NYC Department of Environmental Protection

Green Infrastructure Program

June 10, 2013

Agenda

❖**Green Infrastructure Program**

- Stormwater in NYC
- Green Infrastructure Approach
- Program Implementation

❖**2012 Stormwater Pilot Monitoring Report**

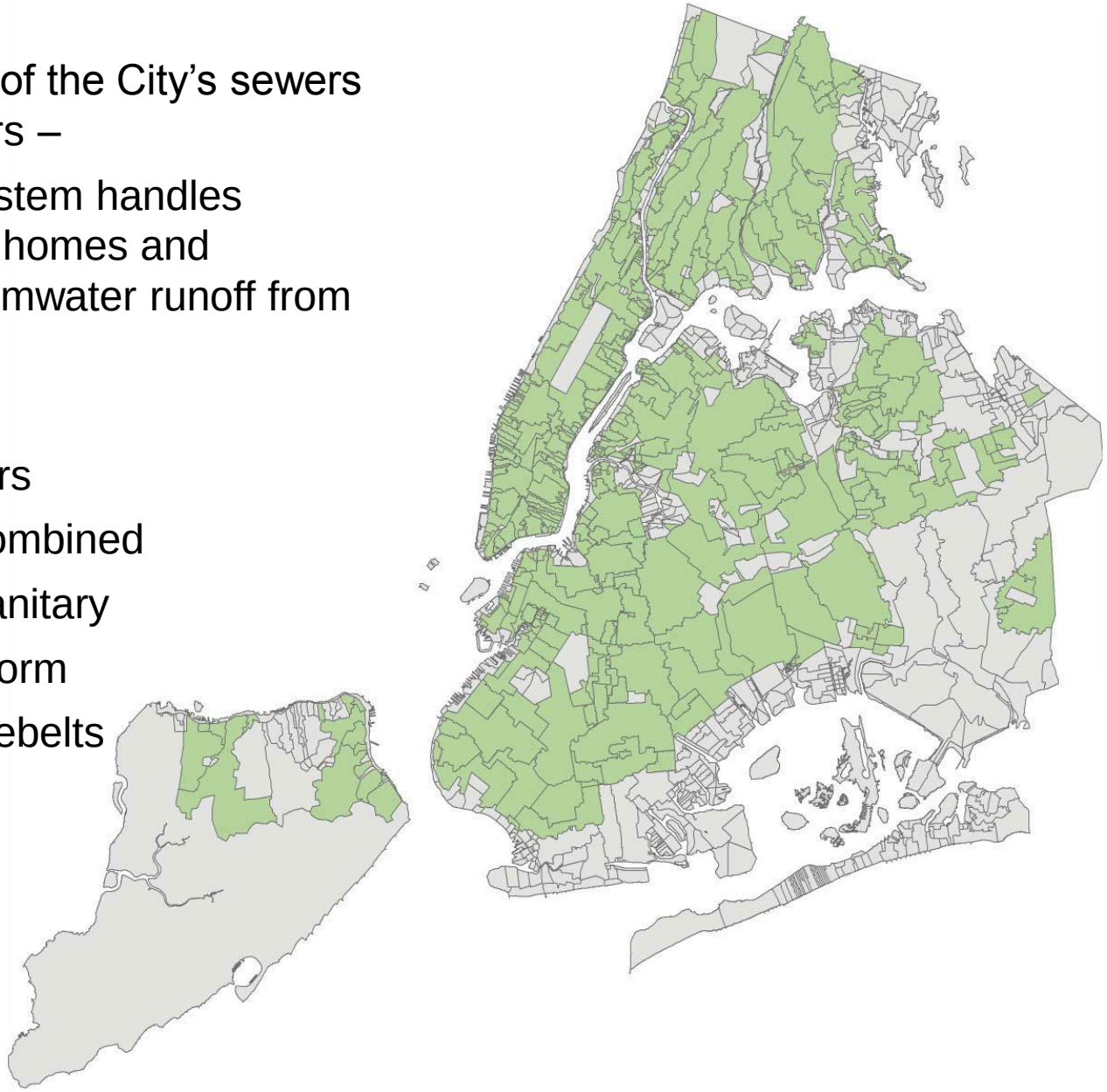
❖**Questions and Answers**

NYC - Sewer System

- Approximately 60% of the City's sewers are combined sewers –

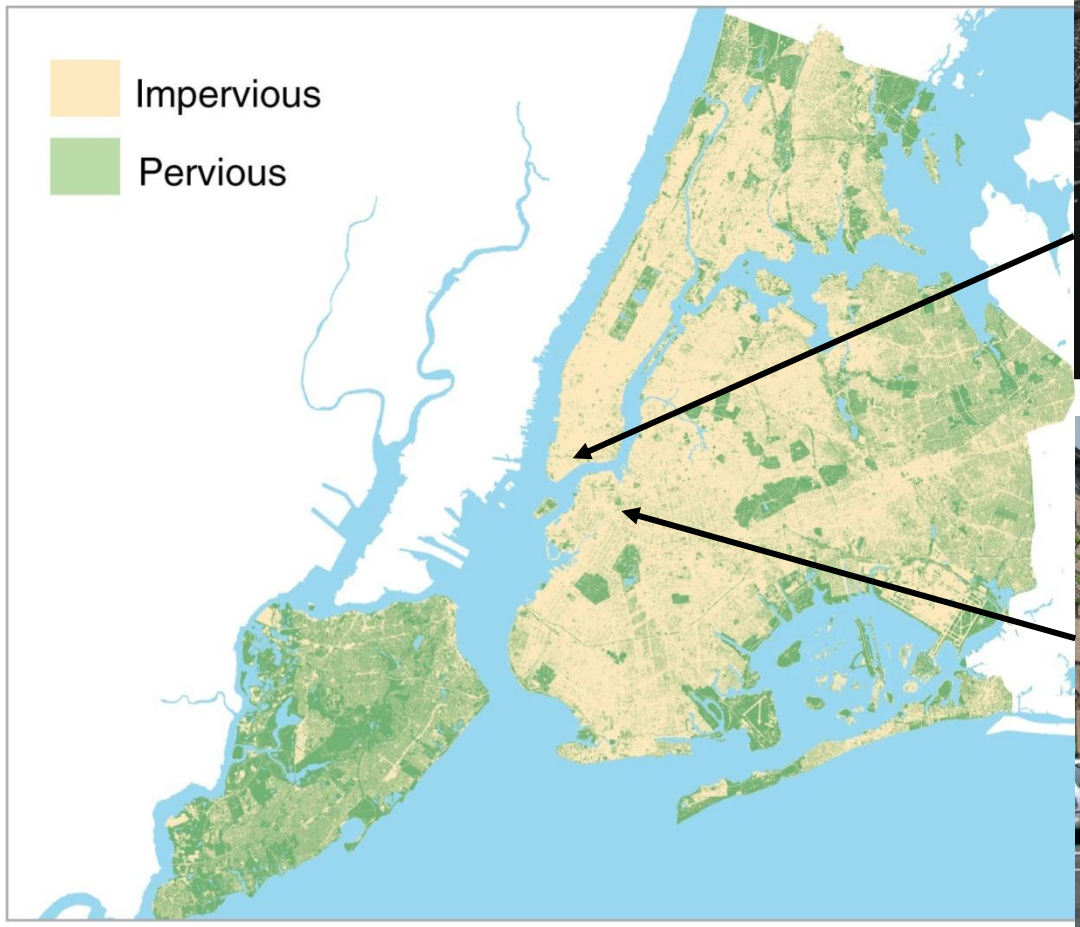
  meaning that the system handles sanitary waste from homes and businesses and stormwater runoff from streets, sidewalks

- 7,400 miles of sewers
  - 3,337 miles of combined
  - 2,271 miles of sanitary
  - 1,801 miles of storm
  - 400 acres of Bluebelts

