CASE STUDY FROM NEW YORK, NEW YORK

New York City Greenstreets and Backyard Low Impact Development Projects:

Implementation, Monitoring, and Community Involvement for Two Case Studies

QUICK FACTS

Theme	Partnerships
Name	New York City Greenstreets and Backyard LID Projects
Unique LID Components	Greenstreet construction and monitoring, community backyard LID projects, cost information, and monitoring
Location	New York City
Land Use	Urban
Watershed Area	Varied; multiple sites
Lessons Learned	Multiple projects explored and lessons learned, partners, research, and education efforts are time intensive

Introduction

New York City's (NYC) Sustainable Stormwater Management Plan is a key initiative of PlaNYC, the City's plan for a greener, greater New York unveiled in 2007. PlaNYC's water quality goal is to improve public access to tributaries from 48 percent today to 90 percent by 2030. Greenstreets (GS) and Backyard Low Impact Development (LID) are two notable programs to help achieve PlaNYC's water quality goal. These programs showcase how NYC is integrating stormwater management as a part of the urban landscape, rather than just an inevitable by-product of development.

The Sustainable Stormwater Management Plan is an interagency effort and is the City's first comprehensive analysis of the costs and benefits of alternative methods for controlling stormwater. The Plan provides a framework for testing, assessing, and implementing small installations to control stormwater at its source, which are known by various terms – source controls, green infrastructure, low impact development, best management practices (BMPs). The implementation of the plan is grounded by partnerships and a multi-faceted approach to implementation that addresses: pilot projects, outreach and education, and water quality and quantity monitoring. This, in turn will provide information to inform future design criteria that may further improve the performance of these practices and computer models used to estimate their effectiveness (e.g., water quality improvements, less runoff, and flooding).

Case Study 1: Greenstreets

Greenstreets is something "old that is new again." The Greenstreets (GS) program is an existing urban beautification and traffic calming program that began in1996 by NYC Department of Parks & Recreation (DPR) to convert unused sections of roads and sidewalks to landscaped areas. There are over 2,400 GS in the City. PlaNYC called for an additional element of the GS program to address the growing issues of combined sewer overflows (CSOs) and water quality. The data generated and experience gained, with the initial projects will inform the next generation of GS to further enhance the benefits of these types of practices in ultra-urban watersheds to include stormwater management, flooding, heat island mitigation and groundwater recharge.

A cornerstone for success for the GS Program for stormwater management is the partnerships. The program is led by the NYC Department of Parks & Recreation while project partners have provided supplemental funding, staffing resources and expertise to develop a comprehensive stormwater GS program that goes beyond construction. The GS program has a monitoring component alongside public education and outreach efforts. Project partners for individual GS projects include one or more of the following organizations:

- New York Soil and Water Conservation District
- Drexel University
- Brooklyn College
- Atlas Scientific

The project was given a financial boost in 2009 with $2 million provided by the American Recovery and Reinvestment Act (ARRA). ARRA funds are being used to construct a series of 26 new Greenstreets in neighborhoods with impaired water quality, and clustered around intersections with significant flood-related '311' call volumes. These sites were also selected given their below-average open space and above average incidence of asthma. Drexel University leveraged this funding and secured additional funds through a National Science Foundation RAPID grant to monitor two stormwater GS and a control site in Alley Pond, a forested park site. The two GS sites are located in Queens at Nashville Boulevard, 116th Avenue and 209th Street and Colfax Street and Murdock Avenue (Figures 1 and 2). Analysis of soil and water quality samples will be completed at Brooklyn College (City University of New York, CUNY). Additionally, New York City Soil and Water Conservation District will also collect water quality data to estimate pollutant removal efficiency. NYC Department of Parks & Recreation will cover the costs for excavation, labor, gravel and other materials, whereas the RAPID funding is used to purchase the monitoring equipment. The monitoring set up is shown in Figure 4.

A Memorandum of Understanding (MOU) was signed between NYC DPR and Department of Transportation as the roads are located on their property. The MOU outlines the partnership between these two departments and ensures that DPR is fully responsible for the sites while they are Greenstreets but DOT may reclaim use of their land at any time desired or necessary.

