

City of New York

OFFICE OF THE COMPTROLLER

Scott M. Stringer
COMPTROLLER



AUDITS AND SPECIAL REPORTS

Marjorie Landa

Deputy Comptroller for Audit

Audit Report on the
Department of Environmental
Protection's Maintenance of Rain
Gardens

SE18-086A

December 16, 2019

<http://comptroller.nyc.gov>



THE CITY OF NEW YORK
OFFICE OF THE COMPTROLLER
SCOTT M. STRINGER

December 16, 2019

To the Residents of the City of New York:

My office has audited the New York City Department of Environmental Protection (DEP) to determine whether DEP is adequately maintaining the rain gardens constructed under the NYC Green Infrastructure Program to ensure that they are functioning properly and retain an appropriate appearance. We perform audits such as these to help ensure that government operations are effectively managed and to identify potential waste of funds and resources.

The audit found multiple areas of weakness in DEP's maintenance of its rain gardens. These weaknesses need to be addressed to better ensure that City-constructed rain gardens continue to effectively capture stormwater runoff and help reduce the amount of pollution that enters into the City's waterbodies, clean the air, and beautify the City's neighborhoods.

Of the 102 sampled DEP rain gardens that we inspected in Brooklyn, Queens, and the Bronx, which cost the City more than \$4 million to construct, we found that the majority were not sufficiently maintained to ensure their proper functioning and appearance. That determination was based on our visual inspection of each sampled rain garden for conditions that DEP's *Rain Garden Maintenance Manual* (Manual) identifies as indicators of whether a rain garden is being properly maintained.

We found that 67 of the 102 sampled DEP rain gardens (66 percent) were affected by two or more conditions that DEP's Manual states can impair a rain garden's functionality, and 53 of the sampled rain gardens (52 percent) exhibited two or more unsightly conditions, also cited in DEP's Manual as factors that detract from a rain garden's appearance and may signal to the community that the site is under-maintained. Overall, 30 of DEP's sampled rain gardens (29 percent) exhibited 4 or more deficient conditions, and 7 sampled rain gardens were found to be fully maintained in accordance with DEP Manual standards, having no visible deficiencies, and well-maintained tree guard rails and curbs, at the times of our inspections.

The audit makes 18 recommendations for addressing the weaknesses in DEP's rain garden maintenance regimen, including adequate recording of the rain garden maintenance, use of photographs to document before and after conditions, installation of rain garden ID tags, verification and quality control of maintenance data, and use of the maintenance data for management analyses.

The results of the audit have been discussed with DEP officials, and their comments have been considered in preparing this report. Their complete written response is attached to this report. If you have any questions concerning this report, please e-mail my Audit Bureau at audit@comptroller.nyc.gov.

Sincerely,



Scott M. Stringer

TABLE OF CONTENTS

| | |
|--|-----------|
| EXECUTIVE SUMMARY..... | 1 |
| Audit Findings and Conclusion | 2 |
| Audit Recommendations..... | 3 |
| Agency Response..... | 4 |
| AUDIT REPORT | 5 |
| Background | 5 |
| Objective..... | 9 |
| Scope and Methodology Statement..... | 9 |
| Discussion of Audit Results..... | 10 |
| FINDINGS AND RECOMMENDATIONS..... | 13 |
| Rain Gardens Were Not Adequately Maintained | 14 |
| Recommendations | 20 |
| DEP's Rain Garden Maintenance Record-keeping Is Incomplete and Inaccurate..... | 21 |
| Maintenance Logs Do Not Reflect Conditions Auditors Observed | 21 |
| Gravel Cleaning Task Missing from the Maintenance Log | 24 |
| BWSO Does Not Photograph Rain Garden Conditions Requiring and Receiving Maintenance | 24 |
| Management Analyses of Maintenance Data Can Be Enhanced..... | 25 |
| Recommendations | 26 |
| Other Issue | 28 |
| An Absence of ID-tags on Rain Gardens May Lead to Service Uncertainty..... | 28 |
| Recommendation | 29 |
| DETAILED SCOPE AND METHODOLOGY | 31 |
| APPENDIX I | |
| APPENDIX II | |
| APPENDIX III | |
| APPENDIX IV | |
| ADDENDUM | |

THE CITY OF NEW YORK OFFICE OF THE COMPTROLLER AUDITS AND SPECIAL REPORTS

Audit Report on the Department of Environmental Protection's Maintenance of Rain Gardens SE18-086A

EXECUTIVE SUMMARY

The New York City (NYC) Department of Environmental Protection's (DEP's) mission is to safeguard public health and the environment by supplying clean drinking water, collecting and treating wastewater, and reducing air, noise, and hazardous materials pollution. DEP is required to reduce stormwater runoff to improve the water quality in waterbodies surrounding NYC pursuant to the Consent Order by the New York State Department of Environmental Conservation (NYS DEC). In connection with that requirement, DEP's Bureau of Environmental Planning and Analysis (BEPA) plans and implements various green infrastructure projects, including rain gardens (formerly known as bioswales), under the NYC Green Infrastructure Program (GI Program), and maintains all related information. DEP is responsible for overseeing the construction of more than 2,500 rain gardens on City owned property such as streets, sidewalks, schools and public housing to reduce the volume of stormwater runoff that enters the City's sewer system. DEP's Bureau of Water and Sewer Operations (BWSO) is responsible for the maintenance of each rain garden under DEP's jurisdiction, after construction and any applicable guarantee period in which the construction contractor maintains it under the terms of its contract with the City.

Overall, rain gardens do an important job of keeping the City's waters clean and improving street aesthetics. In order to do their job properly and retain their appearance, rain gardens need regular maintenance to ensure that they are functioning properly to effectively capture stormwater runoff, thereby helping to reduce the amount of pollution that enters the City's waterbodies. According to DEP, rain gardens are valuable green infrastructure assets that help keep stormwater out of local sewers, improve street drainage, purify air, reduce temperatures during hot weather, and reduce puddles and ponds.

