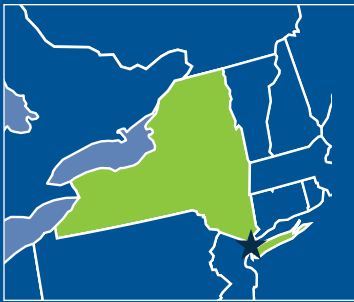


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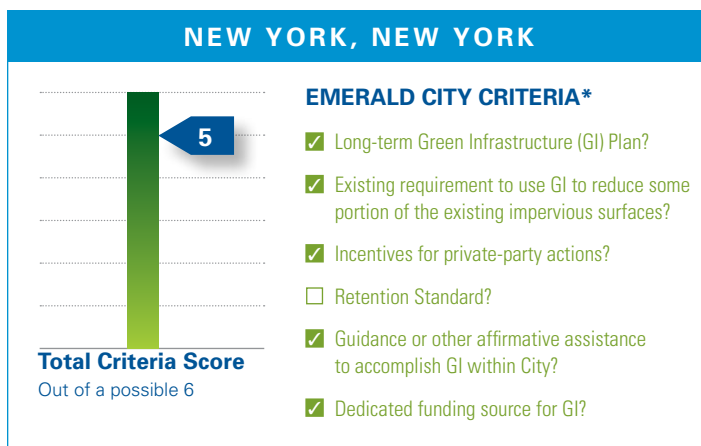
A CASE STUDY OF HOW GREEN INFRASTRUCTURE IS HELPING MANAGE URBAN STORMWATER CHALLENGES

TYPES OF GREEN INFRASTRUCTURE USED: Green roofs, blue roofs, rain barrels/cisterns, permeable pavement, vegetated swales, street trees



New York City, facing one of the nation’s largest sewage overflow problems, is rapidly developing one of the most extensive programs of public investment in green infrastructure in the United States. In its least densely developed areas, the city already makes significant use of constructed or restored wetlands for stormwater management. Elsewhere, the city has installed and is monitoring a range of demonstration projects in the public right-of-way and on developed properties, both publicly- and privately-owned. Guided by a new Green Infrastructure Plan, New York is expanding the use of green infrastructure

citywide, with an initial focus on greening municipal capital projects and implementing several neighborhood-scale demonstration projects. To encourage retrofits on private property, the city relies on incentives including a green roof tax credit, rain barrel giveaways, and a direct grant program. There is no runoff retention standard for new development and redevelopment projects. The city has proposed a draft stormwater management rule and accompanying technical guidelines that may create some incentives for runoff volume reduction but would not require it. The city funds its green infrastructure investments through bond financing and sewer rate revenues, supplemented by federal and other grants when available. A proposed new consent order with the state of New York includes binding near-term and long-term commitments to build green infrastructure to reduce CSOs, requiring a total anticipated investment of over \$1 billion. Further, the city is developing CSO Long Term Control Plans that will integrate planning for green and gray projects in individual watersheds; these may result in additional, cost-effective green infrastructure investments to help satisfy Clean Water Act requirements.



BACKGROUND

In New York City, one of the most densely developed cities in the nation, nearly three-quarters of the surface area is composed of impervious surfaces, such as streets, sidewalks, rooftops, and other paved spaces.¹ Half of the city’s total land area, representing about two-thirds of the city’s sewered areas, is served by a combined sewer system. The other half is served by municipal separate sewers or drains directly to local waterways.²

In dry weather an average of 1.3 billion gallons of sanitary sewage per day are channeled through more than 7,000 miles of sewers and treated at 14 wastewater treatment plants (WWTPs).³ In wet weather, however, as little as one-tenth of an inch of rain can overwhelm the combined sewer system, causing raw sewage from more than 400 outfalls to be dumped into virtually every waterway in the city—including



Porous concrete sidewalk Paerdegat Basin, CSO Detention Facility, Brooklyn, New York.



