

Green Infrastructure in New York City

Monitoring Stormwater Source Controls to Guide Implementation

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Biohabitats

HydroQual

HAZEN AND SAWYER



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- Horsley-Witten
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- Brooklyn College

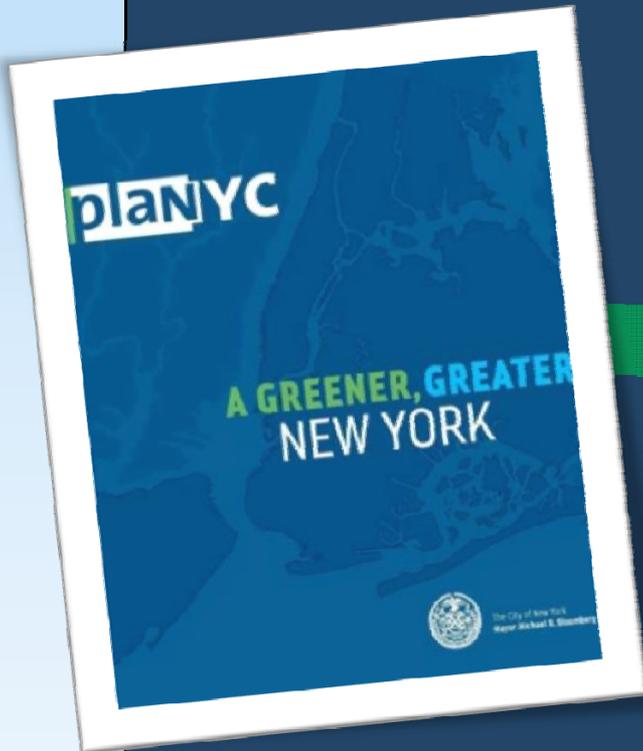
NYC

Green Infrastructure Background



Mayor Bloomberg's PlaNYC

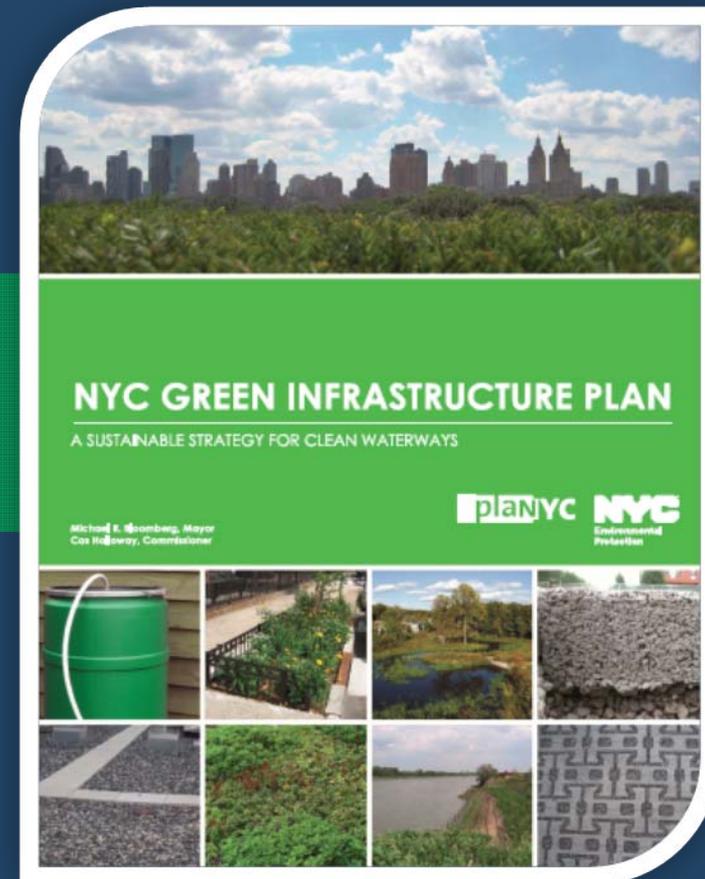
A comprehensive sustainability plan to create a greener, greater New York, PlaNYC is a roadmap to achieve 10 goals:



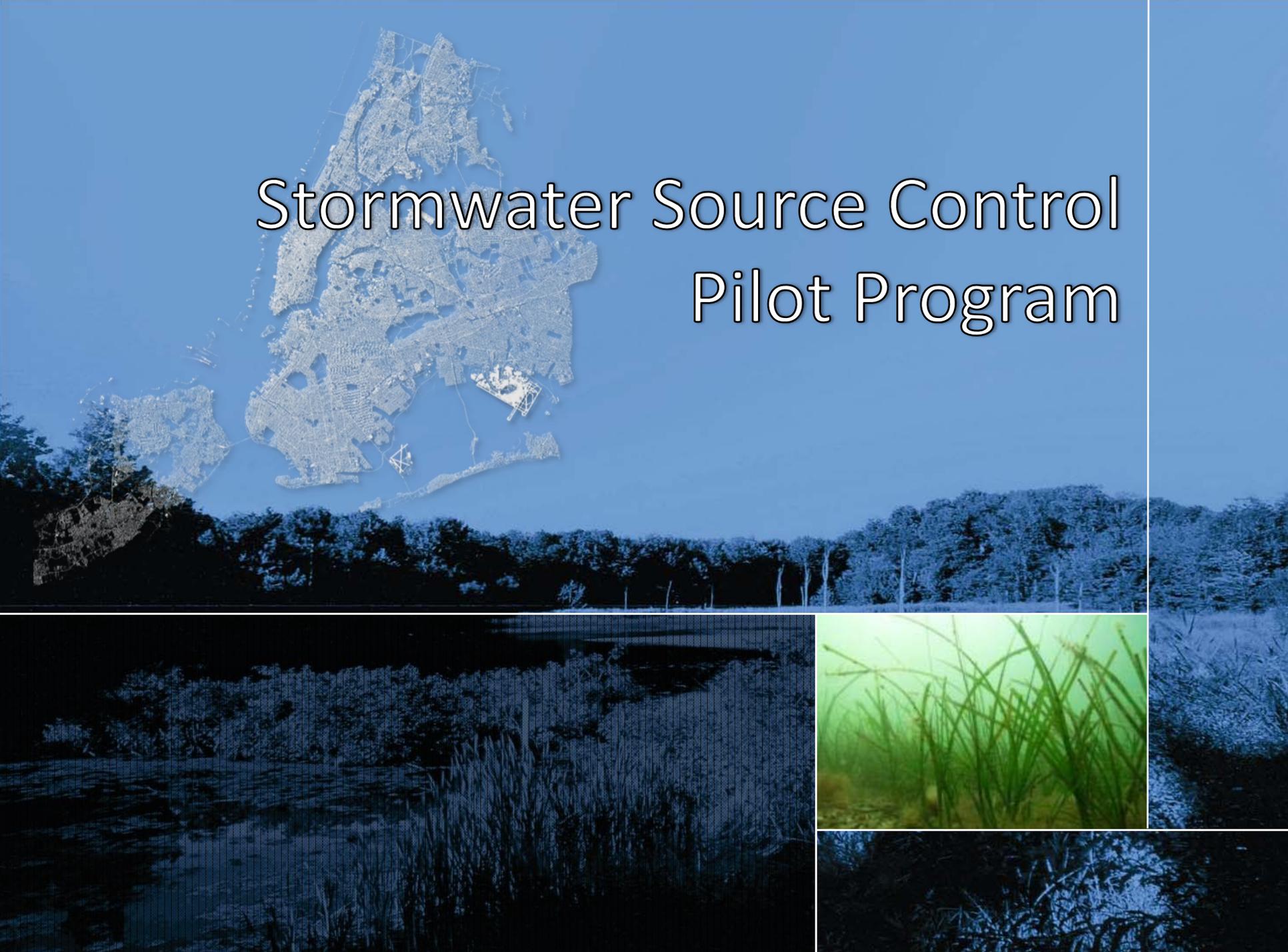
- 1 Create enough housing for our growing population
- 2 Ensure all New Yorkers have parks within a 10-minute walk
- 3 Clean up all contaminated land in New York City
- 4 Develop water network back-up systems
- 5 Open 90% of our waterways and protect natural areas
- 6 Improve travel times by adding transit capacity for millions
- 7 Achieve "State of Good Repair" on our transportation system
- 8 Upgrade our energy infrastructure to provide clean energy
- 9 Achieve the cleanest air of any big city in America
- 10 Reduce global warming emissions by 30%