The monitoring program is designed to fill the knowledge gap of green infrastructure facility performance in terms of stormwater retention and pollutant removal. Monitoring instrumentation of the sites will enable project partners to quantify water budgets for the stormwater GS (e.g., Figure 5). Measurements will be taken for: evapotranspiration, infiltration rate, and surface and subsurface flows that includes soil moisture dynamics. Stormwater flowing

Figure 1. Greenstreet at Riverside Drive and 104th Street (top) and pipe inlets (bottom) that direct water into the bioretention area. Photo credit: Nandan Shetty with NYC Parks and Recreation Department. See Figure 3 for site plan.

into the inlets of the GS will be sampled using an automated ISCO sampler, while soil pore water will be collected from a lysimeter to characterize the runoff as it leaves the GS. Parameters measured include: pH, nutrients (N, P, K), metals (Pb, Ni, Al, Cu, Cr) and bacterial indicator organisms.

Additional monitoring of GS will be accomplished with funding provided to DPR from the New York Department of Environmental Conservation ($63,000) and New York Department of State ($71,052) in the fall 2009. One site is located at Furmanville Avenue in Middle Village in Queens (Figure 6 and 7) while a second site is located in the Bronx at Sagamore Street and Cruger Avenue. The monitoring set-up at these two sites is designed to generate data to estimate interception, surface hydrology (ponding/depression storage, runoff, and infiltration), soil moisture dynamics, and changes in groundwater. An exciting part of this project is the design of new monitoring equipment to generate 3-D images of soil moisture throughout the stormwater GS

site. DPR provided additional funding (e.g., $12,500) to Atlas Scientific to design and construct soil moisture monitoring equipment – specifically for this project. Additional sites may be added with future financial support. The monitoring equipment includes multiple spikes that have three sensors attached to each one to get soil moisture reading at 3 different levels up to 3 feet (1 meter) below the surface.

Overall the outcome of the stormwater GS projects is to aid standard protocol development for monitoring GS, refine design criteria and develop simulation models to better understand how GS can most effectively reduce and treat stormwater runoff. Model results will also inform a GS cost benefit analysis to guide future projects.

Figure 2. Greenstreet at Church Avenue inlet in Brooklyn, NY, constructed in spring, 2009. Curb cuts direct stormwater runoff into the bioretention area. Photo credit: Nandan Shetty with NYC Parks and Recreation Department.

Figure 3. Church Avenue site plan that shows before and after renderings, conceptual landscaping and water flow (site plan), cross section of bioretention area (site section A-AA).

Figure 4. Infiltration testing. Photo credit: Drexel University, Kimberly DiGiovanni June 2010.

Case study 2: Backyard LID

Bringing life back into often neglected spaces is one of the many benefits of New York City Soil and Water Conservation's Backyard LID program. Backyard LID is a keystone program to educate and engage private property owners as an active partner in New York City's Sustainable Stormwater Management Plan. Residential urban property can play a significant role in adapting design elements to address local and global issues – from stormwater to climate change. Backyard LID is designed to engage property owners to assist the city control stormwater at its source in their efforts to reduce CSO events and reduce water treatment costs. All of this can happen in backyards throughout the city. The program also provides a unique opportunity to increase green space in New York City's high density living spaces by constructing planters in the backyards of private property. At least this is how the program started. The program has

