

New Jersey Green Streets



Case Studies August 2020



About

We all consume water and create waste, but seldom think about the underlying pipes, sewers, and utilities that sustain our water usage. Our lives depend upon clean drinking water, and robust wastewater and stormwater infrastructure systems support local economies, create strong communities, and protect our environment.

Green infrastructure is one solution many communities are employing to maximize community benefits including reduced flooding and improved water quality, local economies, community health and long-term resilience. Specifically, green streets are an effective solution to tackle both water and transportation infrastructure issues. These case studies profile how three New Jersey communities—Hoboken, Highland Park, and Camden—planned and implemented green streets to achieve these multiple benefits.

Acknowledgements:

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The Green Streets subcommittee includes the following members: past co-chair, Russ Dudley; project leaders: Russ Dudley and Maureen Krudner; and members: Rosana Da Silva, Jennifer Duckworth, Lia Mastropolo, Kandyce Perry, Rob Pirani, Jess Seamon, Sonia Szczesna, Leigh Ann Von Hagen, Linda Weber, Louise Wilson.

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About Jersey Water Works:

Jersey Water Works is a collaborative effort of many diverse organizations and individuals who embrace the common purpose of transforming New Jersey's inadequate water infrastructure by investing in sustainable, cost-effective solutions that provide communities with clean water and waterways; healthier, safer neighborhoods; local jobs; flood and climate resilience; and economic growth.

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Introduction

How can you manage stormwater in your community's streets while improving resiliency? Consider green streets—the effective use of green infrastructure within the public right-of-way to capture and treat stormwater runoff from impervious surfaces (such as roadways and sidewalks) while keeping streets accessible to all users. Green streets can help New Jersey communities become more resilient as they face increasingly frequent, long, and intense storm events.

Forward-thinking municipal planners, engineers, and designers are evaluating the use of green infrastructure in transportation improvement projects to manage stormwater while preserving the primary function of streets: accommodating the movement of motor vehicles, pedestrians, bicyclists, and transit riders.

Traditional vs. Green Streets

In most communities, traditional streets are a significant contributor to stormwater runoff. A traditional street is designed to direct untreated stormwater runoff from impervious surfaces into storm sewer systems (gutters, drains, pipes) that discharge directly to surface waters such as rivers and streams.

A green street, in contrast, is designed to capture stormwater at its source to reduce its impact on the storm and combined sewer system, reduce flooding from storm events, and improve water quality by removing pollutants from captured stormwater.

Complete Streets Are Green Streets

Green streets are an integral design element of complete streets—streets that are designed to be safe and convenient for people of all ages, abilities, and transportation modes. Green streets reduce localized flooding, which creates barriers to mobility and accessibility for the traveling public. Green streets can incorporate green infrastructure in traffic calming measures to slow vehicle speeds and make streets safer for people walking and bicycling. Green streets also incorporate green spaces that are aesthetically pleasing to pedestrians and cyclists and provide shade and noise buffering.

What Is Green Infrastructure?

Green infrastructure is a set of stormwater management practices designed to capture and treat stormwater. Design elements of green infrastructure can include street trees, porous pavements, rain gardens or bioretention systems (see Figure 2), vegetative curb areas, and swales. These green features protect, restore, and mimic the natural water cycle. Instead of allowing untreated stormwater to run off from hard surfaces such as roadways, sidewalks, parking lots, and rooftops, green infrastructure captures stormwater runoff. The runoff can then soak into the ground, evaporate into the air, be reused as a resource, or be stored and slowly released into the storm sewer system.

As of 2019, 151 municipalities in New Jersey have adopted complete streets policies,¹ but most have not incorporated green streets language or requirements into their policies. Municipalities can enhance their roadways by incorporating green streets practices into their complete streets designs. To learn more about how to incorporate green streets into your complete streets policy, see the New Jersey Department of Transportation's (NJDOT's) [Complete & Green Streets for All: Model Policy & Guide](#), a one-stop resource for New Jersey municipalities, counties, agencies, organizations, and advocates interested in implementing complete streets in their communities (see Figure 1). The [New Jersey Green Infrastructure Municipal Toolkit](#) is another resource to learn more about green infrastructure.

