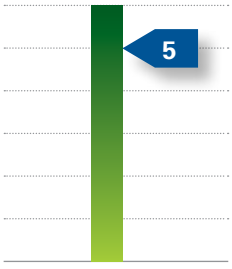
WASHINGTON, D.C.

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

TYPES OF GREEN INFRASTRUCTURE USED: Green roofs, rain barrels/cisterns, permeable pavement, rain gardens, street trees, downspout disconnection, green streets, vegetated swales

Thanks to its newly issued federal stormwater permit, Washington, D.C., has the makings of a very strong green infrastructure program. Containing a 1.2-inch retention standard for new development and redevelopment—to be achieved through evapotranspiration, infiltration, and harvesting—and numeric retrofit targets for street trees and green roofs, the permit will strongly encourage the use of green infrastructure on properties throughout the District. Washington's Department of the Environment is considering implementing the permit's retention standard through an innovative credit market that would be the first of its kind. Even prior to the new permit's issuance, D.C. agencies had begun a vigorous public education and assistance campaign, providing subsidies and technical help for the installation of a wide array of green infrastructure practices. A stormwater fee based on impervious area, along with a proposed discount program for on-site retention of runoff, provide an additional incentive for green infrastructure implementation.

WASHINGTON, D.C.



Total Criteria Score
Out of a possible 6

EMERALD CITY CRITERIA*

- ☐ Long-term Green Infrastructure (GI) Plan?
- ☑ Existing requirement to use GI to reduce some portion of the existing impervious surfaces?
- ☑ Incentives for private-party actions?
- ☑ Retention Standard?
- ☑ Guidance or other affirmative assistance to accomplish GI within City?
- ☑ Dedicated funding source for GI?

BACKGROUND

Washington, D.C., which is bordered by Virginia and Maryland, encompasses 61.4 square miles. It is located at the confluence of the Potomac and Anacostia Rivers and includes two other major streams, Rock Creek and Oxon Run. While 35 percent of the District's area is covered by tree canopy,[1] its rivers are significantly affected by urbanization. About 39 percent of the District was covered with impervious surfaces as of 2008, with the amount of imperviousness varying by neighborhood or ward from 30 to 60 percent.[2] Development and urbanization have taken a toll on the natural features within Washington; over the past 30 years, the District has lost 64 percent of its areas with heavy tree cover and experienced a 34 percent increase in stormwater runoff.[3]

The District of Columbia Water and Sewer Authority (D.C. Water), which was established in 1996, operates 1,800 miles of sanitary and combined sewers.[4] One-third of the city is served by a combined sewer system dating to the beginning of the 1900s and earlier. Today, an estimated 1.5 billion gallons of combined sewer overflows are discharged to the

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To help incentivize privately financed green roofs, Washington, D.C.'s Department of the Environment initiated a green roof subsidy program. The Department provides a rebate of $3 per square foot for installed green roofs; as a result, more than 50,000 square feet of green roof projects are under construction. The rebate has since grown to $5 per square foot.

Anacostia River, 850 million gallons into the Potomac, and 52 million gallons into Rock Creek each year.[5,6] The Anacostia River, which has 15 outfall locations and receives 60 percent of the CSO discharges, is one of the most polluted in the nation. In one study, 50 percent of brown bullhead catfish collected from the river had cancerous liver tumors, and approximately 25 percent had cancerous skin tumors.[7]

To correct the CSO problems, D.C. Water entered into a consent decree with the U.S. EPA in 2005 to build three huge tunnels over 15 years to hold combined stormwater and sewage during storm events, and then to slowly release the diluted sewage to the massive Blue Plains wastewater treatment plant after each storm subsides. Dubbed the Clean Rivers Project, the tunnels are now expected to cost the city $2.6 billion rather than the $1.9 billion reported in the 2006 *Rooftops to Rivers* report.[8]