NYC Green Infrastructure Plan

- 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

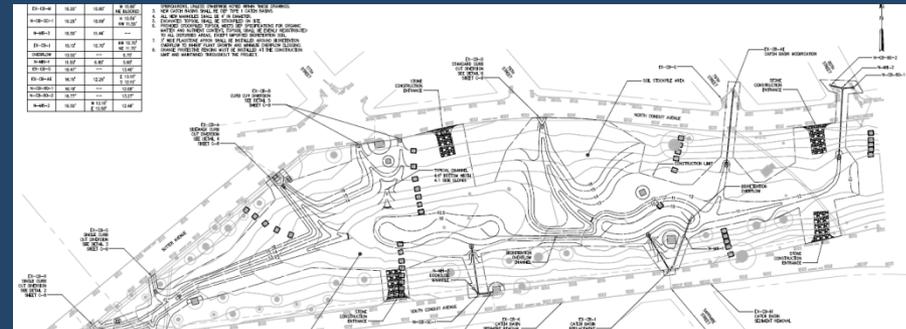


Stormwater Source Control Pilot Program



Stormwater Pilot Study Objectives

- Develop stormwater pilot designs
- Construct and maintain pilots within NYC
- Evaluate pilot performance

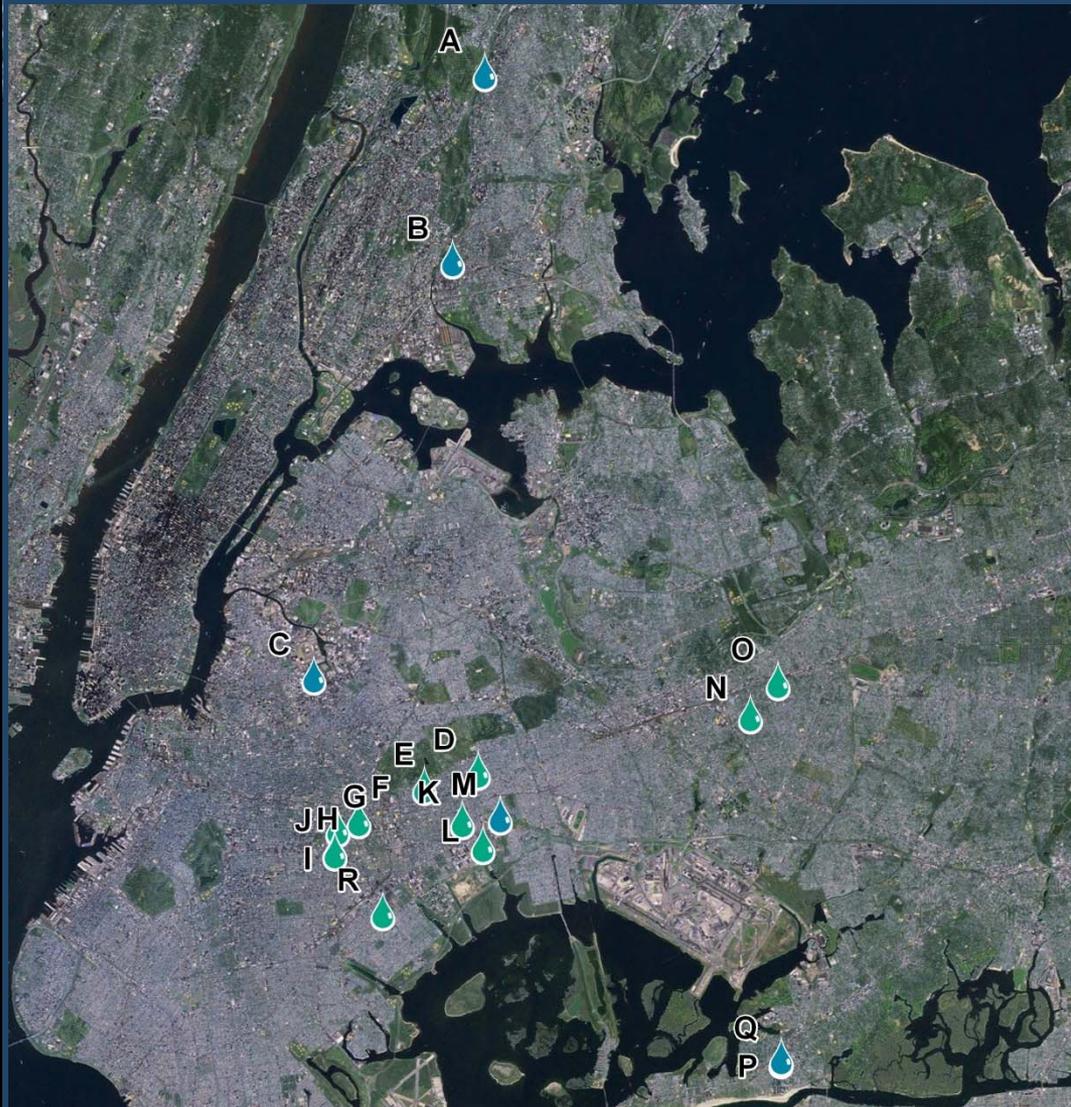


Stormwater Pilot Practices

- Subsurface Detention and Infiltration Systems
- Bioretention
- ROW Bioswales
- Permeable Pavement
- Blue Roofs
- Green Roofs



Distribution of Stormwater Pilots



A	Public Park Bioretention
B	Public Housing Pilots
C	Blue Roof
D	Bioswale - ETP
E	Bioswale - SSIS
F	Bioswale - SSIS
G	Bioswale - SSIS
H	Bioswale - ETP
I	Bioswale - ETP
J	Bioswale - SSIS
K	Bioswale - ETP
L	Bioswale - ETP
M	Median Bioretention
N	Blue and Green Roof
O	Bioswale - SSIS
P	Permeable Pavement
Q	Parking Lot Bioretention
R	Parking Lot Bioretention

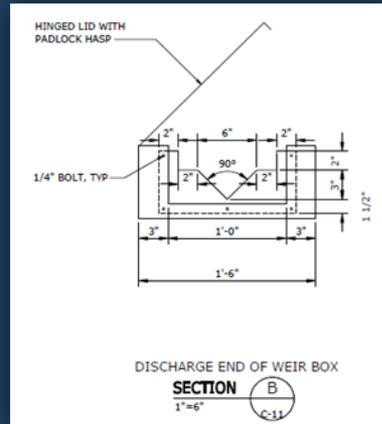
Monitoring Objectives

- Storm hydrology and hydraulics
- Water quality
- Qualitative performance / maintenance
- Additional benefits



Overall Monitoring Strategy

- Remote monitoring equipment
- Standardized equipment setups
- Regular site visits
- Standardized forms and procedures



C-1: Water/Soil Quality Sampling Visit Task List

Site	WFOGA
Date	
Arrival Time	
Departure Time	
Monitoring Personnel	
Weather Conditions	
Network File Location	C:\00000001\log\1-13-09\00000001\00000001

Visit to Site Visit

- Communicate with monitoring coordinator on timing and locations of water quality sampling
- Collect and organize all field equipment
- Communicate with the lab to ensure samples can be dropped off for analysis
- Apply preservative to sampling bottles as specified by the lab
- Label all sample bottles as specified by the lab, including at a minimum: site location, sampling location

