



<p><b>THE GREEN APPLE</b> Implementation of Green Infrastructure in New York City Depends on Collaboration</p>	
	<p>Magdi Farag Margot Walker Raymond Palmares Virginia Roach</p> <p> 2014 Winter Conference Santa Fe, New Mexico</p> <p>February 3, 2014</p>

## Overview

- Green infrastructure approach in New York City
- Establishing a collaborative effort
- Programmatic areas of the NYC Green Infrastructure Program
  - Right-of-Way Program
  - Public Retrofit Program



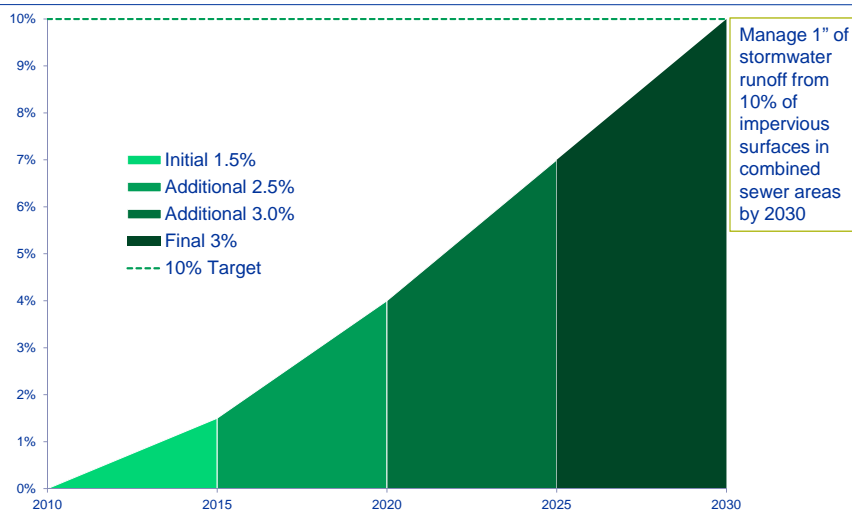
## NYC Green Infrastructure Plan: A Sustainable, Hybrid Approach

1. Build cost-effective grey infrastructure
2. Optimize the existing wastewater system
3. Control runoff from 10% of impervious surfaces through green infrastructure and other source controls
4. Institutionalize adaptive management, model impacts, measure CSOs, and monitor water quality
5. Sustain stakeholder engagement

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## GI Application Rates and Milestone Schedule

- \$730 million in the 10-year capital plan for green infrastructure
- \$1.5 billion projected over the 20-year program.



## Water Quality in New York City Harbor



= does not meet water quality standards (pathogens/DO)

**75%** of Harbor meets pathogen standards for swimming

**19%** meets standards for boating and fishing

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

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## A Collaborative Effort

- Created DEP Office of Green Infrastructure in January 2011
- Created interagency Green Infrastructure Task Force in January 2011
  - Dept. of Buildings
  - Dept. of City Planning
  - Dept. of Citywide Administrative Services
  - Dept. of Cultural Affairs
  - Dept. of Design and Construction
  - Dept. of Education
  - Dept. of Transportation
  - Dept. of Parks and Recreation
  - Dept. of Housing & Preservation Development
  - Economic Development Corporation
  - Law Department
  - NYC Housing Authority
  - Office of Management and Budget

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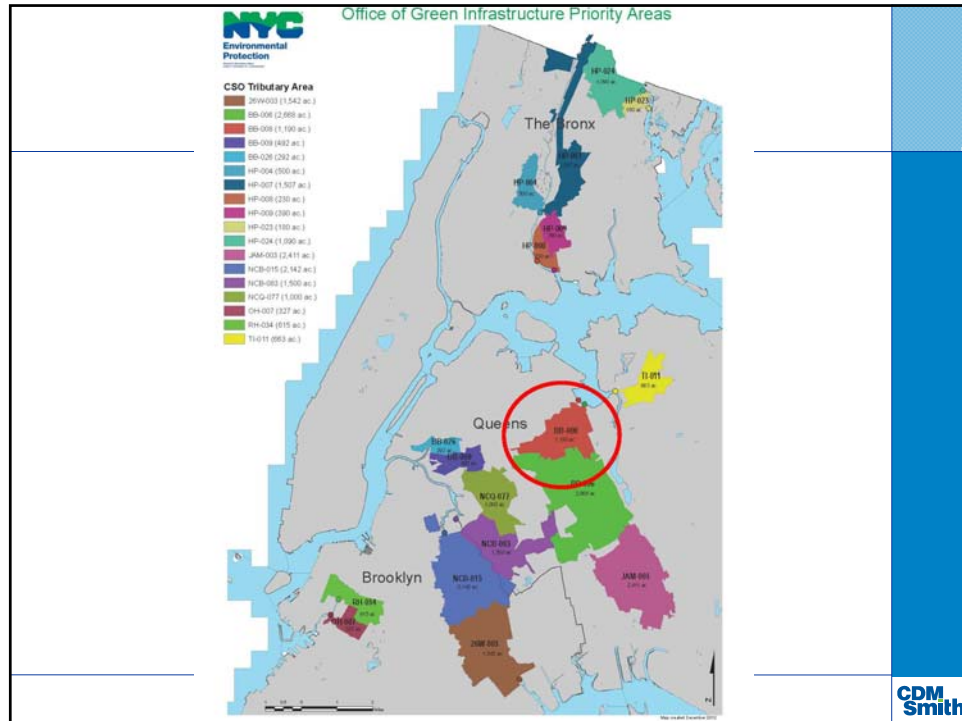
## Public Engagement

