Hazen

Green Infrastructure in New York City:

NYC Environmental Protection

Three Years of Pilot Implementation and Post-Construction Monitoring

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Acknowledgements

NYC Department of Environmental Protection

HDR

Biohabitats

Horsley Witten Group

Geosyntec

Brooklyn College

Stormwater Pilot Study

Develop Stormwater Pilot Designs

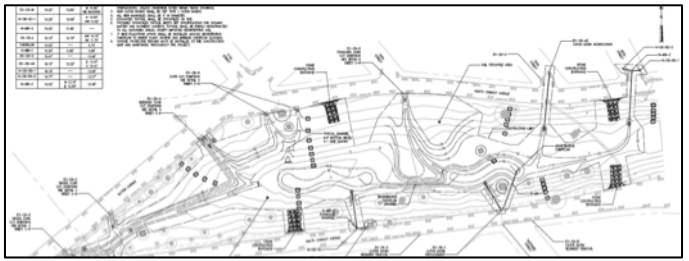
- Find locations suitable for GI retrofits
- Develop designs feasible as retrofits within the dense urban environment

Construct and Maintain Pilots

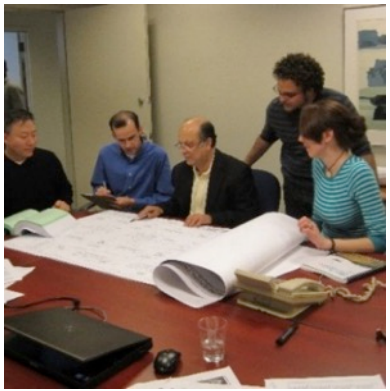
- Evaluate local logistics of implementation
- Characterize the type and frequency of maintenance needs

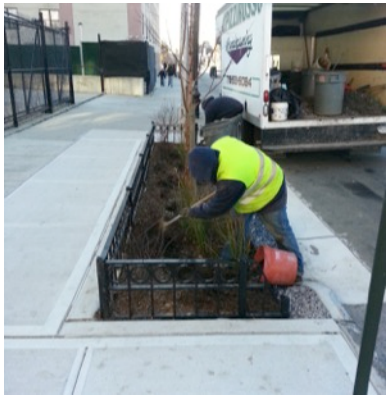
Evaluate Pilot Performance

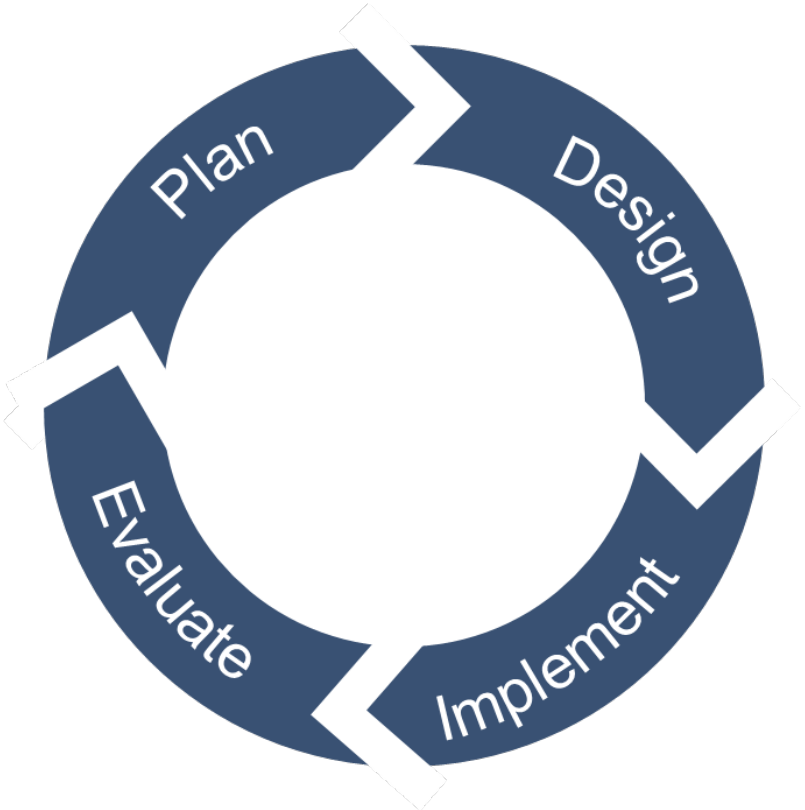
- Qualitative performance
- Quantitative performance