An enhanced tree pit on Autumn Avenue, Brooklyn, New York.

the iconic Hudson River and Long Island Sound; Jamaica Bay, home to the nation's only wildlife refuge accessible by subway; and the long-neglected Bronx River, which public-private partnerships have been working for years to revitalize.⁴

Over the past 20 years, the city has invested more than \$1.5 billion in CSO upgrades, including sewer, regulator, and pumping station improvements as well as four major storage tanks.⁵ The system now captures about 72 percent of the annual wet-weather flow, up from a mere 30 percent annually in the 1980s.⁶

Nonetheless, the city continues to discharge nearly 30 billion gallons of CSO annually,⁷ with overflows in some areas occurring up to 75 times in a typical year.⁸ Even as the city moves ahead with a new “comprehensive waterfront plan” aimed at bringing residents back to local waterways, this untreated sewage poses a threat to people who use, or wish to use, the rivers, creeks, bays, and other waters along the city's 600-plus miles of shoreline for recreation. Additionally, although the city's public beaches along the Atlantic Ocean and Long Island Sound are usually unaffected by CSOs because of their distance from combined sewer outfalls, many private beaches are severely affected, and polluted runoff from municipal separate storm sewers and/or CSOs triggers occasional closures and advisories each year at public beaches.⁹ Polluted runoff from the separately sewered portions of the city also causes localized water quality impairments in some places.¹⁰

Under a legal settlement with New York State, the city's Department of Environmental Protection (DEP), which operates the city's water, sewer, and wastewater systems, is currently developing Long Term Control Plans (LTCPs) to satisfy Clean Water Act requirements to reduce sewage overflows.¹¹ DEP has extensive experience using green infrastructure for stormwater management in its Staten Island “Bluebelt,” a series of restored open spaces, such as wetlands that serve as natural treatment and drainage

systems for stormwater runoff.¹² Between 1997 and 2007, DEP created 10,000 acres of Bluebelt, which saved the city an estimated \$80 million in infrastructure costs while increasing nearby property values and saving homeowners flood damage costs.¹³ However, in 2007, when DEP submitted a series of plans that serve as precursors to LTCPs, it became apparent that the city still viewed the more widespread use of green infrastructure in the more densely developed remainder of the city only as a subject for future study. Those plans relied entirely on traditional gray infrastructure for any quantifiable CSO volume reduction.¹⁴

Since that time, New York City—urged on by advocates and energized by the formation of a mayoral Office of Long-Term Planning and Sustainability—has undertaken substantial planning and outreach to identify, and begin to implement, more sustainable means of managing its water and sewer infrastructure. As described later, the city now anticipates, among other things, investing more than \$1 billion in green infrastructure over the next 20 years to achieve specific CSO reduction targets and advance overall sustainability goals.¹⁵

GREEN INFRASTRUCTURE AS A TOOL FOR LONG-TERM URBAN SUSTAINABILITY

In 2007, Mayor Michael Bloomberg announced a long-term sustainability plan for New York City, known as “PlaNYC 2030,” comprising more than 100 initiatives on a range of issues such as housing, open space, transportation, energy, climate change, and water quality. The main new water quality initiatives focused on using green infrastructure to capture stormwater and reduce sewer overflows. These included expanding the Bluebelt program by 4,000 acres within Staten Island over 25 years and applying the Bluebelt approach, where possible, in other low-density areas of the city; installing and monitoring several pilot projects, such as enhanced tree pits with below-grade water catchments



A green roof at Paerdegat Basin, CSO Detention Facility, Brooklyn, New York.

and vegetated swales along parkways; amending zoning rules to require planted areas as part of any new parking lots; and creating a property tax credit for the installation of green roofs.¹⁶

PlaNYC recognized the overlap between water quality initiatives and the city's parks and open space initiatives. For example, it noted that an ongoing program to plant 1 million new trees would also provide stormwater capture benefits, adding to the estimated 870 million gallons of stormwater that existing street trees capture each year. It also estimated that planted areas in new "Greenstreets" (vacant traffic islands and medians converted into green spaces) would create a further 4 million gallons of stormwater retention capacity.¹⁷

To further investigate green infrastructure opportunities, *PlaNYC* established an "Interagency Best Management Practices (BMP) Task Force," coordinated by the Mayor's Office of Long-Term Planning and Sustainability, to oversee pilot projects and identify practices and designs that are well suited to New York City's environment. The Task Force included many agencies that had not previously considered stormwater management a part of their mission, even though they are responsible for infrastructure or development that significantly affects storm runoff. In addition to DEP, the task force included the Departments of Design and Construction, Parks and Recreation, Sanitation, Transportation, Buildings, City Planning, and others.¹⁸

In 2008, as a complement to *PlaNYC*, the City Council passed detailed legislation requiring the city to develop a "sustainable stormwater management plan."¹⁹ Pursuant to that legislation, the mayor's sustainability office, working with the interagency BMP Task Force, issued a *Sustainable Stormwater Management Plan* that analyzed the city's land use patterns to identify green infrastructure potential; it also provided a preliminary analysis of the cost-effectiveness of various green infrastructure methods. This report identified substantial opportunities for using green stormwater infrastructure to reduce CSOs and established a green infrastructure agenda for the next several years that included, but also went beyond, the initiatives in *PlaNYC*.