- Green Infrastructure Citizens Group
  - DEP presents annually in an open meeting to a larger Citizens Group and encourages questions and discussions
- Steering Committee
  - DEP meets quarterly with stakeholders involved in the following fields
    - Environmental Quality
    - Environmental Justice
    - Economic Development
    - Design / Architecture
    - Stormwater Management and Research

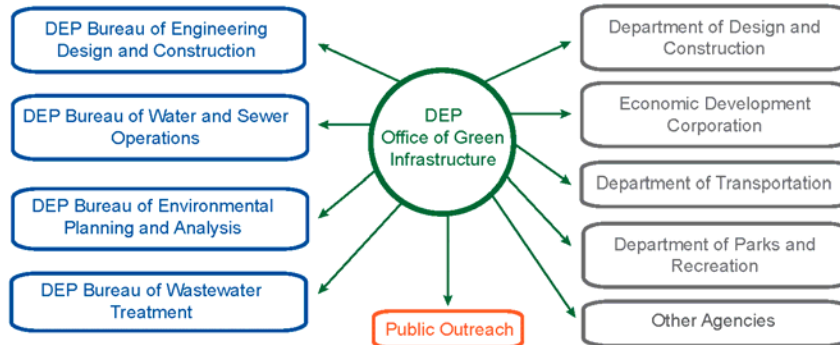
## NYC Green Infrastructure Program

- Key Programmatic Areas
  - ROW Area-Wide Contracts
  - Public On-Site Retrofits
  - Neighborhood Demonstration Areas
  - Green Infrastructure Grant Program
  - Other programmatic areas include
    - DPR Maintenance Program
    - Asset Management System
    - Outreach and Engagement Program





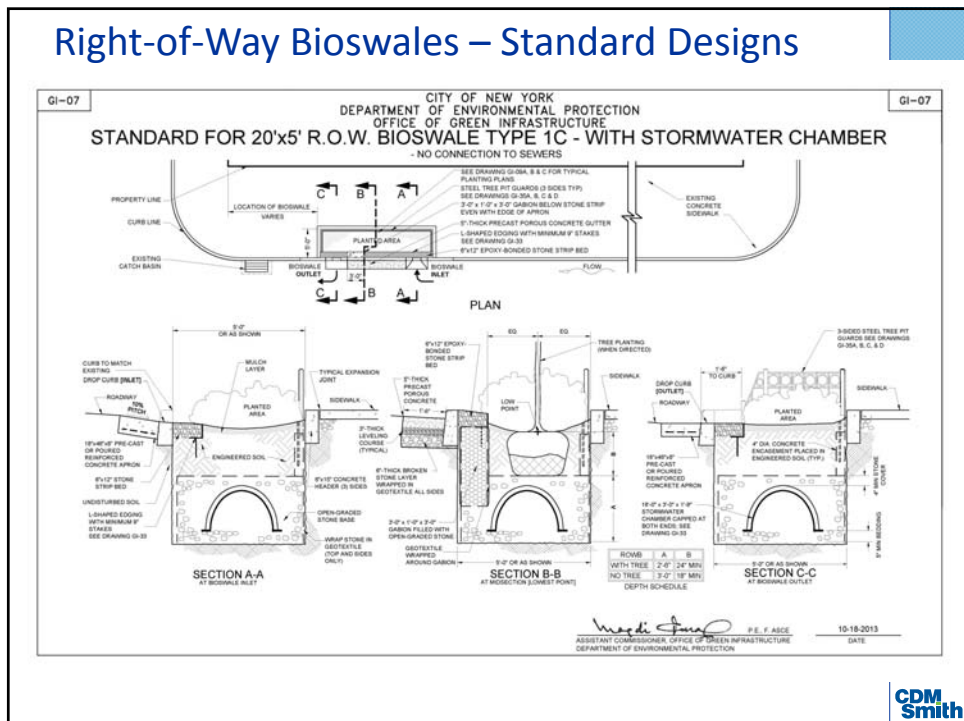
## ROW Area-Wide Program – Interagency Program Coordination