Full Life Cycle Evaluation

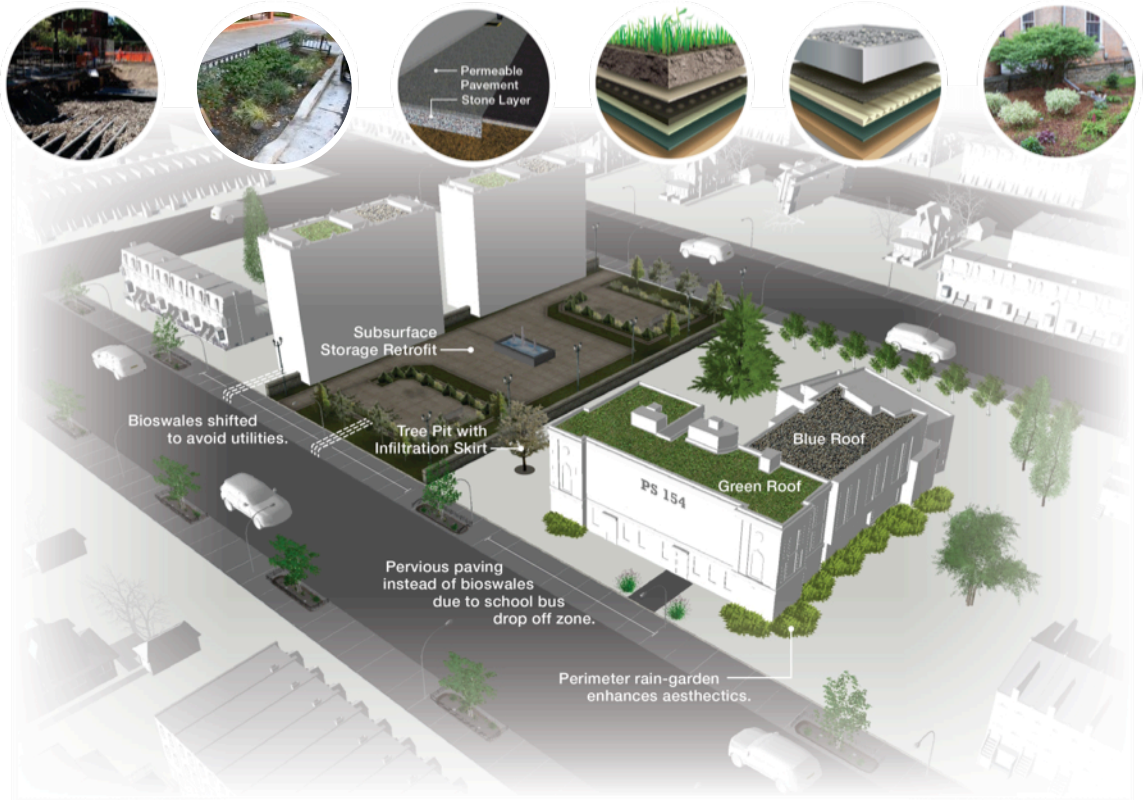


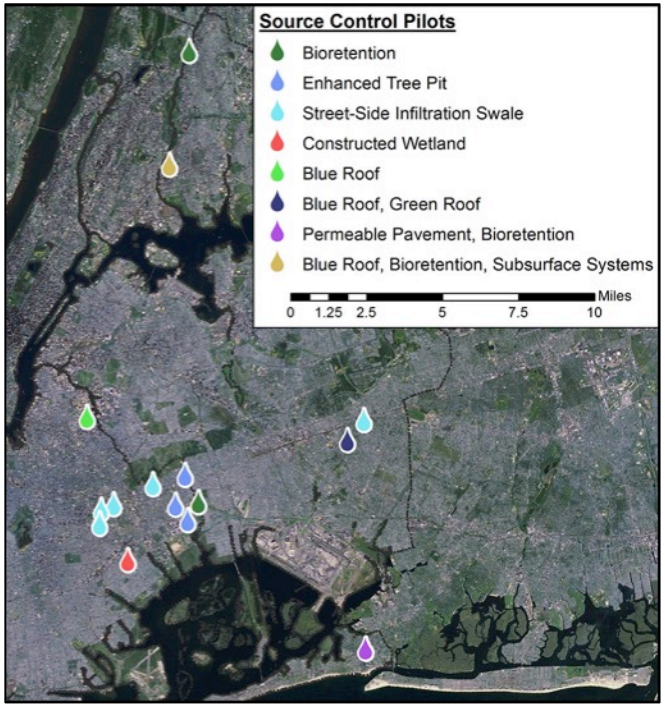




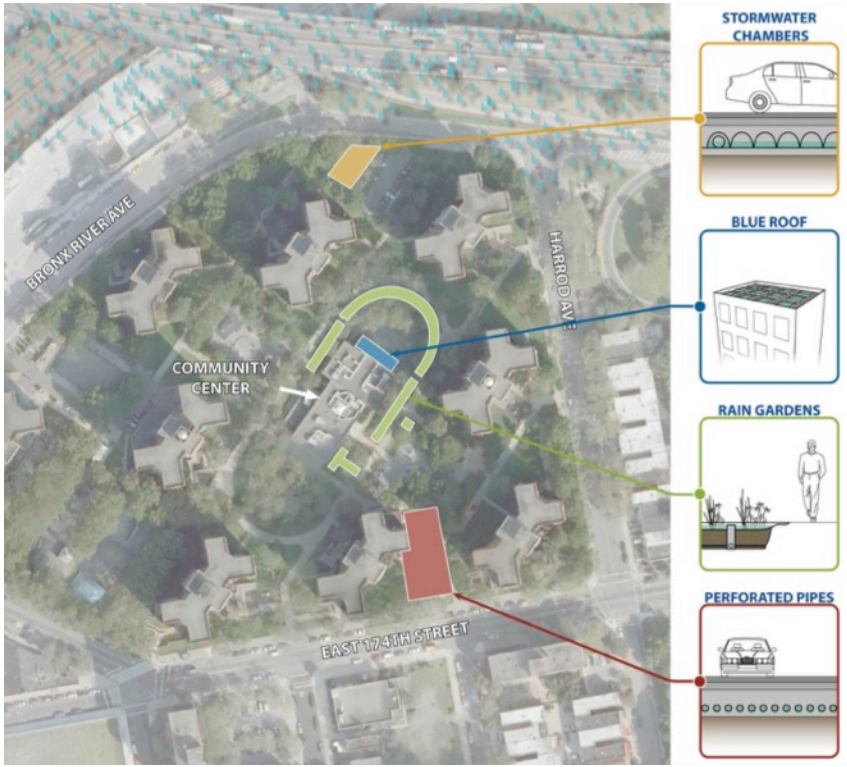
Green Infrastructure Toolbox

Subsurface Retention | ROW Bioswale | Permeable Pavement | Green Roof | Blue Roof | Rain Garden