Benefits of Green Streets

Green streets can **help meet regulatory requirements** for stormwater management, including:

- New Jersey's new development or redevelopment requirements.²
- Municipal separate storm sewer system permit requirements.
- Combined sewer overflow or sanitary sewer overflow permit requirements.
- New Jersey's amended [stormwater management rule](#), which requires that green infrastructure be used to meet the rule's performance standards.

Green streets can provide important **environmental and public health benefits**, such as:

- Reducing flooding in streets.
- Reducing combined sewage flooding in homes, streets, and parks, as well as combined sewage overflows into rivers and streams.
- Replenishing groundwater.
- Improving water and air quality.
- Decreasing energy demand and cooling costs by reducing the urban heat island effect.
- Reducing stress for drivers.
- Increasing streets' walkability and bikeability.

¹<http://njbikeped.org/complete-streets-2/>

² New Jersey's Stormwater Management Rules (New Jersey Administrative Code 7:8) require stormwater treatment for groundwater recharge, removal of total suspended solids and other pollutants, and reduction in peak flows caused by development. These requirements depend on classification of a project as new, major development.



Figure 1. NJDOT Complete and Green Streets for All: Model Complete Streets Policy & Guide.



Figure 2. Rain gardens and curb bump-outs are often used together in urban settings. The curb bump-out leaves enough space for a rain garden while also improving pedestrian safety at busy street crossings.

Green streets can also provide **social and economic benefits**, such as:

- Calming traffic.
- Improving pedestrian and bicycle safety.
- Enhancing neighborhood aesthetics and livability.
- Reducing the strain on traditional gray stormwater infrastructure by decreasing the amount of stormwater that flows through the storm sewer system.

Finally, green streets can **increase the effectiveness of municipal dollars spent**. By adding green streets designs into roadway improvement projects, municipal planners, engineers, and designers in New Jersey can:

- Introduce additional functionality with road improvement projects (e.g., flood mitigation and traffic calming).
- Improve applications for NJDOT local aid grant program funding.

The following sections present case studies showing how three New Jersey communities—Hoboken, Highland Park, and Camden—planned and implemented green streets to achieve some of the benefits described above.

Learn More About Green Streets

U.S. Environmental Protection Agency Green Street, Green Jobs, Green Towns (G3) Program, [Learn About Green Streets](#)

National Association of City Transportation Officials (NACTO), [Urban Street Stormwater Guide](#)

Hoboken, New Jersey: Washington Street Improvements

Hoboken is a densely populated city located directly on the Hudson River. It encompasses 1 square mile and is home to 54,000 residents. Approximately 70 percent of the city is located within a FEMA Special Flood Hazard Area that is vulnerable to localized stormwater flooding from rainfall events and coastal flooding from storm surge and high tides. Combined sewer infrastructure, a high percentage of impervious cover in the city, and increasing intensity and severity of storm events exacerbates stormwater flooding.³

The city conducted a sustainability survey in 2013 and found that flooding was the issue of greatest concern to respondents, with 89 percent indicating that they were concerned or very concerned about flooding. Respondents identified stormwater management as a top priority for making Hoboken resilient and sustainable.¹

To address concerns about flooding from stormwater runoff, the city incorporated green streets elements into a redesign of Washington Street, Hoboken's "main street."

Project Overview and Goals

In 2013, the city embarked on a \$17 million project to rehabilitate Washington Street by addressing pedestrian and vehicle safety issues, upgrading infrastructure, better accommodating all types of transportation modes, and increasing foot traffic for small businesses along the street. At the outset of this project, the city decided to incorporate green streets strategies to reduce the impact of stormwater runoff on low-lying areas to the west that are prone to flooding. The redesign included replacing damaged and missing street trees, improving street tree pit designs, and incorporating rain gardens at street corners with expanded street tree pits.

The city installed 15 rain gardens along Washington Street (see Figure 3) at several intersections between 3rd Street and 12th Street. In addition to capturing stormwater runoff, the rain gardens beautify Washington Street, and the curb bump-outs that contain the rain gardens provide the added benefits of calming traffic and shortening the crosswalk to improve pedestrian safety.



Figure 3. A rain garden installed along Washington Street.