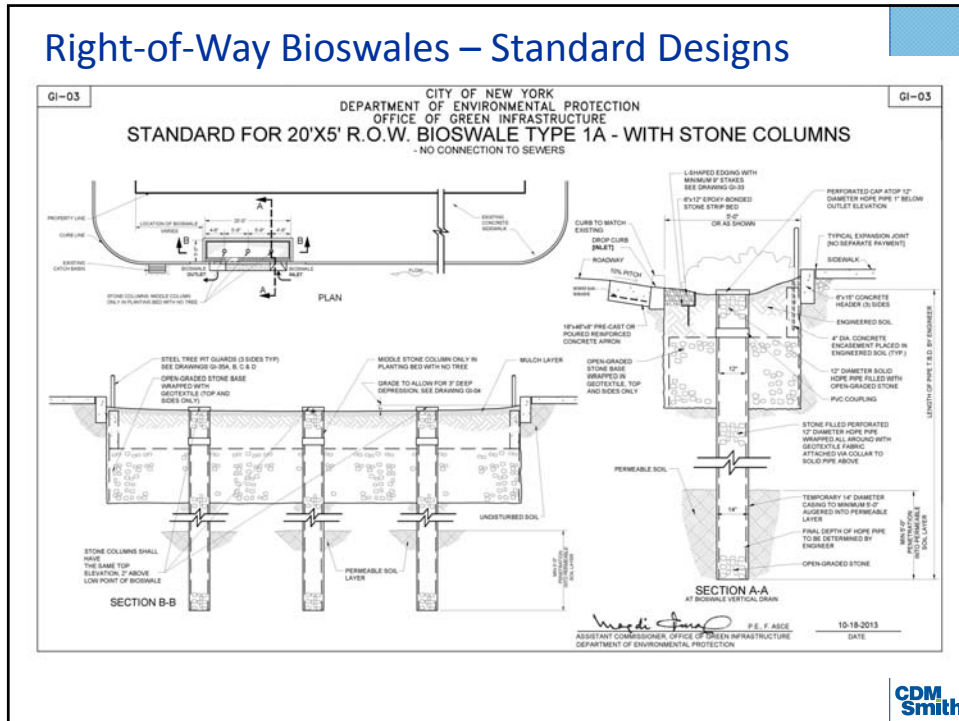
## Right-of-Way Bioswales



## Right-of-Way Bioswales – Standard Designs



## Right-of-Way Bioswales – Standard Designs



## Site Selection Process

### 1. Hydraulic Analysis

- BB-008: More than 4,700 Potential ROWBs



## Site Selection Process

### 2. Walk-Throughs to Investigate Potential Sites

- BB-008: More than 950 Preliminary ROWBs

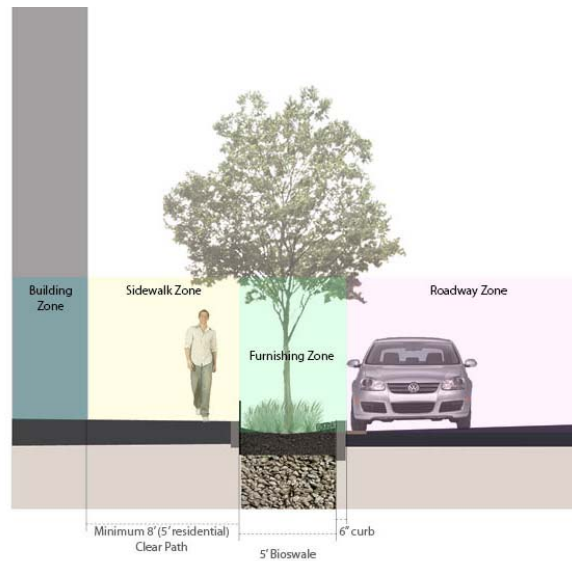


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## DOT Bioswale Siting Criteria

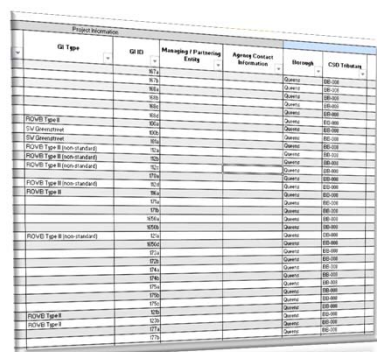
ROW Siting Criteria  
examples:

- Mature Trees
- Sidewalk widths (8' or 5')
- Fire Hydrants
- Pedestrian Ramps
- Building Entrances/Exits
- Driveways
- Muni Meters
- Bus Stops

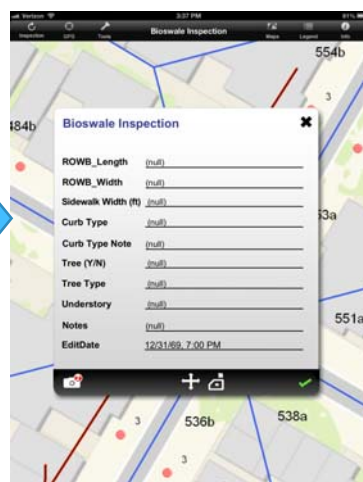


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## Developed Efficient Inspection App



GI Type	GI ID	Manning / Partnering Entry	Agency Contact Information	Biograph	GIS Tables
ROWB Type I	845				
ROWB Type II	846				
ROWB Type III	847				
ROWB Type IV	848				
ROWB Type V	849				
ROWB Type VI	850				
ROWB Type VII	851				
ROWB Type VIII	852				
ROWB Type IX	853				
ROWB Type X	854				
ROWB Type XI	855				
ROWB Type XII	856				
ROWB Type XIII	857				
ROWB Type XIV	858				
ROWB Type XV	859				
ROWB Type XVI	860				
ROWB Type XVII	861				
ROWB Type XVIII	862				
ROWB Type XIX	863				
ROWB Type XX	864				
ROWB Type XXI	865				
ROWB Type XXII	866				
ROWB Type XXIII	867				
ROWB Type XXIV	868				
ROWB Type XXV	869				
ROWB Type XXVI	870				
ROWB Type XXVII	871				
ROWB Type XXVIII	872				
ROWB Type XXIX	873				
ROWB Type XXX	874				



**Bioswale Inspection**

ROWB\_Length (m/d)

ROWB\_Width (m/d)

Sidewalk Width (ft) (m/d)

Curb Type (m/d)

Curb Type Note (m/d)

Tree (Y/N) (m/d)

Tree Type (m/d)

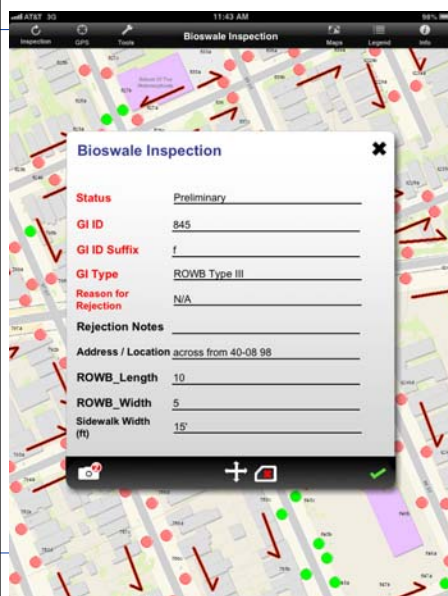
Understory (m/d)

Notes (m/d)