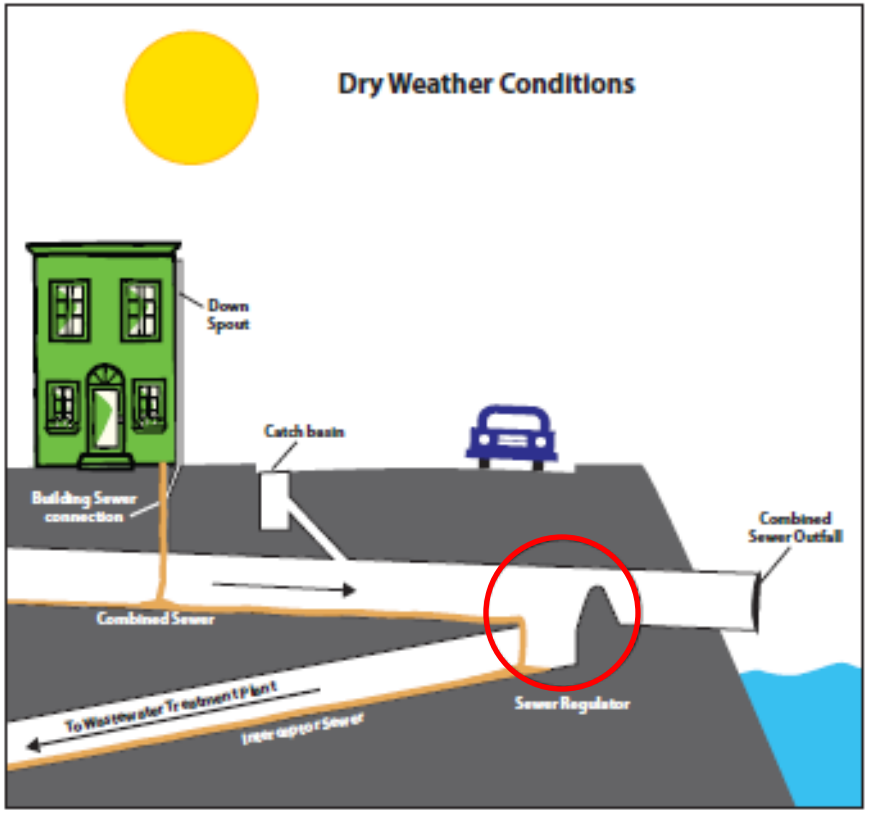


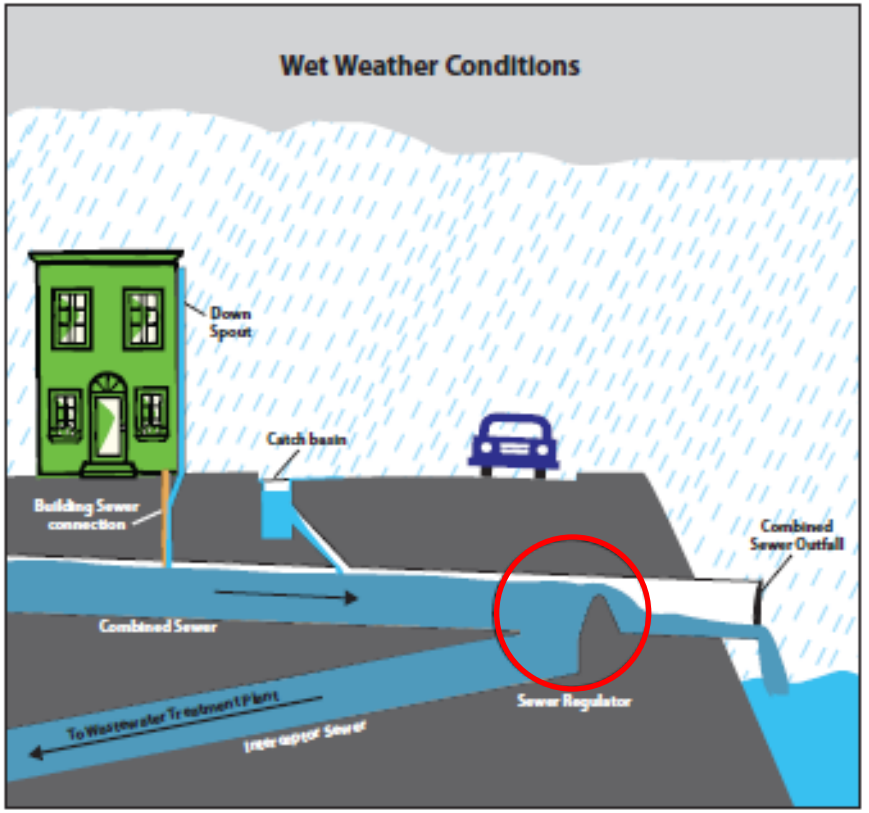
Impervious Surfaces & Dense Landscapes

Impervious surfaces cover 72% of NYC's land area



Wet Weather May Result in CSOs





Water Quality in New York City Harbor

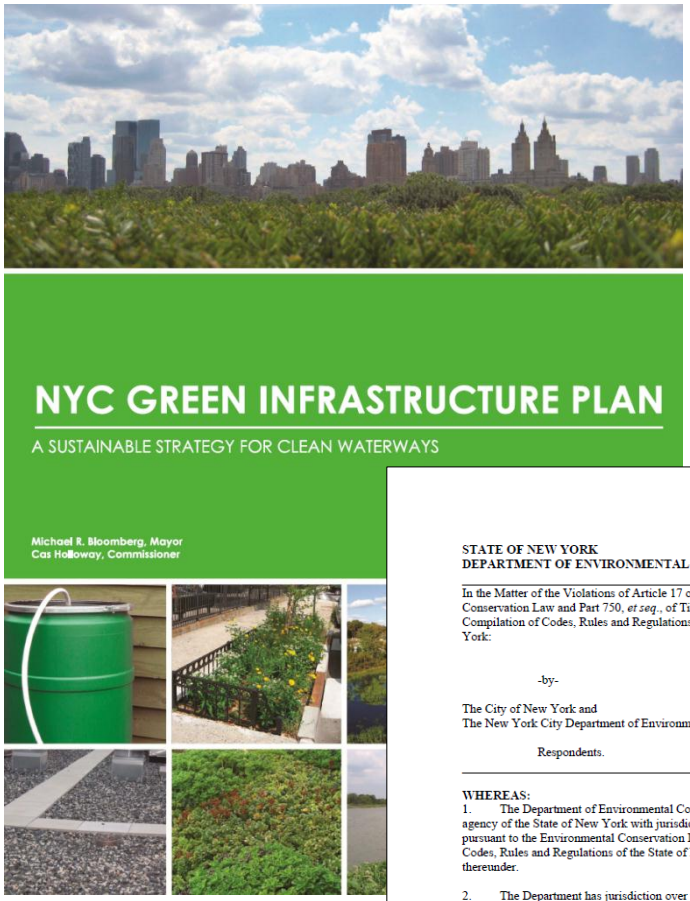
= does not meet water quality standards

75% of Harbor meets pathogen standards for swimming

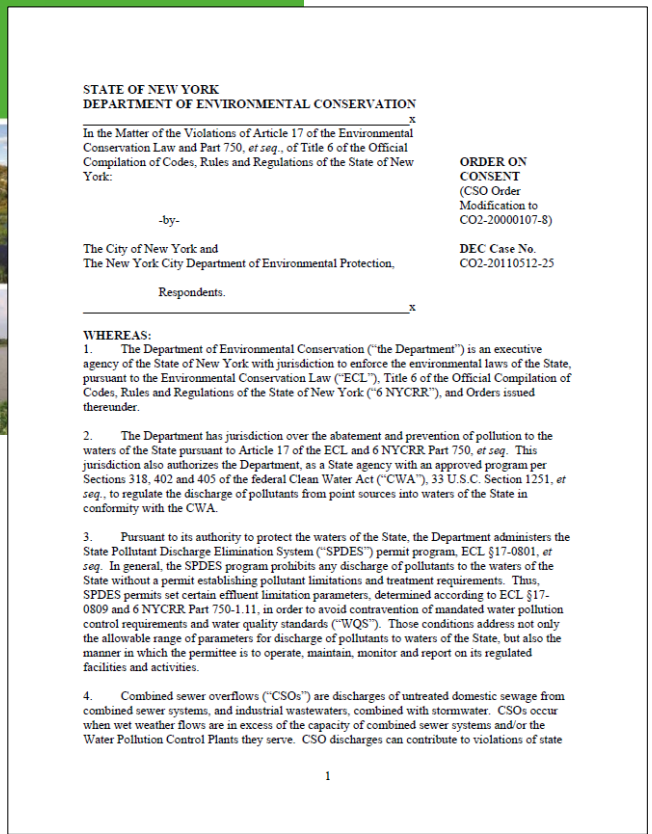
19% meets standards for boating, fishing

7% of our Harbor is made up of tributaries that do not meet secondary contact standards

Green Infrastructure Approach



2010 – NYC Green Infrastructure Plan
Laid framework to use green infrastructure to manage stormwater runoff from 10% of impervious surfaces in combined sewer areas by 2030.



STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of the Violations of Article 17 of the Environmental Conservation Law and Part 750, *et seq.*, of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York:

-by-

The City of New York and
The New York City Department of Environmental Protection,

Respondents.

ORDER ON CONSENT
(CSO Order Modification to CO2-20000107-8)

DEC Case No.
CO2-20110512-25

WHEREAS:

1. The Department of Environmental Conservation ("the Department") is an executive agency of the State of New York with jurisdiction to enforce the environmental laws of the State, pursuant to the Environmental Conservation Law ("ECL"), Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR"), and Orders issued thereunder.

2. The Department has jurisdiction over the abatement and prevention of pollution to the waters of the State pursuant to Article 17 of the ECL and 6 NYCRR Part 750, *et seq.* This jurisdiction also authorizes the Department, as a State agency with an approved program per Sections 318, 402 and 405 of the federal Clean Water Act ("CWA"), 33 U.S.C. Section 1251, *et seq.*, to regulate the discharge of pollutants from point sources into waters of the State in conformity with the CWA.

3. Pursuant to its authority to protect the waters of the State, the Department administers the State Pollutant Discharge Elimination System ("SPDES") permit program, ECL §17-0801, *et seq.* In general, the SPDES program prohibits any discharge of pollutants to the waters of the State without a permit establishing pollutant limitations and treatment requirements. Thus, SPDES permits set certain effluent limitation parameters, determined according to ECL §17-0809 and 6 NYCRR Part 750-1.11, in order to avoid contravention of mandated water pollution control requirements and water quality standards ("WQS"). Those conditions address not only the allowable range of parameters for discharge of pollutants to waters of the State, but also the manner in which the permittee is to operate, maintain, monitor and report on its regulated facilities and activities.

4. Combined sewer overflows ("CSOs") are discharges of untreated domestic sewage from combined sewer systems, and industrial wastewaters, combined with stormwater. CSOs occur when wet weather flows are in excess of the capacity of combined sewer systems and/or the Water Pollution Control Plants they serve. CSO discharges can contribute to violations of state

1

2012 – Amended Consent Order
DEP and NYS DEC signed an historic agreement to incorporate a green and grey adaptive management approach into the CSO program.

Green Infrastructure in New York City

NYC Environmental Protection



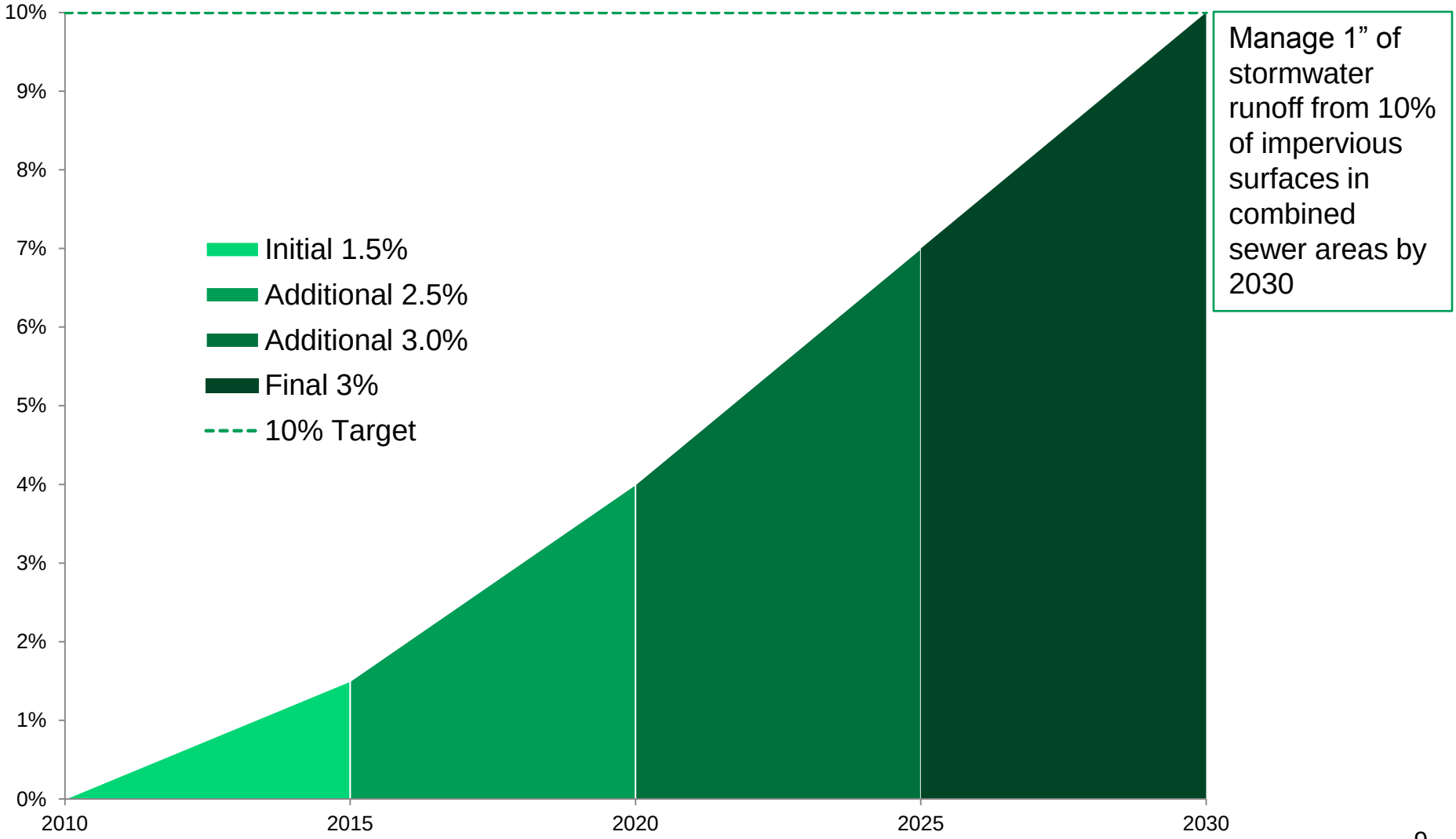






GI Application Rates and Milestone Schedule

- 1.5 billion in capital funding through 2030.
- $192 million committed to be spent by December 2015.



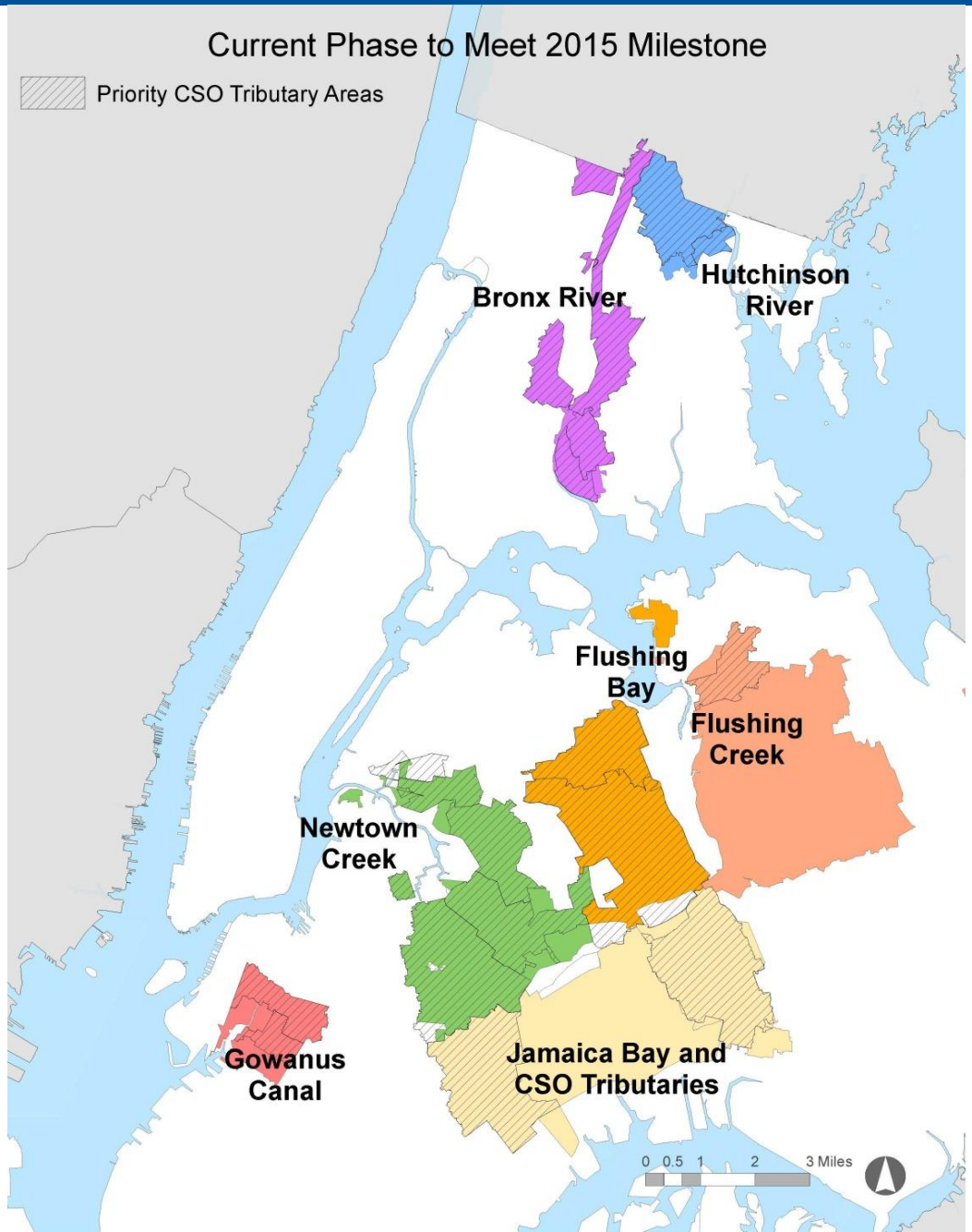
Benefits of Green Infrastructure

- More cost effective than building large detention facilities
- Improved water quality and restored ecosystems
- Reduces urban heat island effect and provides air quality improvements
- May reduce street flooding in some rain events
- Greener neighborhoods

