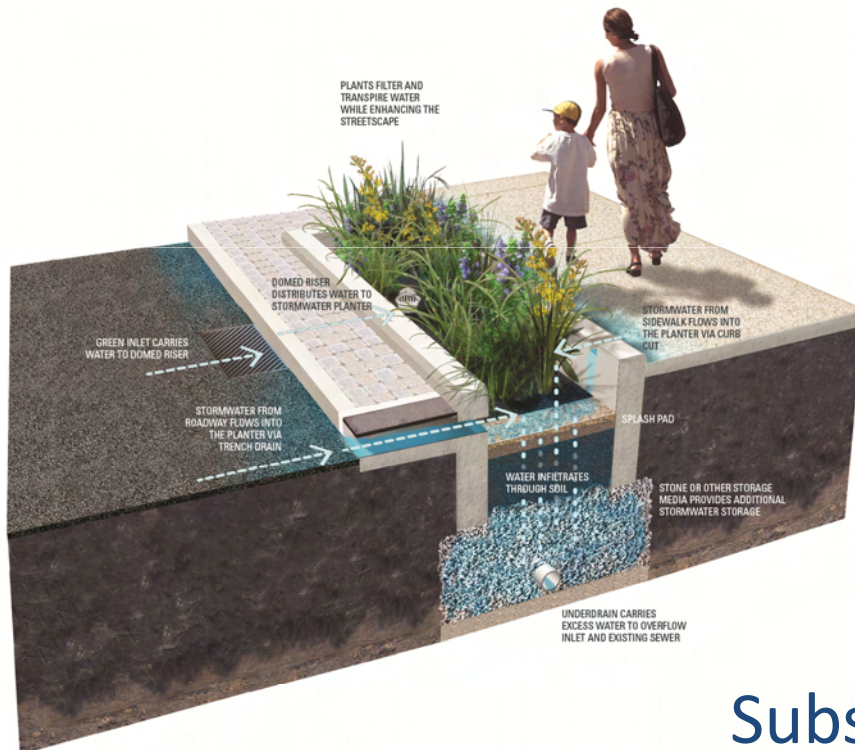
- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize SMP
- Apply mulch
- Remove non-target/invasive vegetation
- Cut back target perennials
- Prune trees and shrubs
- Water trees, herbaceous vegetation and shrubs

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures



STORMWATER PLANTER



Surface Maintenance

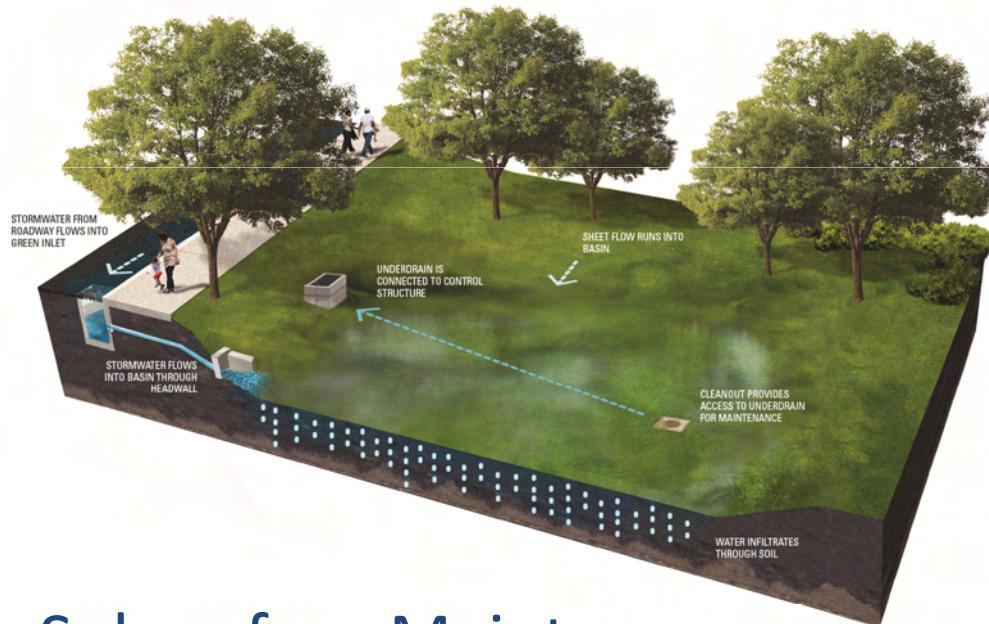
- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize
- Paint planter box wells
- Remove non-target/invasive vegetation
- Cut back target perennials
- Prune trees
- Water trees, herbaceous vegetation and shrubs