EditDate 12/31/09, 7:00 PM

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## The App



**Bioswale Inspection**

Status Preliminary

GI ID 845

GI ID Suffix f

GI Type ROWB Type III

Reason for Rejection N/A

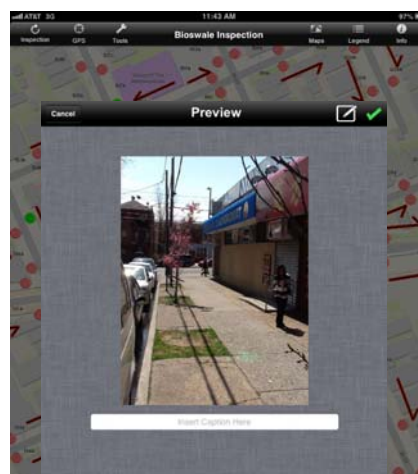
Rejection Notes

Address / Location across from 40-08 98

ROWB\_Length 10

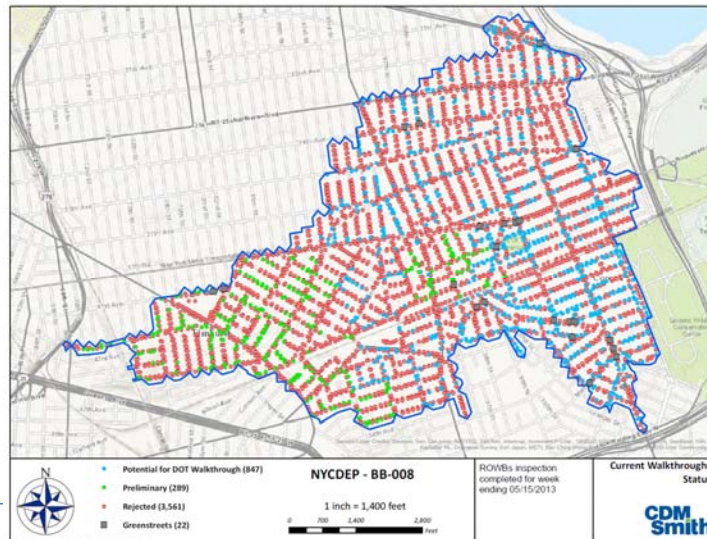
ROWB\_Width 5

Sidewalk Width (ft) 15

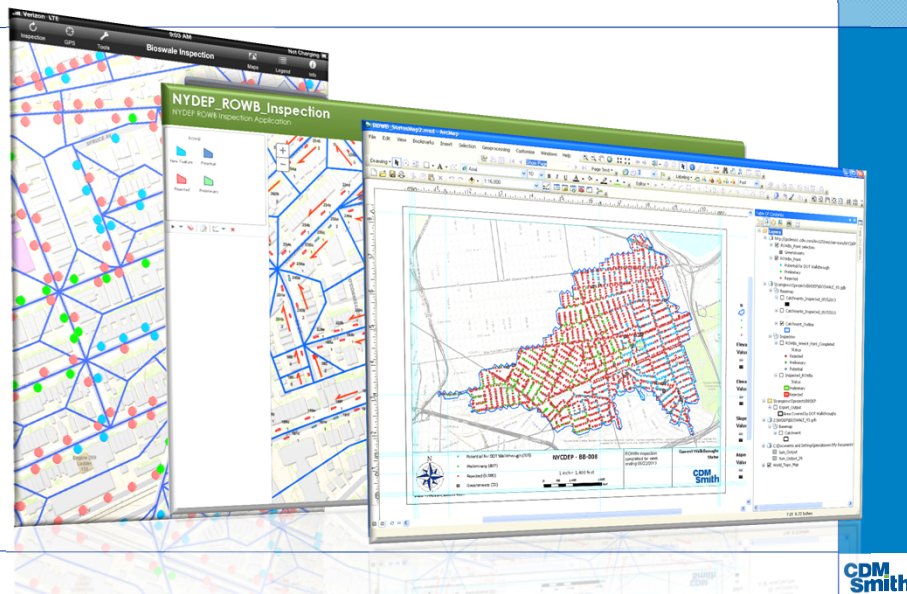


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## Daily Reports



## Updates in Real Time Across All Applications



## Site Selection Process

### 3. Borings and Permeability Tests

- BB-008
  - 650 to 700 geotechnical investigations
  - About half completed
  - 76% success rate
    - Permeable soils
    - Low groundwater



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Geotech\_ROW8

### Geotech Investigations - Database

Select Record:

GI ID:  GI Type:

GWT Depth (ft):  Bedrock Depth (ft):  Stone Column Depth:

Geotech Status:  Geotech. Notes:

QAQC:

---

Nearest Boring ID:  Boring Date:  Boring Cost:

Soil Sample Depth 1A:	<input type="text" value="3 - 5"/>	Soil Sample Depth 2A:	<input type="text" value="8 - 10"/>	Soil Sample Depth 3A:	<input type="text" value="13 - 15"/>
Soil USCS Description 1A:	<input type="text" value="SP"/>	Soil USCS Description 2A:	<input type="text" value="SP"/>	Soil USCS Description 3A:	<input type="text" value="SP"/>
Soil Pass 200 1A:	<input type="text" value="4.3"/>	Soil Pass 200 2A:	<input type="text" value="4.1"/>	Soil Pass 200 3A:	<input type="text" value="4.7"/>
Soil Pass 200 1B:	<input type="text" value="0"/>	Soil Pass 200 2B:	<input type="text" value="0"/>	SOIL_PASS_200_3B:	<input type="text" value="0"/>
Soil Sample Depth 1B:	<input type="text" value="-"/>	Soil Sample Depth 2B:	<input type="text" value="-"/>	Soil Sample Depth 3B:	<input type="text" value="-"/>
Soil USCS Description 1B:	<input type="text" value="-"/>	Soil USCS Description 2A:	<input type="text" value="-"/>	Soil USCS Description 3A:	<input type="text" value="-"/>
Soil Type 0-5 (ft) Depth:	<input type="text" value="SP"/>	Soil Type 5-10 (ft) Depth:	<input type="text" value="SP"/>	Soil Type 10-15 (ft) Depth:	<input type="text" value="SP"/>

---

Nearest Permeability ID:  Date of Permeability:  Permeability Cost:

Permeability 5ft Average 1	<input type="text" value="0.01"/>	Permeability 10ft Average 1	<input type="text" value="18.23"/>
Permeability 5ft Average 2	<input type="text" value="0.01"/>	Permeability 10ft Average 2	<input type="text"/>
5' Permeability Coeff. (k) (cm/hr)	<input type="text" value="7.06E-06"/>	10' Permeability Coeff. (k) (cm/hr)	<input type="text" value="1.29E-02"/>
5' Permeability Coeff. (k) (in/hr)	<input type="text" value="1.00E-02"/>	10' Permeability Coeff (k) (in/hr)	<input type="text" value="1.82E+01"/>

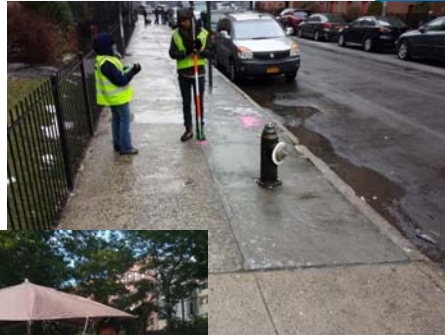
Record: 1 of 401

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## Site Selection Process

### 4. Limited Survey

- BB-008
  - Completing first package of 200 “Final” ROWBs
  - Anticipate 4 construction contracts
  - Will include “Stormwater Greenstreets” and “On-site Green Infrastructure”