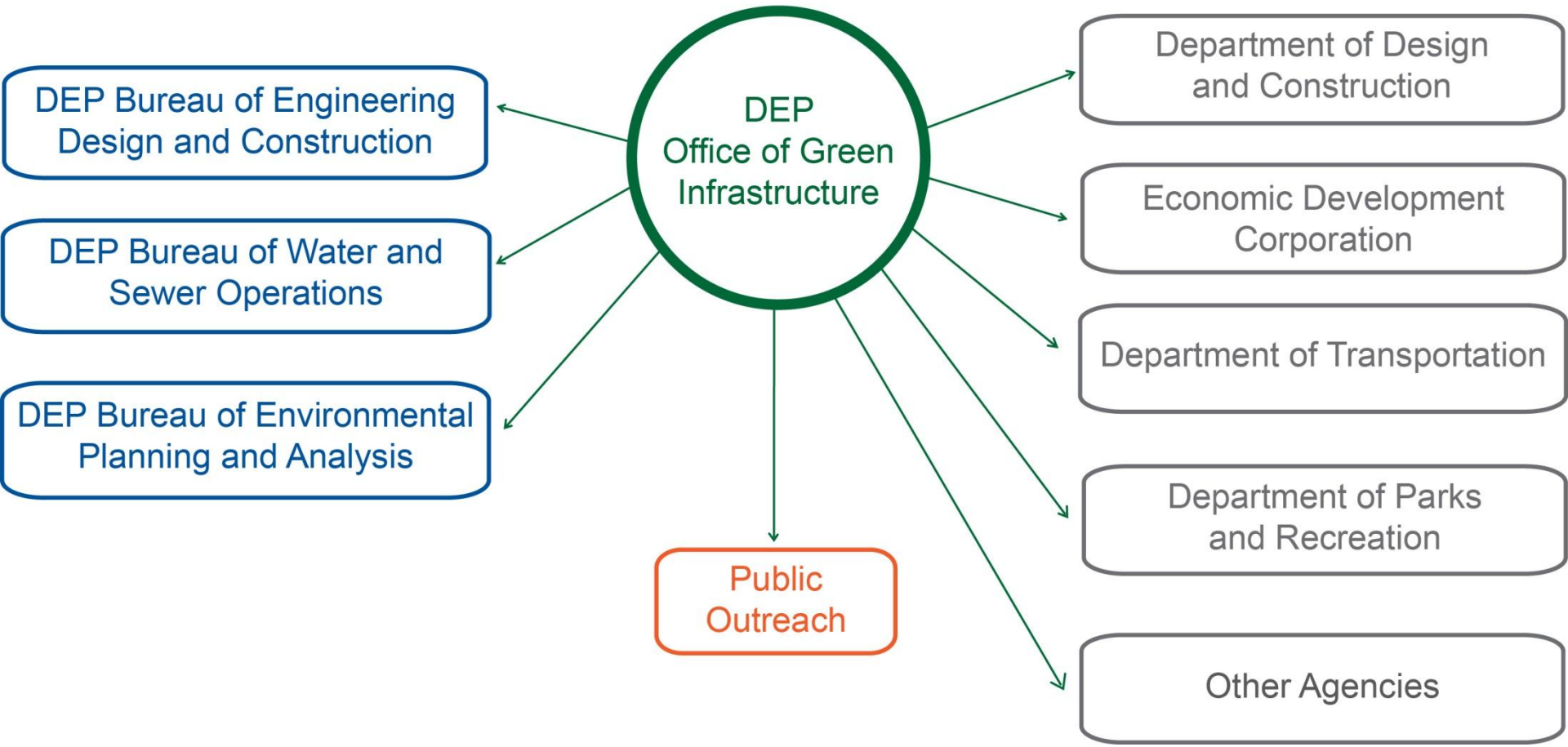
Before

After

Waterbody Prioritization



Office of Green Infrastructure Partnerships

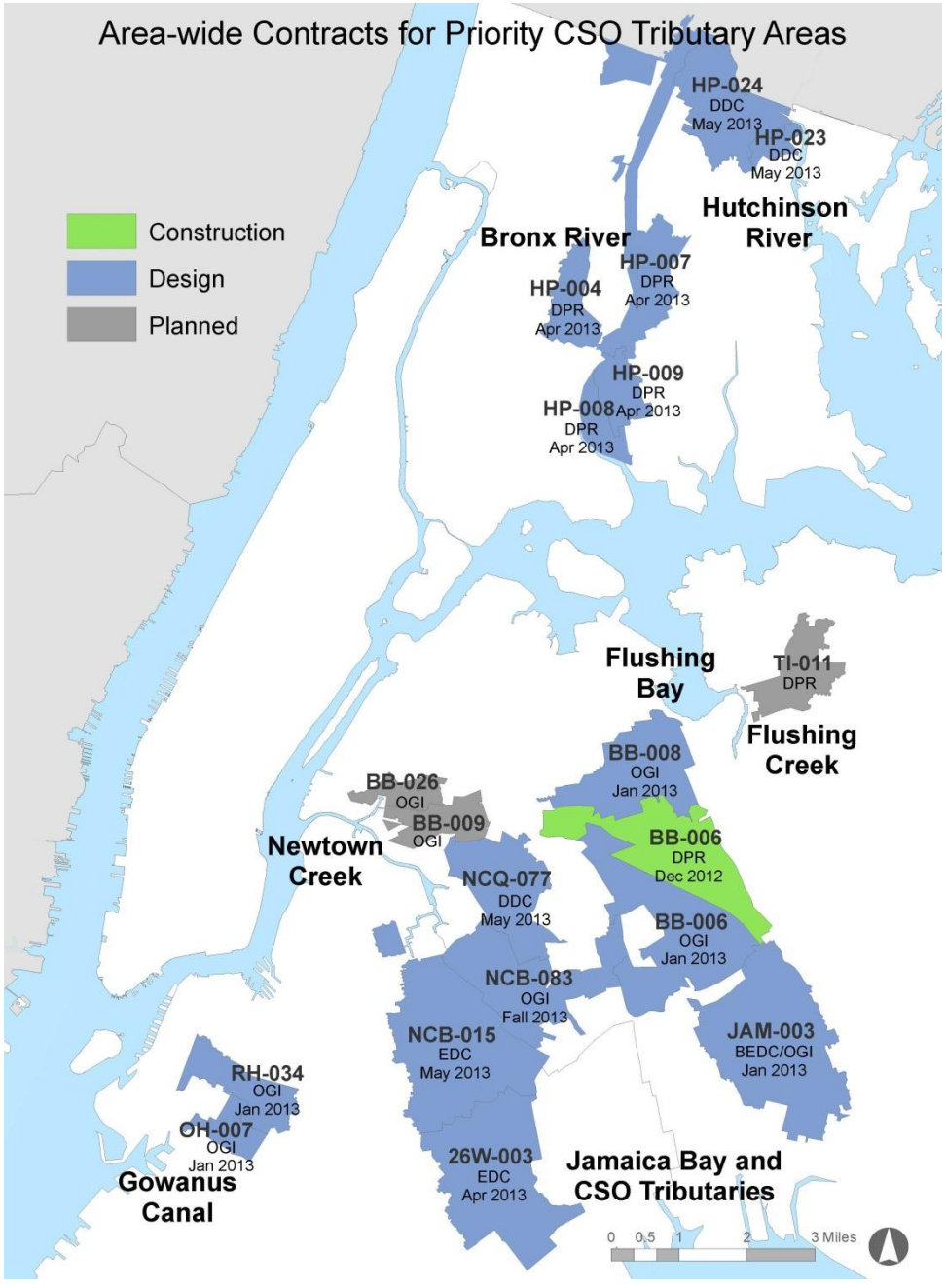


NYC Green Infrastructure Program

Overview: $192 million has been committed for green infrastructure in combined sewer areas through 2015, including Environmental Benefit Program funds.

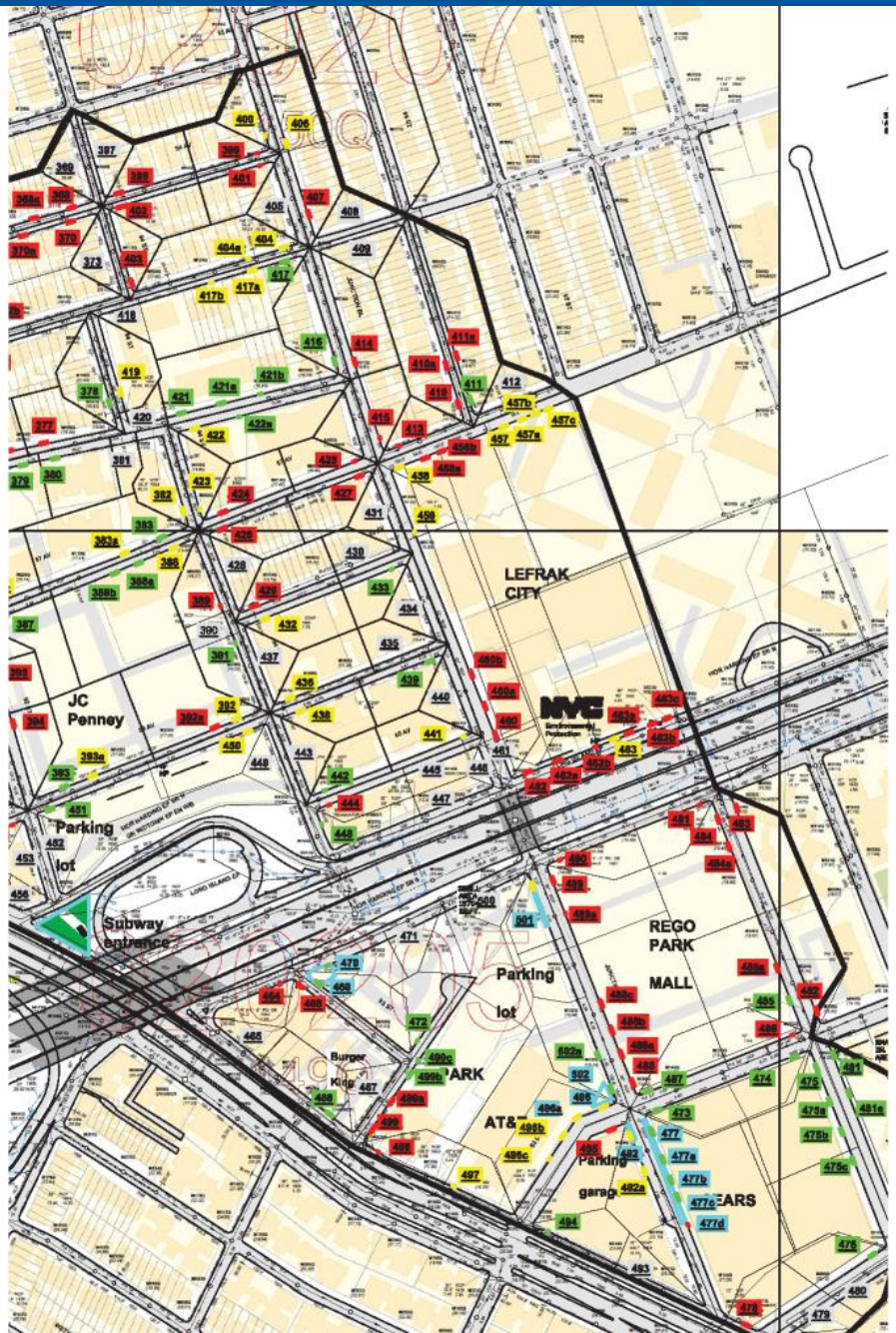
- **Area-Wide Contracts**
- **On-site Retrofits**
- **Neighborhood Demonstration Areas**
- **Green Infrastructure Grant Program**
- **Other programmatic areas include:**
  - DPR Maintenance Program
  - Asset Management System
  - Outreach and Engagement Program

2013-2015 Area-wide Contracts



Right of Way Bioswale

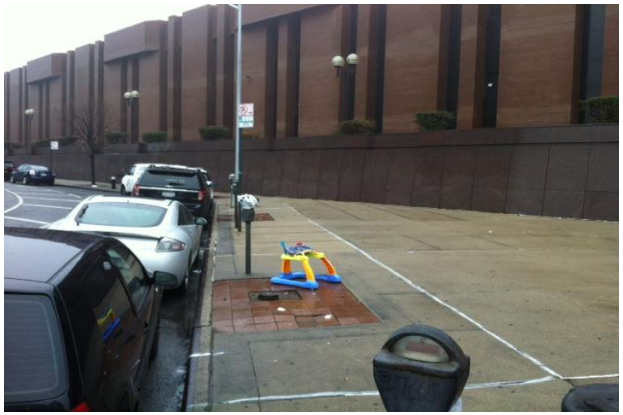
ROWB Site Selection Example: Flushing Bay



1. **Potential** –
   - Desktop Analysis
2. **Preliminary** –
   - Walkthrough
   - Geotechnical Investigation
   - Survey
3. **Final** –
   - Approved sites included in contract plans

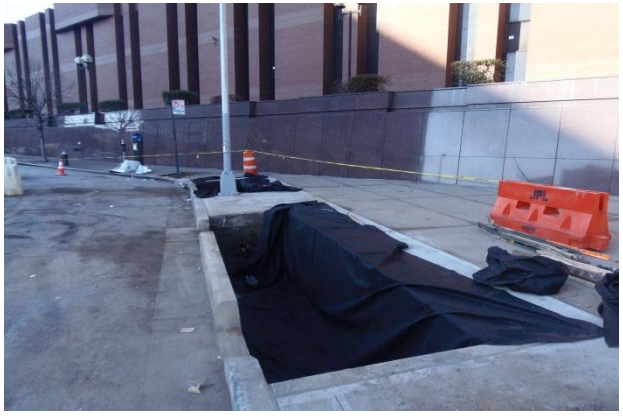
- Eliminated Potential Sites
- Pending DOT Approval
- Final
- Proposed SW Greenstreet