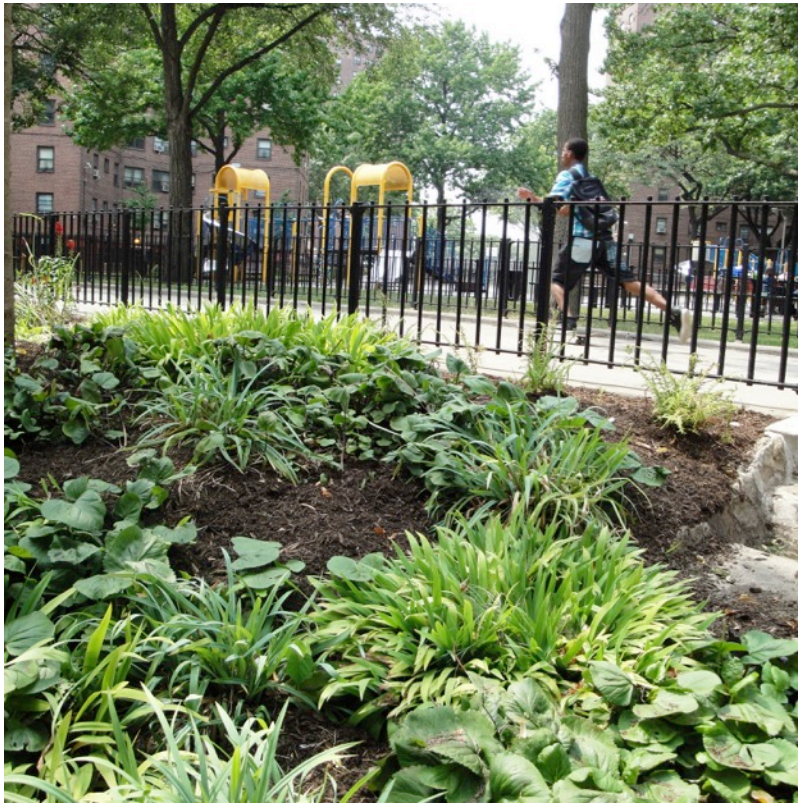




Distributed Green Infrastructure at Public Housing



Completed Bioretention



Monitoring Toolbox

Off-the-Shelf Weirs, Flumes, and Loggers

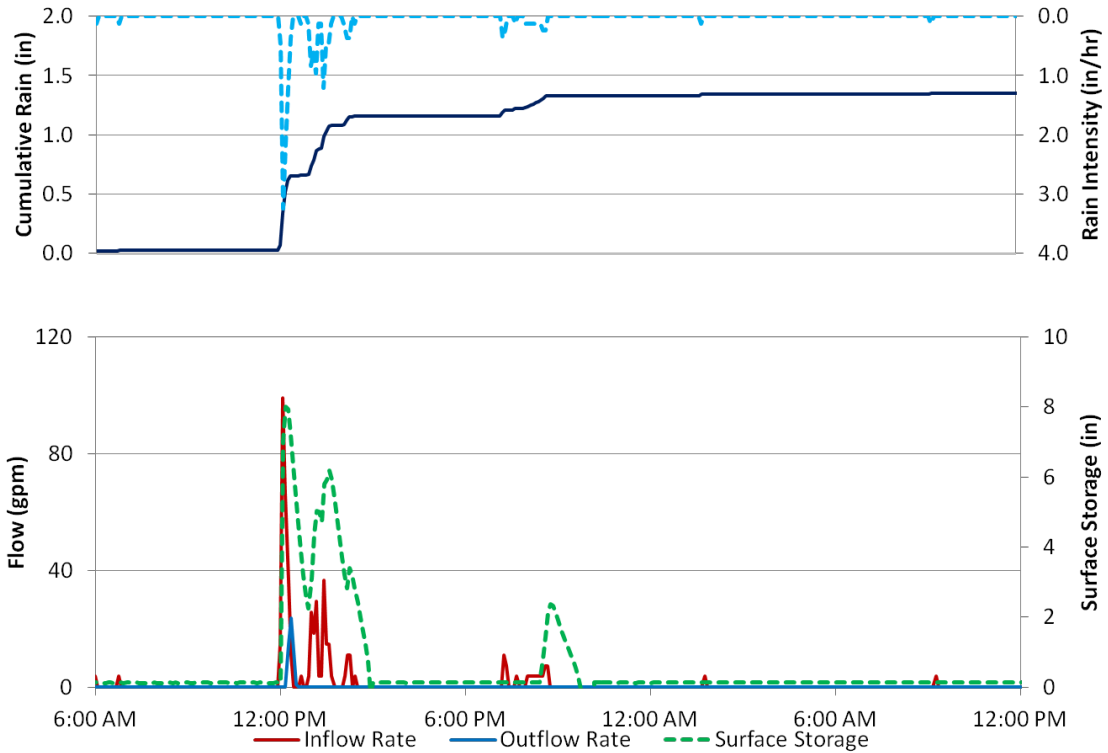
Tested Custom Equipment

Time Lapse Cameras

Water Quality Sampling

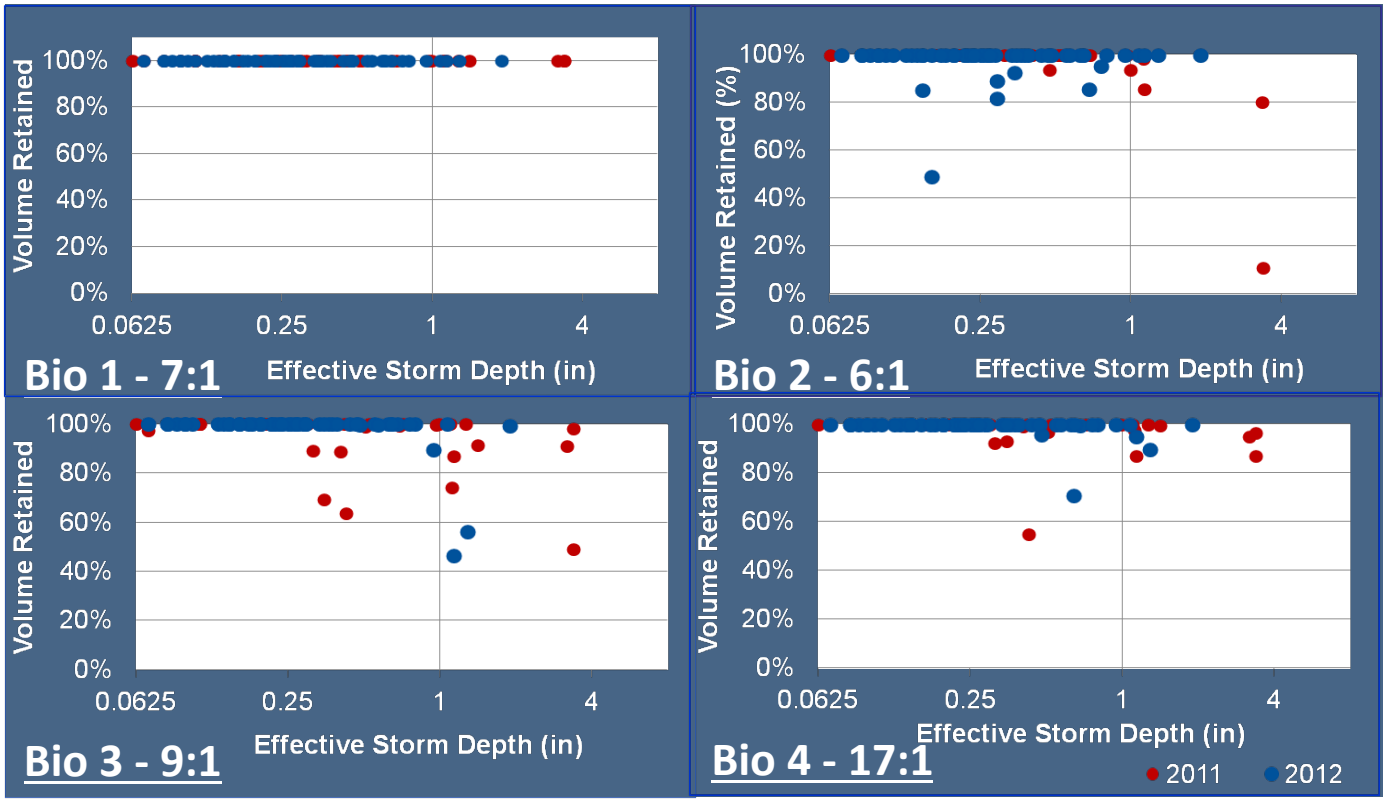
Bioretention Performance

Example 1.4” Storm



Bioretention Performance

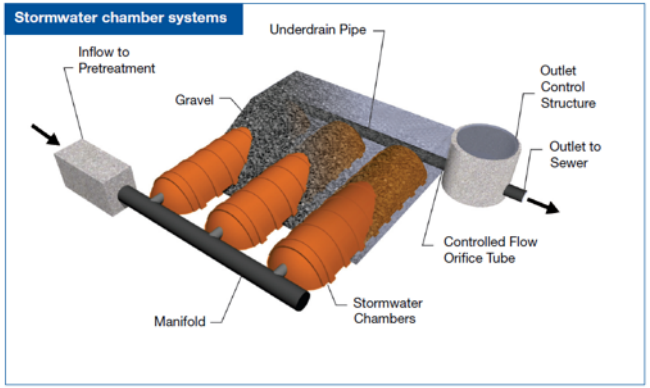
Volume Retained

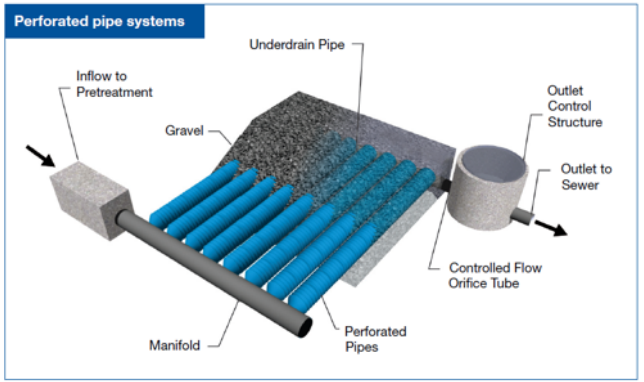


Bioretention Performance Summary

- Retained most runoff they received
- Simple curb cuts without depressed apron allow bypass
- Curb cut sumps effective at capturing litter and debris
- Most plants have performed well
- Positive community reception