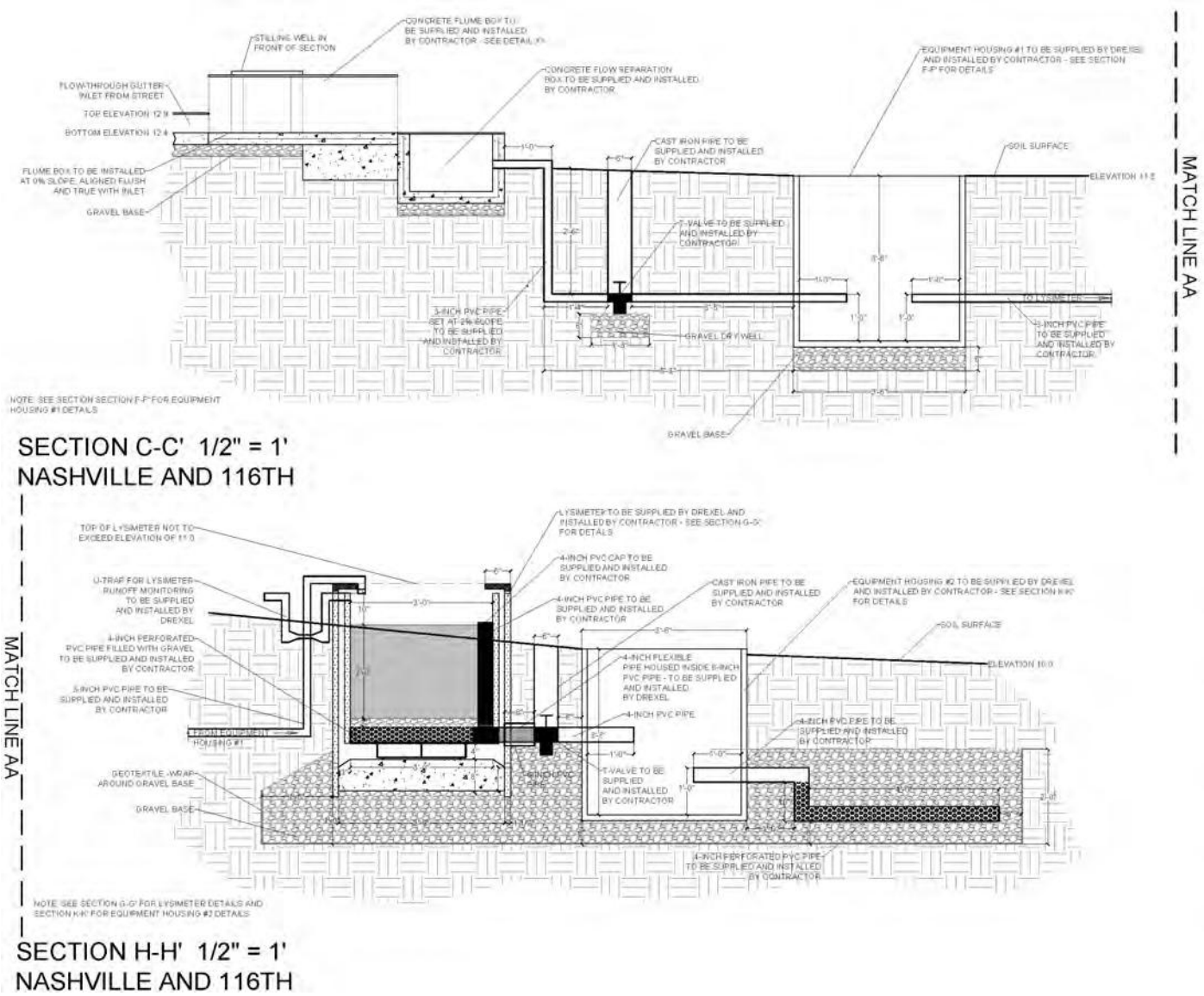

Figure 5. Nashville and 116th Greenstreet design.

identified additional innovative opportunities to partner with schools and incorporate other techniques to reduce stormwater volumes.

Backyard LID is a program developed by the New York City Soil and Water Conservation District (NYC SWCD) to identify retrofit opportunities in densely urban populated areas. The program not only identifies retrofit opportunities but provides the funding needed for construction at no-cost to the private property owner. The Backyard LID projects are designed using native plants to promote habitat restoration and sustainability of the design. The project began in 2008 when the NYC SWCD received funding through the State's Conservation Project Fund for $23,000 to construct the first Backyard LID project. They received additional funding in 2009 along with funding from the competitive New York-New Jersey Harbor Estuary Program (HEP). The funding covers the cost of contractors and supplies, while staff time is provided by the operating budget of the SWCD.

Figure 6. Rain gauge installed on street sign as part of monitoring program. Photo credit: Drexel University, Kimberly DiGiovanni June 2010.