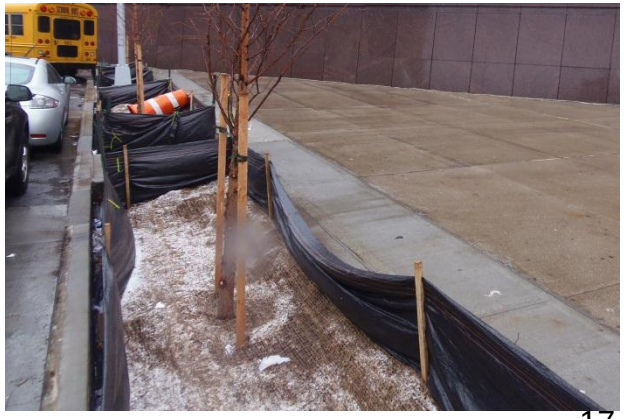
ROW Bioswale Construction











Completed ROW Bioswale

ROWBs In Action

Stormwater Greenstreets

NYC Environmental Protection

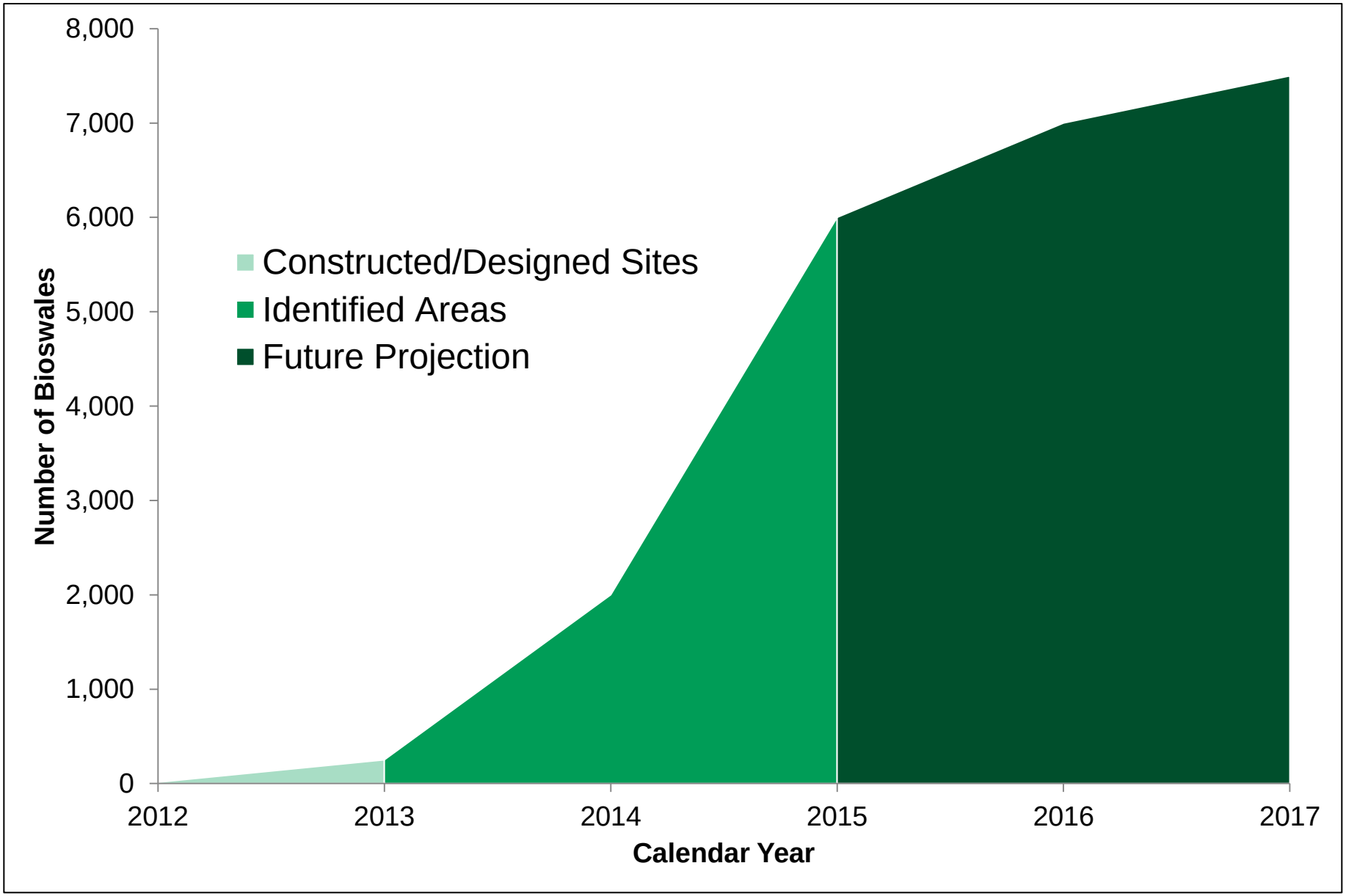
ROWB Statistics & Costs

ROWB Types	Calculated CF Capacity	Calculated SF Managed
Type I	300	3,600
Type II	225	2,700
Type III	150	1,800
Type I - Enhanced	400	4,800
Type II – Enhanced	300	3,600

Photo: Example Type III Bioswale

Average Costs for a Typical ROWB	
Design	$4,000
Surveys and Geotechnical	$5,000
Construction	$25,000
Construction Management (10% of Construction Costs)	$2,500
Total	**$36,500**

2012-2017 ROW Bioswale Construction Targets



Public Property Retrofits

Total Impervious Surface Managed: 370,826 SF

- **Public Housing - NYCHA**
  - Edenwald Houses, Bronx
  - Seth Low Houses, Brooklyn
  - Hope Gardens, Brooklyn

- **Schools – SCA/DOE/TPL**
  - JHS 218, Brooklyn
  - JHS 162, Brooklyn
  - PS 261, Brooklyn
  - PS 65, Brooklyn
  - PS 157, Queens
  - PS 194, Bronx

Trust for Public Land Schoolyard Design

- **Hospitals - NYC HHC**
  - East New York Diagnostic Center, Brooklyn

- **Parking Lots - Cultural Affairs**
  - Flushing Town Hall Parking Lot, Queens

Example: Edenwald Houses, Bronx

Project Cost: $7.5 m

Construction:
Begins Winter 2013

GI Technology

- Rooftop Collection
- Rain Garden
- Porous Paving

Neighborhood Demonstration Areas

Complete: April 2013

Complete: April 2013

Complete: December 2012

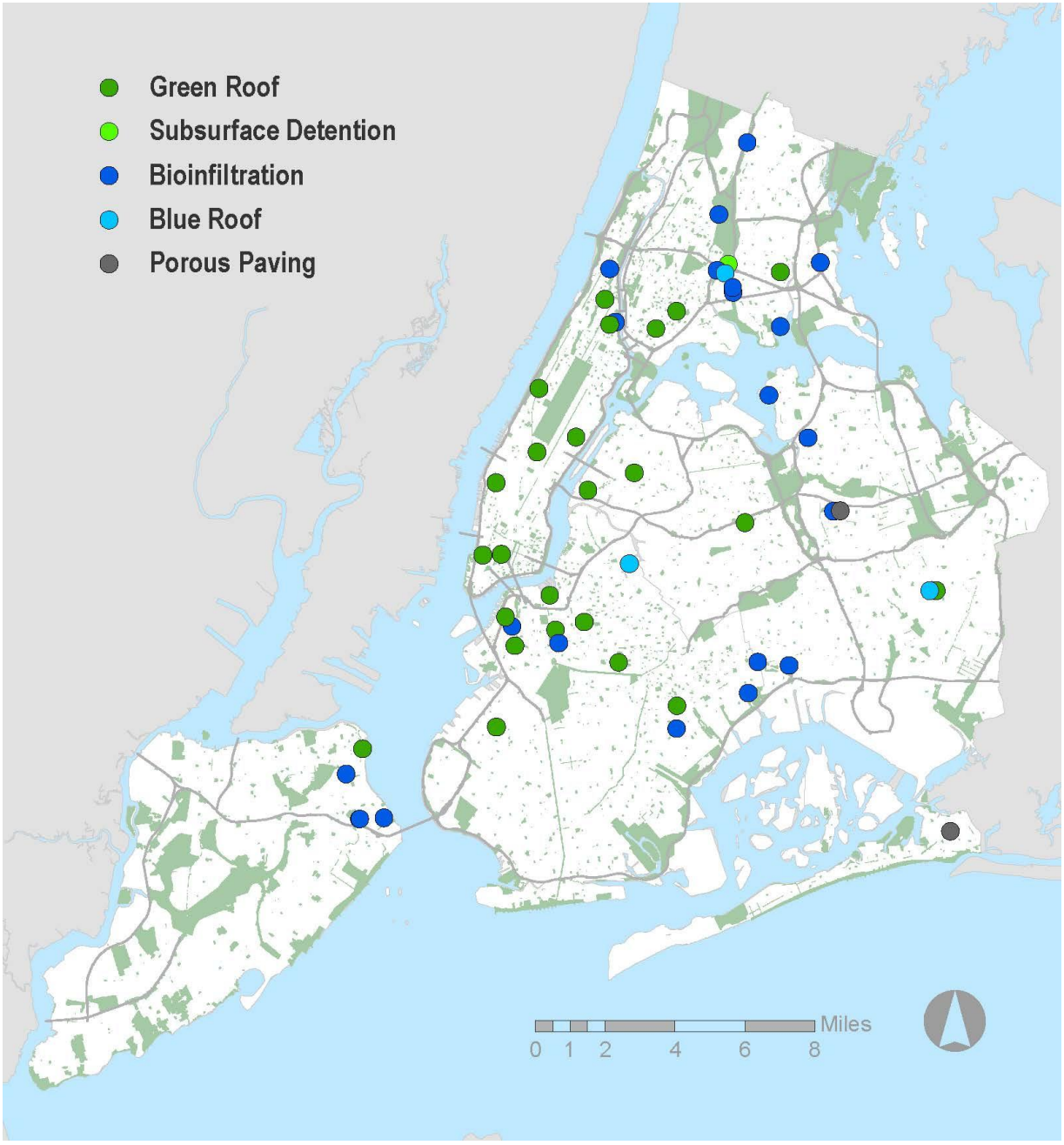
Green Infrastructure Grant Program

- Three grant cycles to date
- $11.1 million has been committed to private property owners
- Winning Projects include:
  - Green Roofs
  - Rain Gardens
  - Rooftop Farms
  - Permeable Pavers
  - Smart detention systems

Brooklyn Navy Yard – Rooftop Farm Summer 2012

Queens College- Pavers/Rain Garden Fall 2012

Built and Designed Projects, 2011-2012



Maintenance of Green Infrastructure

ROW Maintenance:

- Through FY2015 (June 2015), DEP will fund Parks' department crews to maintain all green infrastructure in the right of way.
- Maintenance MOU clearly defines roles and responsibilities for ROW installations for DEP/DOT/DPR.

Onsite Maintenance:

- Project specific maintenance agreements are developed with each partnering agency.

GI Asset Management

- **Project Tracking & Asset Management System**
  - DEP and DOITT developing GIS-based application
  - Track design & construction data of each GI asset
  - Manage built assets citywide for effective maintenance and performance

- **Interim Tracking System**
  - DEP developed a database for interim use
  - System is used by partnering agencies and consultants
  - Migration to final PT/AM system anticipated in 2014

	Project Information					
Project Description	GI Type	GI ID	Managing / Partnering Entity	Borough	CSO Tributary	Waterbody
East New York diagnostic and treatment center	Green Roof	3037380015-A	Other (See Notes)	Brooklyn	26W-003	Jamaica Bay
JHS 218K Playground Improvements	Dual System (See Notes)	3042780001-A	TPL/SCA	Brooklyn	26W-005	Jamaica Bay
JHS 218K Playground Improvements	Dual System (See Notes)	3042780001-B	TPL/SCA	Brooklyn	26W-005	Jamaica Bay
PS 65K Playground Improvements	Dual System (See Notes)	3041020019-A	TPL/SCA	Brooklyn	26W-005	Jamaica Bay
PS 65K Playground Improvements	Dual System (See Notes)	3041020019-B	TPL/SCA	Brooklyn	26W-005	Jamaica Bay
PS 261K Playground Improvements	Dual System (See Notes)	3001880014-A	TPL/SCA	Brooklyn	RH-034	Gowanus Canal
PS 261K Playground Improvements	Dual System (See Notes)	3001880014-B	TPL/SCA	Brooklyn	RH-034	Gowanus Canal
Hope Gardens Houses (need official contract	Rain Garden	3033150001-A	OGI	Brooklyn	NCB-015	Jamaica Bay

Continuous R&D Efforts

- Continue to analyze data on stormwater quantity control aimed at reducing CSOs
- Assess water quality benefits and reductions in pollutant loads
- Gather data on sustainability co-benefits such as pollinator use and temperature effects within localized areas of the city
- Evaluate engineering soil mixes, green roof media types, vegetation selection, and other GI components to guide development of more efficient, better performing GI for NYC
- Continue to improve standard designs and review emerging technologies and installation methods
- Continue to review existing and improve upon modeling of GI performance at various spatial scales (e.g. neighborhood, subwatershed, and watershed)

Community Outreach

❖ Green Infrastructure Stakeholders

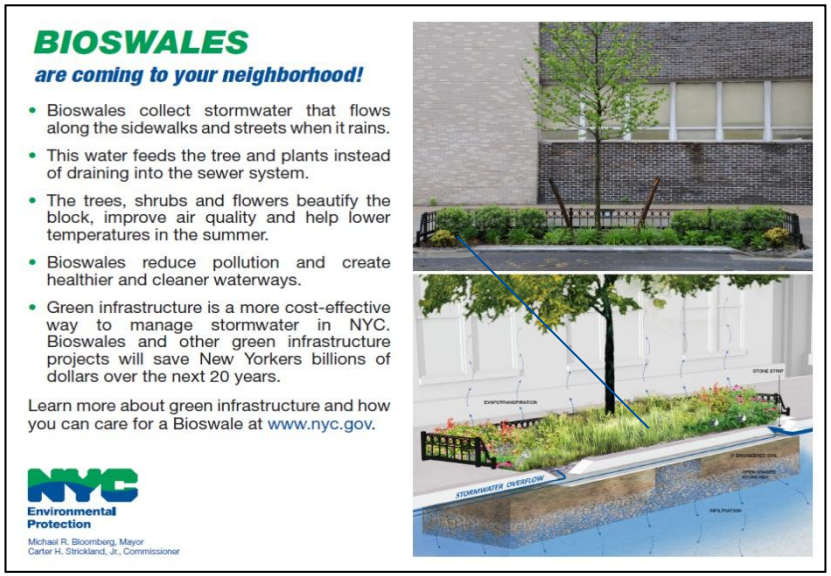
- Citizen's Group:
  citywide public meeting and listserv
- Steering Committee:
  focused on GI implementation related to Green Jobs, Technical Advice & Research, Education & Engagement

❖ Construction Notification

- "Bioswales are Coming to your Neighborhood" Postcard sent to mailing addresses in project areas
- Presentations to Community Boards, Elected Officials, and Local Community Groups
- Engineers provide handouts when approached by residents and businesses

❖ Education and Engagement

- ROW Bioswale Care Stewardship Program with MillionTreesNYC
- Rain Barrel Giveaway Programs




BioswaleCare Workshop at Edenwald Houses

2012 - Additional Accomplishments

- Met all 2012 green infrastructure milestones of the Modified Consent Order
- Promulgated Stormwater Performance Standards
- Published *Guidelines for the Design and Construction of Stormwater Management Systems*
- Conducted Green Infrastructure Program Environmental Review
- Released *NYC Green Infrastructure Plan: 2011 Preliminary Pilot Monitoring Results*

2012 Major Accomplishments

1 Promulgated Stormwater Performance Standard

DEP's stormwater performance standard (or "stormwater rule") took effect in July 2012. By slowing the flow of stormwater to the sewers, the stormwater rule allows the City to manage stormwater runoff from new development and redevelopment more effectively and maximize, to the greatest extent possible, the capacity of the city's combined sewer systems.