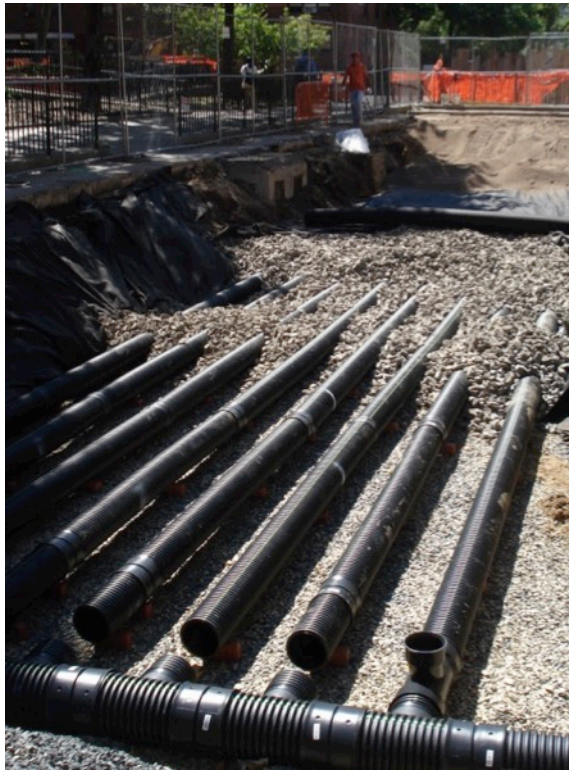
Subsurface Detention and Infiltration





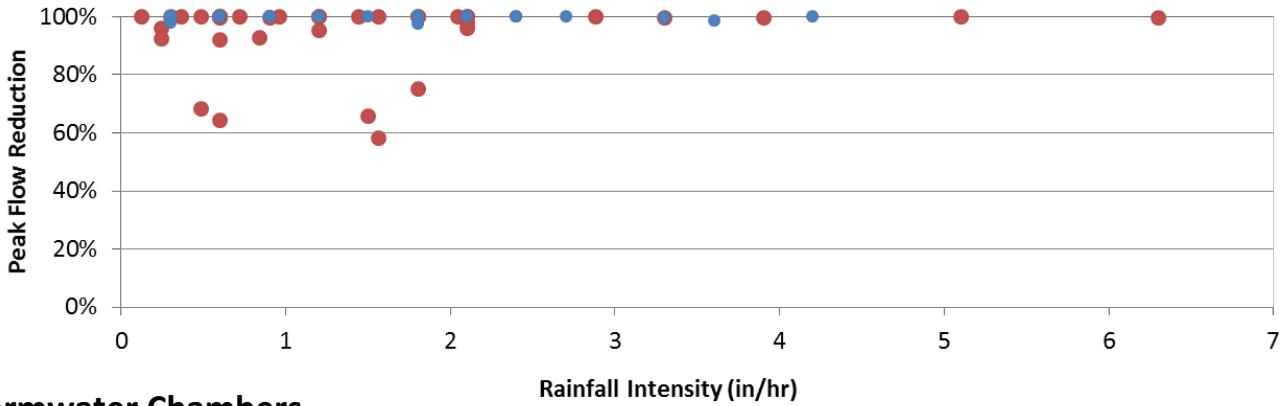
Subsurface Detention and Infiltration

Construction Photos

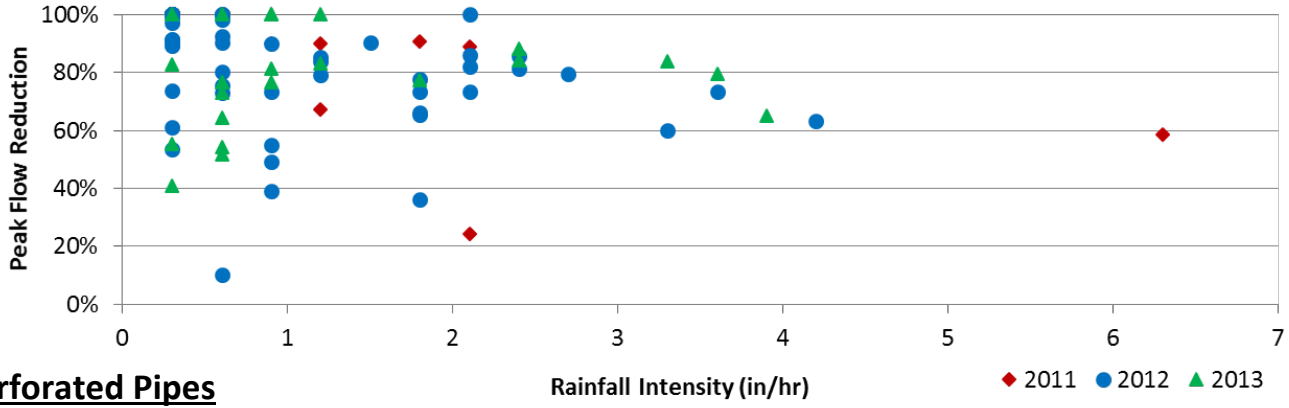


Subsurface Detention and Infiltration

Peak Flow Reduction



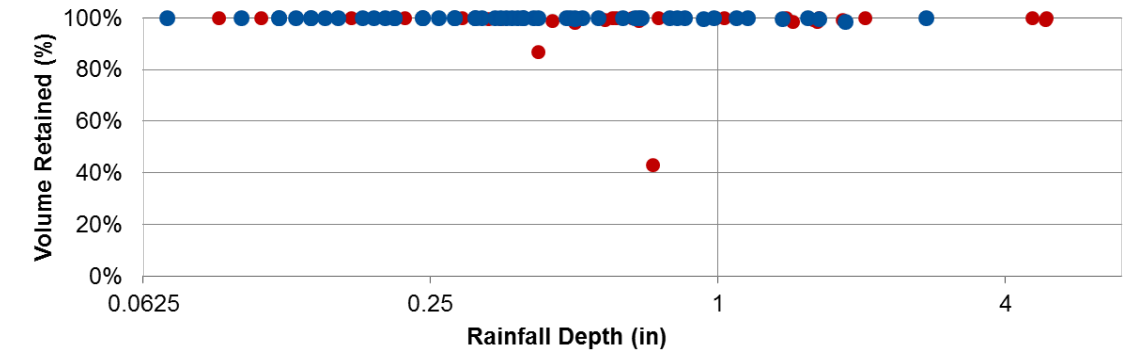
Stormwater Chambers



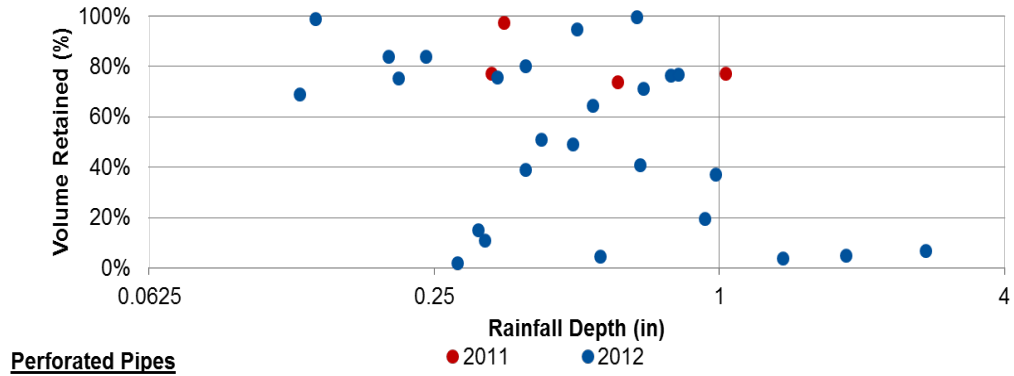
Perforated Pipes

Subsurface Detention and Infiltration

Retention Performance Variability



Stormwater Chambers

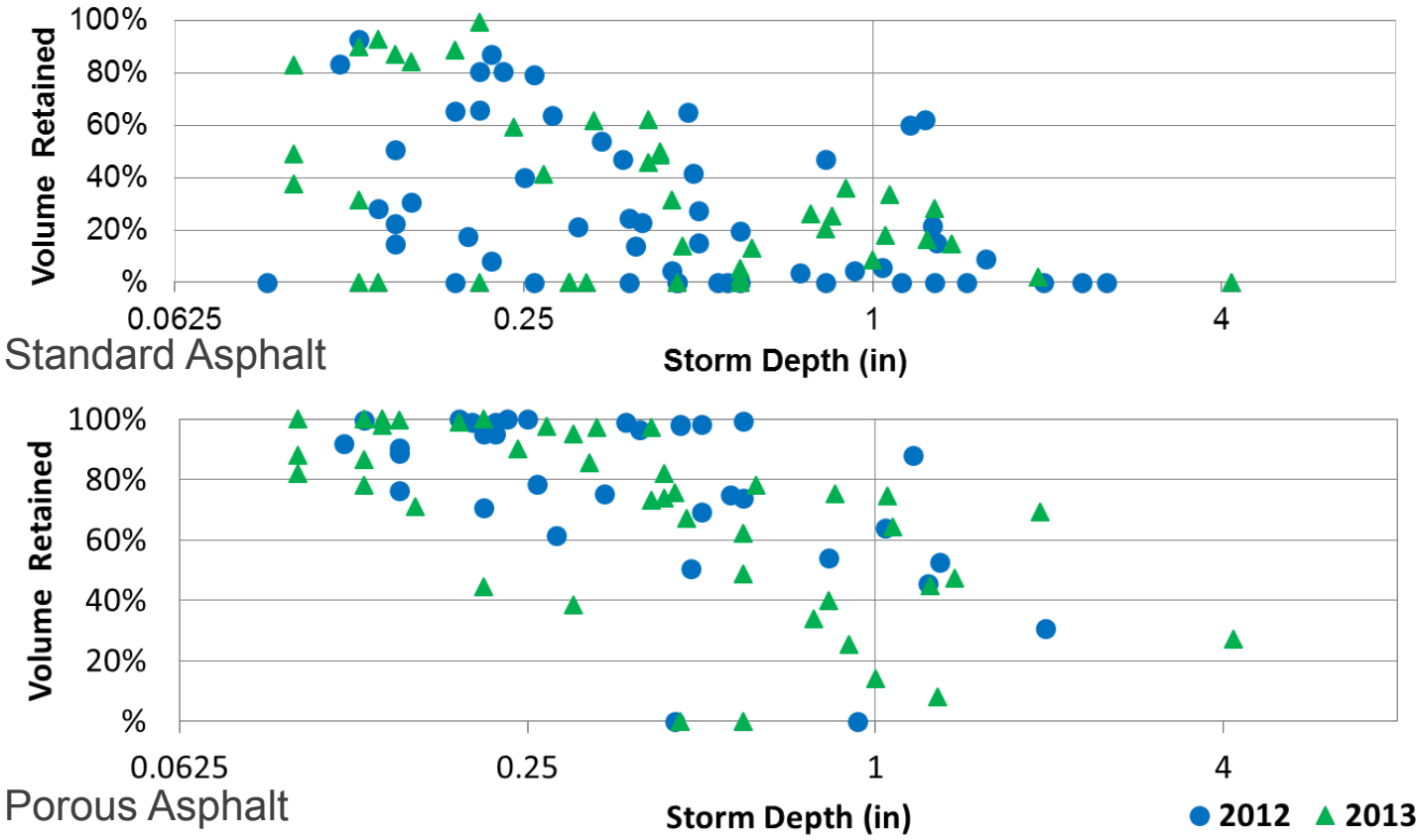


Perforated Pipes

Permeable Pavement

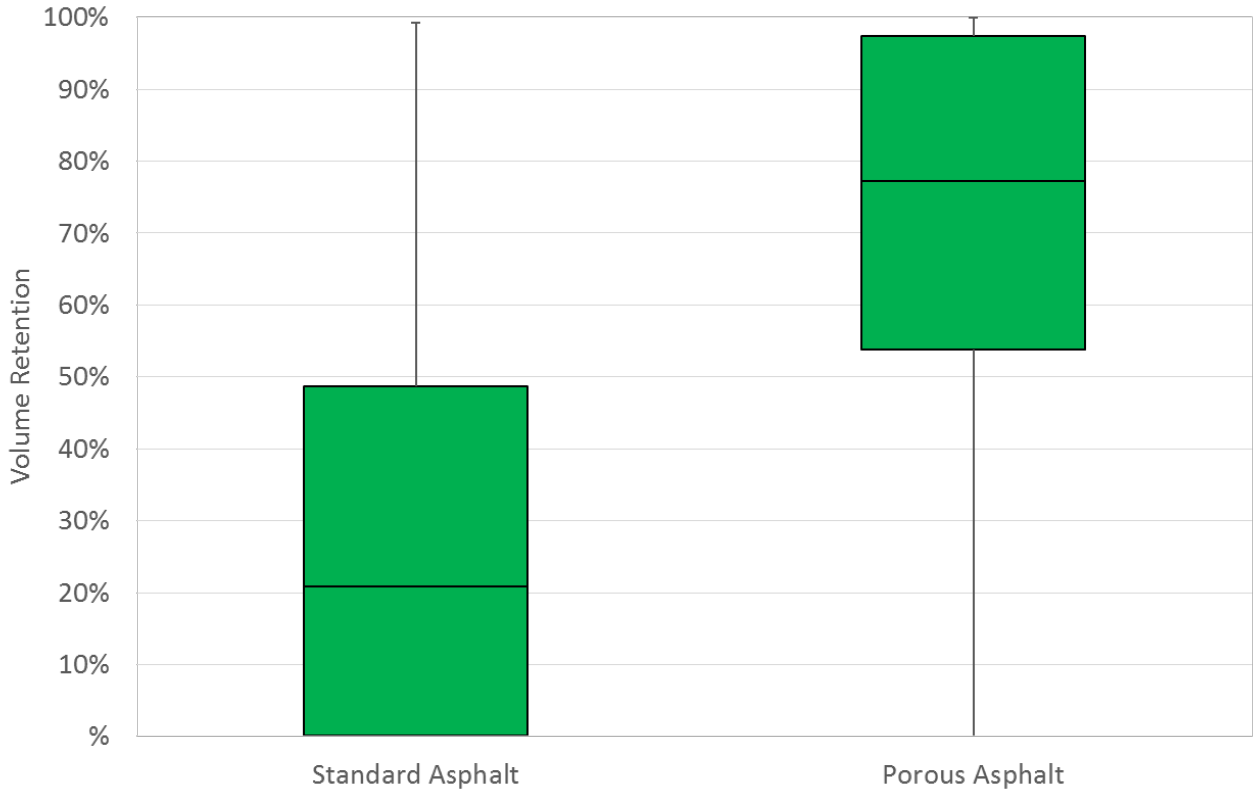
Permeable Pavement