Rain gardens contain plants and engineered soil that have been horticulturally designed to absorb large amounts of stormwater, thereby reducing the amount of water that enters the sewer system. To help ensure that the rain gardens for which it is responsible are appropriately maintained, DEP created the *Rain Garden Maintenance Manual* (Manual). The Manual serves as a guidebook for DEP/BWSO's maintenance personnel and provides a thorough description of the various types of maintenance tasks, procedures and equipment that are required to maintain the rain gardens' appearance and ensure that they are functioning properly.

Once a rain garden's construction is completed, it remains under a guarantee provided by the contractor who installed it. The guarantee period normally spans one to two years during which time the contractor is responsible for performing regular maintenance as stipulated in the contract. Once DEP accepts the rain garden, at or after the expiration of the guarantee period, the rain garden is deemed to be under DEP's sole jurisdiction. At that point, within DEP, responsibility for maintenance of the rain garden is assigned to BWSO for what DEP refers to as "full maintenance." While under full maintenance by DEP, BWSO is responsible for providing maintenance services to the rain gardens one to two times each week, according to the Manual. DEP's maintenance locations are broken down into 18 routes in 31 zones throughout the City.

During the audit scope period, as of April 17, 2018, BWSO was responsible for full maintenance of 805 rain gardens in four boroughs and employed a full-time staff of approximately 36, including 3 Gardener-Level IIs (G2s), oversight employees with overall responsibility for the maintenance of all DEP rain gardens in their assigned areas, 8 supervisors known as Gardener-Level Is (G1s), responsible for directing and performing hands-on maintenance with BWSO's 8 maintenance teams, each generally consisting of 4 to 8 workers. During the period we audited, DEP supplemented the maintenance staff with between 30 and 63 seasonal workers.

According to the BWSO records, as of April 17, 2018, a total of 2,511 rain gardens, at an estimated cost of just over \$100 million, had been constructed within the four Boroughs that were either under a contractor guarantee or in full maintenance. Of the 2,511 rain gardens on BWSO's spreadsheet, BWSO was responsible for the full maintenance of 805 in 4 of the 5 boroughs as shown below:

| Rain Gardens | Brooklyn | Queens | Bronx | Manhattan | Total |
|-------------------------|----------|--------|-------|-----------|--------------|
| Total # | 1,709 | 645 | 154 | 3 | 2,511 |
| Full Maintenance by DEP | 560 | 188 | 54 | 3 | 805 |

According to the data provided by DEP, in Fiscal Year 2017, the total expenditure for the rain gardens' maintenance, including staffing salaries with fringe benefits (both permanent and seasonal), general supplies and other related services, was \$4.23 million and in Fiscal Year 2018 it was \$5.91 million. For Fiscal Year 2019, as of May 21, 2019, that expenditure was \$5.24 million.

This audit determined whether DEP adequately maintains the 805 rain gardens under its jurisdiction in accordance with the Manual.

Audit Findings and Conclusion

Our audit found multiple areas of weakness in DEP's maintenance of its rain gardens. These weaknesses need to be addressed to better ensure that City-constructed rain gardens continue to effectively capture stormwater runoff and help reduce the amount of pollution that enters into the City's waterbodies, clean the air, and beautify the City's neighborhoods.

Of the 102 sampled DEP rain gardens that we inspected in Brooklyn, Queens, and the Bronx, which cost the City more than \$4 million to construct, we found that the majority were not sufficiently maintained to ensure their proper functioning and appearance. That determination was based on our visual inspection of each sampled rain garden for conditions that DEP's Manual identifies as indicators of whether a rain garden is being properly maintained. Such conditions include: the amount of litter and debris present; the presence of sediment in the gravel strips, soil beds, or curb cuts in quantities that could impede water flow and absorption; and the condition of the plants, including whether weeds were growing. These are all factors that affect the system's capacity to manage stormwater effectively and to maintain an appropriate appearance.

Specifically, 67 of the 102 sampled DEP rain gardens (66 percent) were affected by two or more conditions that DEP's Manual states can impair a rain garden's functionality, and 53 of the sampled rain gardens (52 percent) exhibited two or more unsightly conditions, also cited in DEP's Manual as factors that detract from a rain garden's appearance and may signal to the community that the site is under-maintained. Overall, 30 of DEP's sampled rain gardens (29 percent) exhibited 4 or more deficient conditions, and 7 sampled rain gardens were found to be fully maintained in accordance with DEP Manual standards, having no visible deficiencies, and well-maintained tree guard rails and curbs, at the times of our inspections.

Further, and apart from the abovementioned conditions involving functionality and appearance, we observed damaged or sinking tree guard rails at eight rain gardens, damaged or sinking curbs bordering six rain gardens, and one rain garden with both of those conditions. Proper maintenance of tree guards and curbs is essential for protecting the rain gardens and for the safety of pedestrians.

We also found that the BWSO's maintenance logs for many of the sampled rain gardens were incomplete, inaccurate, and ineffective as a management tool for monitoring their condition and maintenance needs. Among other things, we found conditions such as hardscape (tree guards, curbs, concrete) damage, weed growth, sediment accumulation, and missing trees and plants that were not corrected or correctable during routine maintenance. Further, we found that these conditions were not accurately recorded in the logs that would have alerted responsible officials that the conditions remained in need of correction. Moreover, the recording of routine maintenance data on the BWSO's maintenance logs—such as the dates on which trash, weeds, and sediment were reportedly removed—was not always consistent with our contemporaneous observations made during audit inspections of the same rain gardens. In addition, the maintenance logs showed—without any recorded explanation—that some rain gardens in our sample did not receive *any* routine maintenance during a three-week period that coincided with our visual inspections of those sites. The absence of such maintenance contravenes the Manual's standard that requires one- to two-maintenance visits per week for each rain garden. Consequently, DEP management cannot fully rely on BWSO's maintenance logs to accurately account for the condition of the agency's rain gardens and assess the adequacy, efficiency, and effectiveness its maintenance staffing and operations.