³ Hoboken Green Infrastructure Strategic Plan, October 2013, <http://www.hobokennj.org/docs/communitydev/Hoboken-Green-Infrastructure-Strategic-Plan.pdf>

Design and Installation

To prepare the conceptual design for the Washington Street improvements, Hoboken partnered with a planning consultant, RBA Group. The city and RBA Group held a series of public meetings to provide information about the proposed redesign and to gather feedback from residents. They incorporated this feedback into the conceptual design and finalized the design in late 2014.⁴

With the conceptual design complete, the city partnered with a design engineering firm, T&M Associates, to complete the engineering design for the improvements. Several city departments participated in the design process, including the Departments of Transportation and Parking, Environmental Services, and Administration. City staff and the design engineer worked together to develop a feasibility study and conduct soil borings to determine the best strategy for stormwater management. They used this information to design the rain gardens.

The city designed the rain gardens to capture stormwater runoff from Washington Street and allow it to infiltrate into the groundwater below, diverting the stormwater from the city's storm infrastructure and providing water quality benefits and groundwater supply recharge. The city sized most of the rain gardens to handle 500 to 700 cubic feet (3,700 to 5,200 gallons) of stormwater runoff per storm event, and two larger rain gardens to infiltrate 1,500 cubic feet and 3,500 cubic feet (11,000 and 26,000 gallons), respectively, of stormwater per storm event. The city added underground storage tanks to the rain gardens where space was available to store additional runoff. The city also installed monitoring devices in some of the rain gardens to measure the amount of stormwater treated.

After completing the engineering design in 2016, the city began constructing the street improvements from Observer Highway to 15th Street and installed the last of the 15 rain gardens in 2019.

Funding

Construction costs for the rain gardens were \$30,000 to \$50,000 each, depending on size, so funding was an important consideration for the city's goal of turning Washington Street into a green street. Hoboken used the multiple benefits provided by the redesign project—from pedestrian safety to transportation and water infrastructure improvements—to apply for several grants and loans:

- A grant from the New Jersey Division of Highway Traffic Safety's Pedestrian Safety, Enforcement and Education Fund.
- A Transportation Investment Generating Economic Recovery (TIGER) grant (now known as the Better Utilizing Investments to Leverage Development [BUILD] grant) from the U.S. Department of Transportation.
- A long-term, low-interest loan from the New Jersey Infrastructure Bank's clean water and drinking water state revolving loan funds.
- Municipal bonds.

⁴ Washington Street Complete Street Redesign. Available at <http://www.hobokennj.org/washingtonstreet/files/washington-street-final-plan.pdf>

Hoboken’s Chief Sustainability Officer noted that the many benefits of the Washington Street improvements allowed the city to tap into a wide range of funding options, saving Hoboken millions of dollars in financing costs.

The city currently uses its annual operating budget to fund maintenance of the green streets and is considering forming a stormwater utility to provide dedicated funding for maintenance tasks in the future.

Challenges Faced and Benefits Realized

Building Public Support

A significant challenge to implementing green streets for many municipalities is public perception. The city of Hoboken took a proactive approach from the outset of the project to educate residents and address their concerns. The city and its planning consultant held town hall meetings to listen to concerns and gather feedback from residents, explain the benefits of the redesign, and discuss design alternatives—addressing issues such as the possibility of increased traffic due to loss of lanes and bicyclist concerns about the bike path. The city also held a town meeting to show the finalized conceptual plan.

Maintenance Challenges

The city installed green infrastructure before the Washington Street improvements but encountered challenges with training seasonal personnel on maintenance tasks. Drawing on lessons learned from these earlier projects, Hoboken created landscape management specifications for green infrastructure maintenance. The city used these specifications to publicly procure a landscape contractor to maintain green infrastructure installations city-wide, including those along Washington Street. The contractor also inspects the rain gardens after each 1-inch storm, in accordance with New Jersey Department of Environmental Protection regulations.

During the design process, a certified landscape architect selected plants for the Washington Street rain gardens to address issues with plant survival. The landscape architect used the New Jersey Stormwater Best Management Practices Manual as a reference in selecting plants that could thrive in the rain gardens’ unique conditions.

The rain gardens also have custom screens to collect sediment, debris, and oils. The city hired an engineer to monitor accumulation in the screens and change them as needed.