Monitored Performance

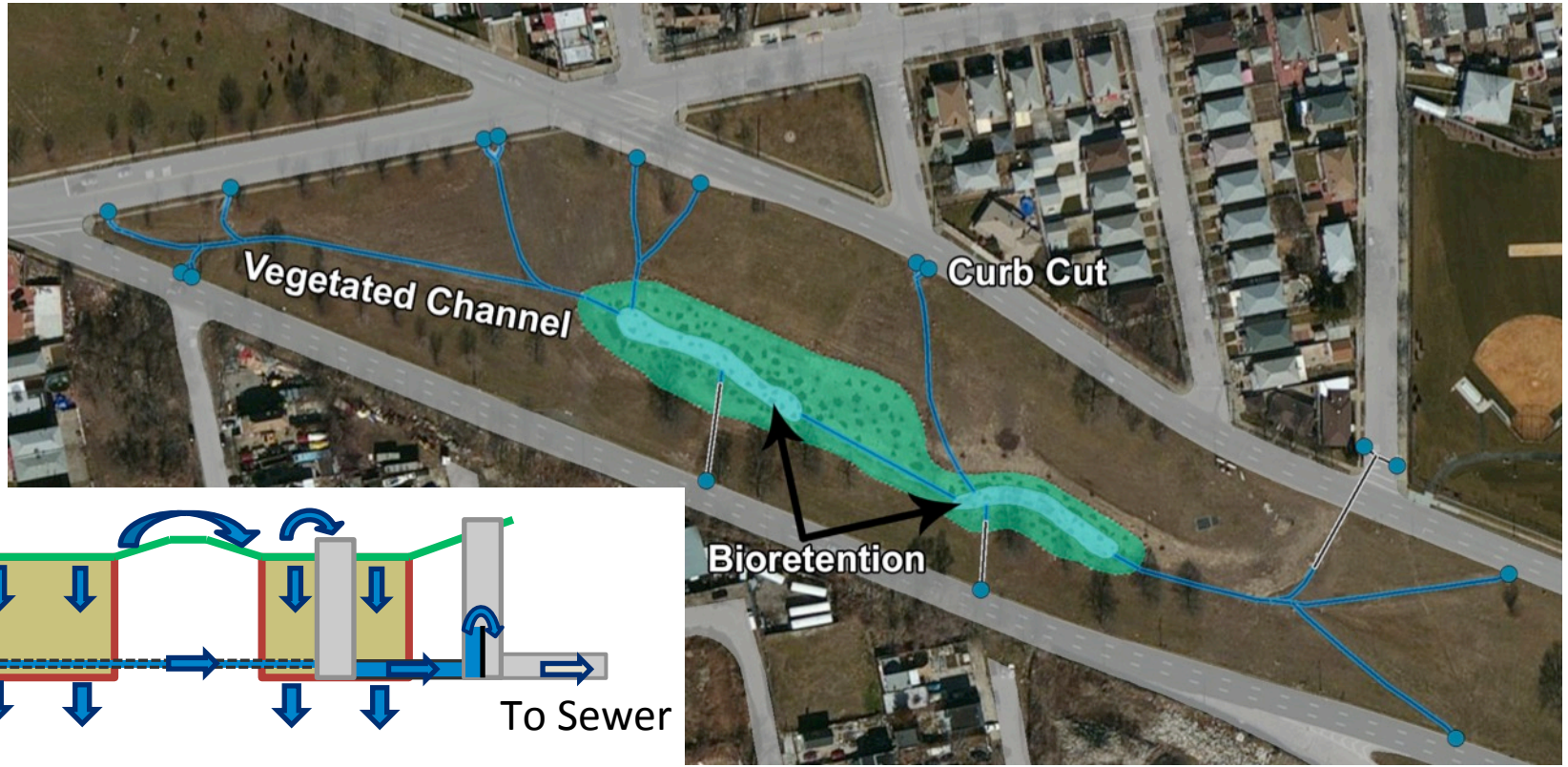


Permeable Pavement

Monitored Performance



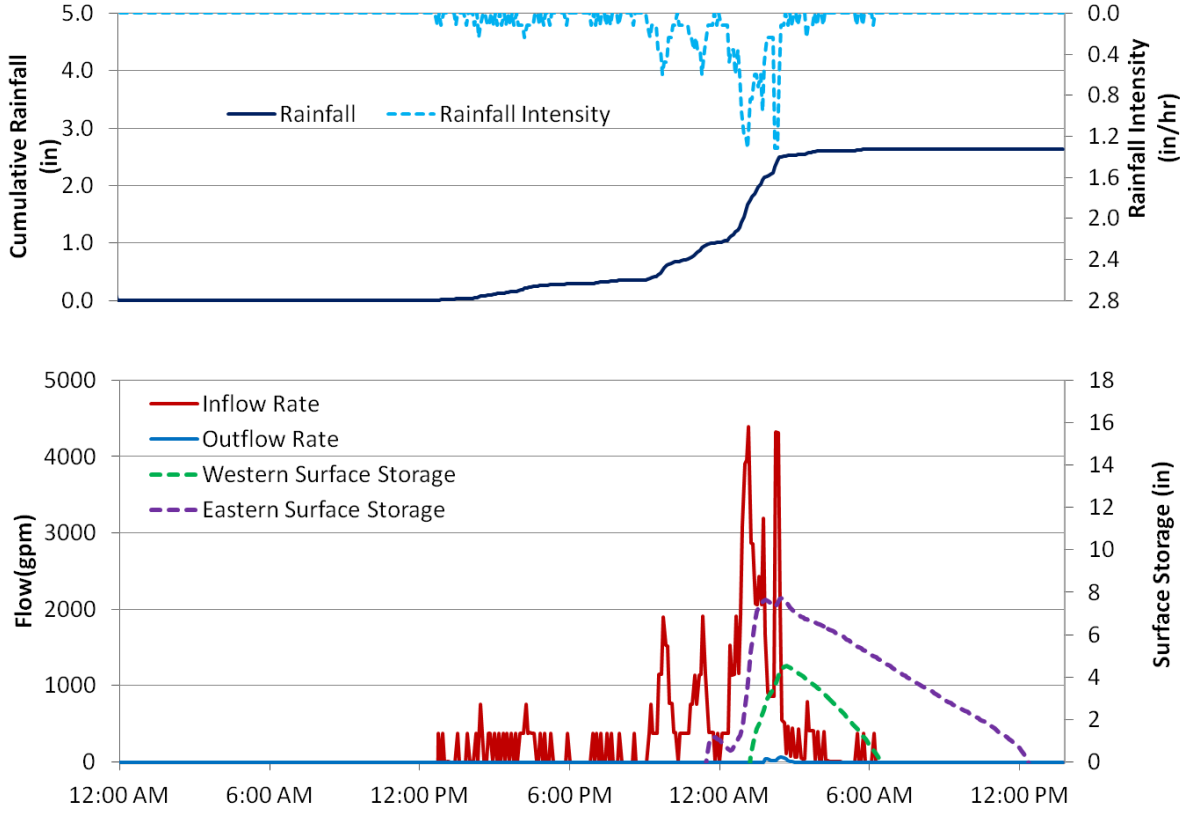
Roadway Median Bioretention



Roadway Median Bioretention

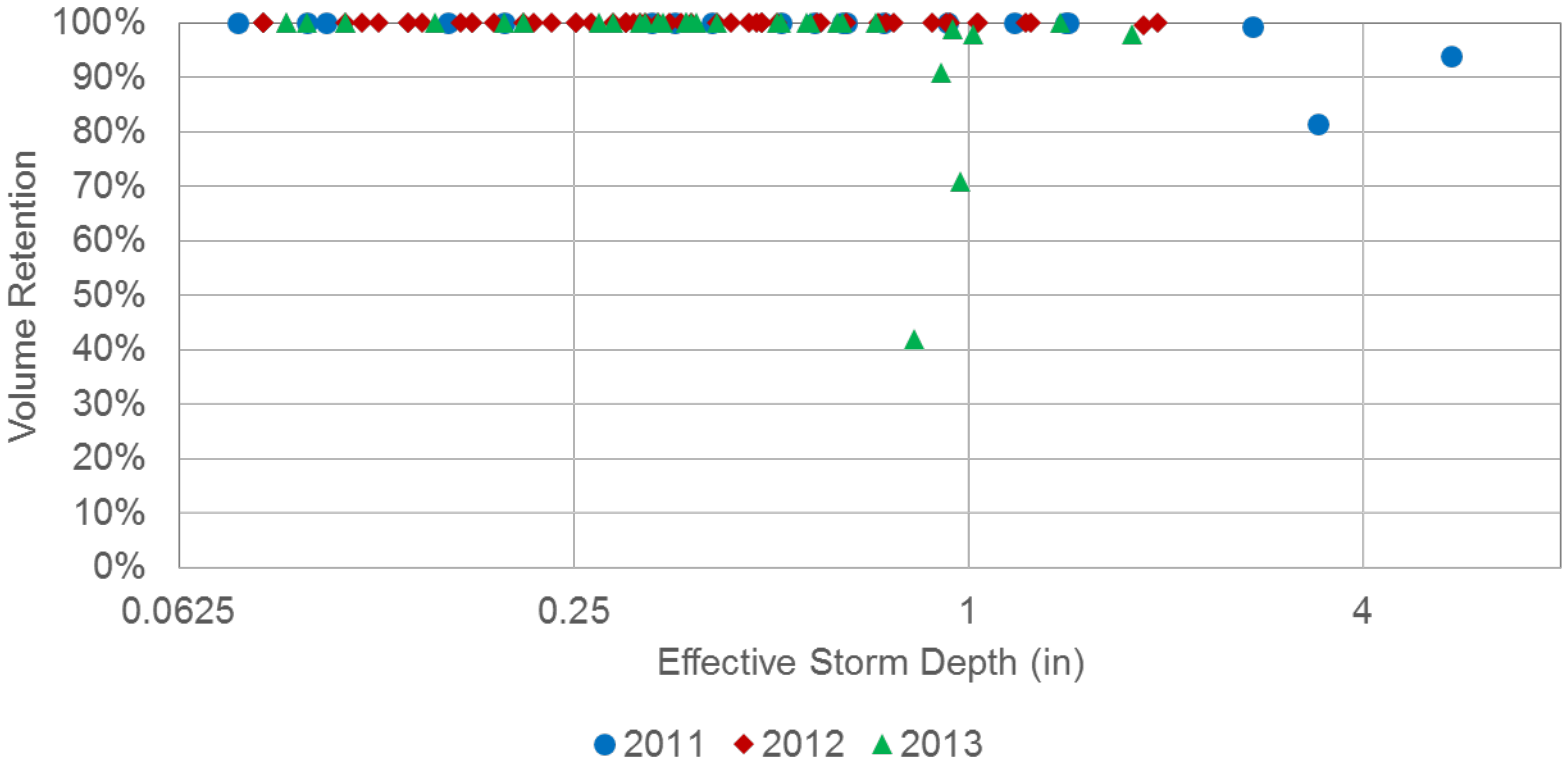
Median Bioretention

Example 2.6” Storm



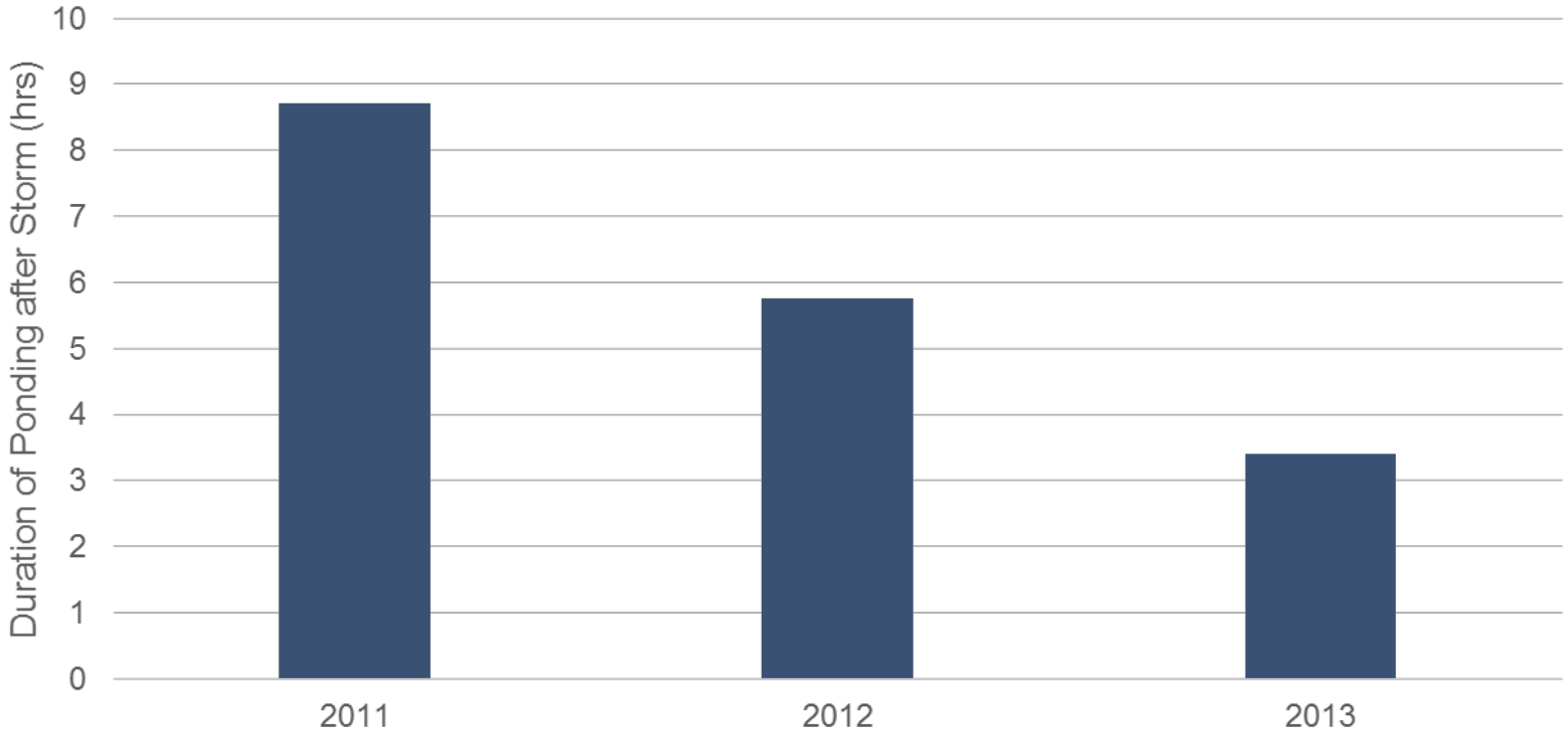
Roadway Median Bioretention

Retention Performance



Roadway Median Bioretention

Drawdown Performance



Co-Benefits Study Goals

Identify and quantify green infrastructure co-benefits

Conduct monitoring for co-benefits validation

Develop a tool to calculate, compare, and track co-benefits and triple bottom line costs