Audit Recommendations

This report makes a total of 18 recommendations, including that DEP should:

- Perform required maintenance in accordance with the Manual, at every rain garden, to maintain each rain garden's appearance and proper functioning.
- Ensure that G1 supervisors examine each rain garden after they and their crews have performed maintenance and that they prepare, review, and initial each maintenance log to indicate that it has been accurately and properly completed with all necessary information, including both the tasks they performed and the follow-up maintenance and repair work, if any, that the rain garden still requires to address conditions that need further attention.
- Establish performance targets for G2s to increase their field visits to independently assess and record the condition of the rain gardens they oversee, verify the G1s' maintenance log-reports, and follow up to address deficient conditions in the rain gardens and document those efforts.
- Ensure that the metal tree guard rails and curbs surrounding the rain gardens that were found either damaged or sinking at the locations cited in this report have been fixed.
- Incorporate and/or enhance community engagement as an alternative or supplemental means for improving rain gardens maintenance. In that regard,

- Consider, partnering with the Department of Sanitation and City-contracted business improvement districts to better assess neighborhoods where trash and litter in rain gardens is a persistent problem and identify special events that should trigger additional cleaning.
 - Conduct community outreach to enlist community input and support to raise awareness on best practices, including the proper disposal of litter and the types of issues to report to DEP through 311, to maintain and improve the appearance and functioning of the rain gardens.
 - Consider approaching or partnering with businesses, home owners, institutions, and community associations to adopt rain gardens.
- Ensure that maintenance records of all rain garden sites are complete and accurate.
 - Establish protocols for verification and quality control of rain garden maintenance data.
 - Document the existence of each maintenance issue every time the rain garden site is visited, until the issue is resolved, so that a record of how long the condition has existed and the time taken to correct each of the various issues can be tracked.
 - Revise the maintenance logs so that all nine of the required maintenance tasks prescribed by Section 6 of the Manual are included as part of the routine maintenance checklist. In connection with that revision, designate codes to capture conditions of the tree guard rails and curbs in and surrounding the rain garden.
 - Use photographs to document “before and after” conditions observed each time a rain garden receives maintenance, routine or otherwise, by a DEP maintenance team.
 - Use the collected maintenance data for management analyses to aid in troubleshooting maintenance issues (such as trash, planting, soil health and permeability) and for maintenance program refinements.
 - Install rain garden ID tags with appropriate control number to effectively address maintenance needs reported by the public, effectively communicate with contractors, and for an additional efficiency measure when DEP deploys its planned technology solution.

Agency Response

In its response, DEP stated that it “agrees with, and has largely implemented most of the recommendations contained in the Report” but also stated that it disagrees with 3 of the 18 recommendations (Recommendations # 14, 15, and 18). Of the remaining 15 recommendations, DEP responded directly to 2 (# 2 and 3), and indicated general agreement with, but did not provide a direct response to the remaining 13.

In addition, DEP stated, “We have reviewed the Report and have significant concerns with the report’s findings and recommendations.” In that regard, DEP commented on several specific statements in the report. DEP’s comments are further described and discussed in the Discussion of Audit Results section of this report.

AUDIT REPORT

Background

DEP's mission is to safeguard public health and the environment by supplying clean drinking water, collecting and treating wastewater, and reducing air, noise, and hazardous materials pollution. DEP's BEPA is responsible for citywide planning and implementation of various green infrastructure projects, including rain gardens, under the GI Program, as well as for maintaining all related information. DEP's BWSO is responsible for the maintenance of the rain gardens that are under the jurisdiction of DEP.¹

According to a September 2017 DEP press release, NYC, like other older urban communities, is largely serviced by a combined sewer system where stormwater that falls on roofs, streets, and sidewalks, and wastewater from homes and businesses in each drainage area are carried through a single sewer line to the treatment plant for that area. NYC's 14 treatment plants can manage and treat, to federal Clean Water Act standards, all the wastewater produced in NYC on a dry weather day, or about 1.3 billion gallons on average. On a rainy day they have the capacity to treat more than twice the dry weather flows. However, during intense precipitation events, the stormwater that falls on the City's impervious surfaces exceeds that capacity and overflows will be discharged into local waterways. If the overflows were not discharged, the City's treatment plants would be flooded and severely damaged and wastewater could backup into homes and businesses.

DEP is required to reduce stormwater runoff to improve the water quality in waterbodies surrounding NYC pursuant to the Consent Order by the NYS DEC.² Under the GI Program, DEP is implementing various green infrastructure measures, including construction of rain gardens on City owned property such as streets, sidewalks, schools and public housing to reduce stormwater runoff entering the City's sewer system. According to DEP, rain gardens are valuable green infrastructure assets that help keep stormwater out of local sewers, improve street drainage, purify air, reduce temperatures during hot weather, and reduce puddles and ponds. Overall, rain gardens do the important job of keeping the City's waters clean and improving street aesthetics. In order to do their job properly and retain their appearance, rain gardens need regular maintenance to ensure that they are functioning properly to effectively capture stormwater runoff, thereby helping to reduce the amount of pollution that enters the City's waterbodies.

¹ At the time this audit was initiated, DEP's Bureau of Engineering Design and Construction (BEDC) was responsible for managing the construction of rain gardens. However, during the audit period, that function was transferred to BEPA.

² The waterbodies surrounding NYC include Alley Creek, Bronx River, Coney Island Creek, Flushing Bay, Flushing Creek, Gowanus Canal, Hutchinson River, Newtown Creek, Jamaica Bay & Tributaries, Westchester Creek, and East River & Open Waters. The City of New York, DEP, and NYS DEC entered into a consent order on Combined Sewer Overflow (DEC Case # CO2-20000107-8) on January 14, 2005, which was modified April 14, 2008, September 3, 2009, and March 8, 2012 (collectively, the "CSO Order" or "Order"). Pursuant to the Order, DEP is required to manage the equivalent of 1 inch of rainfall on impervious surfaces in combined sewer areas, among other goals outlined in the Order. NYC's strategy to meet the NYS DEC mandates is laid out in its 2010 Green Infrastructure Plan (GI Plan), and is implemented through the GI Program, a multiagency effort led by DEP. The agency and other DEP partners design, construct, and maintain a variety of sustainable green infrastructure practices such as green roofs and rain gardens on City owned property such as streets, sidewalks, schools, and public housing.