Discharge, Preliminary, Site Visit

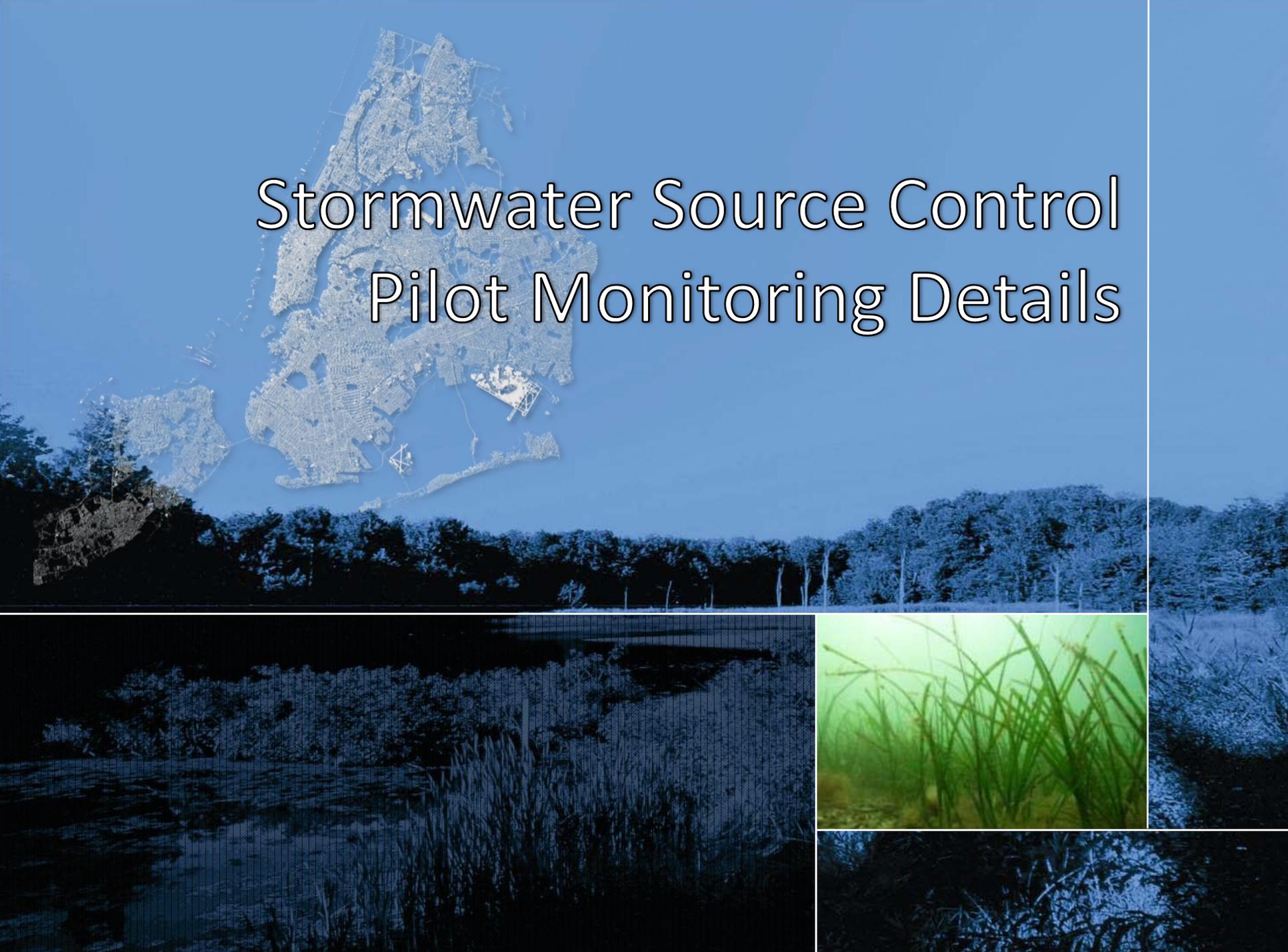
- Based on coordination with monitoring coordinator, visit the site in advance of the storm to prepare sampling equipment
- Install clean sampling bottles at monitored inlet and outlet (if total)

Discharge, Sampling, Site Visit

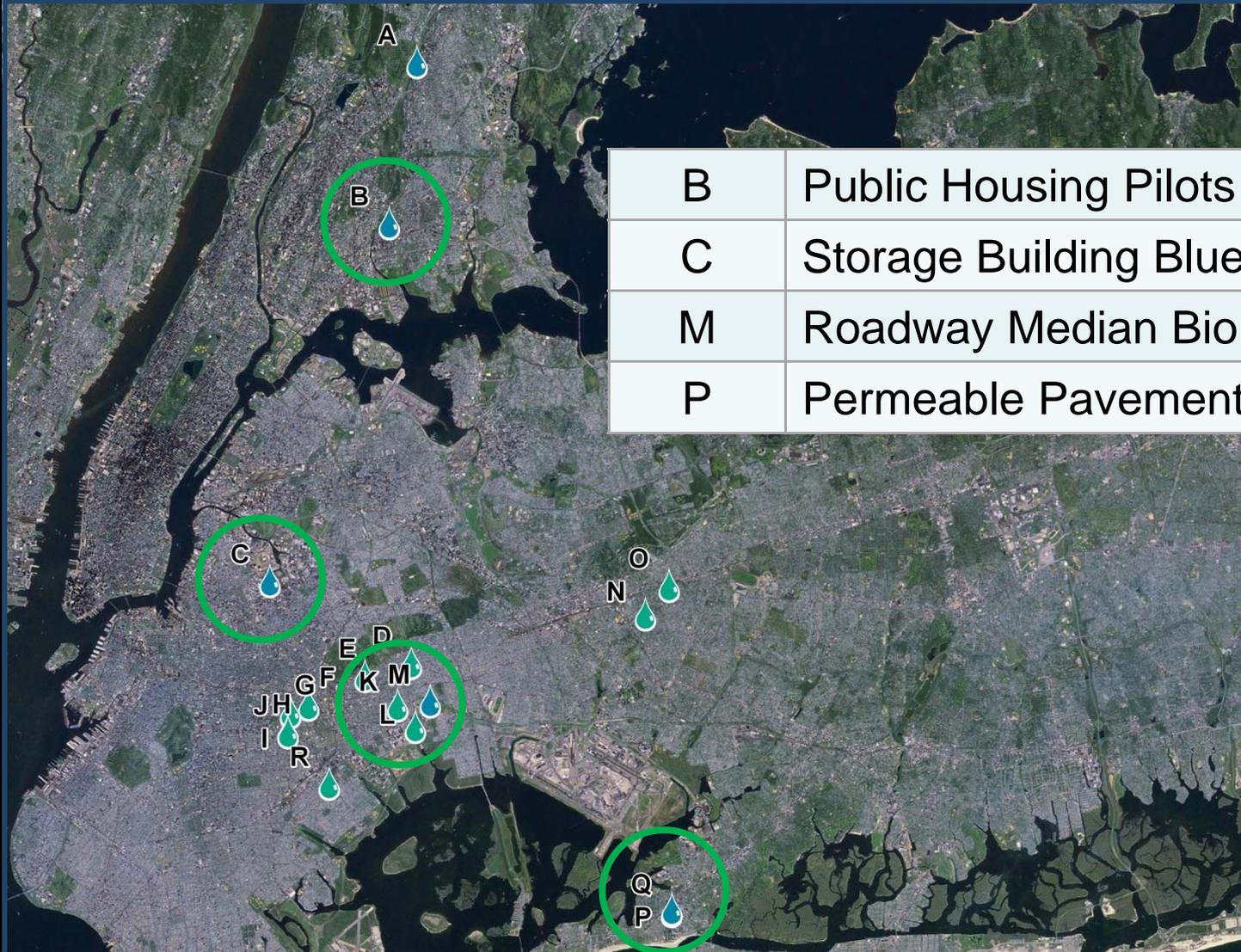
- Document date and time of site visit, weather, and general site conditions
- Collect water quality samples from inlets and outlet (if total)
- Add current date and time to sample bottle label
- Unless collecting final storm sample, replace collected sample bottle with new
- Composite samples according to the following schedule:
 - Single 90% sample collected after 1 hour of rainfall
 - Subsequent samples collected at 2 hr intervals
 - 2-hr samples mixed thoroughly and combined to form 4-hr composite
 - Composite samples collected for 8 hours, or until rainfall/flow stops
 - Additional 4-hr composite sample may be collected, if feasible
- Store samples as specified by the lab
- Note any monitoring or general maintenance needs and address where practical

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Stormwater Source Control Pilot Monitoring Details