GREEN INFRASTRUCTURE PROGRAMS UNDER WAY

The city has made significant progress with many of the initiatives set forth in *PlaNYC* and the Sustainable Stormwater Management Plan. In the last several years, city agencies have implemented (or planned) more than 30 green infrastructure demonstration projects and added 65 acres to the Bluebelt system on Staten Island while designing two new Bluebelt locations in Queens.²⁰ Through the state Environmental Facilities Corporation's Greening Innovation Grant Program,²¹ the city also secured \$2 million in federal stimulus funding to install at least 26 Greenstreets designed

specifically to maximize stormwater capture, and another \$15 million to restore 38 acres of wetlands and natural grasslands abutting Jamaica Bay, which will also serve to capture and filter stormwater.²²

While city agencies worked on implementing pilots, DEP focused on developing a comprehensive approach to substantial, long-term, citywide investment in green infrastructure. The result was the *NYC Green Infrastructure Plan*, released in September 2010. In the plan, the city proposed to use decentralized stormwater retention and detention measures to manage, on-site, runoff from at least 10 percent of the impervious surfaces in combined sewer watersheds. These decentralized measures would combine \$1.6 billion in public investment with \$900 million in private investment to reduce CSOs by an estimated 1.5 billion gallons. Most of the public investment (\$1.1 billion) would be in the public right-of-way, where the city would rely primarily on vegetated approaches to retain runoff. The city estimates that, over a 20-year period, new vegetated spaces created under this approach would generate between \$139 million and \$418 million in benefits through reduced energy bills, increased property values, improved health, and mitigation of carbon dioxide emissions.²³

DEP immediately began putting into place some of the elements of its proposed 20-year plan. It established a new Green Infrastructure Task Force in December 2010, composed of city agencies, to identify the best opportunities to systematically incorporate green infrastructure into capital projects on an ongoing basis, using DEP capital funds and other available funding. The Task Force is also developing approved specifications for green infrastructure techniques to streamline design and permitting processes.²⁴ By the end of 2012, the city plans to install more than 100 bioswales in combined-sewer areas and begin design on green infrastructure projects for public schools, New York Housing Authority (NYCHA) properties, and other publicly owned land.²⁵

The city has also used direct grants to stimulate innovation in green infrastructure, both on private property and in the public right-of-way. In two rounds of grant-making, DEP has provided more than \$6 million to nonprofit organizations, community groups, and private property owners for projects such as curbside bioswales, rain gardens, porous sidewalks and parking lots, and a number of green roofs, some of which will also serve as rooftop farms or gardens.²⁶

The city has adopted several new zoning requirements and incentive programs to promote green infrastructure on private property and in new developments. In 2008 the city adopted zoning rules to require new parking lots of more

than 6,000 square feet, or with 18 or more parking spaces, to incorporate perimeter and interior landscaping, with paved spaces graded to drain into the planted areas.²⁷ Further zoning code amendments require new developments in all districts to plant street trees and, in lower-density areas, install continuous planting strips along sidewalks; another amendment prohibits residential properties in lower-density districts from paving over their entire front yards for parking.²⁸

Within the past several years, city agencies have also developed design guidelines for public projects that promote green infrastructure principles. These include a Street Design Manual, High Performance Landscape Guidelines, and a Sustainable Urban Site Design Manual.^{29,30,31}

The City also instituted a pilot property tax credit of \$4.50 per square foot (up to a maximum of \$100,000) for installing a green roof. To qualify, property owners must green 50 percent of their total roof surface and commit to maintaining the green roof for at least three years.³²

DEP also gave away 2,000 rain barrels to homeowners in Brooklyn, Queens, the Bronx, and Staten Island from 2008 through 2011.³³

DEP established a green infrastructure advisory committee in February 2011 to help guide the agency's efforts. It meets quarterly and is composed of representatives from the development community, environmental and other nonprofit groups, academia, and design professionals.³⁴ Early next year the agency will convene a technical advisory group of independent experts to periodically review the city's green infrastructure efforts and offer recommendations based on performance results from pilot programs and recently installed projects.³⁵