Benefits to Date

As of early 2020, Hoboken does not yet have data to assess the stormwater control benefits that the rain gardens provide. The main benefit so far is that rain gardens have added native plants that beautify the streetscape. Residents and businesses have generally provided positive feedback about the rain gardens.

Borough of Highland Park, New Jersey: Community Green Infrastructure

The borough of Highland Park is a community of 14,000 residents in central New Jersey along the Raritan River. Residents and Highland Park government have a goal of creating an environmentally, economically, and socially sustainable borough and strive to be at the forefront of addressing sustainability issues. The borough has completed previous sustainability projects, such as installing solar panels and green roofs. To continue addressing sustainability issues, the borough added green streets elements to a planned streetscape project.

Project Overview and Goals

In 2012, Highland Park embarked on a significant streetscape project to improve the pedestrian experience along its main thoroughfare, Raritan Avenue. The borough partnered with Main Street Highland Park, a nonprofit community development organization that manages the borough's downtown business district. Main Street Highland Park advocated the use of green streets practices as part of the streetscape improvements. The borough turned side streets into green streets to improve sustainability while adding aesthetic benefits and increasing the quality of life for pedestrians and residents in general.

Design and Installation

Because the streetscape project already included infrastructure upgrades and beautification, rain gardens were a natural fit. Main Street Highland Park worked closely with its design consultant, Wallace Roberts & Todd, to turn the conceptual street improvements into a final plan that included five rain gardens along 3rd, 4th, and 5th Avenues near their intersection with Raritan Avenue.

The design used curb bump-outs to create space to install the rain gardens (Figure 4) but accommodated them without losing parking spaces or changing the road width along the side streets.

Funding

The New Jersey Department of Transportation, which has jurisdiction over Raritan Avenue, provided a significant amount of funding for the streetscape improvements. In addition, Main Street Highland Park helped the borough obtain a Downtown Business Improvement Zone loan from the state's Department of Community Affairs as well



Figure 4. Rain garden with curb bump-out installed as part of Highland Park streetscape improvements.

as a Community Development Block Grant. Middlesex County and the borough provided additional funding for the project.

Challenges Faced and Benefits Realized

Maintenance Challenges

Personnel changes and an overall lack of experience led to operation and maintenance challenges at the installed green infrastructure locations. The borough initially hired green infrastructure specialists for the rain gardens but only retained their services until the plantings were established; the Highland Park Department of Public Works then took over maintenance responsibilities. A lack of training led to maintenance personnel removing the wrong plants from the rain garden and allowing weeds to overtake the original plants. The borough is still struggling with maintenance issues and notes that it did not create a plan to fund maintenance tasks. Currently, volunteers maintain the rain gardens by planting flowers and trimming trees.

To address the maintenance issues, the borough plans to hire a contractor to help re-establish native plants and then transfer maintenance responsibilities back to the Department of Public Works. The need to plan for future maintenance activities is an important lesson learned from this project. The borough also recommends partnering with experts, such as Rutgers University, for planning and engineering design.

Benefits to Date

In addition to capturing stormwater runoff, the areas near the rain garden serve as “outdoor living rooms” where Highland Park added benches to create outdoor recreational spaces (Figure 5). The curb bump-outs near the rain gardens provide traffic calming and shorten the crosswalk distance along the side streets, making the area safer for pedestrians. The rain gardens and surrounding improvements have also provided significant aesthetic benefits.

Despite maintenance challenges, the rain gardens are operating as intended. Overall, Highland Park is pleased with the rain gardens and is considering future green streets projects. The borough is interested in using green infrastructure for all development and is considering developing a policy that encourages developers and borough staff to use green streets designs during the planning and design phase of development projects.

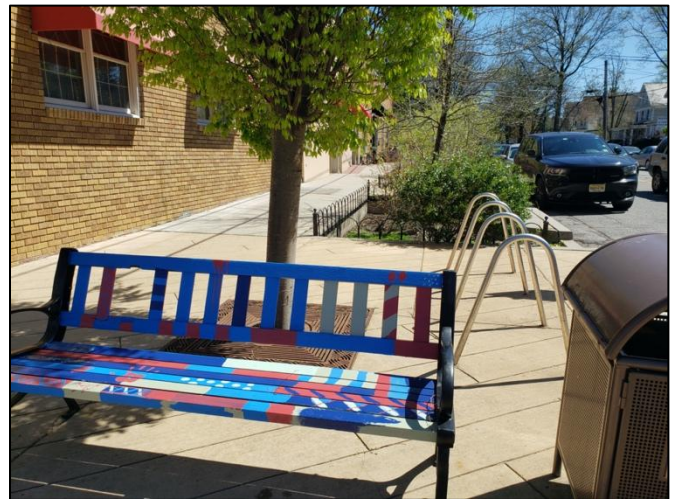


Figure 5. Bench installed as part of the Highland Park streetscape project.