While the city's existing CSO control plan focuses primarily on the deep tunnel system and partial sewer separation, it also recognizes to a limited extent the importance of incorporating green infrastructure within the city. The current Long Term Control Plan includes a provision for $3 million to fund low-impact-development retrofits at D.C. Water facilities.[9] D.C. Water has also conducted a rain barrel distribution pilot project. In addition, to meet its overarching water quality goals, the city and the District Department of the Environment (DDOE) have adopted the use of green infrastructure practices such as green roofs, rain barrels, rain gardens, "bayscaping" (landscape designed to help improve local streams and waterways within the Chesapeake Bay watershed), and pervious pavements to capture and slow stormwater before it hits the pipes,[10] with combined sewer overflows identified as one of multiple motivators for incorporating green infrastructure practices.[11] This includes funding for the D.C. Department of Transportation (DDOT) to plant more than 3,500 trees throughout the public right-of-way and to retrofit a major intersection in the city with green infrastructure.[12]

The portions of the city without a combined sewer system are served by a Municipal Separate Storm Sewer System (MS4) that collects stormwater runoff for direct discharge to Rock Creek and the Potomac and Anacostia Rivers. The District's existing MS4 permit, which went into effect in 2004 and was scheduled to end in 2009, was modified in 2007 to incorporate an aggressive schedule for implementing

pollution reduction technologies and policies throughout the District. Under a new MS4 permit finalized in October 2011, the city will be required to promote and install various green infrastructure practices such as tree plantings and green roofs with numeric goals attached to each. The MS4 permit also includes new performance standards requiring that the first 1.2 inches of stormwater be retained on-site for all new development and redevelopment over 5,000 square feet; the District is also required to retrofit 18 million square feet of impervious surfaces to meet this standard. The permit also requires a new monitoring strategy for compliance with Total Maximum Daily Loads (TMDLs) for impaired waterways, which include the Potomac and Anacostia rivers and Rock Creek.[13]

Several significant planning and green development studies have helped drive the implementation of green infrastructure. The Green Build-Out Model (GBOM) developed by Casey Trees and Limnotech demonstrates the benefits of green infrastructure on a citywide basis. The original GBOM applied a scenario of significant additions of green roofs and trees throughout the District to study the potential stormwater and CSO reductions. A moderate greening scenario, which involves increasing the tree cover from 35 to 40 percent by adding trees and green roofs where practical and reasonable to do so, would prevent more than 311 million gallons of stormwater from entering the sewer systems, reducing discharges to the river by 282 million gallons and reducing cumulative CSO frequency by 1.5 percent (16 fewer CSO discharges per year). In total, D.C. Water could expect to save $1.4 million to $5.1 million per year due to reduced pumping and treatment costs.[14] In April 2009 the District adopted an Urban Tree Canopy Goal of 40 percent by 2035.[15]

A subsequent Enhanced Green Build-Out Model, developed in 2009, added five more green practices: rain gardens, rain barrels, permeable pavement, and streetside and curb bump-out bioretention, to the green roofs and trees used in the original GBOM. These five additional modeled practices represent 107,500 individual retrofit practices deployed citywide. The Enhanced GBOM, assuming an average rainfall year and using an "intensive greening" scenario that applied all seven practices wherever physically possible, found that the enhanced model would prevent more than 4 billion gallons of stormwater each year from entering the sewer systems—a 26 percent annual runoff discharge reduction—including 2 billion gallons of reduced stormwater in the Anacostia watershed. The Enhanced GBOM also would reduce CSO discharges to the District's rivers by close to 1 billion gallons. This would be a 43 percent reduction in total annual CSO discharge volume and would reduce cumulative CSO frequency by 14.7 percent (162 fewer CSO discharges per year).[16]

The upshot is that Washington's water resource officials are working to establish green infrastructure as a significant solution to the District's water resource needs, to work in tandem with gray infrastructure projects. The Director of D.C. Water, George Hawkins, has noted that he hopes an aggressive greening of the District will curtail the need for future CSO tunnels planned for Rock Creek and the Potomac (while construction proceeds on the Anacostia tunnel).[17]