Rain gardens contain plants and engineered soil that have been horticulturally designed to absorb large amounts of stormwater, thereby reducing the amount of water that enters the sewer system. A bowl-shaped depression in the garden holds the water so it can slowly infiltrate into the soil as the plants and mulch naturally remove pollutants from the runoff. For rain gardens to function as intended, an inlet curb cut allows the flow of stormwater runoff to enter the rain garden area.³ During heavy rain events, excess water that cannot be absorbed is discharged as runoff through an outlet curb cut. Gravel is used to filter debris and for protection, a metal tree guard rail surrounds the rain garden on three sides. Most rain gardens have a tree set in the center, surrounded by plants. According to DEP data, a typical standard rain garden—15' long, 5' wide, and 2.5' deep, will hold on average over 1,600 gallons of rainwater, the equivalent of about 20 bathtubs.⁴

Figure 1 - How Rain Gardens Work (source: DEP)

See footnote #3
for explanations of numbered components



³ Numbered rain garden components are: ① **Curb Inlet** – The inlet allows water to flow into the rain garden as it flows down the curb toward the catch basin; ② **Curb Outlet** – Large rain gardens also have an outlet. If the rain garden fills to capacity, water can exit through the outlet; ③ **Stone Strip** – The stone strip (gravel) allows people to step out of their cars without damaging the plants; ④ **Plants** – All rain gardens have plants and grasses which have been carefully selected to ensure they can survive on busy NYC streets; ⑤ **Soil** – The soil is graded so that water ponds in the center of the rain garden; ⑥ **Tree Guard** – All rain gardens have tree guards around them that protect the plants and keep people and dogs from walking inside of it; and ⑦ **Tree** – DEP plants trees in rain gardens as often as possible. Trees benefit neighborhoods by lowering temperatures in hot summer months, improving air quality, and providing habitat for birds and butterflies. (<https://www1.nyc.gov/html/dep/html/stormwater/rain-gardens.shtml>, accessed April 15, 2019)

⁴ The reported capacity of the 15'x5' standard rain garden in GreenHub is 225 CF or 1683 gallons (225 CF x 7.48 gallons/CF). Capacity can vary by size and type of a rain garden; various DEP standard designs are at https://www1.nyc.gov/html/dep/pdf/green_infrastructure/bioswales-standard-designs.pdf.

A rendering of how NYC curbside rain gardens are constructed and function, and a photograph of rain gardens in Rego Park (Queens) posted on the Internet are shown below.



See Appendix I for DEP's standard design of its 15'x5' Type 2 rain garden.

After a rain garden's construction is completed, it is under a guarantee by the contractor. According to DEP, the guarantee period normally spans one to two years where the contractor is responsible for performing regular maintenance tasks as stipulated in the contract to ensure that both the hardscapes (tree guards, curbs, concrete) and plants are in satisfactory condition when rain gardens are turned over to DEP.⁵ The guarantee provisions of these contracts specify maintenance requirements for items such as watering, weeding, cultivating, mulching, soil replacement, etc. necessary for the proper growth of plants during the establishment period. During the guarantee period, BWSO will remove trash and litter on alternate weeks, as deemed necessary, to augment the contractor requirements. Once DEP accepts the rain garden, at or after the expiration of the guarantee period, the rain garden is deemed to be under DEP's sole jurisdiction. At that point, within DEP, responsibility for maintenance of the rain garden is assigned to BWSO for what DEP refers to as "full maintenance."

To help ensure that the rain gardens in full maintenance are appropriately maintained, DEP created the Manual. The Manual serves as a guidebook for DEP/BWSO's maintenance personnel and provides a detailed description of the various types of maintenance tasks, procedures and equipment that are required to maintain the rain gardens' appearance and ensure that they are functioning properly. During full maintenance, BWSO is responsible for providing maintenance services to the rain gardens one to two times each week, according to the Manual. Maintenance locations are broken-down into 18 routes in 31 zones throughout the City.

BWSO's G2s, are oversight employees responsible for the overall maintenance of all DEP rain gardens. During the audit scope period, as of April 17, 2018, DEP was responsible for full maintenance of rain gardens in four boroughs and employed a full time staff of approximately 36, including three G2s: one for Queens, one for the Bronx, and one who covered both Brooklyn and Manhattan. (DEP subsequently acquired four rain gardens in Staten Island; none were in full maintenance during our audit scope period.) Each G2 manages a staff consisting of several supervisors in the job title Gardener-Level I (G1), a total of eight during the period we audited. Each of the G1s directs and performs hands-on maintenance with one of BWSO's maintenance teams, each consisting of four to eight workers. During the period we audited, DEP supplemented the maintenance staff with between 30 and 63 seasonal workers.

According to the Manual, crew leaders (G1s) conduct evaluations of the rain gardens on their assigned routes, as part of their responsibility for the gardens' routine maintenance, before beginning work. Under the supervision of a G1, a team of full-time staff and seasonal workers is supposed to perform prescribed maintenance tasks on the rain gardens on its assigned routes. The G1s are also supposed to document the completed work at each rain garden and any additional tasks that each garden still needs on a pre-printed, hard-copy maintenance log.⁶ The G2s may, at their option, check the sites to verify that the work reported on the logs was done. A BWSO staff analyst receives the G1s' completed maintenance logs and updates BWSO's Excel spreadsheet to reflect all work performed on DEP's rain gardens the preceding week. Additionally, DEP obtains road repaving schedules from the Department of Transportation so that temporary protection for the rain gardens may be installed to prevent asphalt debris from entering into and clogging rain gardens.