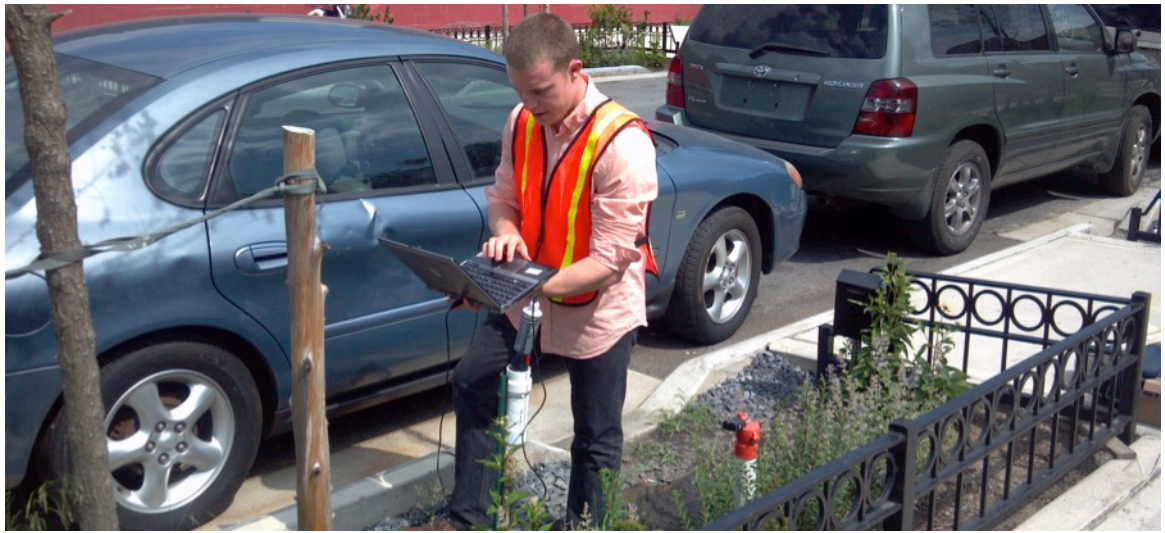
Field Monitoring

Temperature differences between control and green infrastructure

Pollinators, animal species, and bloom periods

Vegetative coverage and success of planting schemes

Soil investigations (nutrients, respiration, gasoline)



Field Monitoring Results

Temperature

GI surfaces generally cooler than nearby pavement

Cooler surfaces don't directly translate to cooler air temperatures

Vegetation

Substantial differences in vegetation performance

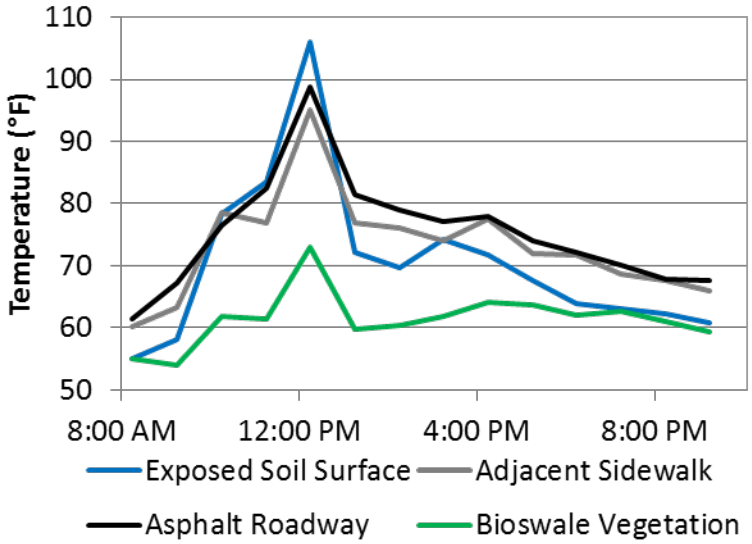
Pollinators

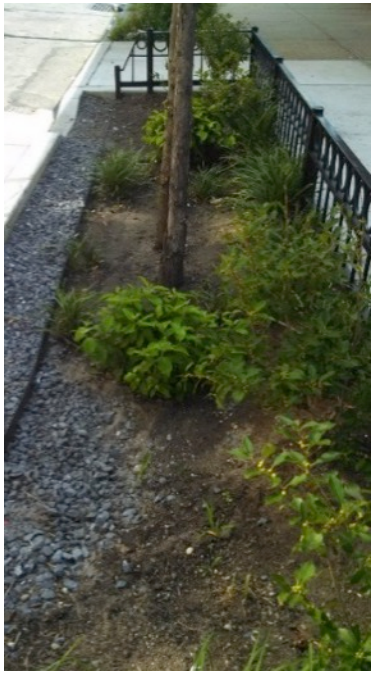
Confirmed presence even within isolated, highly urbanized areas

