Green Infrastructure
New York City

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Green Infrastructure in NYC
NYC Land Area
72% impervious
25% ROW
14% parkland
Wastewater Drainage & Collection

**DEP City Operated Facilities**
- 14 treatment plants
- 4 CSO retention facilities
- 96 pumping stations
- 426 combined sewer outfalls

*Treat 1.3 billion gallons of dry weather flow per day*
Sewer System

Combined Sewers (49% of the city)

- 7,400 miles of sewers
- 3,337 miles of combined
- 2,271 miles of sanitary
- 1,801 miles of storm
- 400 acres of Bluebelts (draining 14,500 acres)
What is a Combined Sewer Overflow?
A City-Wide Plan
DEP GI Plan

Objectives

• Build cost-effective grey infrastructure

• Optimize the existing wastewater system

• Control runoff from 10% of impervious surfaces through green infrastructure

• Institutionalize adaptive management, model impacts, measure CSO's, and monitor water quality

• Engage and enlist stakeholders
Budget

Distribution

- $1.5 billion public investment for GI
- $.9 billion private investment for GI
- $2.9 billion cost-effective grey investments

$187 million in capital funds for Green Infrastructure work for the next four years
Primary Agency Roles

**New York City Department of Environmental Protection:**
- funding source
- overall program management
- specification & detail development
- site selection

**New York City Department of Parks & Recreation:**
- maintenance
- site design & construction
- property Owners
- specification & detail development
- site selection

**New York City Department of Transportation:**
- property owners
- site selection

**New York City Department of Design & Construction:**
- site design & construction
Approach
Bronx River Sewershed
Site Selection

Hydraulic Analysis

- Mapping of TDA’s (Tributary Drainage Area)
- Analysis of TDA square footage
Site Selection

Field Analysis

• Walkthrough selection conducted with NYC DPR, DEP, & DOT
Site Selection

Geotechnical Analysis

• Boring to 15’ depth
• Permeability test at 5’ & 10’
• Survey of site location and context
Community Outreach

Green Infrastructure Stakeholders
• Neighborhood Outreach: citywide public meetings & listserve
• Steering Committee: GI implementation focus related to green job creation, technical advice & research, education & engagement

Construction Notification
• Postcard sent to over 25,000 addresses in project vicinity
• Presentations to community boards, elected officials, and local community groups
Community Outreach

Education and Engagement

- BioswaleCare stewardship initiative with MillionTreesNYC
- BioswaleCare workshops in priority sewersheds
- Online Resources
Design & Engineering
ROWB Requirements

Major Siting Considerations
- Must maintain 8’ Clear Path
- Provide clear access to major building entrances
- Follow standard DOT siting requirements for distances between street furnishings
- Must be located upstream from a DEP catch basin and at least 35’ from an intersection
ROWB Components

Typical NYC Tree Pit

Typical NYC ROWB
ROWB Components

- Tree
- Tree Guard
- Curb Outlet w/ Concrete Apron
- Plants and Shrubs
- Stone Buffer
- Curb Inlet w/ Concrete Apron
ROWB Components

Engineered Soil 2’-3’ Depth
(70-85% Sand, Max 30% Fines)
ROWB Components

Standard Sizes
- Length: 20’, 15’, or 10’
- Width: 5’
CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF GREEN INFRASTRUCTURE
STANDARD FOR 20'x5' R.O.W. BIOSWALE TYPE 1
- NO CONNECTION TO SEWERS

PLAN
(IN CROSS-SECTION)

SECTION A-A
AT ROADWAY OUTLET

SECTION B-B
AT INFILLMENT OUTLET

SECTION C-C
AT INFILLMENT OUTLET

ASSISTANT COMMISSIONER, OFFICE OF GREEN INFRASTRUCTURE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

7/25/2012
ROWB Design

Planting Schematics

- Residential Schemes (2)
- Urban Schemes (3)
- Especially Wet
- Especially “Dry”
- Especially Shady
- No Grass Scheme

RESIDENTIAL SCHEME 2 - SITES IN RESIDENTIAL NEIGHBORHOODS AND LOW VOLUME CIRCULATION AREAS
Greenstreet

**Total Existing Greenstreet Sites**

- Queens: 855
- Bronx: 461
- Manhattan: 381
- Brooklyn: 514
- Staten Island: 325

**Citywide:** 2,536
Greenstreet Design Evolution
Seagirt Boulevard between Beach 19th and Beach 20th Street

Jamaica Bay Watershed

Photographed Summer 2010 / Design improves pedestrian flow and creates an amenity for the neighboring homeowners and hospital.
Westbourne Ave. & Bay 25th St.
Jamaica Bay Watershed

Photographed Fall 2011 / Site captures stormwater during a post-construction hydraulic evaluation and provides an educational tool for the neighboring public school.
Francis Lewis Blvd. between 217th St. & 220th Ave.
Thurston Basin Watershed

Photographed Fall 2012 / Design eliminated hazardous ponding conditions, simultaneously creating a space with year-round interest.
Stormwater Greenstreet | Before
Stormwater Greenstreet | 1 month post-installation
Stormwater Greenstreet | 1 year post-installation
Stormwater Greenstreet | Construction