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures



STORMWATER BASIN



Surface Maintenance

- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize
- Apply mulch
- Remove non-target/invasive vegetation
- Cut back target perennials
- Mow turf and meadow
- Prune trees and shrubs
- Water trees

Subsurface Maintenance

- Jet Pipes
- Vacuum clean structures



STORMWATER TREE

TREE FILTERS AND TRANSPIRES WATER WHILE PROVIDING SHADE AND ENHANCING THE STREETScape

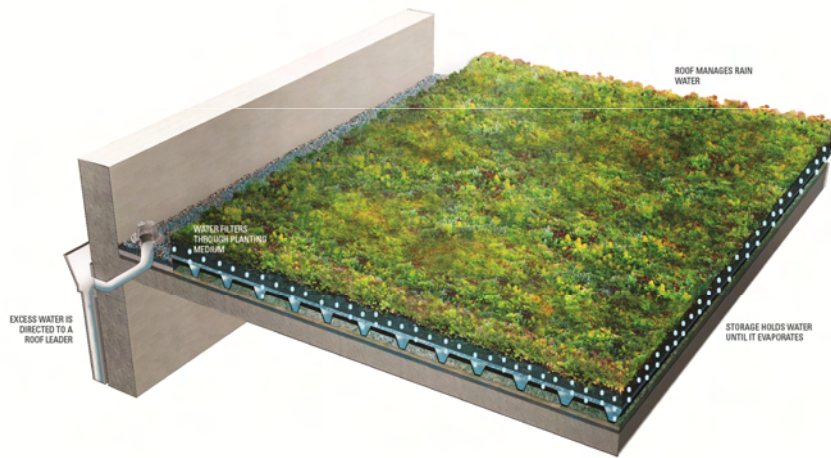


Surface Maintenance

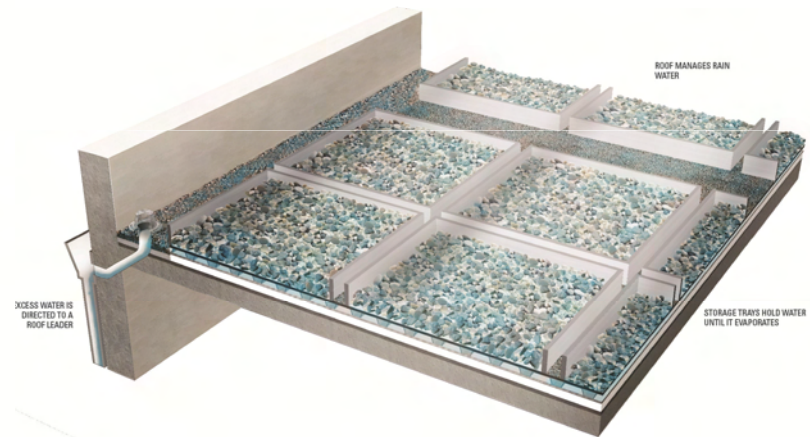
- Remove trash, sediment, and organic debris from all SMP surfaces
 - Clean pretreatment devices
- Winterize
- Remove non-target/invasive vegetation
- Apply mulch
- Prune trees
- Water trees