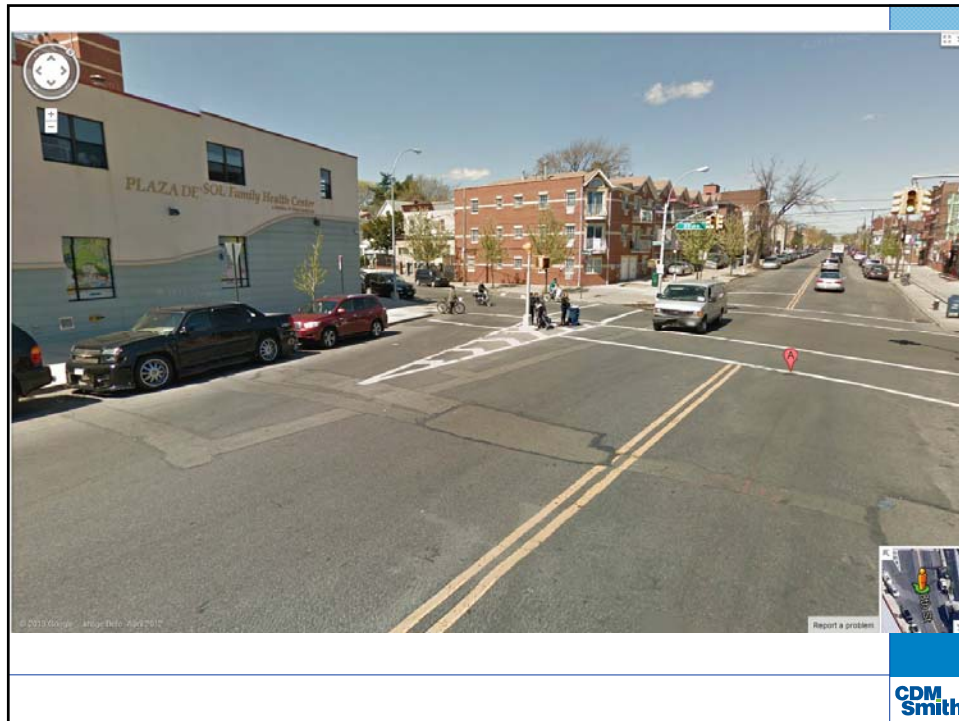


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## Stormwater Greenstreets

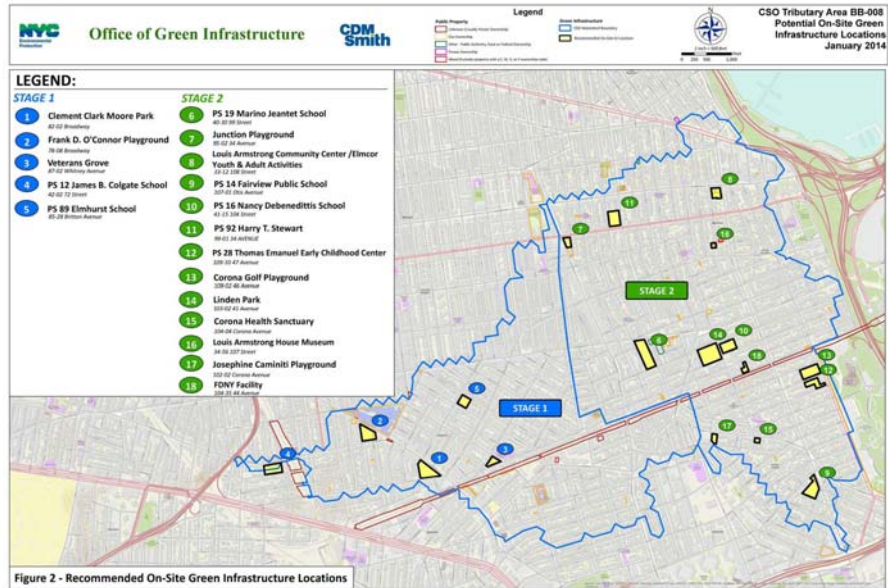


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## BB-008 Public Property Retrofit Opportunities



## Public Property Retrofits: Edenwald Houses - A Collaboration with the New York City Housing Authority (NYCHA)

## Edenwald Houses

- Largest NYCHA development in New York City
- Over 50 acres
- 41 buildings
  - 3-story and 14-story
  - Community Center
- 5,450 people



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## Edenwald Houses

- Total drainage area
  - 53 acres
  - 54% impervious
    - Sidewalks 17%
    - Buildings 14%
    - Roadways 8%
    - Parking areas 3%

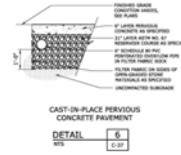


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## Edenwald Houses: Geotechnical Investigations

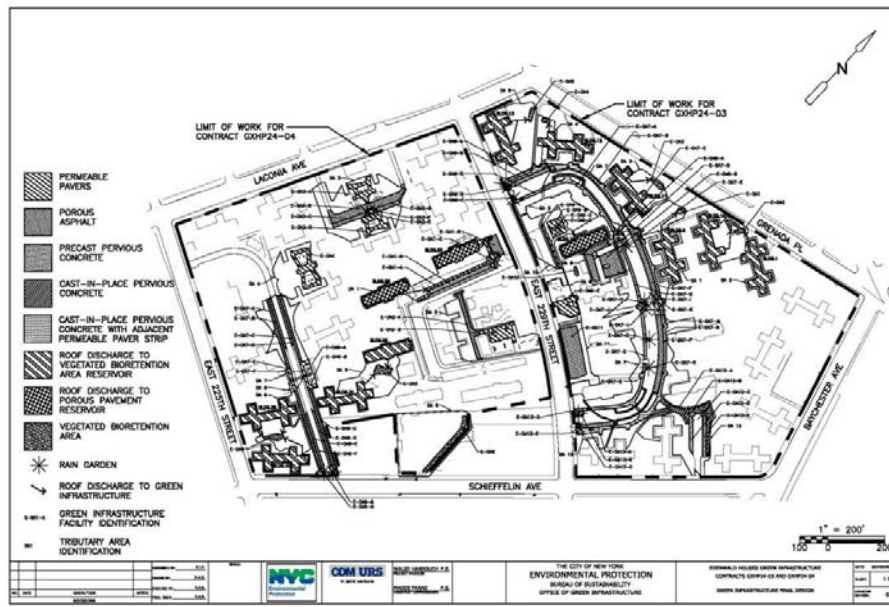
### Low Permeability Rates

- 0.00014 to 0.13 in/hr at Edenwald Houses
  - 0.5 in/hr min acceptable rate for stormwater quality (NY and NJ)
    - Use underdrains/overflow pipes if less than this
  - 0.2 in/hr min acceptable rate for groundwater recharge (NJ)
  - 0.17 in/hr absolute min for stormwater infiltration (MA)
- High percentage of fines in soils
- At 0.13 in/hr – 3 days to infiltrate 10 inches of water