Examining Subsurface Infiltration Rates
Francis Lewis Blvd & 220th Street, Queens

Setting Formwork for Concrete Check Dams
Targee Avenue & Van Duzer Street, Staten Island

Installing Research & Monitoring Equipment
Colfax Street, Murdock Avenue & 221st Street, Queens

Installing Geotextile & Piping
Victory Boulevard & St. Pauls Avenue, Staten Island

Installing Plant Material
Camp Road & Fernside Place, Queens

Testing Post Construction Hydraulic Evaluation
Westbourne Avenue & Bay 25th Street, Queens
Lessons Learned

Challenges
Lessons Learned

Coordination
Lessons Learned

Improvements
Performance
Monitoring Equipment

**Inlet Flume**
- Monitors flow rates of stormwater runoff
- Nashville Boulevard and 116th Avenue, Queens

**Climate Station**
- Measures precipitation, wind speed and direction, solar radiation, and relative humidity
- Nashville Boulevard and 116th Avenue, Queens

**Monitoring Well**
- Quantifies fluctuations in the water table
- Nashville Boulevard and 116th Avenue, Queens

**Weighing Lysimeter**
- Measures evapotranspiration and soil moisture
- Colfax Street and Murdock Avenue, Queens

**Water Quality Samplers**
- Determines pollutant removal efficiency
- Colfax Street and Murdock Avenue, Queens

**Shallow Well**
- Measures ponding depth in planting bed
- Colfax Street and Murdock Avenue, Queens
Nashville Boulevard between 116th Avenue and 209th Street
Thurston Basin Watershed

Photographed Fall 2012 / Design is composed of a robust selection of native plants and a variety of monitoring equipment.
Monitoring Equipment

SECTION C-C' 1/2" = 1'  
NASHVILLE AND 116TH

SECTION H-H' 1/2" = 1'  
NASHVILLE AND 116TH
Monitoring Equipment

SECTION C-C'  1/2" = 1'
NASHVILLE AND 116TH

SECTION H-H'  1/2" = 1'
NASHVILLE AND 116TH
Monitoring Equipment

SECTION C-C'
NASHVILLE AND 116TH

SECTION H-H' 1/2" = 1'
NASHVILLE AND 116TH
Monitoring Equipment
Hurricane Irene & Superstorm Sandy

Irene:
The total volume of precipitation falling on Nashville was 6.4” of rain, totaling 5,382 gallons over an area of 1,560 square feet. A total of 2,166 gallons of water entered through the curb cut.

Sandy:
The total volume of precipitation falling on Nashville was 1.3” of rain, totaling 1,083 gallons over an area of 1,560 square feet. A total of 38,806 gallons of water entered through the curb cut. Inflow from the street was thus approximately 31 times as much as direct precipitation on the site.
Hurricane Irene & Superstorm Sandy

Irene:

Ponding occurred throughout much of the event, though overflow only occurred twice for a duration of 20 minutes total and estimated to total 1,570 gallons. The retention rate of runoff was 79.3% throughout the storm event.

Sandy:

Ponding was minimal throughout the storm, only reaching 5mm above the surface, and there was no overflow. Thus, 100% of the runoff was managed.
Hurricane Irene & Superstorm Sandy

Though large quantities of precipitation and runoff were infiltrated at Nashville, neither storm appears to have resulted in more than a 20 cm temporary increase in the water table elevation. The soils were wetter during Irene than during Sandy, but in both cases returned to near their pre-storm values within about 24 hours of the most intense precipitation.
Overall Performance

- Inflow from the street was approximately 31x direct precipitation on the site.
- Approximately 40,000 gallons of water deposited by Sandy either infiltrated or evaporated.
- On an annual basis, modeling of the site’s performance suggests 74% - 86% retention of all stormwater presented to it. This percentage is dependent upon annual precipitation amounts.
Future of Green Infrastructure
Hurricane Sandy
Storm Surge Inundation

Water depth
- High: 14 feet
- Low: 2 feet
- NYC Parks

Indundation data provided by FEMA
Prepared by Forestry, Horticulture & Natural Resources
Updated FEMA Advisory Zones

- Zone A - 1% Annual Coastal Flood Chance
- Zone V - Subject to high velocity wave action

FEMA Advisory Base Flood Elevation Maps were released on February 24th, 2013.

City of New York - Parks & Recreation
Michael R. Bloomberg, Mayor
Serena R. Webb, Commissioner
Forestry, Agriculture & Natural Reuse

NYC Parks
Updated FEMA Advisory Zones

- Zone A - 1% Annual Coastal Flood Chance
- Zone V - Subject to high velocity wave action
- Park Properties

FEMA Advisory Base Flood Elevation Maps were released on February 24th, 2013.
Updated FEMA Advisory Zones

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Thank You

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LINKS:
DEP GI Plan

GI Standard Details

NYC DPR Green Infrastructure
http://www.nycgovparks.org/greening/green-infrastructure