⁵ After the exit conference, DEP stated that from 2013 to 2018, the contractor guarantee periods (on plants, trees and hardscapes) varied among DEP and other partner agencies. However, from 2018, all agencies have aligned the plant, tree, and hardscape guarantees to one year.

⁶ Subsequent to the exit conference, DEP informed the auditors that BWSO staff have followed a standard protocol to determine whether a rain garden may be draining slowly or holding water. In addition, if those conditions are confirmed, DEP has additional recordkeeping, follow-up, and testing requirements.

According to the BWSO records—specifically the Excel spreadsheet it provided to us—as of April 17, 2018, a total of 2,511 rain gardens had been constructed within the 4 Boroughs that were either under a contractor guarantee or in full maintenance.⁷ We estimate the City’s cost for the construction of those rain gardens at just over \$100 million, based on DEP’s estimate of \$35,000 to \$45,000 for each one. Of the 2,511 rain gardens on BWSO’s spreadsheet, BWSO was responsible for the full maintenance of 805 in 4 boroughs as shown below:

| Rain Gardens | Brooklyn | Queens | Bronx | Manhattan | Total |
|-------------------------|----------|--------|-------|-----------|--------------|
| Total # | 1,709 | 645 | 154 | 3 | 2,511 |
| Full Maintenance by DEP | 560 | 188 | 54 | 3 | 805 |

According to the data provided by DEP, in Fiscal Year 2017, the total expenditure for the rain gardens maintenance including staffing salaries with fringe benefits (both permanent and seasonal), general supplies and other related services was \$4.23 million and in Fiscal Year 2018 it was \$5.91 million. For Fiscal Year 2019, as of May 21, 2019, that expenditure was \$5.24 million.⁸

During a recent audit of the *Department of Parks and Recreation’s (DPR’s) Oversight of Construction Management Consultants* (SE16-062A) issued on June 15, 2018, we found that many rain garden sites under DPR’s jurisdiction were not properly maintained. Additionally, a March 23, 2017 *New York Times* article reported complaints by the public of inadequate maintenance of rain gardens in Brooklyn and Queens.

The scope of the audit covers the 805 rain gardens that DEP’s BWSO identified it was responsible for providing full maintenance as of April 17, 2018. The audit inspections of the sampled rain gardens were conducted during the months of August and September 2018.

Objective

To determine whether DEP is maintaining the rain gardens constructed under the NYC Green Infrastructure Program to ensure that they are functioning properly and to maintain their appearance.

Scope and Methodology Statement

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. This audit was conducted in accordance with the

⁷ DEP uses a web-based asset tracking system called GreenHub to record the size, location, and construction status of all Green Infrastructure projects, including rain gardens. BEPA is responsible for maintaining the GreenHub system. According to GreenHub, as of May 3, 2018—about two weeks after our audit scope period—DEP was responsible in some capacity for a total of 3,568 rain gardens in all 5 Boroughs, including 4 in Staten Island, 20 in Manhattan, and 1,564 in Queens, an overall difference of 1,057 (42 percent) more rain gardens than BWSO’s record of April 17, 2018 reflected. That difference is partly attributable to the fact that GreenHub, unlike BWSO’s spreadsheet, includes rain gardens that are under construction. Of the 3,568 rain gardens reflected in GreenHub, 924 were in full maintenance status, while BWSO reported in its Excel spreadsheet that only 805 rain gardens were completed and in full maintenance status, a difference of 119 (14.8 percent). According to DEP, before August 2018, there was a 1-2-month administrative lag time in its updating of BWSO’s record—the Excel spreadsheet that BWSO used as its record of the completed rain gardens it was partly or solely responsible to maintain. DEP informed us that as of August 2018—while our audit was in progress—BWSO began using GreenHub for identifying the rain gardens in full maintenance status.

⁸ After the exit conference, DEP reported that BWSO began full maintenance of rain gardens in July 2015, but the rain garden maintenance expenditure amount for Fiscal Year 2016 was not provided to the auditors.

audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The scope of this audit covers DEP's maintenance of rain gardens throughout the City that were identified by DEP's BWSO as in full maintenance, as of April 17, 2018. Please refer to the Detailed Scope and Methodology at the end of this report for the specific procedures and tests that were conducted.

Discussion of Audit Results

The matters covered in this report were discussed with DEP officials during and at the conclusion of this audit. A preliminary draft report was sent to DEP on June 11, 2019, and discussed with DEP officials at an exit conference held on June 25, 2019. On September 20, 2019, we submitted a draft report to DEP with a request for written comments. We received a written response from DEP on October 4, 2019.

In its response, DEP stated that it agreed with and has largely implemented most of the audit's 18 recommendations and expressly disagreed with 3 (recommendations 14, 15, and 18). Of the 15 recommendations that DEP did not expressly disagree with, it directly responded and indicated general agreement with two (recommendations 2 and 3), but did not provide a direct response to the remaining 13. DEP also stated, "We have reviewed the Report and have significant concerns with the report's findings and recommendations." In that regard, DEP provided an overall comment and several individual comments concerning specific statements contained in the audit report.

Specifically, DEP challenged the premise of both the audit report and its own Manual—that appropriate maintenance is necessary to ensure that City-constructed rain gardens continue to function properly, in addition to beautifying the City's neighborhoods and helping clean the air. DEP stated:

Overall, the [audit] Report conflates surface appearance with functionality, which seems to indicate a fundamental misunderstanding by the auditors of how rain gardens are built to operate. The rain gardens are designed and constructed to absorb stormwater flowing down curb lines and to infiltrate that water through the soil and stone layers of the rain garden system, into the underlying soil below the rain garden. When DEP references the terms "rain garden functionality," "functioning rain garden," or "function as designed," in the Rain Garden Maintenance Manual (the Manual) we are referring to how rain gardens perform in the context of this specific purpose. While the plants and trees provide important co-benefits including reducing the urban heat island effect and carbon dioxide sequestration with some limited stormwater benefits such as evapotranspiration and erosion control of the soil, rain gardens would still function without them.