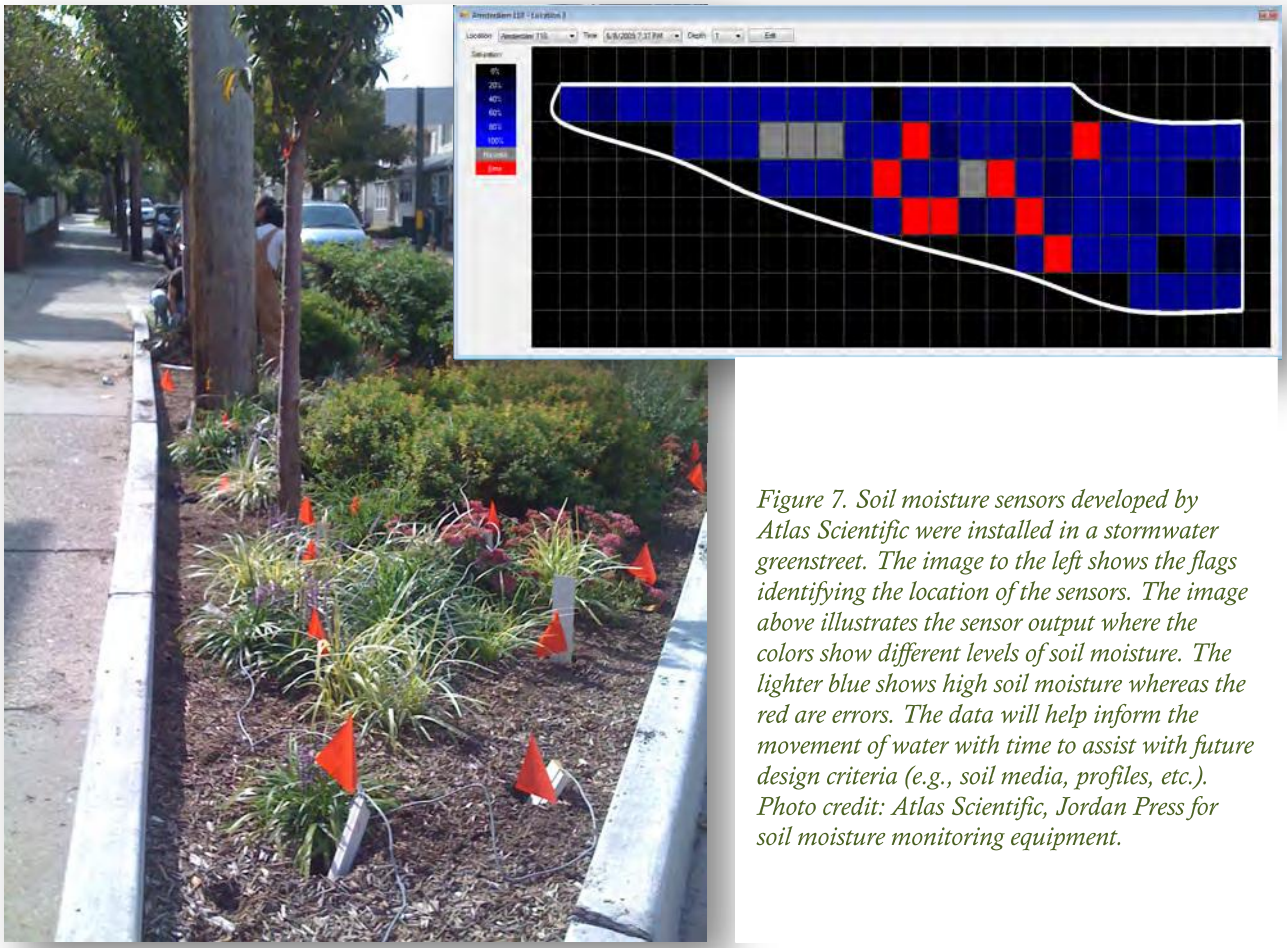

Figure 7. Soil moisture sensors developed by Atlas Scientific were installed in a stormwater greenstreet. The image to the left shows the flags identifying the location of the sensors. The image above illustrates the sensor output where the colors show different levels of soil moisture. The lighter blue shows high soil moisture whereas the red are errors. The data will help inform the movement of water with time to assist with future design criteria (e.g., soil media, profiles, etc.). Photo credit: Atlas Scientific, Jordan Press for soil moisture monitoring equipment.