2 Signed Additional Agreements with Partner Agencies

In January 2012, building on its agreement establishing maintenance roles with the New York City Department of Parks and Recreation (DPR) and the New York City Department of Transportation (DOT), DEP finalized an agreement with the New York City Housing Authority (NYCHA). The agreement established a working relationship between DEP and NYCHA for a five year term. The agencies will amend the agreement as new projects are accepted and completed.

3 Continued Outreach and Notification in Green Infrastructure Project Areas

In 2012, DEP expanded its outreach and notification strategies. DEP made presentations to inform communities of new green infrastructure projects within neighborhood and area-wide project areas, and coordinated with the New York City Department of Design and Construction (DDC) on construction project newsletters. DEP mailed over 25,000 postcards notifying the public of upcoming build-out of Right-of-way Bioswales and Stormwater Greenstreets in affected areas. DEP continues to participate in conferences and webinars, and hold outreach events. DEP also continues to make presentations upon request to elected officials, community boards, schools and universities, and other civic organizations.

4 Conducted Green Infrastructure Program Environmental Review

In March 2012, the City published an Environmental Assessment Statement for the first five years of the Green Infrastructure Program. DEP, as lead agency, concluded there would be no foreseeable adverse impacts on the environment from constructing a large scale green infrastructure program, assuming a range of technologies to be constructed in concentrated throughout combined sewer areas of the city.

5 Published Guidelines for the Design and Construction of Stormwater Management Systems

In conjunction with the implementation of the new stormwater performance standard, DEP published a companion document, *Guidelines for the Design and Construction of Stormwater Management Systems*, to assist New York City's development community and licensed professionals in the selection, planning, design, and construction of onsite source controls that comply with the new rule.

6 Constructed Right-of-way Bioswales

In 2011 and 2012, DEP constructed 14 Right-of-way Bioswales in conjunction with ongoing DDC capital projects on 4th Avenue and Dean Street, Atlantic Avenue in Brooklyn, and on College Point Boulevard in Queens.

7 Initiated Public Onsite Retrofit Projects

In 2012, DEP reviewed designs for five schoolyard sites with the Trust for Public Land and the School Construction Authority (SCA). DEP and SCA are also identifying other opportunities within Priority Areas for green infrastructure retrofits. DEP and SCA identified eight schools for the next fiscal year. Additionally, DEP is currently designing green infrastructure installations for a number of NYCHA facilities, including the Seth Low Houses and the Hope Gardens Houses in Brooklyn and the Edenwald Houses in the Bronx.

2013 Action Plan

- Describes 10 specific action items for 2013
- Each action item is currently in development and/or nearing completion
- DEP will report on the progress in the 2013 Annual Report next spring

Stormwater Pilot Monitoring 2012 Annual Report

Objectives

- Summarize the monitoring data and observations collected in 2011 and 2012 from multiple source control projects
- Evaluate effectiveness of each source control at reducing the volume and/or rate of stormwater runoff
- Test the data collection techniques and establish a methodology for long term monitoring program
- Identify qualitative issues like maintenance requirements, appearance and community perception

Monitoring Parameters

- Water Quantity
  - Inflow/Outflow Water Balance
  - Soil Moisture at various depths- selected sites
- Weather
  - Precipitation
  - Evaporation/Transpiration Rates - selected sites
  - Relative Humidity/Solar Radiation - selected sites
- Water/Soil Quality

Location of Pilot Projects and Monitoring Setup

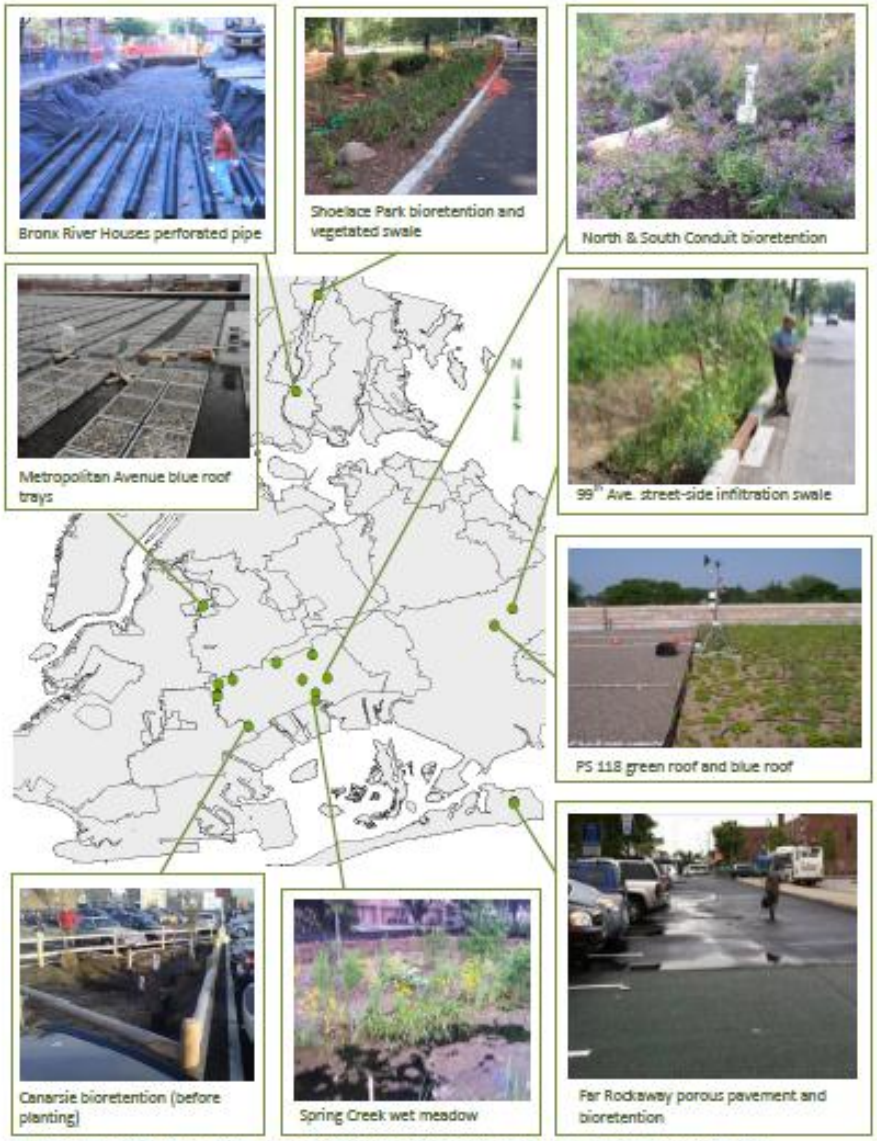


Figure 1. The location of green infrastructure pilots being monitored in priority CSO watersheds across the City.

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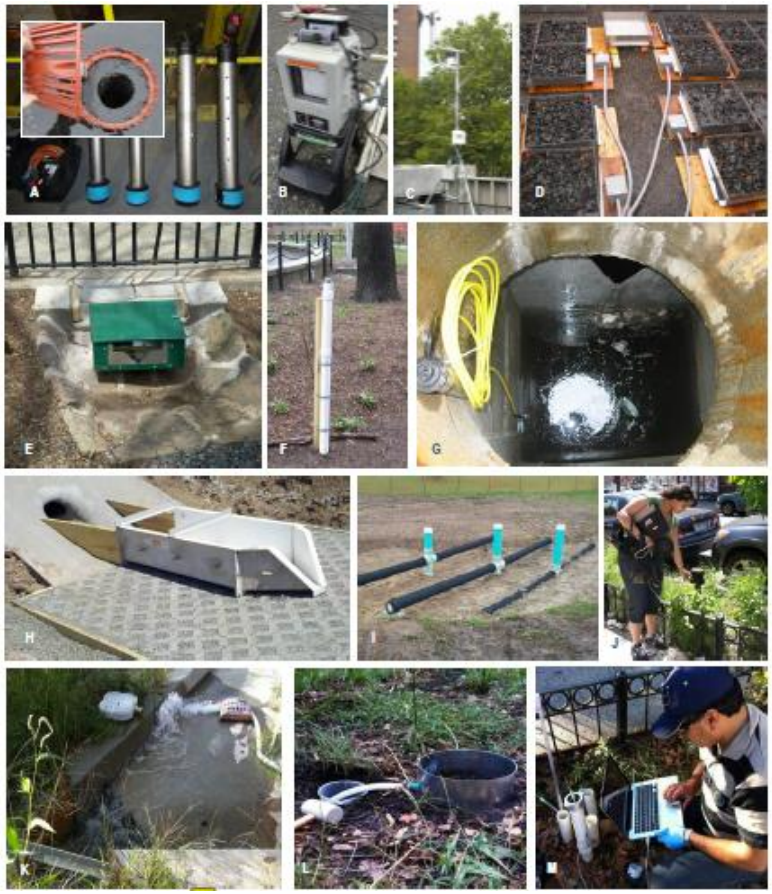
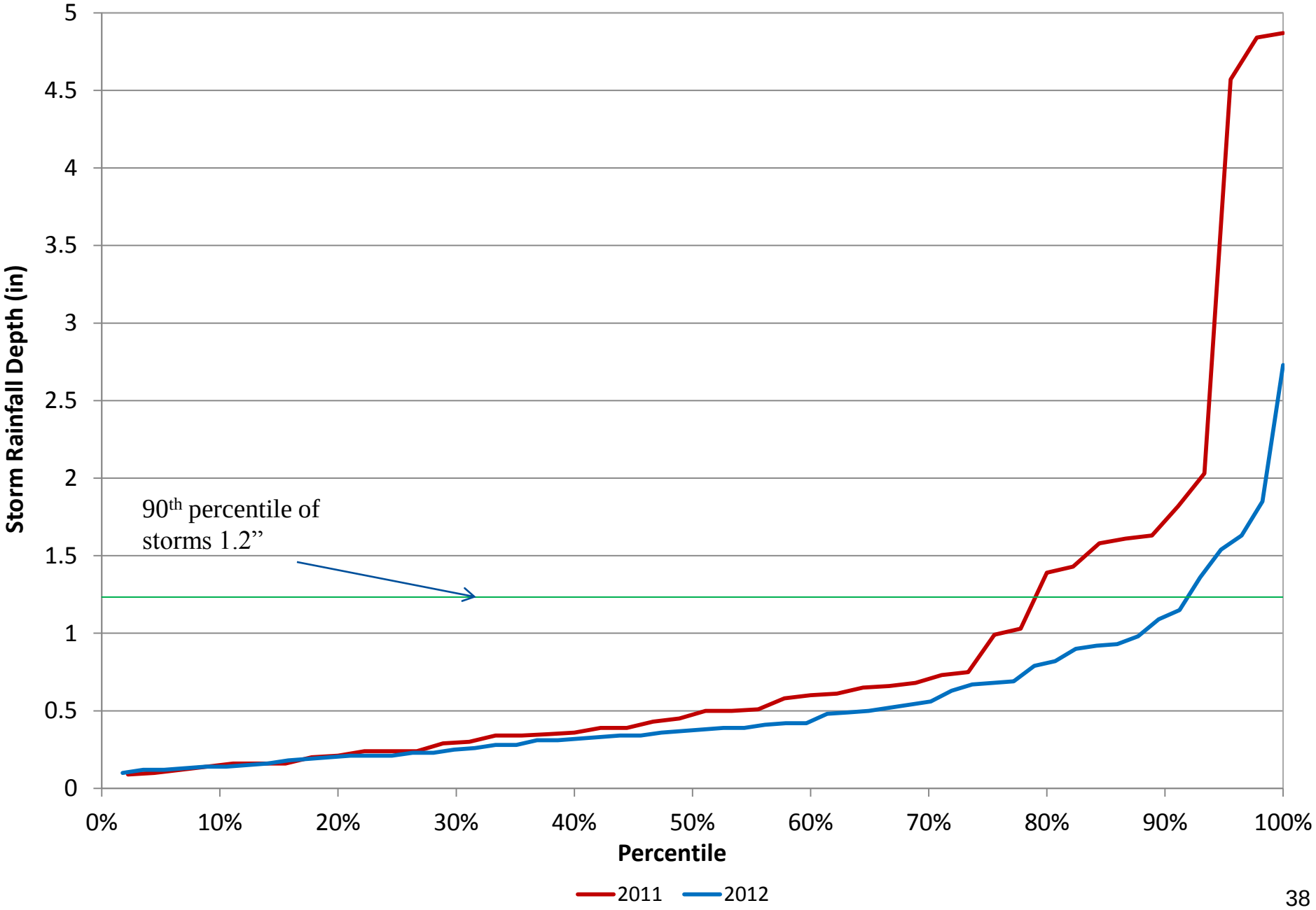


Precipitation Patterns – Storm Depth



Bronx River Houses: Bioretention

Monitoring Site Area	
Impervious Area	18,750 ft²
DA:GI Footprint	6:1 to 20:1

BRH Bioretention: Data Summary

❖ Monitoring data from May 2011 to December 2012

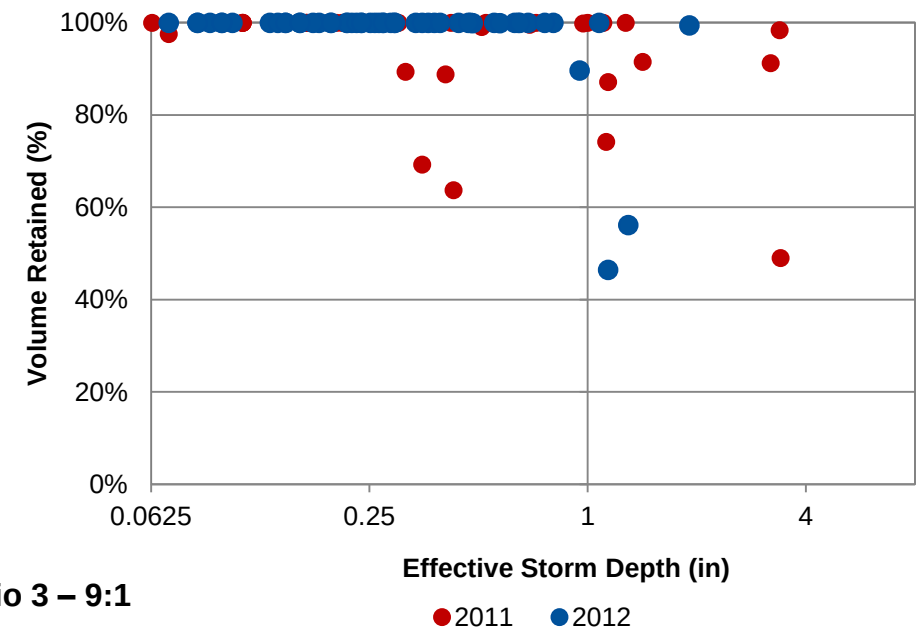
Storm Characteristics		
	2011	2012
Number of Storms	45	57
Storm Depth	0.1” to 4.9”	0.1” to 2.7”
Peak Intensity	0.1 to 5.4 in/hr	0.1 to 3.2 in/hr
Storm Duration	0.4 to 54 hrs	0.1 to 41 hrs