Camden, New Jersey: Waterfront South Rain Gardens

Camden is an economically distressed, post-industrial city with an area of 10 square miles and 74,000 residents located on the Delaware River across from Philadelphia, Pennsylvania. The Delaware River borders the city to the north and the west, making the city susceptible to flooding. An aging combined sewer system that overflows even during minor storms serves the majority of the city. To address flooding issues from storm events, the Camden County Municipal Utilities Authority (MUA) has been implementing green infrastructure practices throughout the city. The first large-scale rain garden project that Camden County MUA and its partners attempted was the Waterfront South rain gardens in 2011.

Project Overview and Goals

The site of the project was an abandoned gas station at Broadway and Chelton Avenue. A leaking fuel storage tank at the site contaminated the surrounding soils, leached contaminants into groundwater, and emitted hazardous vapors into the air.

In addition to these contamination concerns, streets and basements in a nearby neighborhood frequently flooded; even minor storms were enough to cause significant flooding in the area. Because 80 to 85 percent of Camden County has a combined sewer system, this flooding was not only disruptive, but was also a significant public health concern.

Camden County MUA partnered with the New Jersey Department of Environmental Protection (NJDEP), New Jersey Tree Foundation, and Rutgers University to turn the site into a rain garden and community green space. The Waterfront South rain gardens project replaced the contaminated soils with clean soils, addressed chronic flooding in the area, and provided residents of the nearby neighborhood much needed green space.

What Is a Combined Sewer System?

A combined sewer system (CSS) collects rainwater runoff, domestic sewage, and industrial wastewater into one pipe. Under normal conditions, it transports all of the wastewater it collects to a sewage treatment plant for treatment, then discharges to a water body.

When the volume of wastewater exceeds the capacity of the CSS or treatment plant (for example, during heavy rainfall events), untreated stormwater and wastewater discharges directly to nearby water bodies. These discharges can contain untreated or partially treated human and industrial waste, toxic materials, and debris as well as stormwater.



Figure 7. Bioretention area inside the Waterfront South rain gardens.



Figure 6. Riprap-lined inlet channel to a bioretention area in the Waterfront South rain gardens.

Design and Installation

Each partner in this project contributed expertise that made it possible. NJDEP worked with Camden County MUA to devise solutions to the environmental problems at the site and also provided permitting assistance for the cleanup portion of the project. Rutgers University provided the engineering design of the rain gardens and drainage for the site, and the New Jersey Tree Foundation provided the landscape design for the rain gardens.

To address soil contamination, the project team removed the leaking fuel storage tank at the site and excavated and replaced the contaminated soil with clean, pervious soil. Camden County MUA and its partners then created the rain gardens to capture stormwater runoff and infiltrate it into the groundwater below (Figure 7). Slopes at the site were altered to ensure that water drained from the adjacent streets and into the rain gardens (Figure 6). No major road work was needed, but minor adjustments were made along the edges of the streets.

The team designed the rain gardens to safely capture and infiltrate 1 million gallons (134,000 cubic feet) of stormwater runoff each year. In addition to alleviating flooding issues and replenishing groundwater, the rain gardens provide treatment by removing pollutants from the stormwater as it passes through the soil and other media in the rain gardens.

Community volunteers helped install the Waterfront South rain gardens. Camden County MUA and its partners conducted a two-day training workshop on rain gardens for landscape professionals and Camden City residents. The training included classroom instruction and field training (Figure 8), during which participants helped install inlets and outlets, spread mulch, and plant the gardens.



Figure 8. Trainees and volunteers during installation of Waterfront South rain gardens.