GREEN ROOF

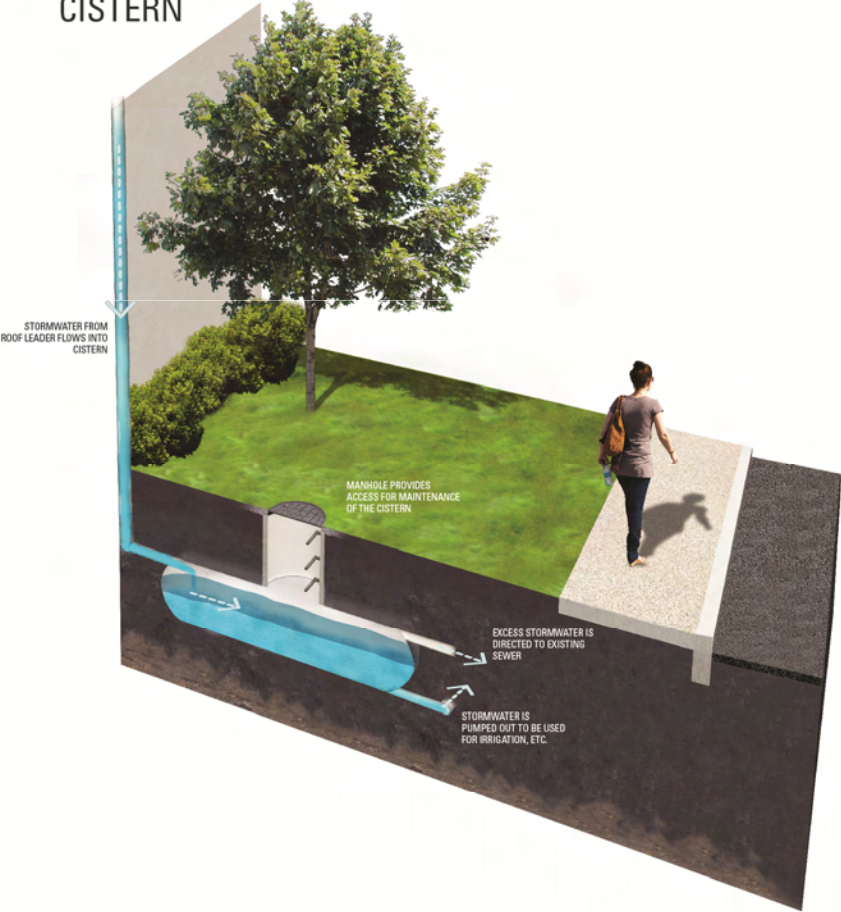


BLUE ROOF



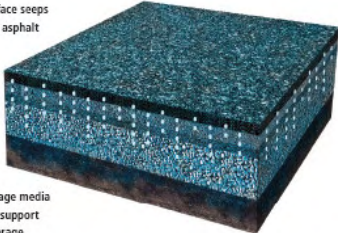


CISTERN



Permeable Asphalt

Stormwater on surface seeps through permeable asphalt



Stone or other storage media provides structural support and stormwater storage

Permeable Concrete

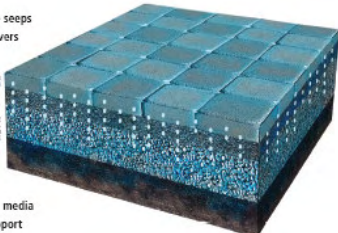
Stormwater on surface seeps through permeable concrete



Stone or other storage media provides structural support and stormwater storage

Permeable Paver

Stormwater on surface seeps through permeable pavers



Stone or other storage media provides structural support and stormwater storage



GSI Maintenance Manual Format

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Division 3 – Appendices

- 3.1 Documentation
- 3.2 Health and Safety
- 3.3 Personnel
- 3.4 Access Requirements
- 3.5 Maintenance Event Procedures
- 3.6 Points of Contact
- 3.7 Jetting Nozzles

Division 4 – Glossary





Questions?

Special Thanks :

AKRF — Kevin Flynn, Beth Boivert,
Lia Mastropolo, Akta Patel

PWD — Katie Shafer, Rupal Patel, Brittany Coyle