A list of potential sites on the Upper West side was made available through Sustainable Yards and Landmark West, two of the project partners. The Backyard LID program was also advertised locally in the neighborhood where free design and construction services would be provided. Once applications from potential backyard owners were received, the Backyard LID team conducted site visits to assess which site would be the most appropriate. The sites were reviewed based on the following: relative access to the backyard, the level of neglect and lack of green space, the type of design that could be afforded for the space, and the willingness of the owner to maintain and use the facility design. eDesign Dynamics, who focus their work in hydrologic and ecologic restoration and stormwater management, joined the project team to provide their design expertise.

As a participant in the Backyard LID program, property owners agreed to provide access to NYC SWCD one year following project completion to conduct site visits to ensure performance and integrity of the design. The information and experience gained by the pilot project served to test the implementation of a low budget, 'do-it-yourself', low maintenance greening projects in these ultra-urban areas.

W74th Street project Co-OP

The first project was completed in 2009 at the West 74th street Co-Op built in 1924, the Alfie Arms Corporation. NYC SWCD initiated work with the Co-Op residents to design and construct an LID practice as a retrofit. The State Conservation Project Assistance Fund of the New York State Environmental Protection Fund provided $26,000 to the NYC SWCD to construct planters to collect rainfall rather than becoming runoff in the rear of the Co-Op. NYC SWCD was the project lead with project partners, eDesign Dynamics who provided the design and construction management and Landmark West! as the outreach and communication coordinator. Landscaping LLC provided tools and services in the construction of the planters and hauling of the soil.

This project demonstrates the constraints and opportunities to retrofit high density, ultra urban living spaces. The spaces are typically tight and don't permit the access and use of heavy equipment and machinery, while also contending with utilities that limited the disconnection of downspouts from the building. Take a look at Figure 8 that shows the stairwell negotiated by project team members to access the project area to remove and bring in soil.

The final project design at the West 74th Street Co-Op was eventually limited for rainwater capture only. The design includes: three 4 feet by 4 feet planters, one L-shaped 30 feet by 4 feet, and a third 8 feet by 4 feet planter using a total of 11 cubic yards of soil. The planters were lined a geotextile and pond liner and a perforated 1.5 inch PVC pipe on the bottom which were connected to a vertical PVC pipe of the same diameter on the outside of the planters. The planters and plants selected were designed with minimal maintenance requirements. Residents will only need to water at beginning to establish the plants, although there was no maintenance program or agreement as part of this first project. Following a year after implementation, site visits discovered that the clay content in the planters was not providing effective drainage. The planters were dug out and plants replaced. In the end, project partners hauled away six cubic feet of soil, by shovel and bucket, due to the tight spaces of these backyard projects, and replaced with gravel and sandy loam soil. The initial project was installed in a little over a week.

A monitoring program is in place to include a weather station to collect data on precipitation, air temperature, relative humidity and wind speed and direction, while

soil monitoring equipment generates data on moisture and water levels in the soil. Atlas Scientific is working with NYC SWCD to customize monitoring system.

83rd Street Goodard Riverside Preschool

NYC SWCD received funding from New York/New Jersey Harbor Estuary Program Stewardship Grant Program for $33,000 to install a series of 22 rain barrels to catch roof runoff at property owned by St. Matthew and St. Timothy Church Center. The site is occupied by the Goodard Riverside Preschool and a low-income housing complex. NYC SWCD was joined by eDesign Dynamics who provided design and construction management for the project while Sustainable Yards coordinated the outreach and communication efforts.