❖ Maintenance:

- Removal of debris and sediment
- Mowing, mulching, and weeding

BRH Bioretention: Observations

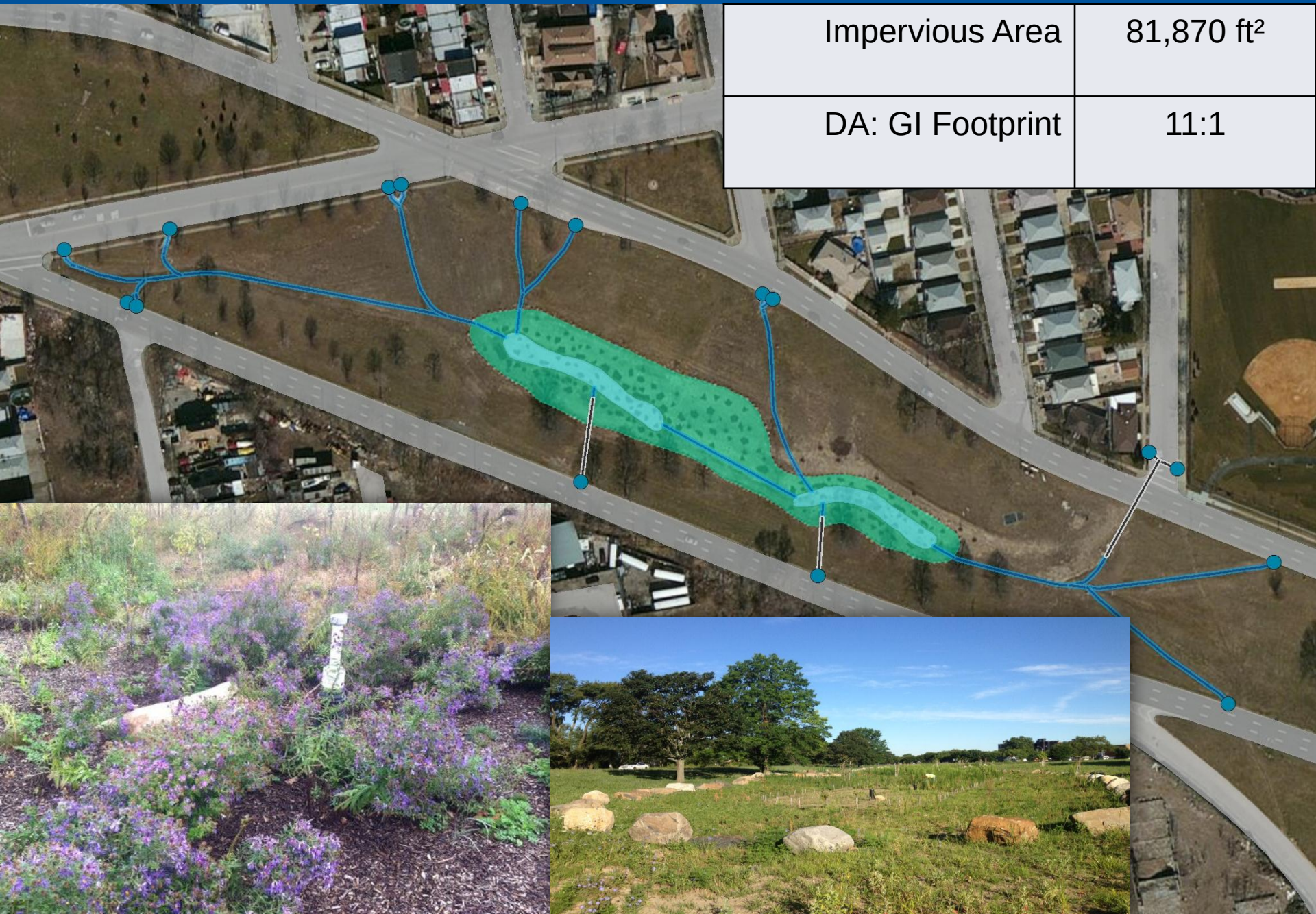
- Bioretention areas retaining much of the water they receive
- 2011 and 2012 drawdown rates are similar (~6 in/hr)
- Simple curb cuts without localized depression are about 70% effective at runoff capture
- Leaf and litter pickup can be challenging in some areas
- Majority of the plant species have survival rate > 50%



Bio 3 – 9:1

N&S Conduit Bioretention

Impervious Area	81,870 ft²
DA: GI Footprint	11:1



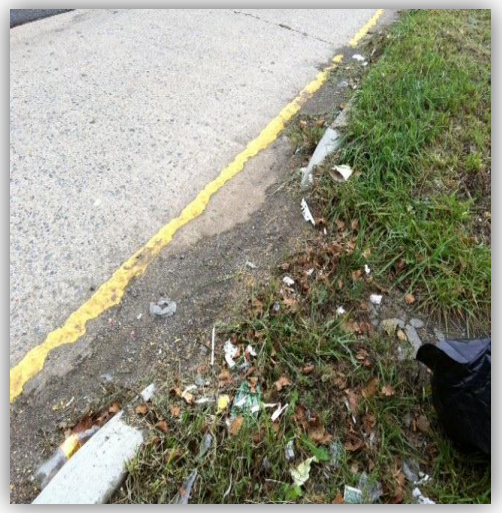
N&S Bioretention: Data Summary

❖ Monitoring data from August 2011 to December 2012

Storm Characteristics		
	2011	2012
Number of Storms	20	53
Storm Depth	0.11” to 7.78”	0.12” to 2.78”
Peak Intensity	0.24 to 4.92 in/hr	0.24 to 4.2 in/hr
Storm Duration	0.2 to 53 hrs	1.5 to 77 hrs

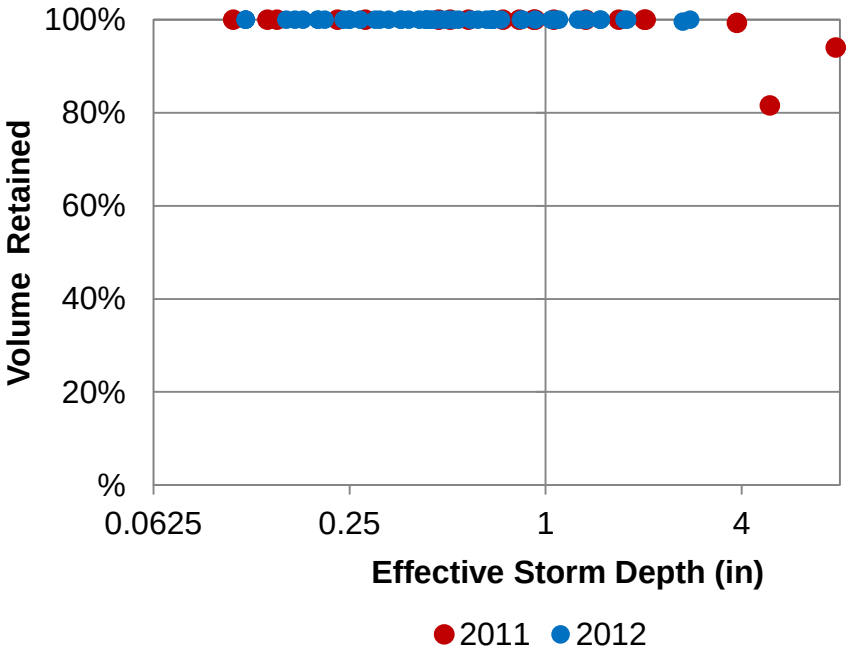
❖ Maintenance:

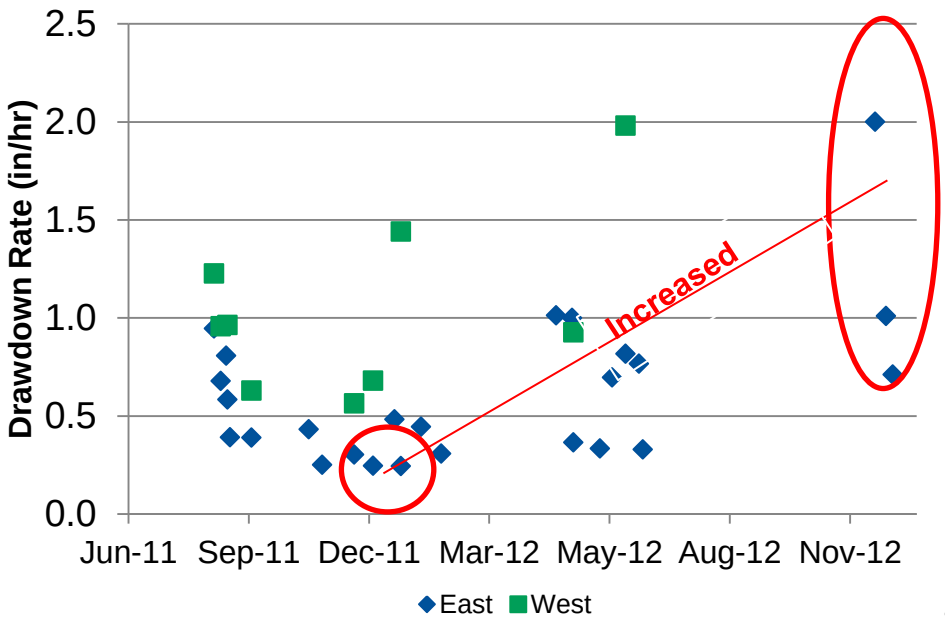
- Removal of debris and sediment from curb cuts
- Weeding and mulching



N&S Bioretention: Observations

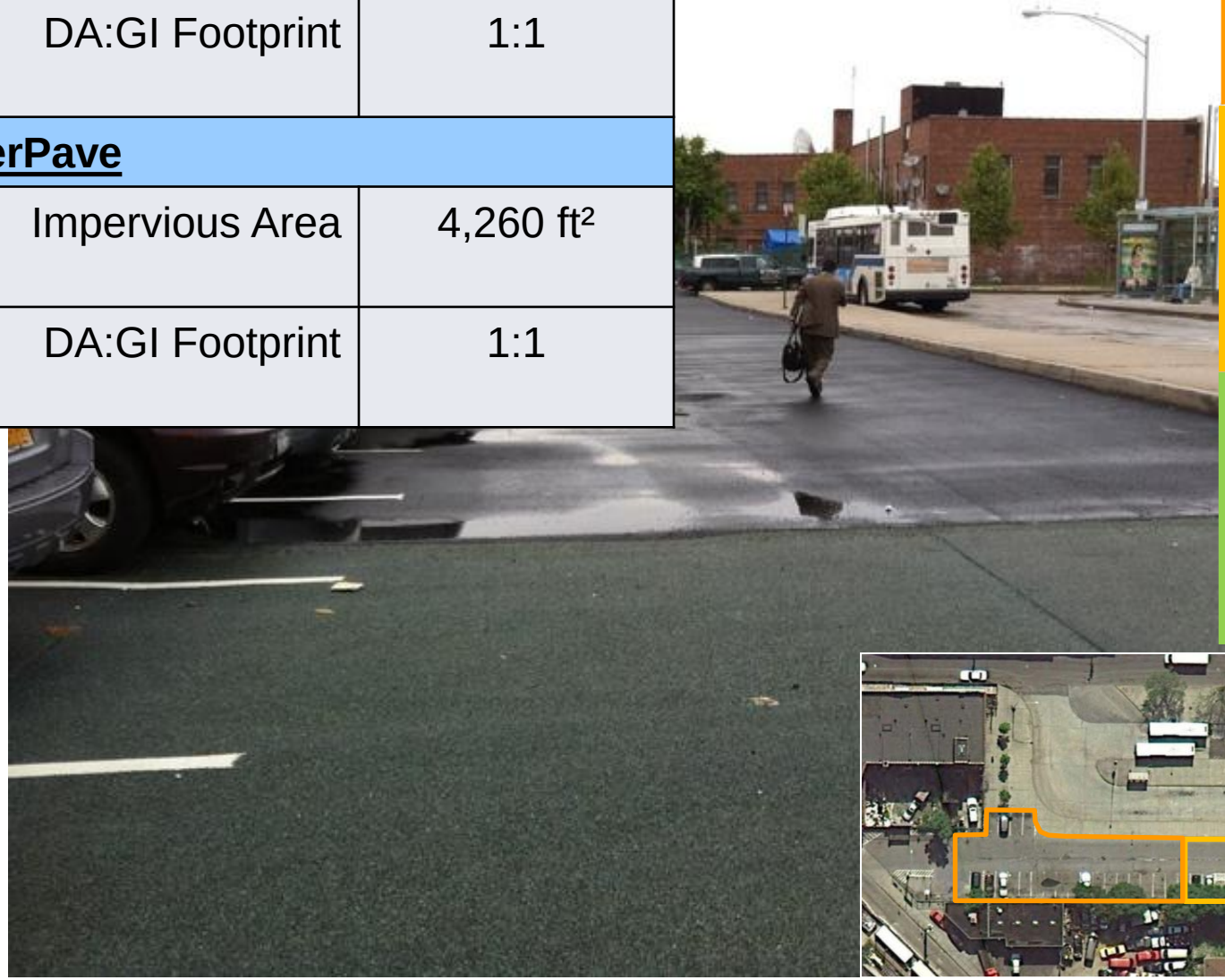
- Only 4 outflow events since installation
- Typical surface drawdown duration < 8 hours
- Ponding drawdown rate increasing, and fewer ponding events occurring, likely due to root growth.
- Inlet vegetated swales effective at infiltrating offsite runoff