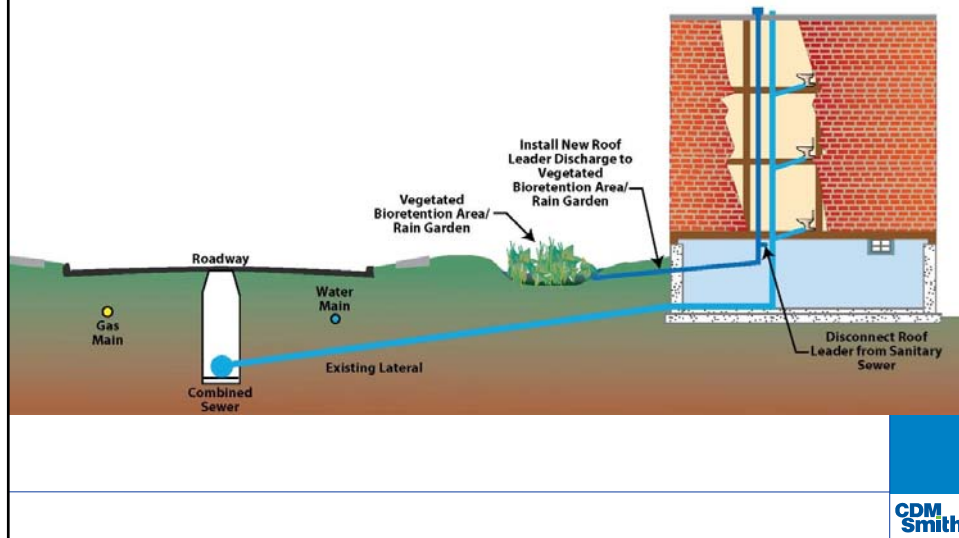


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## Edenwald Houses: Green Infrastructure Practices



## Edenwald Houses: Rooftop Runoff Redirection to Bioretention



## Edenwald Houses: Bioretention



## Edenwald Houses: Porous Asphalt



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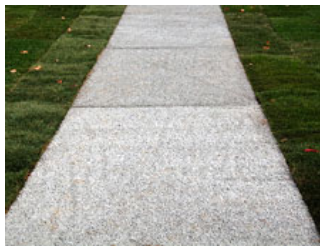
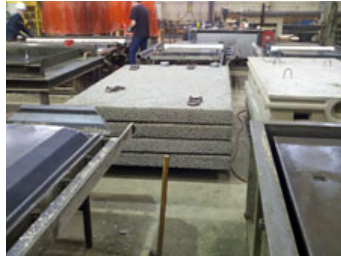
## Edenwald Houses: Cast-in-Place Pervious Concrete

“Hose test”



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## Edenwald Houses: Precast Pervious Concrete Panels



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## Edenwald Houses: Permeable Pavers and Rain Gardens at Entrance Areas



Before



After  
Permeable Pavers, Rain Gardens, Benches

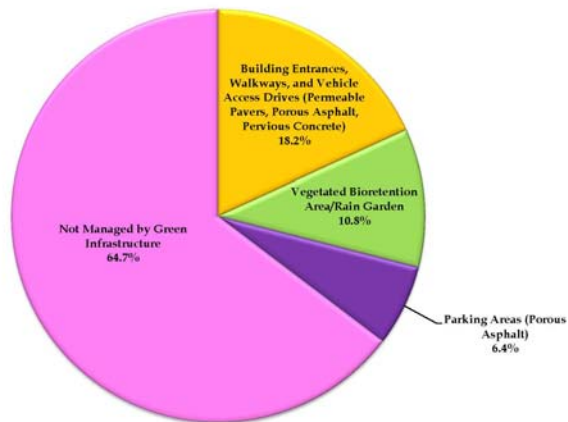


Edenwald Houses Green Infrastructure Planning and Design  
New York City Department of Environmental Protection  
Bureau of Engineering Design and Construction

April 2014

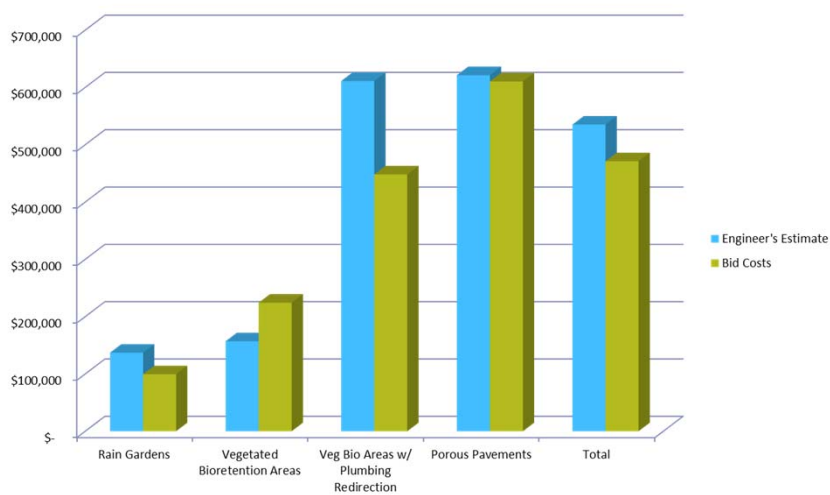
## Edenwald Houses: 35% of Impervious Area Managed

**Edenwald Houses**  
Percent of Impervious Area Managed by Green Infrastructure



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## Edenwald Houses: Cost per Impervious Acre Managed



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## Discussion



[nyc.gov/dep/greeninfrastructure](http://nyc.gov/dep/greeninfrastructure)

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