Funding

As a brownfield remediation project, the site was eligible for a 319(h) grant to address nonpoint source pollution. This grant, obtained with NJDEP assistance, funded a portion of the project. To fund the majority of the project, however, Camden County MUA applied for and received a loan from the state's revolving fund. This loan eased the financial impact of the project because it had a low interest rate, had a repayment term of 30 years, and did not require payment until the project was completed.

To provide funding and training for maintenance activities, Camden County MUA looked to Philadelphia's PowerCorpsPHL program for inspiration. PowerCorpsPHL received a grant from AmeriCorps to provide paid working opportunities for youth to maintain green infrastructure in the city. Camden used this idea to create its own PowerCorps program, which accepts 60 participants each year and has provided work opportunities and life skills training for at-risk youth for the past five years. Green infrastructure experts from Rutgers University train PowerCorps participants, who spend five hours per day maintaining Camden's green infrastructure and another three hours receiving life skills training. In addition to providing the city's youth with valuable jobs and training, Camden County MUA notes that the maintenance they provide is cost-effective in comparison with hiring a professional landscaping company.

Challenges Faced and Benefits Realized

Partnering for Expertise

The Waterfront South rain gardens were Camden County MUA's first large-scale green infrastructure project; the MUA therefore lacked experience with green infrastructure design, landscape design for green infrastructure practices, maintenance, and funding. For this reason, Camden County MUA's partnership with NJDEP, Rutgers University, and the New Jersey Tree Foundation was critical to the success of this project. These organizations provided expertise and assistance in contaminated site cleanup, engineering design, landscaping, grant writing, and implementation.

Benefits to Date

The Camden community has noted several benefits of the rain gardens. Several years after being installed, the Waterfront South rain gardens still drain stormwater from the nearby roads and neighborhood, and the plants are still thriving. Residents and the county have reported significant reductions in flooding in the area since the rain gardens were installed. The community is also very pleased to have a beautiful green space nearby that they can take pride in. Overall, the Waterfront South rain gardens project was a huge success and demonstrated the infrastructure and community benefits that are possible using green infrastructure.

The PowerCorps training program has also been a source of pride for the community. To date, 300 youth have gone through the program. The PowerCorps program boasts a 40 percent job placement rate and has even led to some of its participants gaining employment with the county.

The success of the rain garden led to more green infrastructure projects and programs to address environmental concerns in Camden City. One of these programs is the Camden SMART Initiative, created by Camden County MUA and several other organizations. Its goal is to develop a network of green infrastructure projects in the city to eliminate combined sewer overflows caused by a 1-inch storm by the end of 2021. To date, 60 rain gardens and 125 acres of green parks, capable of treating 100 million gallons (13.4 million cubic feet) of stormwater each

year, have been built in the city. The green infrastructure projects include additional brownfield remediation projects. The Camden Collaborative, an organization that provides environmental services to underserved communities, also came about as a result of the success of the Waterfront South rain gardens.

Conclusions

Green infrastructure is an important tool capable of reducing flooding, reducing combined sewer overflow events, and treating stormwater runoff pollution from roadways and other impervious areas. In addition to rain gardens, there are many other types of green infrastructure practices that communities can install along roadways, including tree boxes, porous pavements, vegetative curb areas, and swales. To ensure the success of their green streets projects, communities must consider several challenges, including the following:

- **Funding**—Several communities have relied on grants to fund green infrastructure projects. Successfully obtaining grants, however, may depend on a city or municipality having experienced grant writers on staff.
- **Operation and maintenance (O&M)**—O&M challenges can include longevity of plantings, buildup of sediment, and proper conveyance of water. A lack of experienced staff and funding dedicated to maintenance contributed to the O&M challenges illustrated in several of the case study communities.

While green streets projects can face challenges, the communities surveyed in these case studies reported significant benefits, including the following:

- Green streets **capture and treat significant amounts of stormwater runoff**, directly reducing street flooding and the amount of pollutants that enter nearby waterways.
- Green streets create **more walkable and bike-friendly streets and intersections**. Rain gardens placed within curb bump-outs may function as traffic calming devices and provide shorter crosswalks for pedestrians, thus increasing pedestrian and bicyclist safety.
- Green streets can be an effective way to **encourage civic engagement**, such as by training young volunteers to maintain rain gardens and city parks.