DEP's above-quoted response minimizes both the significance it has represented of proper rain garden maintenance and the negative effects of inadequate maintenance. It further completely disregards the clear delineation made in our audit of the deficiencies we observed into three categories: (1) those that could affect a rain garden's proper functioning; (2) those that affect a rain garden's appearance; and (3) those that could affect both. Those categories, and all of our observations and findings, are based on DEP's own maintenance standards and procedures as set forth in its Manual.

Perhaps more tellingly, DEP's above-quoted response directly contradicts the following statements in its Manual:

- “Rain gardens work best when they are well maintained.” (Page 10)
- “In order to function properly, rain gardens must be able to collect stormwater runoff, store and infiltrate it in planted areas, and pass overflow back into the gutter during large storms. They must be able to support a healthy plant community to take up stormwater. Soils must remain permeable to allow infiltration. When maintaining rain gardens, it is important to keep these key priorities in mind.” (Page 10)
- “Plants allow the system to manage stormwater effectively. Without a healthy plant community, the system cannot fully function.” (Page 10)

DEP’s Manual at Section 6, Maintenance Tasks (pages 39 – 59), prescribes nine categories of maintenance tasks and explains each one’s effects on a rain garden’s appearance and function. In particular, according to the Manual, inadequate trash removal, sediment removal, gravel cleaning, and soil replenishment will over time reduce the flow of water through the soil and stone layers of the rain garden system, and rain gardens would consequently lose their ability to effectively infiltrate storm water—meaning that those surface-level maintenance issues impact the rain garden’s functionality. That conclusion is consistent with guidance provided by the U.S. Environmental Protection Agency (EPA): that inadequate maintenance of rain gardens can lead to diminished stormwater infiltration.⁹ As reported, we found, at 67 of 102 sampled DEP rain gardens, inadequate maintenance in two or more categories of tasks that DEP’s Manual states can impact a rain garden’s functionality, and we found two or more unsightly conditions at 53 of the sampled rain gardens—all of which are indicators of the maintenance weaknesses that DEP needs to address.

In its October 4, 2019 audit response, DEP stated that the Manual cited in our audit report “was in draft form and still being refined and that “[i]t had not yet been distributed to field staff and . . . fully communicated to supervision and field staff.” However, we note that it is the *only* compilation of the standards, requirements, and procedures applicable to rain garden maintenance that DEP has identified as existing during the period covered by audit. Moreover, DEP, through BWSO, provided the Manual to us in June 2018 with a cover email that represented that its date was March 12, 2018, i.e., approximately six months before we conducted our field observations. At no time throughout the audit, through and including our exit conference held on June 25, 2019 when all of our findings *based on the Manual* were presented to DEP, did any DEP representative claim that the Manual DEP provided to us was merely a draft, had not been fully distributed, or was something less than what it facially purports to be—DEP’s written set of maintenance procedures intended to keep the City’s rain gardens clean and functioning properly. To the contrary, at the exit conference a DEP official claimed in substance that the Manual was intended to establish guidelines rather than a set of hard and fast requirements for proper rain garden maintenance. Further, DEP did not inform us until after the June 2019 exit conference that it had updated and distributed the Manual in March 2019. We have reviewed the 2019 Manual and found that the maintenance standards and procedures the March 2019 version of the Manual prescribes as necessary to keep the City’s rain gardens clean and functioning properly are identical to the requirements specified in the 2018 Manual.¹⁰

⁹ EPA, *The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure*, March 2013, at page 9 (“Failure to properly maintain green infrastructure can lead to excessive sedimentation, clogged inlets and outlets, loss of vegetative plantings, soil compaction, and failure to properly infiltrate stormwater.”).

https://www.epa.gov/sites/production/files/2015-04/documents/green_infrastructure-om_report.pdf (accessed October 23, 2019).

¹⁰ In the 2019 Manual we obtained from DEP, the agency has removed an asset evaluation checklist which provided instructions to the BWSO maintenance staff for steps to be taken when specific issues were discovered. We also noted that neither the old nor the new Manual states the date on which it was issued or its effective date; consequently neither date can be discerned from the content of either document.

DEP's remaining substantive comments consist generally of additional explanations in response to specific audit findings, including operational challenges that DEP faces or faced during the audit period, and steps it has taken or is taking to address the audit findings.

As noted in the audit report, the City has invested over \$100 million of public funds in its rain gardens. Moreover, during the last three fiscal years (2017-2019), on average, DEP spent over \$5 million per year on the maintenance of roughly 1/3 of those rain gardens (805 of 2,511 under full maintenance). To protect the City's substantial investment in those green infrastructure assets and ensure that its ongoing expenditures to maintain them produce the intended results, we urge DEP to confront and purposefully address the multiple areas of weakness the audit identified and implement the audit recommendations on an aggressive schedule.

The full text of DEP's response is included as an addendum to this report.

FINDINGS AND RECOMMENDATIONS

The audit found multiple areas of weakness in DEP's maintenance of its rain gardens. These weaknesses need to be addressed to better ensure that City-constructed rain gardens continue to effectively capture stormwater runoff and help reduce amount of pollution that enters into the City's waterbodies, clean the air, and beautify the City's neighborhoods.

Of the 102 sampled DEP rain gardens that we inspected in Brooklyn, Queens, and the Bronx, which cost the City more than \$4 million to construct, we found that the majority were not sufficiently maintained to ensure their proper functioning and appearance.¹¹ That determination was based on our visual inspection of each sampled rain garden for the conditions that DEP's Manual identifies as indicators of whether a rain garden is being properly maintained. Such conditions include: the amount of litter and debris present; the presence of sediments in the gravel strips, soil beds, or curb cuts in quantities that could impede water flow and absorption; and the condition of the plants, including whether weeds were growing. These are all factors that affect the system's capacity to manage stormwater effectively and to maintain an appropriate appearance.