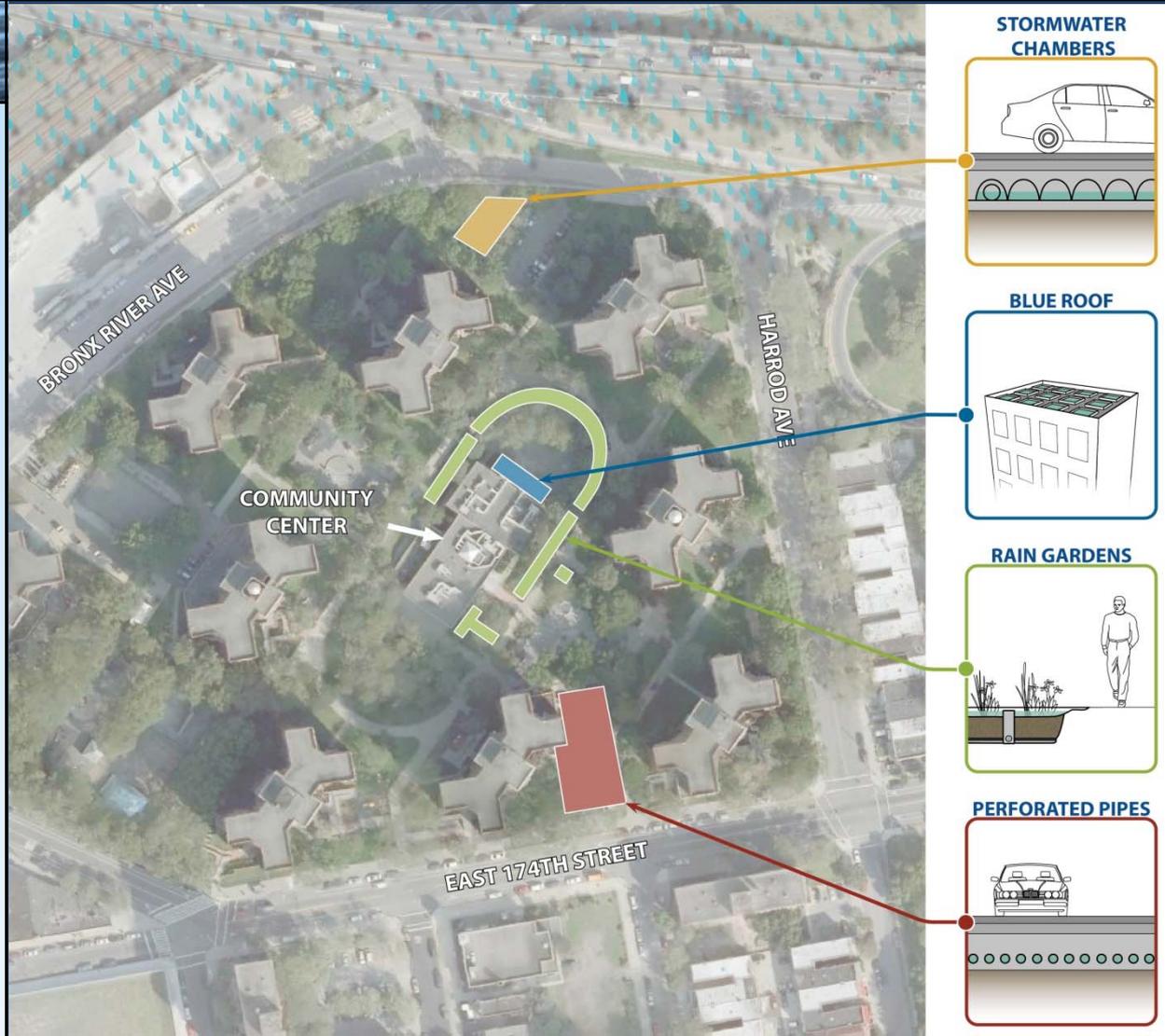


Stormwater Pilot Highlights

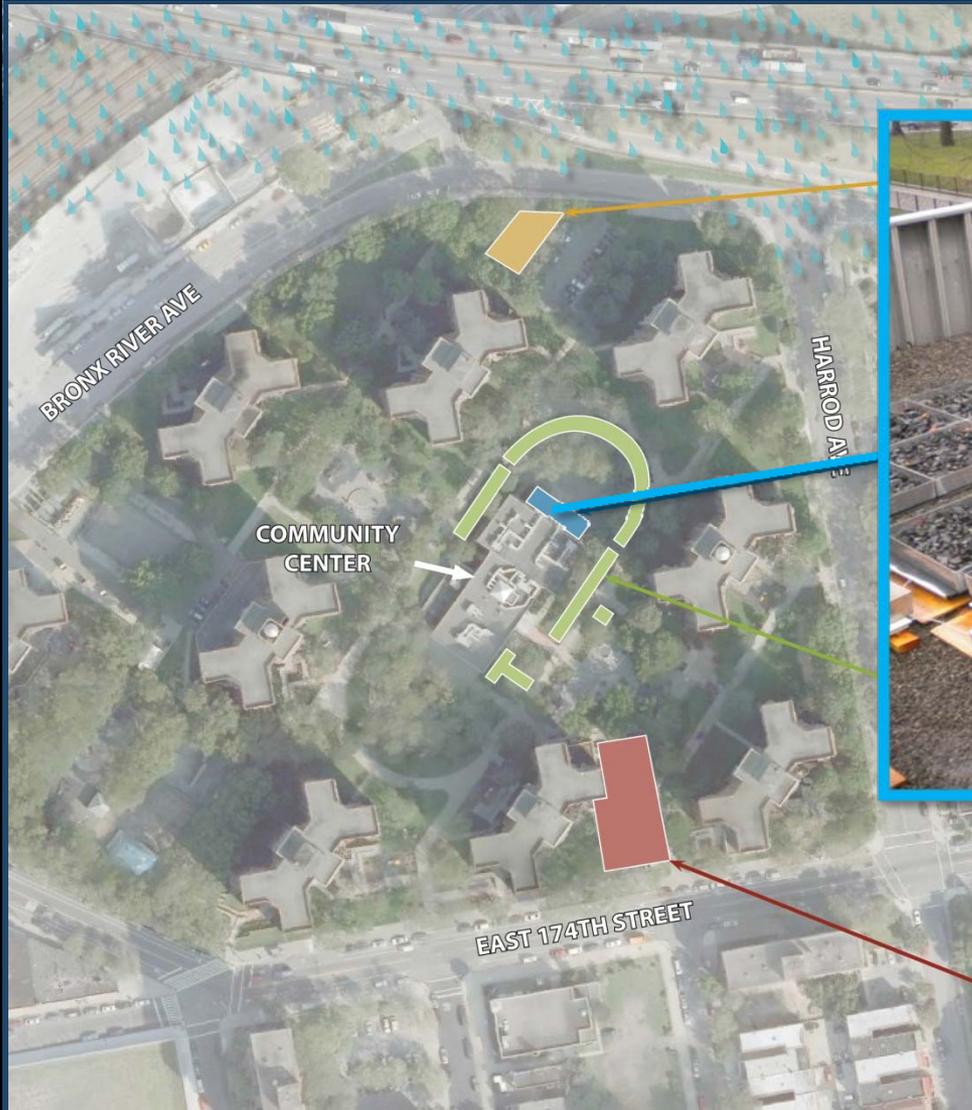


B	Public Housing Pilots
C	Storage Building Blue Roof
M	Roadway Median Bioretention
P	Permeable Pavement

Public Housing Pilots



Blue Roof



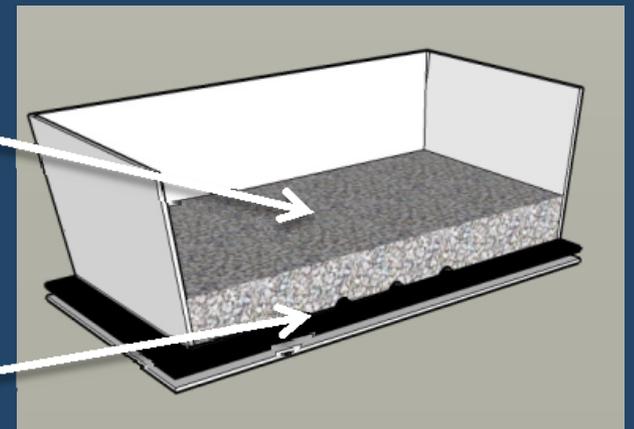
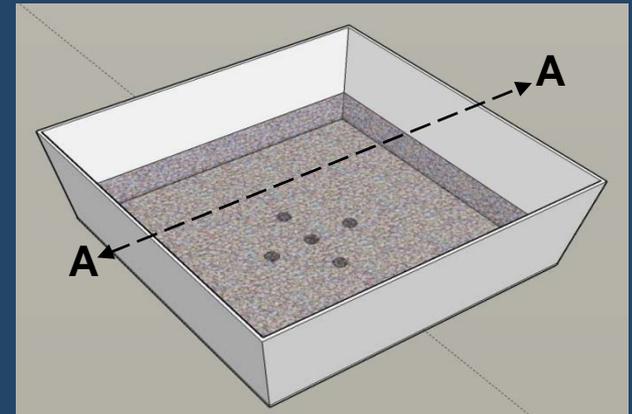
Blue Roof Functional Elements



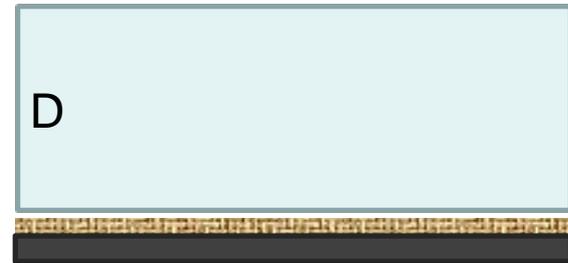
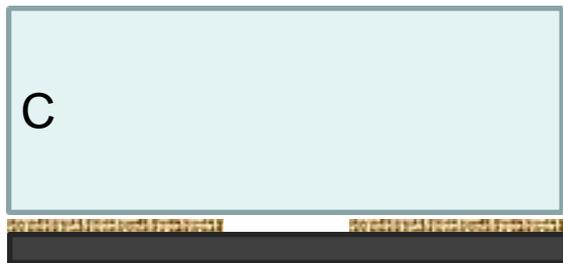
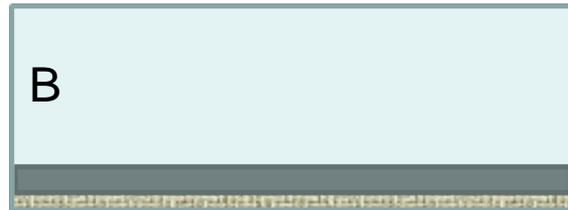
Coarse Stone Ballast
(expanded shale)