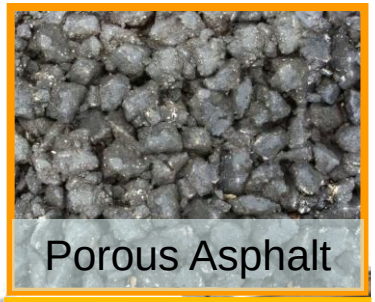




Far Rockaway Porous Pavement

Porous Asphalt	
Impervious Area	6,380 ft²
DA:GI Footprint	1:1
FilterPave	
Impervious Area	4,260 ft²
DA:GI Footprint	1:1





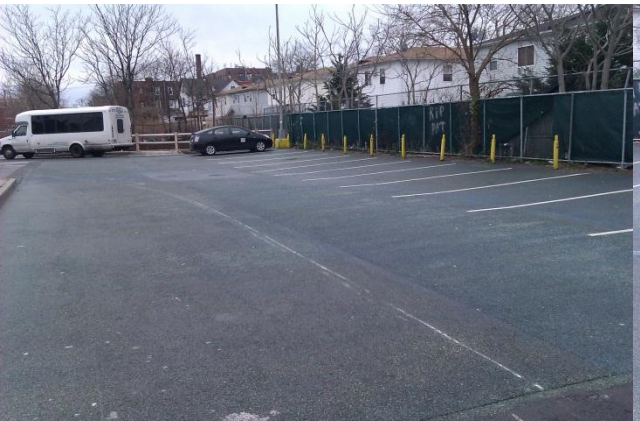
Far Rockaway Porous Pavement: Data

❖ Monitoring data October 2011 to December 2012

Storm Characteristics		
	2011	2012
Number of Storms	12	54
Storm Depth	0.1” to 2.06”	0.1” to 2.53”
Peak Intensity	0.24 to 0.84 in/hr	0.12 to 4.80 in/hr
Storm Duration	3.33 to 45 hrs	0.8 to 77 hrs

❖ Maintenance Activities:

- No routine maintenance performed to date
- Filterpave resurfaced within travel lane



Far Rockaway Bioretention

Impervious Area	9,720 ft²
DA: GI Footprint	4.2:1

Far Rockaway Porous Pavement

	Total Volume Runoff Coefficient
Standard Asphalt	0.73 +/- 0.28
Porous Asphalt	0.23 +/- 0.27
Filterpave	0.00

- Filterpave is providing excellent stormwater control, preferred use within parking stalls
- Porous asphalt is providing moderate stormwater control, with no structural issues

Street-Side Pilots

Site	Impervious	DA:GI
Autumn Ave ETP	3,948 ft²	39:1
Blake Ave ETP	2,176 ft²	22:1
Ridgewood ETP	4,420 ft²	44:1
Union St ETP	1,679 ft²	17:1
Eastern Pkwy SSIS	19,883 ft²	99:1
Howard Ave SSIS	6,630 ft²	33:1
Ridgewood SSIS	5,513 ft²	28:1
Union St SSIS	2,231 ft²	11:1

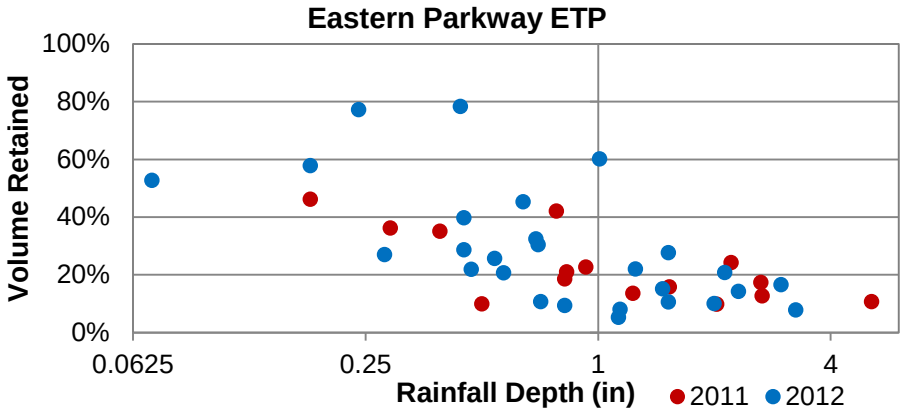
Street-Side Pilots: Data Summary

- Monitoring data from September 2011 to December 2012

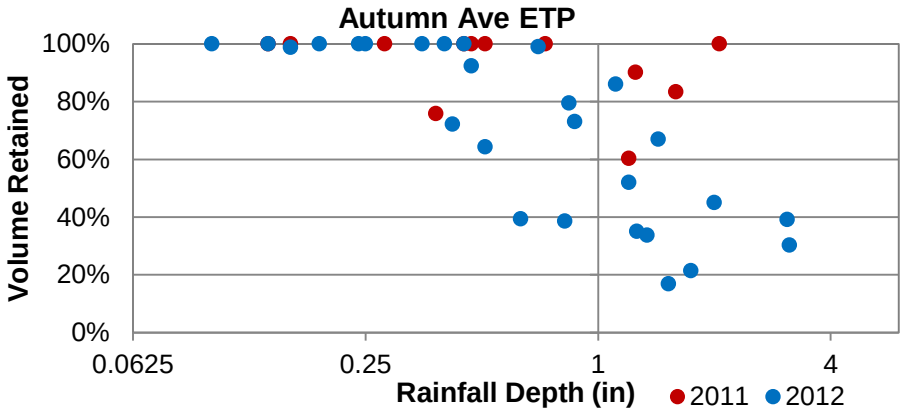
Storm Characteristics		
	2011	2012
Number of Storms	13-17	25-27
Storm Depth	0.1” to 5.2”	0.1” to 3.3”
Peak Intensity	0.1 to 5.3 in/hr	0.1 to 4.8 in/hr
Storm Duration	0.1 to 81 hrs	0.5 to 56 hrs

- Maintenance:
  - Litter pickup
  - Inlet clearing
  - Weeding and mulchin

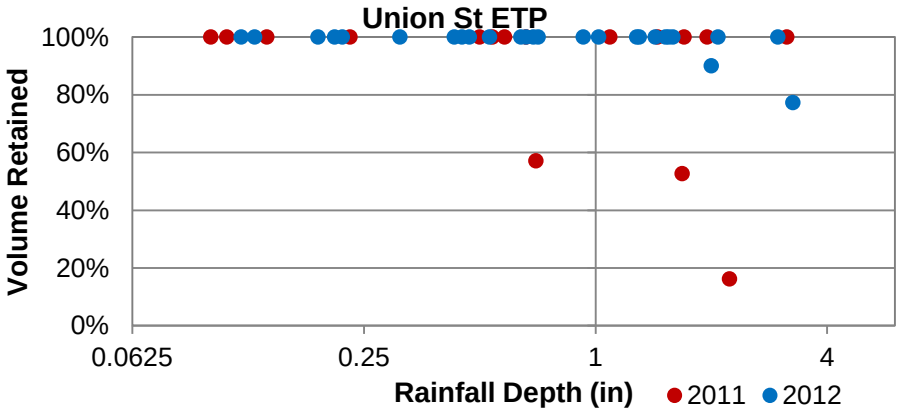
Street-Side Systems: Volume Retained



Watershed drainage area to BMP practice 99:1



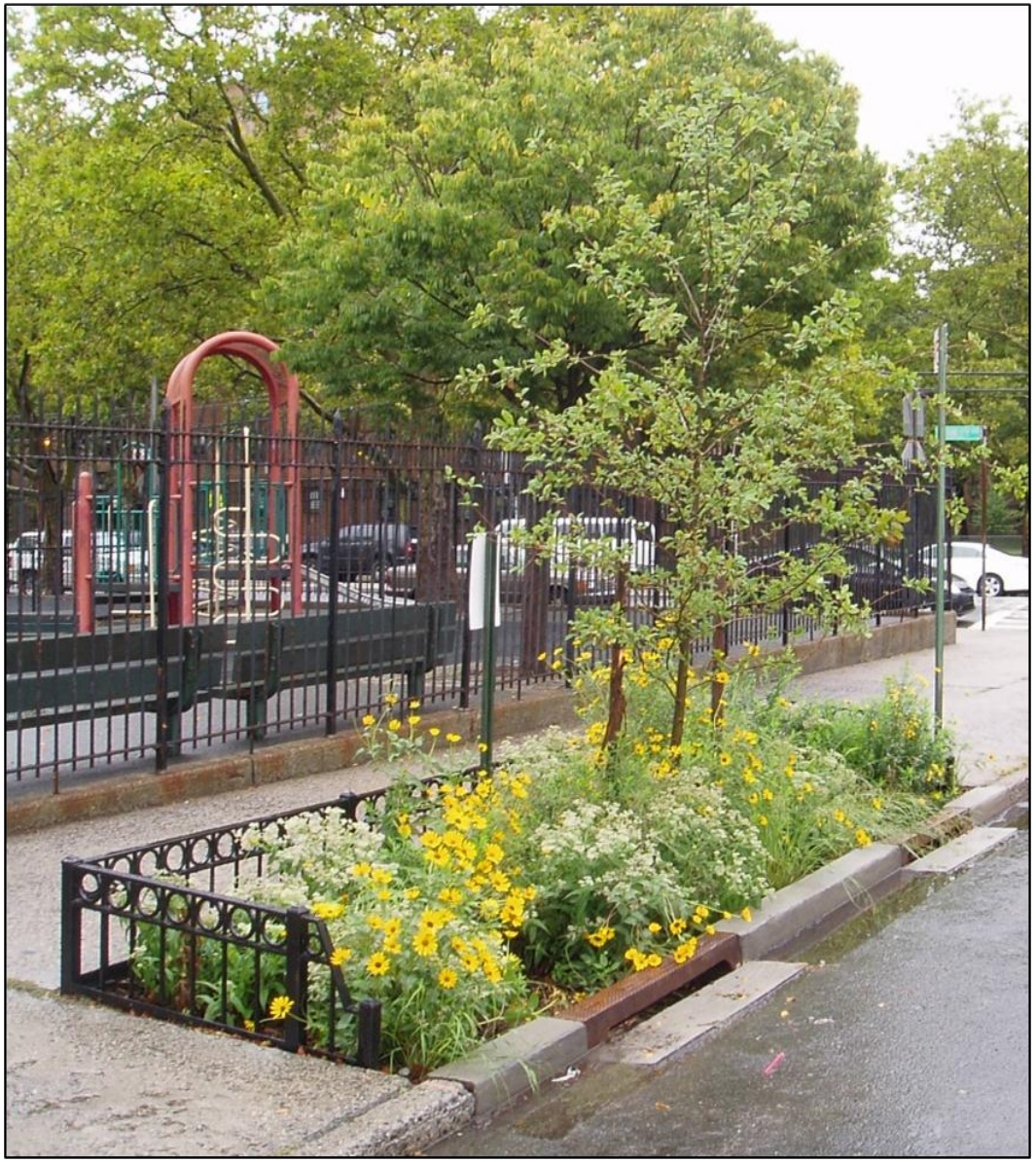
Watershed drainage area to BMP practice 39:1



Watershed drainage area to BMP practice 17:1

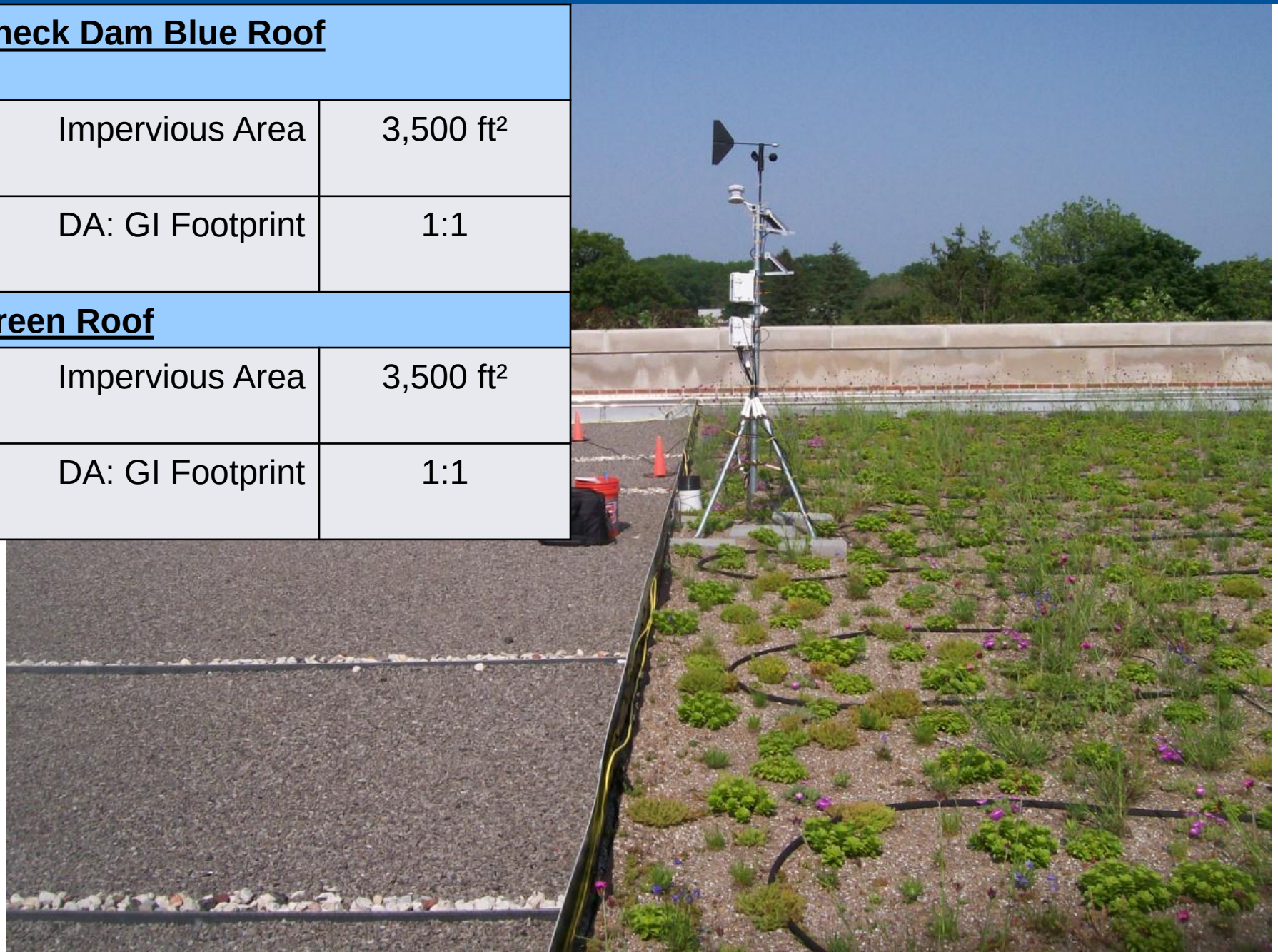
Street-Side Systems: Observations

- 1 inch storm typically captured and retained for a number of ETP and SSIS locations
- Performance reduced at sites with large tributary drainage area ratios
- Limited capture and infiltration performance observed for SSIS along steep slope
- Buildup of litter and debris a frequent issue