Green Infrastructure Soils

Higher levels of biological activity and some pollutant accumulation

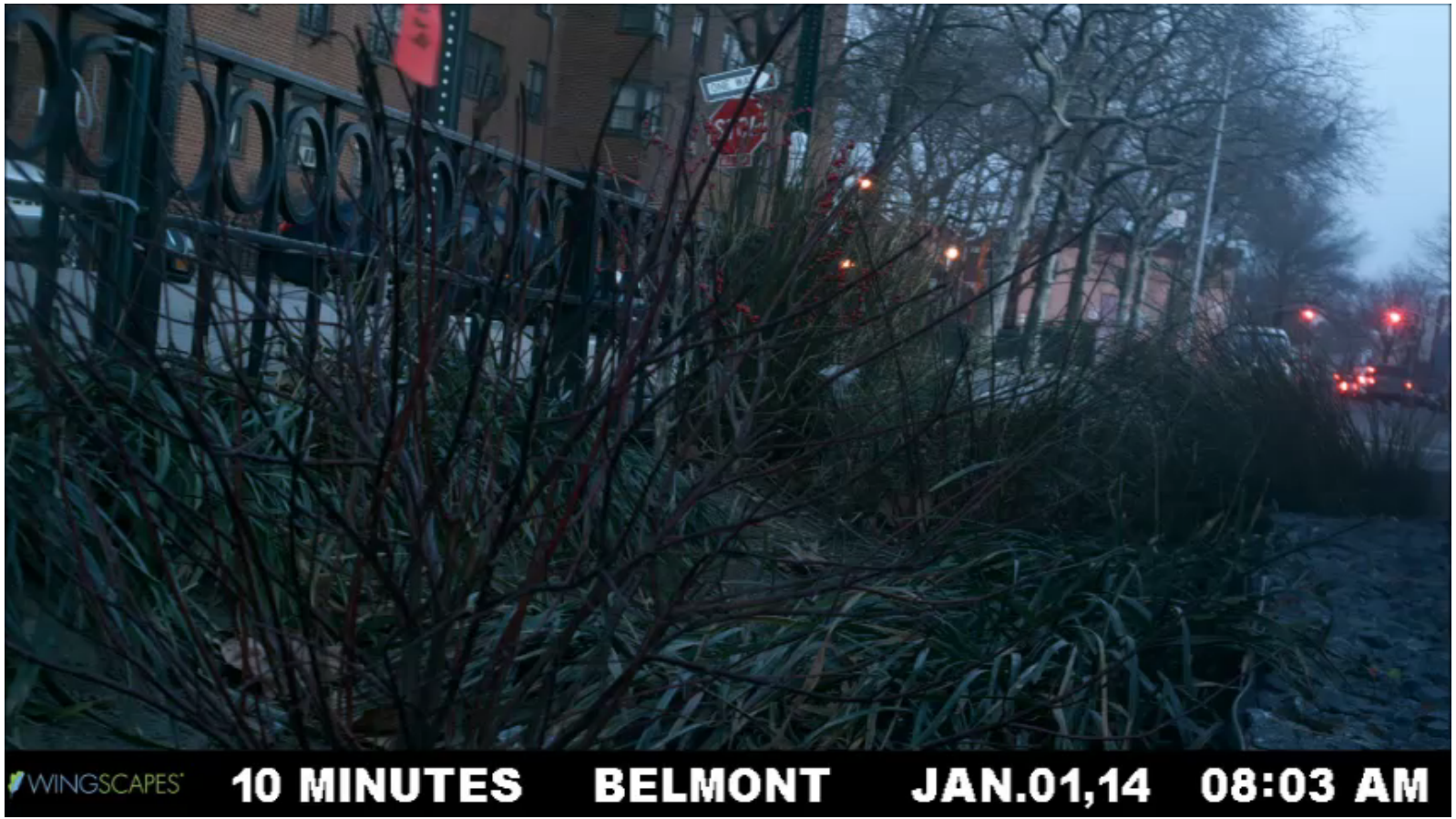
Monitoring Results



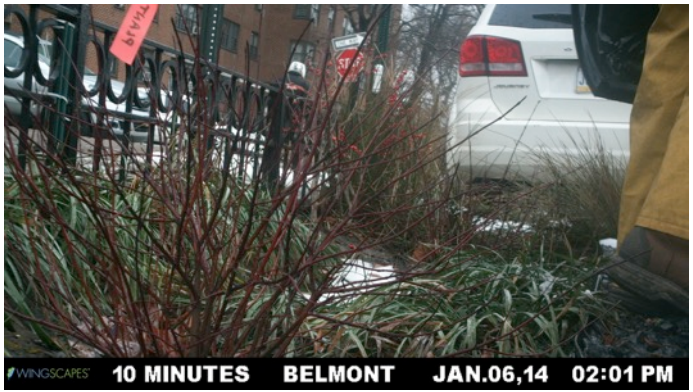


Bioswale Time Lapse

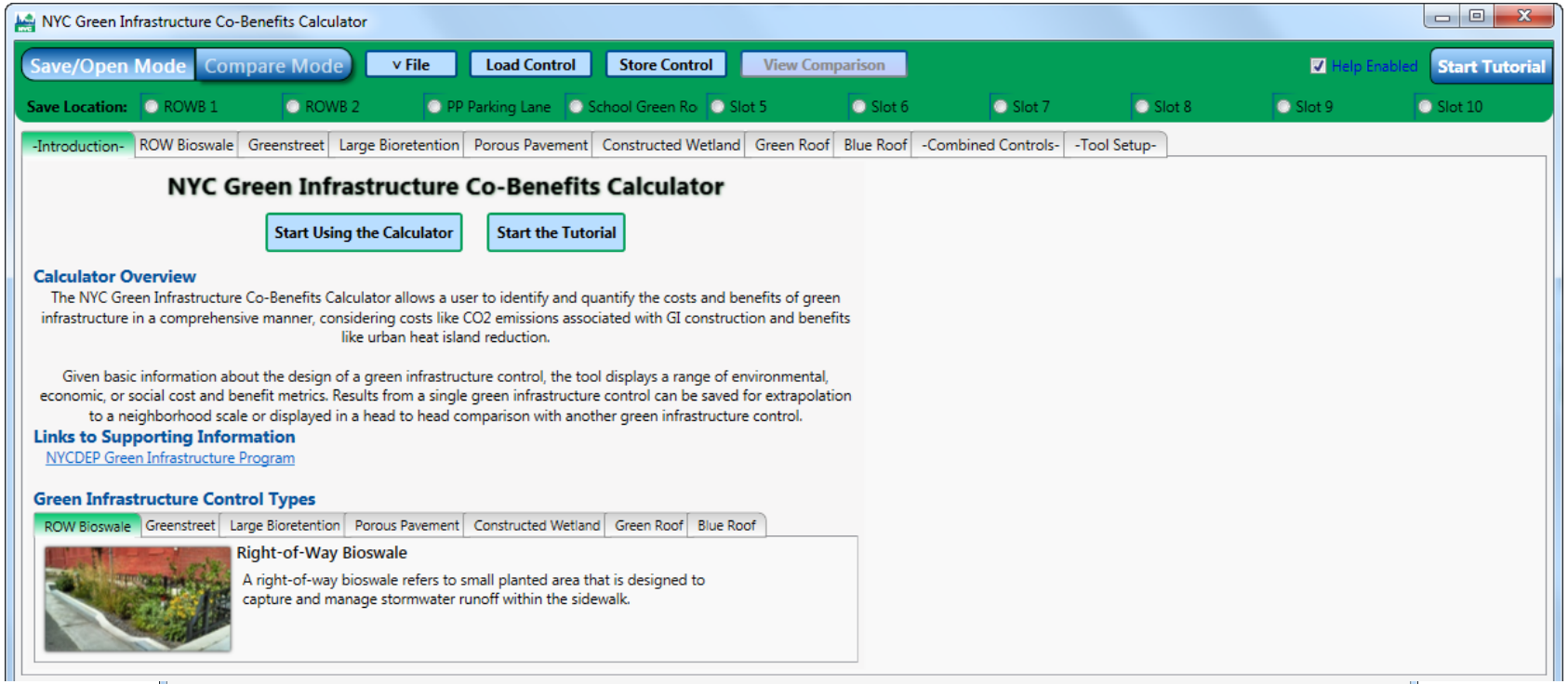
Bioretention and Snow



Bioretention and Snow

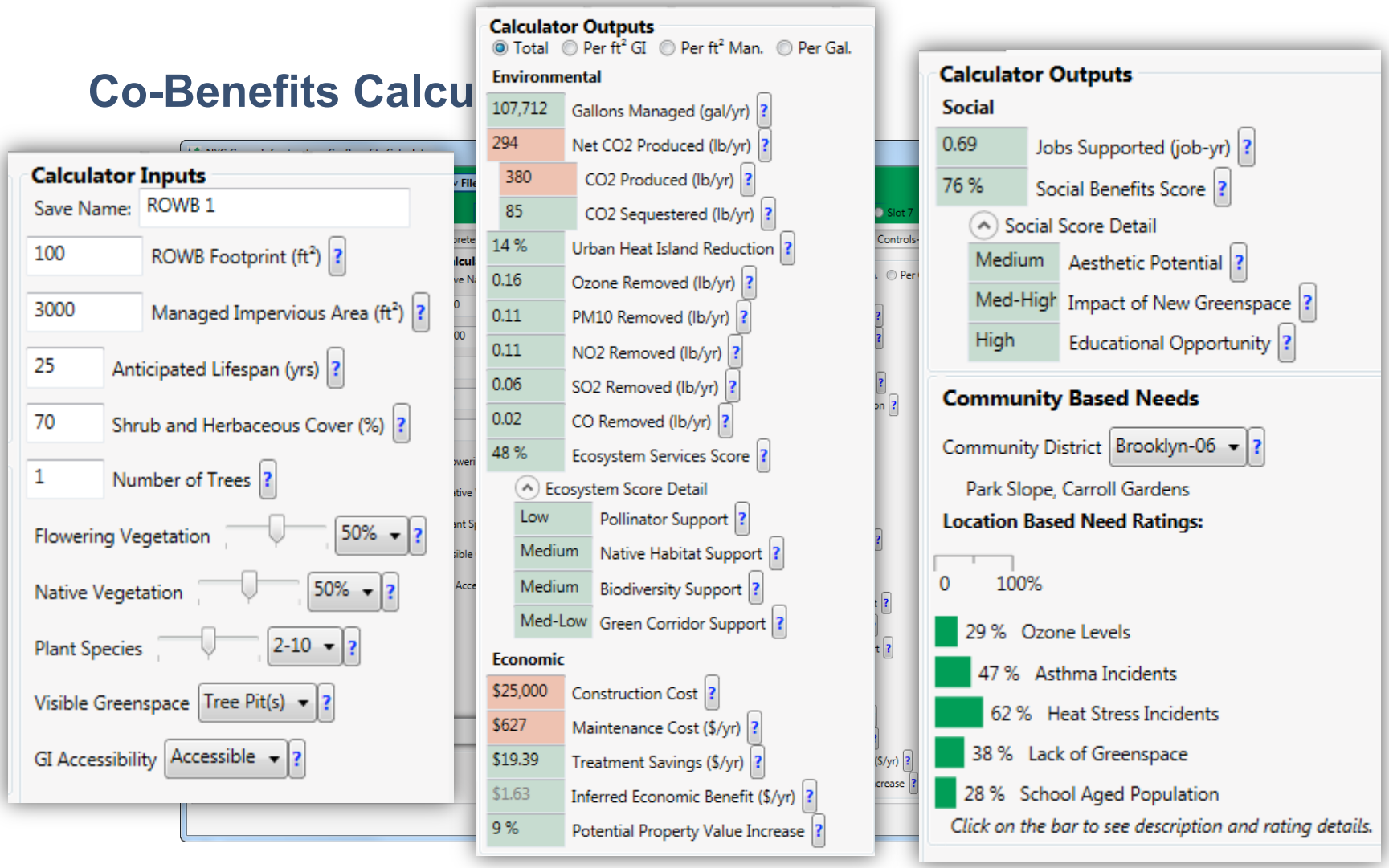


Co-Benefits Calculator



www.nycgicobenefits.net

Co-Benefits Calcu



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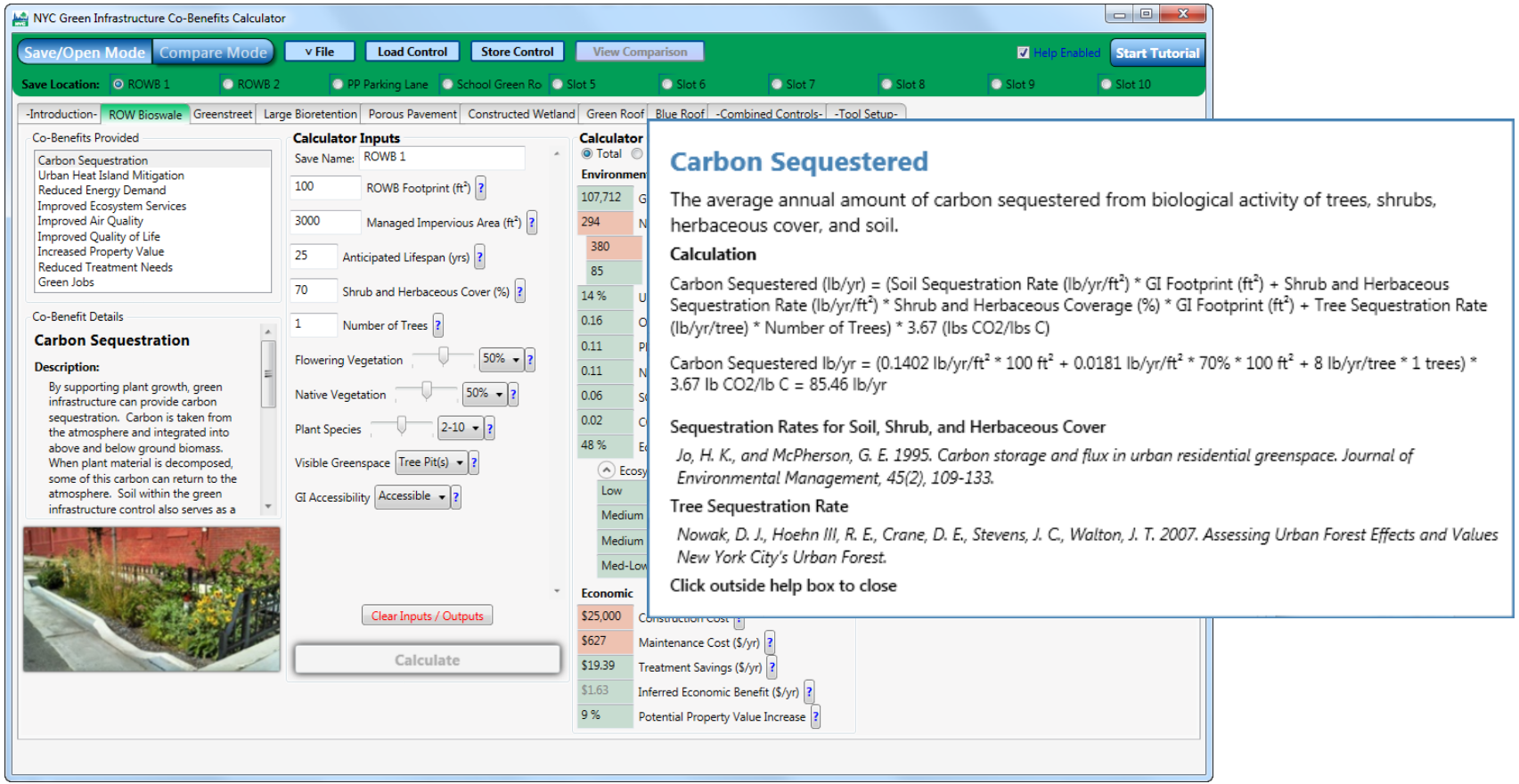

Carbon Sequestered

The average annual amount of carbon sequestered from biological activity of trees, shrubs, herbaceous cover, and soil.

Calculation

Carbon Sequestered (lb/yr) = (Soil Sequestration Rate (lb/yr/ft²) * GI Footprint (ft²) + Shrub and Herbaceous Sequestration Rate (lb/yr/ft²) * Shrub and Herbaceous Coverage (%) * GI Footprint (ft²) + Tree Sequestration Rate (lb/yr/tree) * Number of Trees) * 3.67 (lbs CO2/lbs C)

Carbon Sequestered lb/yr = (0.1402 lb/yr/ft² * 100 ft² + 0.0181 lb/yr/ft² * 70% * 100 ft² + 8 lb/yr/tree * 1 trees) * 3.67 lb CO2/lb C = 85.46 lb/yr

Sequestration Rates for Soil, Shrub, and Herbaceous Cover

Jo, H. K., and McPherson, G. E. 1995. Carbon storage and flux in urban residential greenspace. Journal of Environmental Management, 45(2), 109-133.

Tree Sequestration Rate

Nowak, D. J., Hoehn III, R. E., Crane, D. E., Stevens, J. C., Walton, J. T. 2007. Assessing Urban Forest Effects and Values New York City's Urban Forest.

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Green Infrastructure Implementation and Performance

Green infrastructure provides an array of tools to overcome stormwater challenges

Retention can be significant within the ultra-urban environment

Evidence that co-benefits are being realized

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