Geotextile Drainage
Layer with Corrugated
Plastic

Orifice Outlet Controls



Blue Roof Tray Configurations



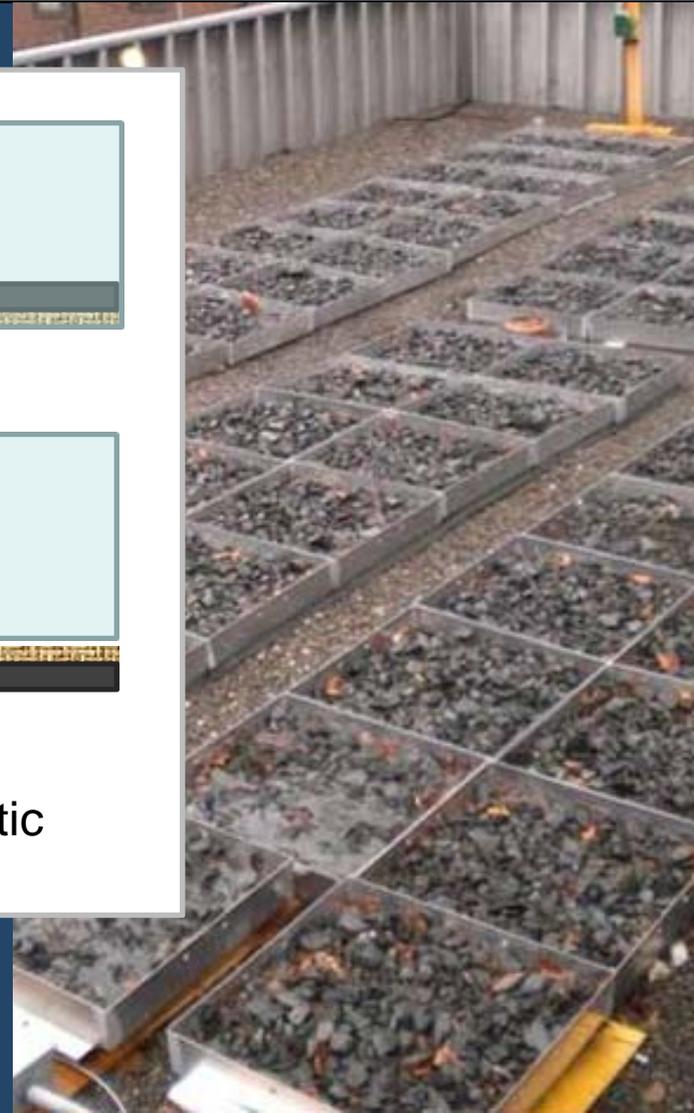
Tray



Geotextile



Plastic



Blue Roof Monitoring



Weather Station

- Measurements
 - Rainfall
 - Temperature
 - Relative humidity
 - Solar radiation
 - Wind speed
 - Gust speed
 - Wind direction

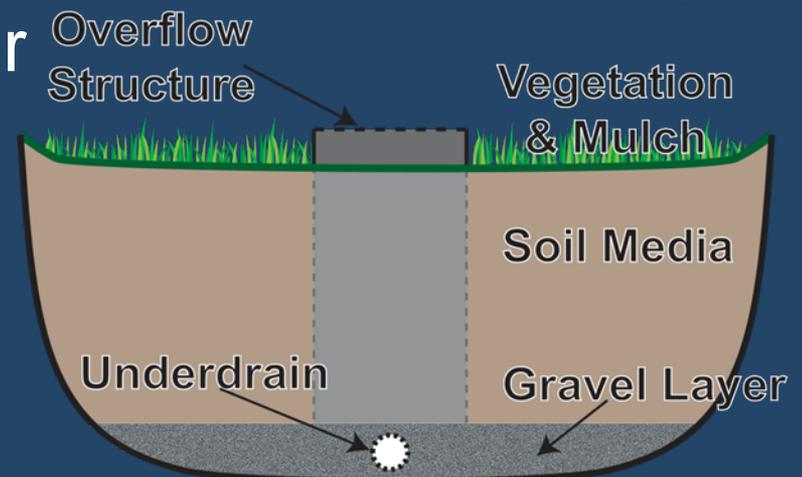


Bioretention

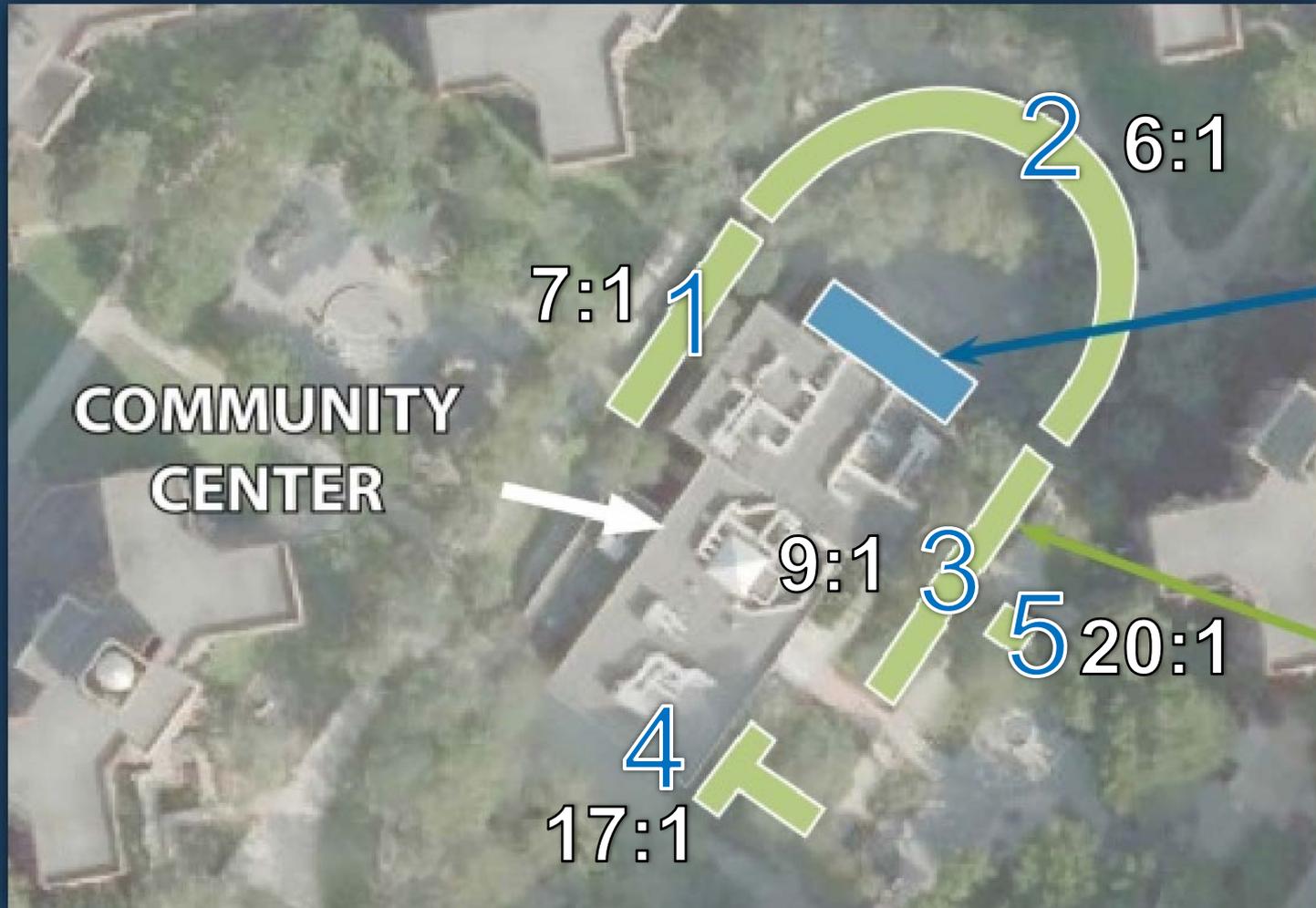


Bioretention

- Major Functional Elements
 - Surface storage for detention
 - Subsoil contact for seepage losses
 - Bio-soil evapotranspiration losses
 - Underdrain and overflow to prevent long term standing water