The preschool has approximately 4,000 square feet of rooftop area where runoff goes directly to the storm drains without any treatment. It is estimated that a 1/2" of rainfall will generate nearly 1,250 gallons of stormwater runoff. Site visits found little space to accommodate planters so creativity lead the way and the final design included the use of a greenwall product, Wally, a proprietary device of Woolly Pocket Garden Company, Inc. Wally pockets were installed along with twenty-two, 55-gallon rain barrels in a series that will be used for detention with slow-release that drains over two-days back to the sewer to help with combined sewer overflows. The water stored in the last barrel is used for irrigation on the school grounds. A few may have vegetated tops. Plumbing services were provided by a local professional from the West 74th Street Co-op. The available workspace was estimated to be 560 square feet (8 feet by 70 feet). Additional elements of the project included replanting small tree pits (1.5 feet by 1 foot) with small shrubs. See Figure 9 for pictures.

The benefits of the project at a school site will allow NYC SWCD to broaden its outreach and education efforts to include the students, staff as well as residents of the surrounding neighborhood. An extensive education component includes: painted murals on the outside school wall, painted floor and an interactive learning station directed towards the students ages 2 to 10 years (preschool plus K-5). The mural was donated by Ksenia Pitaleff, a local freelance artist. The mural depicts the story of the hard cityscape where the polluted runoff is filtered by plants and soils.

Curriculum was developed by NYC SWCD to teach students about water conservation and their special project on the site. An open house to engage the school and residents provided an opportunity to learn more about these innovative practices along with informational signed at the site.

NYC SWCD is granted access to the site for one-year following construction, although staff will be available whenever needed to ensure on-going success of the project. Atlas Scientific is working with NYC SWCD to customize monitoring system.

150th Street

A Community Assistant Tenant Housing Association (CATCH) on 150th Street is the location of the third Backyard LID project. The State Conservation Fund provided $26,000 to NYC SWCD to construct a rain garden at the 15-unit building, owned by Central Harlem Bradhurst LP, a low-income development. eDesigns Dynamics was a project partner for design and construction management.

Site investigations found a small 1,400 square feet green lot on the side of the property that was neglected, overgrown, and not used for much of anything. The site was full of debris, the soil was 'urban fill', and a portion of the site appeared to have an old foundation with brick patio, pipes, amongst other trash. Following an evaluation of the site, project partners created a design to

Figure 8. West 74th Project. Construction (top), access to site via stairwell (middle), and completed project (bottom). Photo credit: Tatiana Morin with New York City Soil Water Conservation District

minimize the removal of material from the site, other than the trash and debris due to indirect access routes to backyard areas from the street that is common in NYC. The design could also incorporate downspout disconnection where the runoff could be used to irrigate a garden. Overall, this was ideal location for an LID project to capture and treat runoff.

The project team met with the building owner and tenants to agree upon the final design. The NRCS NYC Soil Survey volunteered their services to evaluate soil conditions and characteristics (e.g., infiltration rates). See the image of volunteer jackhammering 'soil' to prepare site for planting (Figure 10b). The roof runoff is directed to the raingarden but water will be stored in series of 10 rain barrels and released slowly into the rain garden. The garden itself is designed with a deep, trench-like wetland area. A float switch is installed in a rain barrel to control the volume of water entering the rain garden. Any overflow is directed back into the stormdrain. A local plumber from the West 74th Co-Op provided services to set-up the rain barrel and water delivery system to the rain garden. This design provides a garden to attract birds, butterflies and insects, enhancing habitat and cleaning while the site will have limited access by tenants (Figure 10). However, a sitting area in a nearby elevated section of the garden is planned. The excavation and planting was completed in a week.

CATCH is working to put together a resident garden maintenance crew/committee and other Harlem CATCH-owned buildings. Atlas Scientific is working with NYC SWCD to customize monitoring system. It is an exciting and new pilot that will demonstrate the functionality and survivability of a constructed urban miniature wetland/rain garden.

A grand opening and press event will be planned after completion.