LOOKING AHEAD: A 20-YEAR GREEN INFRASTRUCTURE PLAN FOR NYC

In October 2011, the DEP announced a proposed modification to its consent decree with New York State, which would modify existing gray infrastructure requirements and add new requirements to implement key aspects of the city's Green Infrastructure Plan. The proposed order eliminates some planned gray projects and substitutes certain others, which are projected to achieve comparable CSO volume reductions on a citywide basis, for a net savings of \$1.4 billion. It also defers until 2017 any decisions on two potential CSO detention tunnels, estimated to cost \$2 billion, to allow the city an opportunity to develop green alternatives that could substitute for, or allow the downsizing of, those projects.³⁶

Under the order, much of the savings on gray investments would be reinvested to meet new green infrastructure requirements. Debt payments and operations and maintenance costs are funded through water and sewer rate revenues. By 2013, the city would be required to retrofit three neighborhood-scale demonstration areas (18 to 40 acres each) with an array of green infrastructure installations, in order to measure the cumulative effect of intensive greening efforts. Citywide, by 2015, the order would set a target of managing the first inch of runoff from at least 1.5 percent of the impervious surfaces in combined sewer areas citywide, at an anticipated cost to the city of \$187 million. By 2016, the order would require the city to complete updated modeling analyses, using monitoring data from the three demonstration areas, to refine the Green Infrastructure Plan's estimates of CSO volume reductions associated with green infrastructure. Over the next 20 to 25 years, the city would be required to meet the Green Infrastructure Plan's target of managing the first inch of runoff from at least 10 percent of the impervious surfaces in combined sewer areas citywide—and to achieve corresponding CSO volume reductions. Finally, on a rolling basis through 2017, the order would require DEP to complete Long-Term Control Plans for each of the combined sewer areas within the city. These plans, subject to review and approval by the state, would specify any additional green and gray infrastructure improvements necessary to meet the Clean Water Act's water quality requirements, in each of the city's waterways, as well as a compliance schedule to implement such projects.^{37,38}

The DEP's capital program, including both gray and green projects, is primarily financed with bonds. (Stormwater rates are currently based on potable water usage; however, in 2010, DEP instituted a pilot program that bases fees on impervious area, specifically for parking lots.³⁹) DEP will also pursue other funding sources for green infrastructure, such as Clean Water Act State Revolving Fund monies and other federal funds, private funds, ecological restoration funding from the Army Corps of Engineers and other governmental partners, and other resource commitments from community and civic groups. As of September 2010, DEP was expecting to receive approximately \$30 million a year in the State Revolving Fund's Green Reserve, based on recent allocation levels.⁴⁰ DEP recently updated its Ten-Year Capital Plan to include \$735 million for its planned green infrastructure investments.⁴¹

DEP anticipates that over the next 20 years, the majority of impervious acreage to be retrofitted for on-site stormwater management will be on private property, where redevelopment projects will have to meet new performance standards that DEP is developing for the combined sewer portion of the city.⁴² For a half-acre property, the proposed

performance standard would reduce short-term (6-minute) peak discharges into the system by 80 to 90 percent, and would reduce longer-term (1-hour) peak discharges into the system by 20 to 50 percent.⁴³ However, the performance standard would limit the rate of release into the sewer system, rather than requiring any reduction in the volume of runoff through infiltration, evapotranspiration, or harvesting for reuse, as other cities require.⁴⁴ While this detention-based approach should help reduce CSOs by limiting peak wet-weather flows into the combined sewer system, the city's preliminary analysis indicates that it would achieve less CSO reduction than would be achieved if runoff volume reduction measures were installed across a comparable number of acres.⁴⁵ The city's intended approach would also fail to ensure the full range of benefits that genuinely green—i.e., vegetated—stormwater infrastructure provides, although the proposed rule provides property owners with the option to satisfy some portion of their compliance obligations with volume reduction techniques like green infrastructure. As this report goes to press, DEP is accepting comment on its draft regulation.⁴⁶

*EMERALD CITY RATING SYSTEM

Each of the cities profiled in *Rooftops to Rivers II* is a leader in green infrastructure investment—rethinking the design of municipal services and infrastructure. These cities leverage funding in creative ways. They provide tools to residential and commercial land owners to retrofit private properties and realize the multiple benefits provided by green infrastructure. In short, they are changing how cities look and function.

NRDC's Emerald City Rating System identifies six actions cities should undertake to maximize their green infrastructure investment. Our metric does not directly compare one city to another, due to geographical, population, budgetary and other differences. Instead, it identifies the presence or absence of common factors of success that NRDC believes are essential elements of a robust green infrastructure commitment. Only one city profiled, Philadelphia, is undertaking each of the actions identified, although each city is undertaking at least one.

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