LOW-IMPACT DEVELOPMENT AT THE NAVY YARD ON THE ANACOSTIA RIVER

The Washington Navy Yard along the banks of the Anacostia River was included as one of the case studies in the original 2006 *Rooftops to Rivers* report. At that time, several significant green infrastructure pilot projects were being constructed at the Navy Yard. Since the release of the first *Rooftops to Rivers* report, many more projects have been constructed as parts of retrofits or as public works maintenance projects. This is primarily due to the Navy's Low Impact Development (LID) Policy, which was adopted in 2007, as well as the commitment of the base commander.[18]

The LID Policy, which affects both new construction projects in excess of $750,000 and renovation projects that cost more than $5 million at Navy and Marine bases across the country, required the incorporation of green infrastructure wherever possible in fiscal years 2008 to 2010, and full implementation in 2011 and thereafter.[19] New projects have included bioretention planter boxes, bioretention parking lot retrofits, and permeable paver areas. Monitoring of the initial pilot projects has shown these practices to be extremely effective at removing metals and reducing the volume of runoff.[20]

WASHINGTON'S GREEN ROOFS AND BUILDINGS

Washington's first commercial green roof was installed in 2004. The 3,500-square-foot green roof was a collaboration between two nonprofit organizations and the real estate company that owns the building. There have been several substantial privately and publicly funded green roof projects since then. For example, as part of a 2003 lawsuit settlement, D.C. Water provided more than $300,000 to the Chesapeake Bay Foundation to administer grants to design, install, and maintain green roof demonstration projects. More than 121,000 square feet of green roofs were constructed in connection with this effort, providing estimated annual stormwater retention of 1.8 million gallons.[21] One project that was funded in part from the settlement program was a 3,000–

square-foot green roof installed in 2006 at the headquarters of the American Society of Landscape Architects (ASLA). Subsequent monitoring over a 10-month period showed that the green roof was able to retain 75 percent of total rainfall.[22] Although pollutant concentrations have gone up, total pollutant loads have gone down because the volume of stormwater leaving the site has been greatly reduced.[23]

To help incentivize privately financed green roofs, in 2007 the District Department of the Environment (DDOE) initiated a green roof subsidy program offering a rebate of $3 per square foot, which resulted in the installation of 10 green roof projects totaling 50,137 square feet.[24] The rebate has since grown to $5 per square foot, with a maximum of 5,000 square feet for new development and no maximum for retrofits.[25] The District also administers grants that fund green infrastructure efforts by nonprofit groups and community organizations.

Through June 2010, approximately 1 million square feet of green roofs have been installed or approved for construction in the District.[26] Dr. Hamid Karimi, Deputy Director of the DDOE, noted in the spring of 2011 that "with more than 100 green roofs installed, the District is demonstrating how a model green city should look and perform."[27] DDOE Director Christophe Tulou has announced that D.C. will soon challenge Chicago's place as the top-ranking city for square footage of green roofs.[28] In addition to the grant and incentive programs described above, much of this success has been spurred on by several laws and programs promoting more sustainable development, including the Green Building Act of 2006,[29] the RiverSmart Homes program initiated in 2007 (and discussed below), and the Clean and Affordable Energy Act of 2008.[30] The Green Building Act of 2006 and subsequent amendments to the building code were particularly helpful in removing impediments to downspout disconnection and mandating green building practices that reduce urban heat island effects. The city is currently seeking to amend its zoning code to remove other impediments to green building practices by incorporating a Green Area Ratio (GAR) incentive for bonus density and land uses. The plan would provide a sliding scale of practices tailored to particular zones to reduce the amount of impervious area and encourage the use of green infrastructure techniques such as trees, permeable pavers, and green roofs.[31] In addition, the DDOT has released a Low Impact Development Action Plan, with associated deadlines for incorporating green infrastructure and reducing the amount of impervious surfaces in right-of-way construction projects.[32]