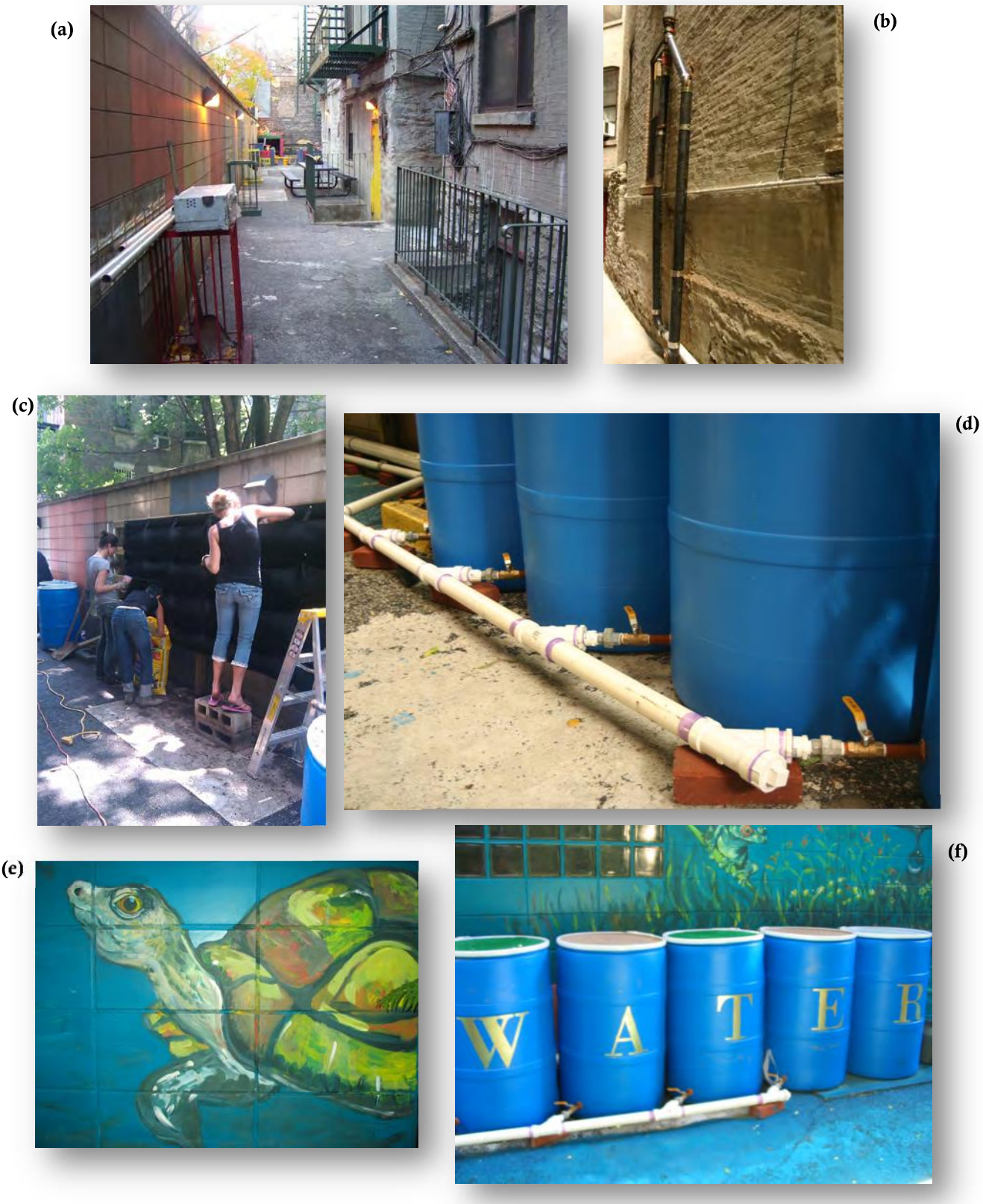

Figure 9. 83rd Street Preschool project (a), playground before project 9b), completed downspout disconnection (c), filling pocket planters (d), series of rain barrels (e), and mural open house (f). Photo credit: Tatiana Morin with New York City Soil Water Conservation District.

Figure 10. 150th Street Project. Site before project (a), site prep (jackhammering the soil) (b), planting (c), rain barrel hookup (d), raingarden and rain barrel float switch installation (e). Photo credit: Tatiana Morin with New York City Soil Water Conservation District.

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Additional Resources

Seattle Washington's Natural Drainage Projects: Measuring Success

Seattle has several innovative LID programs such as green streets and provides specific guidance as well as monitoring reports. Available online at:

http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/MeasuringSuccess/

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CICEET

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