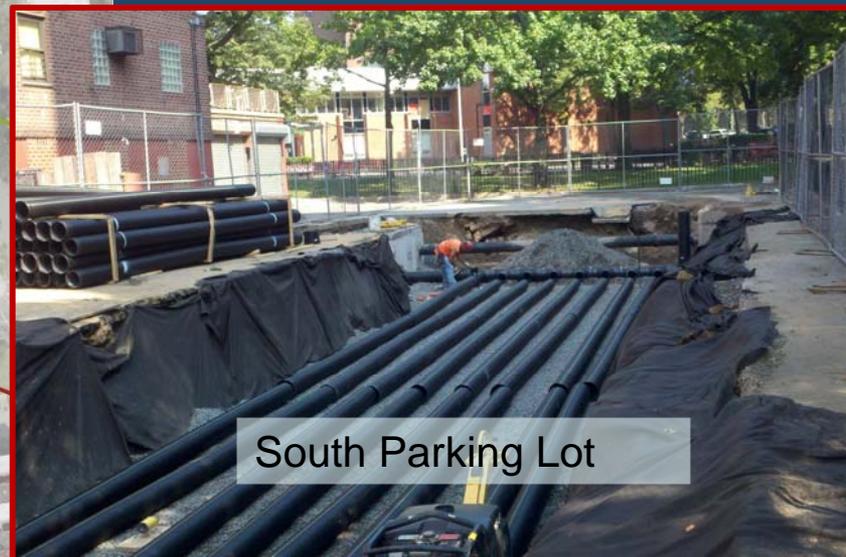
Bioretention: Contributing Drainage



Bioretention Monitoring

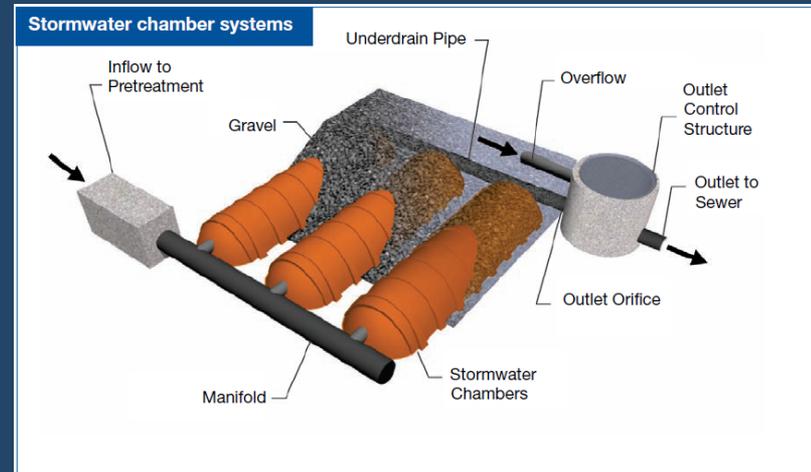
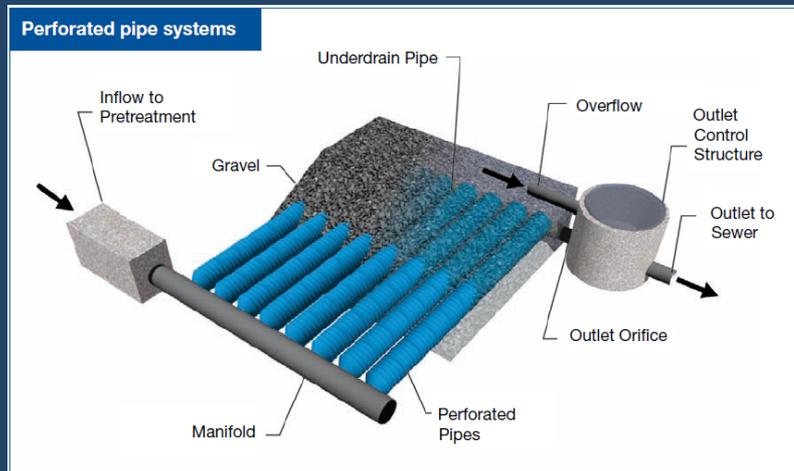


Subsurface Detention & Infiltration

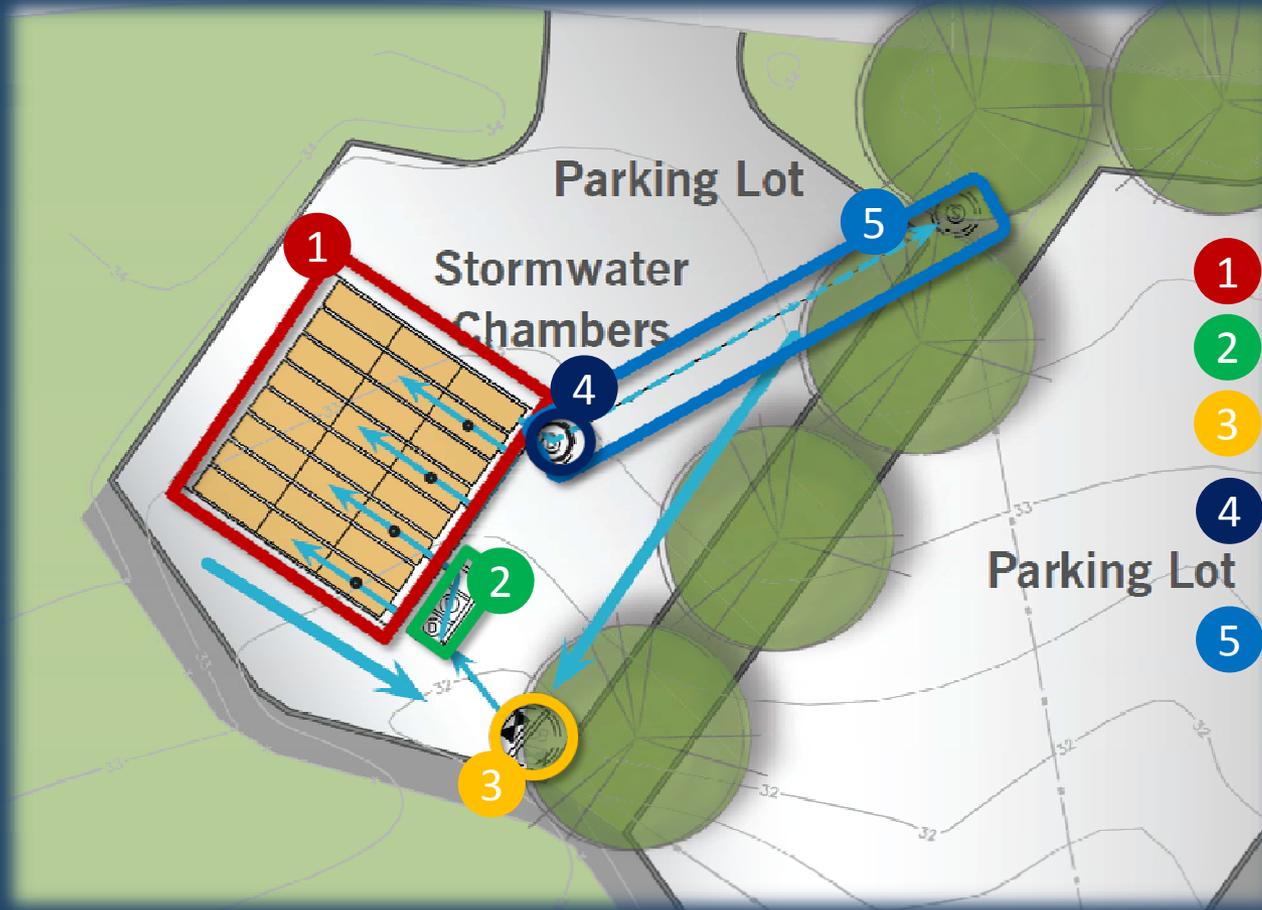


Parking Lot Subsurface

- Major Functional Elements
 - Catch basins directed to subsurface
 - Subsoil contact for seepage losses
 - Outlet flow restriction for detention



Subsurface Chamber System



- 1** Chamber System
- 2** Pre-Treatment
- 3** Diversion Inlet
- 4** Outflow Monitoring Manhole
- 5** Connection to Combined Sewer