PS 118 Blue and Green Roof

Check Dam Blue Roof	
Impervious Area	3,500 ft²
DA: GI Footprint	1:1
Green Roof	
Impervious Area	3,500 ft²
DA: GI Footprint	1:1



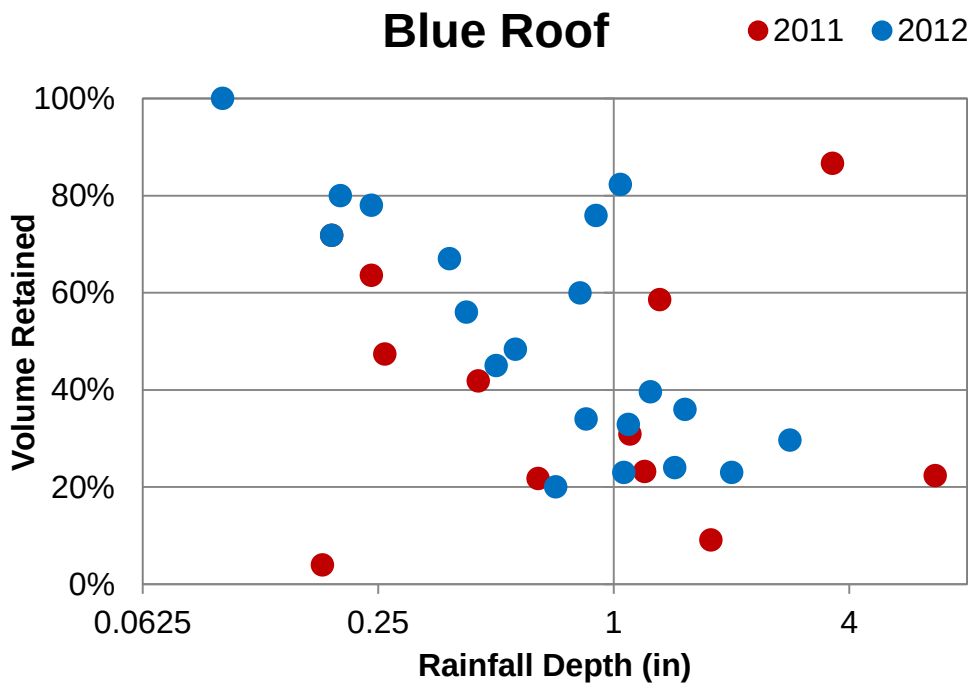
PS 118: Data Summary

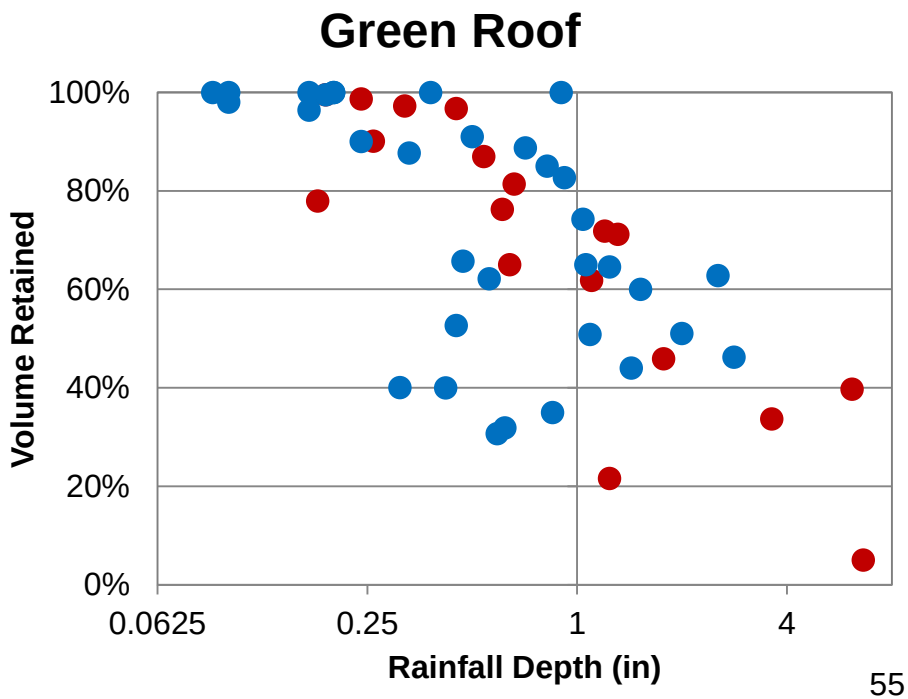
- Monitoring data from July 2011 to December 2012

Storm Characteristics		
	2011	2012
Number of Storms	22	33
Storm Depth	0.2” to 6.6”	0.1” to 2.8”
Peak Intensity	0.24 to 3.6 in/hr	0.1 to 2.9 in/hr
Storm Duration	0.5 to 60 hrs	0.5 to 54 hrs

PS 118: Observations

- Green roof retained runoff more effectively than blue roof
- Both systems significantly reduce peaks, particularly for low intensity storms
- Only minor differences in performance between 2011 and 2012



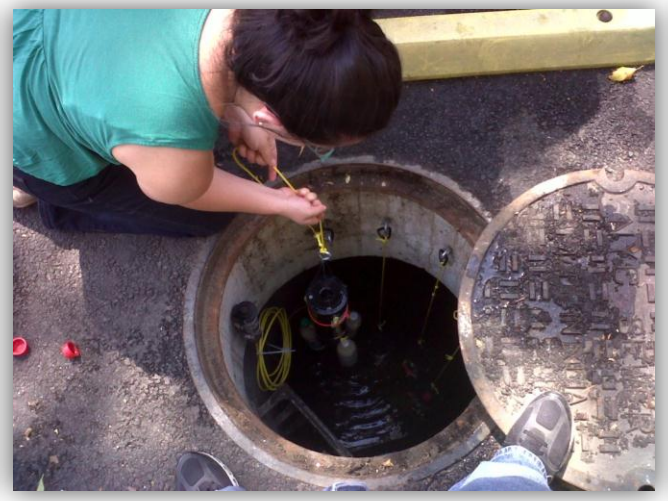


Water Quality and Soil Quality Monitoring

- Water and soil quality sampling performed at a number of pilots – possibly due to retrofit soil disturbance during 2012 – results may not be indicative of actual performance
- Preliminary results show no consistent evidence that NYC water quality is substantially different from other areas
- The total load of pollutants being delivered to the sewer system is being reduced due to volume retention
- Analyses ongoing to better characterize inflow and outflow and compare to other national metrics

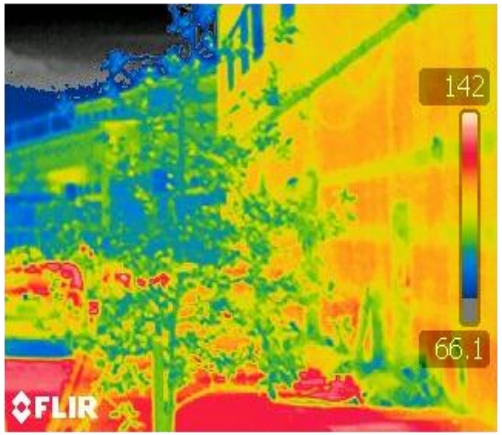
Next Steps

- Evaluate additional large scale opportunities (e.g., North/South Conduit type installations)
- Continue to refine soil and water quality monitoring efforts at selected sites
- Initiate monitoring of right of bioswales within the neighborhood demonstration projects
- Conduct co-benefits monitoring and analysis



Co-Benefits Monitoring and Analysis

- Carbon sequestration
- Urban heat island mitigation
- Reduced energy demand in buildings
- Improved habitat and ecosystem services
- Improved air quality
- Beneficial pollinators (very important!!!)



Questions?

For more information:

sustainability@dep.nyc.gov nyc.gov/dep/greeninfrastructure

GI Program Spending

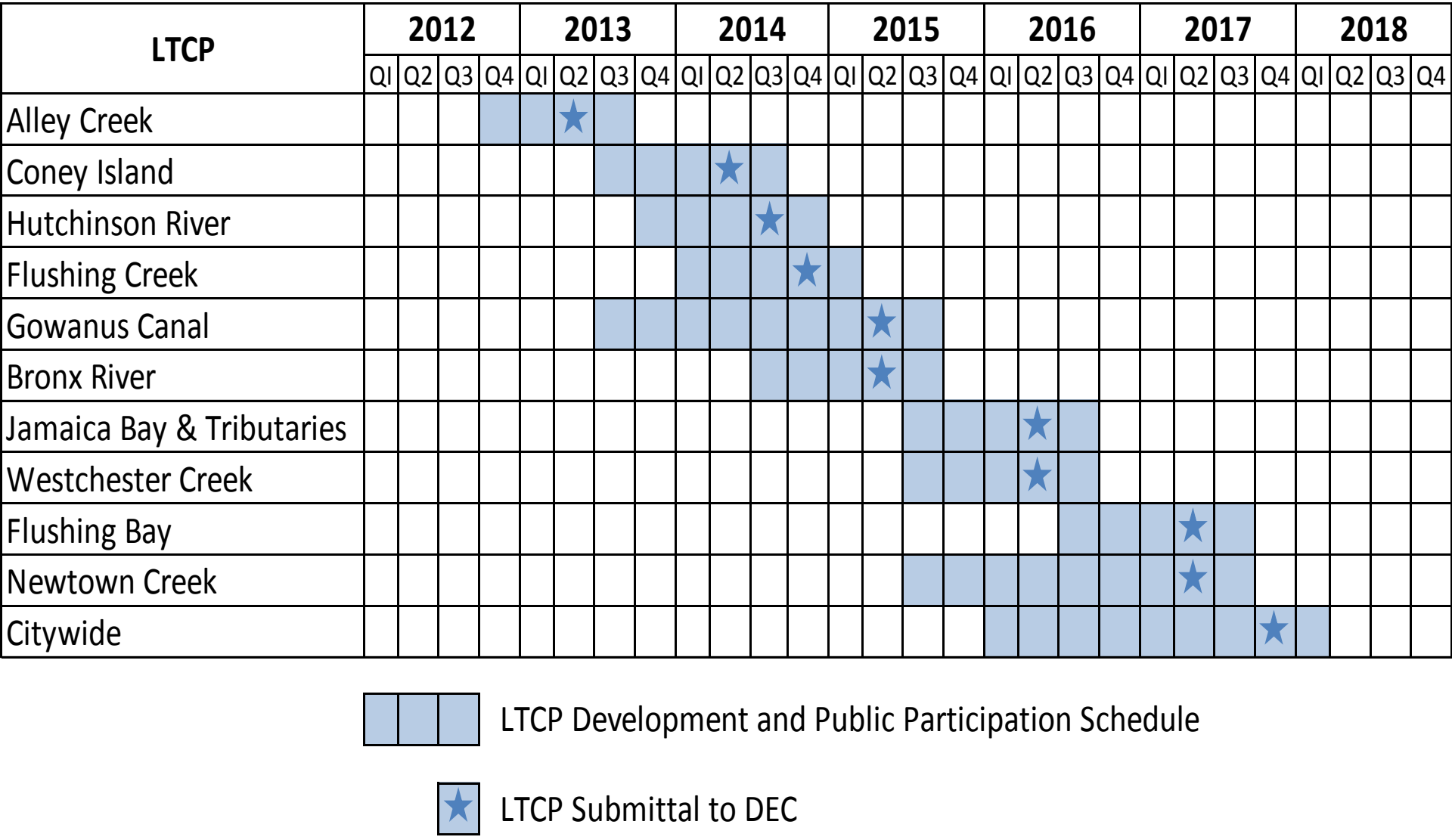
- To date, the GI Program has spent a total of **$104 million** in capital dollars.
- The GI Program plans to spend an additional **$140 million** in capital dollars by the end of FY 16.

Program Summary	FY12	FY13	FY12 & FY13 Total
Capital	$10,099,000	$94,003,000	$104,102,000
Expense	$0	$595,885	$595,885
TOTAL	**$10,099,000**	**$94,598,885**	**$104,697,885**

Capital Summary	FY12	FY13	FY12 & FY13 Total
Design	$2,647,000	$49,269,000	$51,916,000
Construction/CM	$7,452,000	$44,734,000	$52,186,000
Total	**$10,099,000**	**$94,003,000**	**$104,102,000**

Expense Summary	FY12	FY13	FY12 & FY13 Total
DPR Green Infrastructure Maintenance Program	$0	$462,385	$462,385
Rain Barrel Giveaway Program	$0	$133,500	$133,500
Total	**$0**	**$595,885**	**$595,885**

LTCP Schedule



BioswaleCare Workshops

- Wednesday, June 19th
  - Hope Gardens Houses
  - 422 Central Avenue, Brooklyn
  - 6:30-8:30PM

- Saturday, June 22nd
  - Church of St. Luke and St. Matthew
  - 520 Clinton Avenue, Brooklyn
  - 10-11:30AM