RIVERSMART HOMES

Another program initiated by DDOE in 2007 provides incentives to homeowners interested in reducing stormwater runoff from their properties. Known as RiverSmart Homes, the program provides outreach and education, design and construction assistance, materials and facilities, and incentives for communities, businesses, and homeowners. The program addresses some of the key roadblocks for implementation at the scale of the individual homeowner, including installation assistance so homeowners don't have to transport materials or find knowledgeable contractors, and assistance in negotiating the regulatory system for construction permits.[33]

To date, the RiverSmart Homes program has audited more than 1,500 homes in D.C., installed 1,000 rain barrels, planted 700 trees, replaced 25 impervious surfaces, and installed 100 rain gardens and 175 BayScapes.[34] This program includes using local vendors and contractors for designs and installations. Tree planting has been done in partnership with the Casey Trees Foundation, which provides training, inventory, and rebates for tree planting, as well as conducts its own tree planting efforts.[35] The District has also partnered with the Rock Creek Conservancy to reach out to homeowners for intensive greening of two target neighborhoods; as of 2011 the Conservancy's extensive and intensive outreach, including block meetings, has yielded requests by 40 percent of owners for a DDOE audit to determine whether their property was eligible for up to $5,000 in landscaping improvements.[36]

FINANCING STRATEGY

To cover the costs of stormwater management under the city's MS4 program and the federally mandated Long Term Control Plan, D.C. Water customers receive two charges on their utility bills. The stormwater fee, which is paid to the DDOE, was established in 2001; it was originally a flat fee to single-family residences and based on total water consumption for other customer classes.[37] In 2009, legislation was enacted to allow DDOE to assess stormwater fees based on impervious cover. The District's stormwater fee is structured to generate approximately $13.2 million annually. This revenue total addresses only the costs of the Stormwater Management Program required by the current MS4 permit. The costs of achieving compliance with the District's Total Maximum Daily Load (TMDL) requirements and of addressing stormwater runoff impacts in general are likely to be orders of magnitude greater.[38] The Impervious

Area Charge (IAC), also implemented in 2009, is paid to D.C. Water to recover costs related to the CSO Clean Rivers Project. All District property owners pay both fees.

By basing both the stormwater fee and the IAC on impervious surfaces, the intent was to shift costs from multifamily residential properties, such as apartment buildings, which typically have relatively small amounts of impervious area but consume larger amounts of water, to properties that generate larger volumes of stormwater runoff, such as large office complexes and parking lots. For the stormwater fee, this also served to increase the federal government's burden from 15 to 24 percent of the total revenue collected.[39] Basing the fees on imperviousness creates a market incentive for new development to pave less and for existing buildings to retrofit paved areas with greener stormwater management practices. To further incentivize practices that reduce stormwater runoff, the District is also developing a Stormwater Fee Discount Program for properties that install stormwater retention practices,[40] and is considering revising its stormwater regulations to promote an innovative stormwater credit market that DDOE hopes will encourage the use of green infrastructure.[41]

Other grants and incentives for property owners to install green infrastructure on District, residential, and commercial buildings include subsidy programs for the installation of rain barrels, shade trees, rain gardens, and pervious pavers, as well as energy efficiency programs for homeowners, nonprofits, small businesses, and condominiums.[42] In 2010, DDOE also gained access to a new source of revenue through the District's disposable bag fee. This fee, enacted by the Anacostia River Clean Up and Protection Act of 2009, places a five-cent fee on disposable plastic and paper bags provided by any District retailer selling food or alcohol. Revenue generated by this fee is directed to a special-purpose fund dedicated to activities to clean up and protect the Anacostia River and other impaired waterways. Revenue projections from the bag fee are difficult to make; the District expects that over time the fee will discourage consumers from using disposable bags, resulting in a gradual decrease in revenue. Between January 2010 (when the bag fee went into effect) and January 2011, the District collected $2 million in revenue from the fee, and bag use dropped from 270 million bags in 2009 to 55 million bags in 2010.[43]

*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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