Subsurface System Monitoring



Inflow

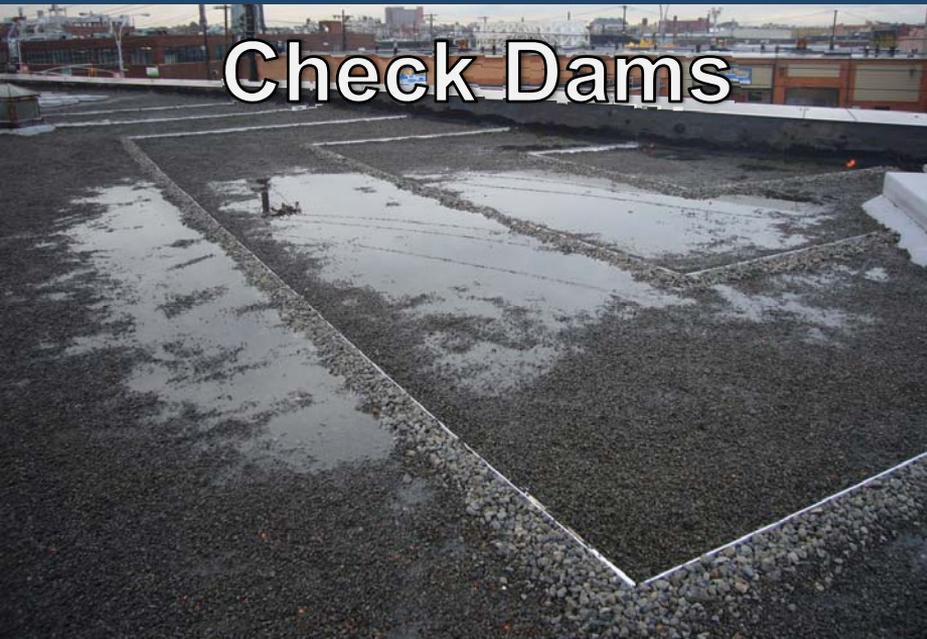
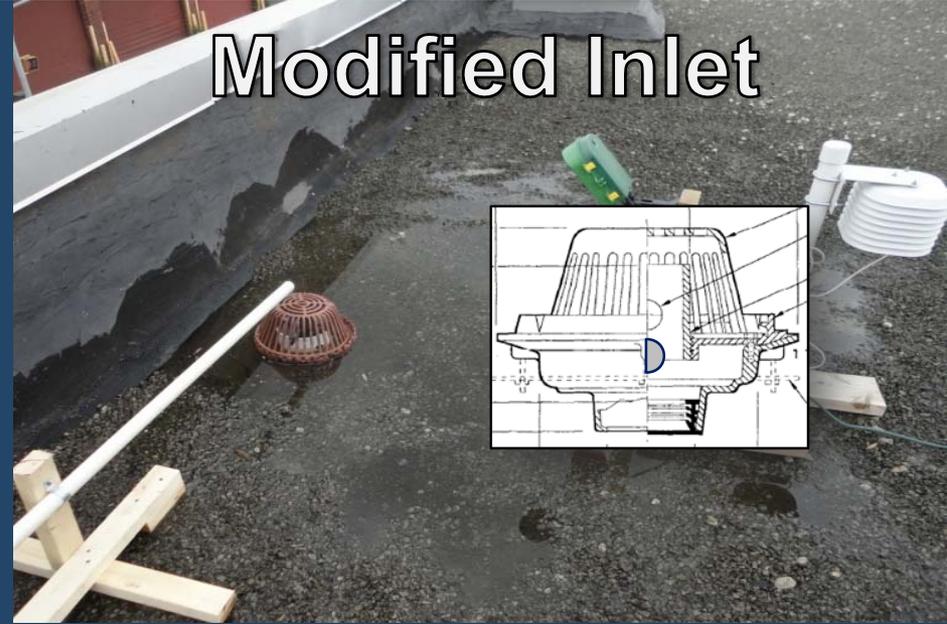
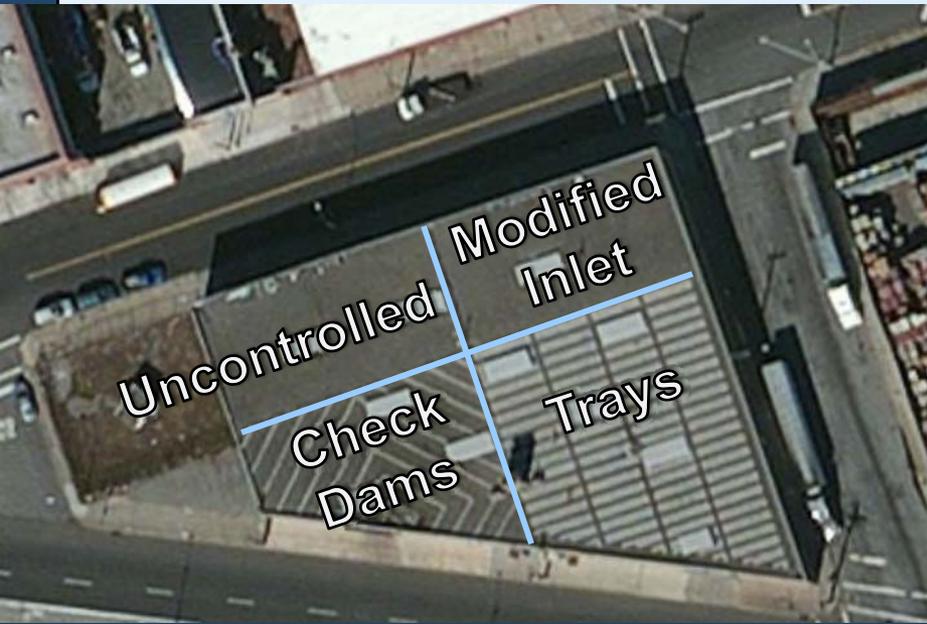


Outflow

Storage Building Blue Roof

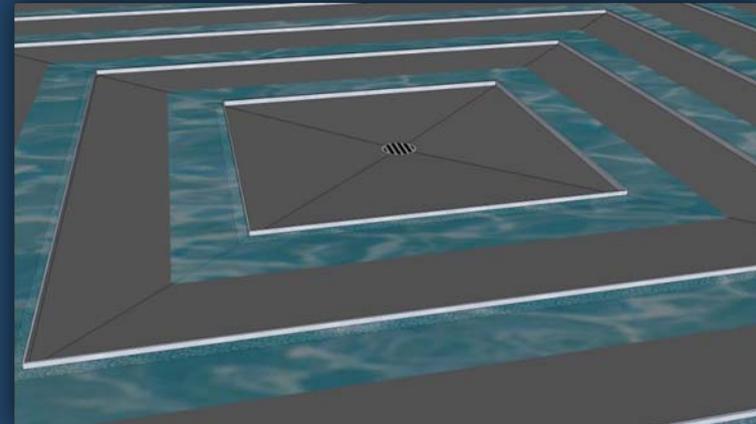
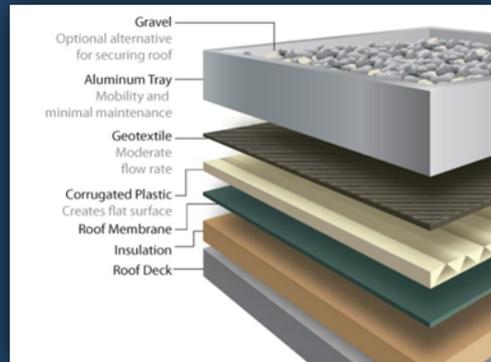
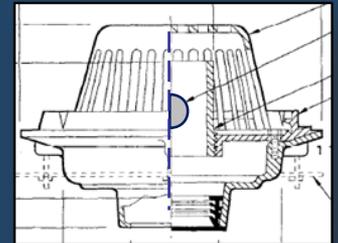


Multiple Blue Roof Systems



Multiple Blue Roof Systems

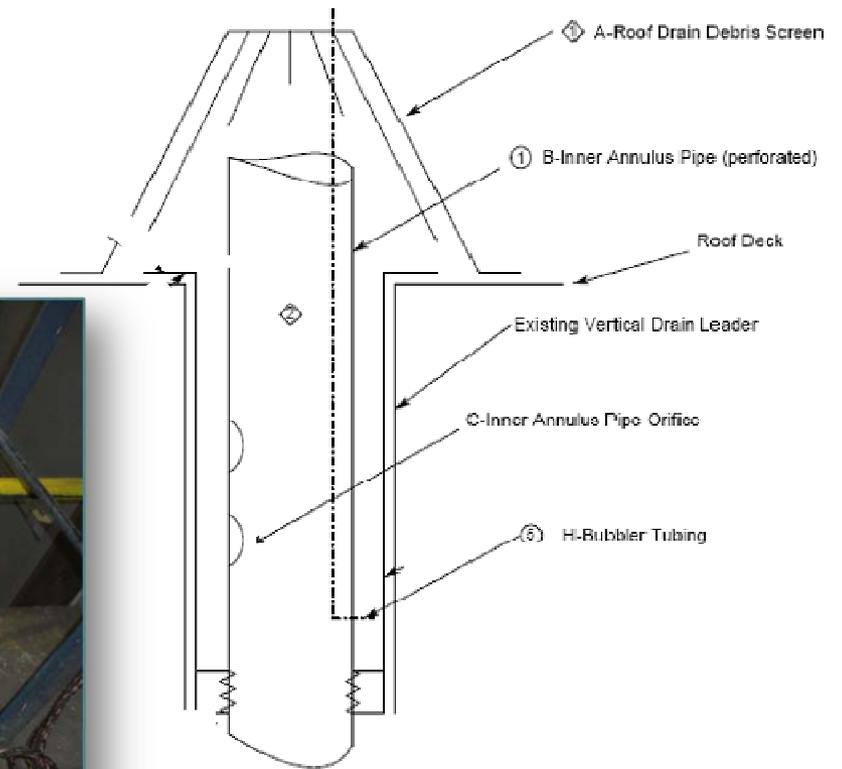
- Major Functional Elements
 - Rooftop storage for detention
 - Four “quadrants”
 - Slowed drainage from trays
 - Slowed drainage through check dams
 - Slowed flow at modified inlet
 - Control Section (“as-is”)



Flow Monitoring on Roofs



Flow Measurement Primary Device



Roadway Median Bioretention



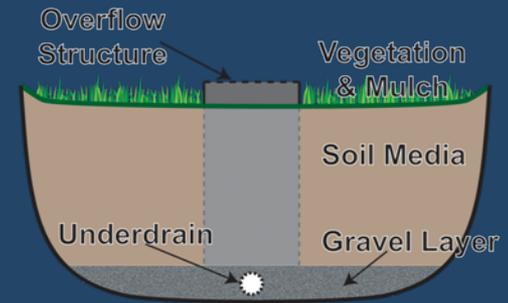
Roadway Median Bioretention



N&S Conduit: Bioretention

■ Major Functional Elements

- Surface storage for detention
- Subsoil contact for seepage losses
- Bio-soil evapotranspiration losses
- Underdrain and overflow to prevent long term standing water
- Infiltration losses in conveyance swales

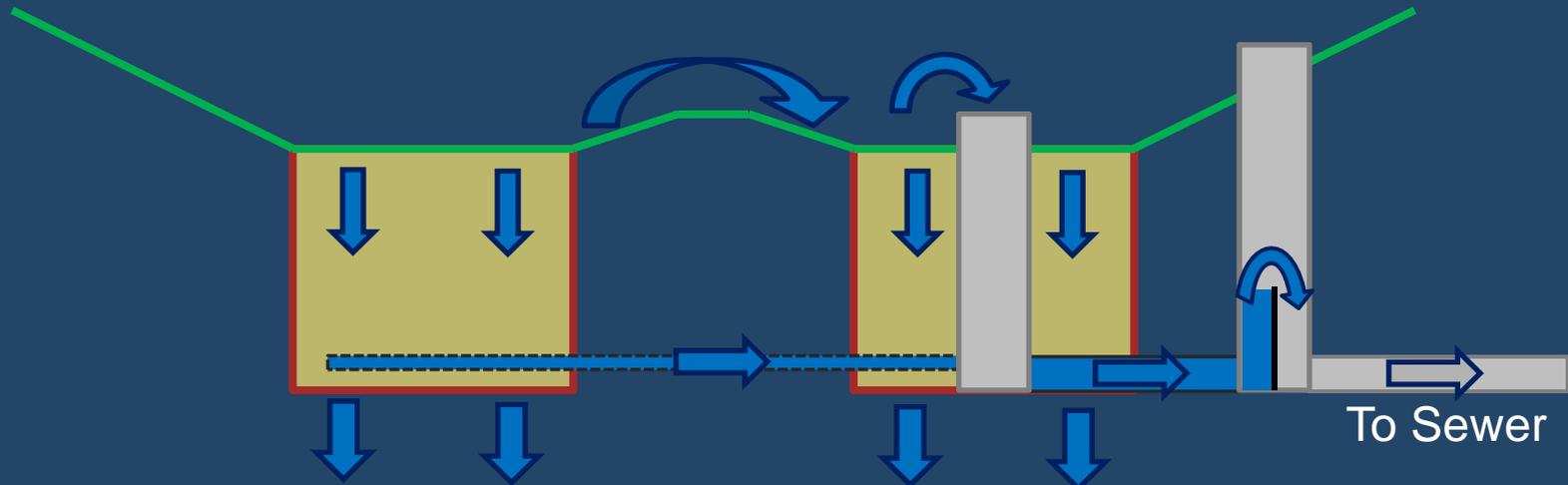


Roadway Median Bioretention



Enhancing Volume Reduction

- Infiltration losses in swales
- Large area available for storage and infiltration
- Subsurface storage backup needed to generate outflow



Permeable Pavement

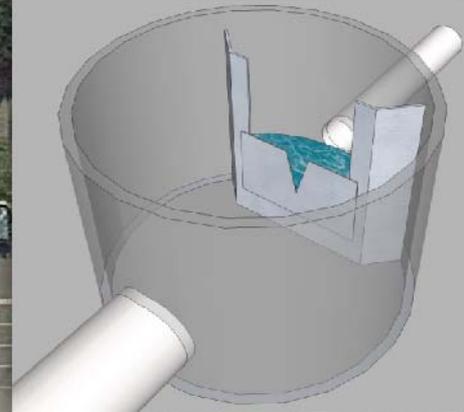
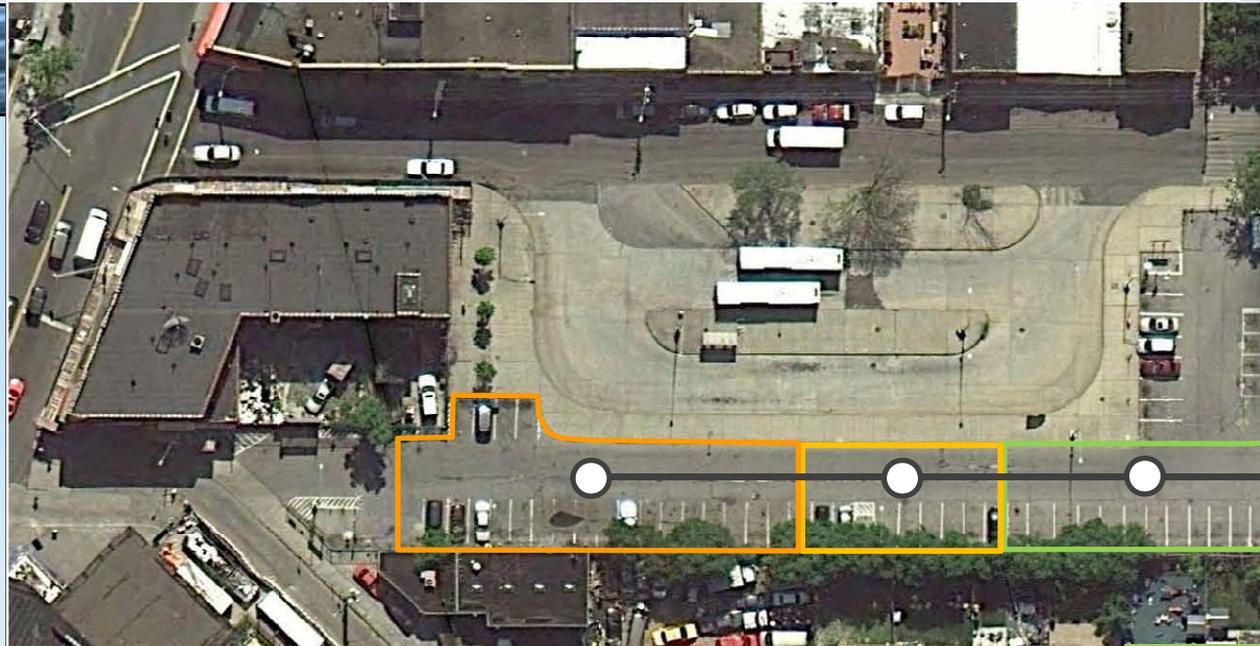


Permeable Pavement

- Major Functional Elements
 - Surface infiltration of runoff
 - Subsurface detention
 - Subsoil contact for seepage losses
 - Retention within subsurface drainage layers



Permeable Pavement



Porous Asphalt



Standard Asphalt



FilterPave

Water Quality Analysis

- Evaluate whether pollutant concentrations are similar to those observed elsewhere
- Inform potential maintenance needs
- Diesel, gasoline, nitrogen, phosphorus, total organic carbon, total suspended solids, total salts, and metals



Qualitative Performance



The image features a blue-tinted aerial map of an urban area, possibly a coastal city, overlaid on a background landscape. The landscape includes a line of trees and a body of water. The text is centered over the map.

Pilot Monitoring Program: Urban Implementation and On-Site Testing



Protecting and Concealing Monitoring Equipment



Routine Monitoring Maintenance



Hydrant Testing

- In-field calibration of monitoring equipment
- Rating curve differences observed for all equipment
- Testing provided insight into general system functionality



Overall Summary

- Stormwater pilot monitoring supporting green infrastructure adaptive management approach
- Numerous factors impact effective stormwater monitoring in an urban environment
- Valuable qualitative and quantitative data being collected from all pilots

Questions?

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www.nyc.gov/html/dep/html/stormwater/index.shtml