Specifically, 67 of the 102 sampled DEP rain gardens (66 percent) were affected by two or more conditions that DEP's Manual states can impair a rain garden's functionality, and 53 of the sampled rain gardens (52 percent) exhibited two or more unsightly conditions, also cited in DEP's Manual as factors that detract from a rain garden's appearance and may signal to the community that the site is under-maintained. Overall, 30 of DEP's sampled rain gardens (29 percent) exhibited 4 or more deficient conditions, and 7 sampled rain gardens were found to be fully maintained in accordance with DEP Manual standards, having no visible deficiencies, and well-maintained tree guard rails and curbs, at the times of our inspections.

Further, and apart from the abovementioned conditions involving functionality and appearance, we observed damaged or sinking tree guard rails at eight rain gardens, damaged or sinking curbs surrounding six rain gardens, and one rain garden with both of those conditions. Proper maintenance of tree guards and curbs is essential for protecting the rain gardens and for the safety of pedestrians.

We also found that the BWSO's maintenance logs for many of the sampled rain gardens were incomplete, inaccurate, and ineffective as a management tool for monitoring their condition and maintenance needs. Among other things, we found conditions such as hardscape damage, weed growth, sediment accumulation, and missing trees and plants were not accurately recorded, and that such conditions could not be, or were not, corrected during routine maintenance. Further, we found that these conditions were not accurately recorded in the logs that would have alerted responsible officials that the conditions remained in need of correction. Moreover, the recording of routine maintenance data on the BWSO's maintenance logs—such as the dates on which trash, weeds, and sediment were reportedly removed—was not always consistent with our contemporaneous observations made during audit inspections of the same rain gardens. In addition, the maintenance logs showed—without any recorded explanation—that some rain gardens in our sample did not receive *any* routine maintenance during a three-week period that coincided with our visual inspections of those sites. The absence of such maintenance contravened the Manual's standard that requires one- to two-maintenance visits per week for each rain garden. Consequently, DEP management cannot fully rely on BWSO's maintenance logs to accurately account for the condition of the agency's rain gardens and assess the adequacy, efficiency, and effectiveness its maintenance staffing and operations.

¹¹ The \$4 million amount was computed using an average cost of \$40,000 per rain garden for the 102 sampled rain gardens (i.e., \$40,000 x 102). The average cost (\$40,000) was based on \$35,000 to \$45,000 per rain garden costs reported to the auditors by DEP.

These matters are discussed in detail in the following sections of this report.

Rain Gardens Were Not Adequately Maintained

The audit found that the majority of DEP's rain gardens that we examined were not adequately maintained to ensure proper functioning and appearance. We inspected 102 sampled rain gardens and found:

- At 67 (66 percent) of the sampled rain gardens, there were two or more maintenance issues that, according to DEP's Manual, would hinder those rain gardens from functioning properly, i.e., they would not be able to effectively collect stormwater runoff, store and absorb it in planted areas, remove pollutants, and pass the overflow into sewer drains during large storms.
- At 53 (52 percent) of the sampled rain gardens there was trash and/or weedy plants or conditions such as sparse plant coverage, which indicated a need for supplemental plants, or overgrown plants that were in need of pruning. DEP's Manual identifies those types of conditions as factors that detract from a rain garden's appearance and creating unsightly conditions.

See *Appendix III* for a complete list of sampled rain gardens and the specific deficiencies we observed at each of them.

DEP's maintenance regimen is set forth in the Manual and in other records and information the agency provided during the audit. It consists of the following detailed components:



DEP's Maintenance Regimen

DEP's Manual identifies ensuring the proper functioning and appearance as key priorities, and provides instructions for: the maintenance tasks and procedures that must be followed; how to document work performed in the rain garden; how an employee is to assess a rain garden for recurring problems and how to resolve them; and instructions on employee safety. The Manual also explains all tasks and why each task is important for keeping the rain gardens clean and functioning properly.

The following rain garden maintenance tasks are detailed and explained in Section 6 of the Manual: (1) trash removal; (2) sediment removal; (3) gravel cleaning; (4) weeding; (5) watering; (6) cutting back perennials and grasses; (7) supplemental planting; (8) soil replenishment; and (9) snow removal.

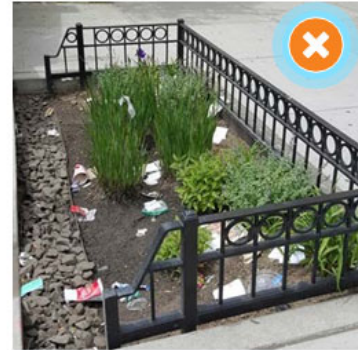
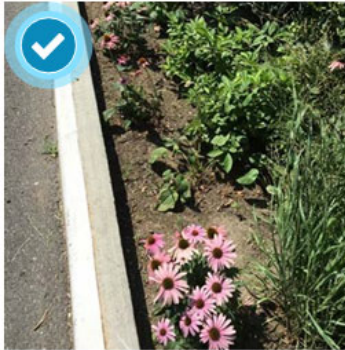
See *Appendix II* for detailed explanations of "effects on appearance and function" for each of the tasks listed above.

DEP's Maintenance Standards for Litter and Debris, Soil Health and Permeability, and Water Flow Paths

According to the Manual, Section 1, the key priorities for maintaining a rain garden to ensure proper functioning are maintaining: plant health, flow paths, and soil health and permeability. The key priorities for maintaining rain garden appearance are ensuring: plant appearance, sight lines, and litter and debris removal. The priorities are illustrated in the Manual, with well-maintained conditions indicated by a  and poorly-maintained conditions indicated with a . Among other things, the Manual describes the importance of maintaining rain gardens free of litter and debris (for

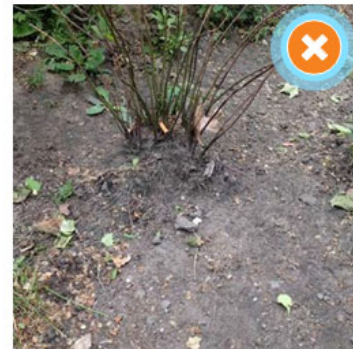
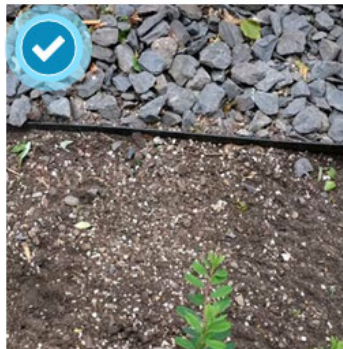
appearance) and maintaining soil health and permeability, and keeping flow paths/curb cuts clear (for proper functioning). Specifically, the Manual states:

Litter and Debris. One of the biggest challenges of maintaining rain gardens is keeping up with the litter that washes in with stormwater, is dropped by pedestrians, or is blown in by the wind. Litter may be worse after large gatherings, weekends and holidays, or in highly trafficked areas. Litter instantly detracts from the appearance of a rain garden and can affect how the community regards the site. Litter must be cleaned up frequently, as well as any other debris (for example large amounts of leaves, dead plants, sticks, or any dumped material).



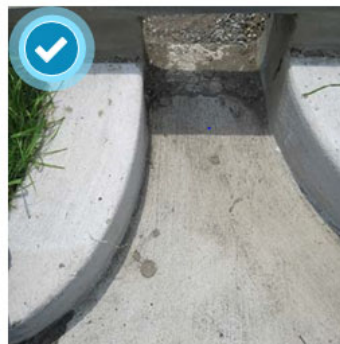
(Left) A cleaned curbline and well-tended plant bed. (Right) Trash, sediment, displaced stones, and weeds create an unsightly appearance.

Soil Health and Permeability. Soil needs to be permeable to allow water to infiltrate. But, over the lifetime of the system, fine particles tend to build up in the soil layer and clog its pores, preventing infiltration. Regularly removing sediment and debris from the planting bed can help prevent clogging.



(Left) A loose, well-aerated soil surface. (Right) Compacted soil at base of a shrub.

Flow Paths. In order to be managed, stormwater must be able to get into the rain garden. It must also be able to get out in a controlled manner during larger storms. Since the flow of stormwater is concentrated at the inflow points, trash, sediment, and other debris carried by stormwater often collect there. Large quantities of debris can alter the flow of water, creating pools of water in the gutter or erosion in the planting bed. In severe cases, debris clogging the inlet can cause stormwater to completely bypass the system. Removing trash and debris from these areas on a weekly basis (or more often if possible) helps keep flow paths clear.



(Left) A clean inlet opening for water entering a rain garden. (Right) An inlet to a rain garden that is partially obstructed with sediment and debris.

DEP/BWSO's Maintenance Organization

Maintenance of DEP's rain gardens in each borough is performed under the management of a G2. The G2 sets up a cyclical routing schedule with a weekly maintenance log in the form of a checklist, known as "DEP GI Maintenance log" (maintenance log). It includes columns to record the date the maintenance was performed and the type of work performed, including removal of trash and leaves, weeding, watering, and the removal of sediment and snow. Snow is removed from catch basins around the rain garden in order to make it visible to any plow drivers.

BWSO's staff perform all listed tasks in the field for each rain garden with the following protocol established for internal oversight and recordkeeping:

- G1s conduct evaluations of rain gardens as part of routine maintenance before beginning work, supervise the work and are required to document in the maintenance log all tasks performed in the field. According to the Manual, Section 3, maintenance tasks that cannot be completed during the routine cyclical maintenance and work requiring additional tools or material should be noted on the maintenance log; examples include damaged or sinking tree guards, a need for soil or gravel replenishment, dead or missing plants, or dead trees. Issues that cannot be addressed during routine maintenance visits are supposed to be reported to the administrative staff and required repairs should be coordinated accordingly.¹²
- G2s may thereafter verify the work and records by visiting sites.
- Finally, a staff analyst records the previous week's maintenance logs data in an Excel spreadsheet.

BWSO management uses the above-described information recorded in the maintenance logs and copied to the Excel spreadsheet for several purposes, including field staff monitoring, internal reporting and management reporting.

Auditors' Observations of Sampled Rain Gardens - Overview

We inspected 102 sampled rain gardens in Brooklyn, Queens, and the Bronx that were in full maintenance, that is, where maintenance was solely within BWSO's responsibility, and to assess whether DEP's maintenance staff were adequately performing the maintenance tasks prescribed in Section 6 of the Manual, we specifically looked to determine whether the following conditions were found: (1) the presence of trash and weeds; (2) an accumulation of sediment in the curb cuts (inlet and/or outlet) or clogging the soil bed or gravel strip; (3) plants that appeared to be either overgrown or sparse; and (4) soil that had become depleted or compacted and needed to be raked and/or replenished.¹³ We also documented whether the metal tree guard rails and/or the curbs surrounding the rain gardens were damaged or sinking; both items are considered safety matters.

Based on our inspections, we determined that in the majority of the sampled rain gardens BWSO was not adequately performing the maintenance tasks as prescribed by the Manual. The results of our inspections are summarized in Table I.

¹² Table 3-1 of the Manual presents additional maintenance issues and scenarios along with next steps and contact information to guide maintenance staff in how to address the issues. After the exit conference, DEP stated that it assumes that the rain garden is functioning as designed unless BWSO maintenance staff observes an abnormal condition in the rain garden (e.g. standing water, sinkholes, adjacent property flooding, damage from outside factors, etc.) during their routine visits, or such issues are reported through 311 or by other means.

¹³ The audit inspections were conducted in the months of August and September 2018. We established that all maintenance tasks except for the snow removal task were seasonally applicable during the months of August and September 2018, according to "Seasonal Applicability" cited for each task in Section 6 of the Manual. Therefore, observation for snow removal task was deemed not applicable, and the soil moisture (watering task) appeared to be not an issue during our inspections.

Table I
Summary of Maintenance Issues

Found during audit inspections at the sampled 102 rain gardens

| Maintenance Tasks | Issues | Issues found at Rain Gardens | |
|---|---|------------------------------|-----|
| Trash Removal * | Contains trash | 66 | 65% |
| Sediment Removal ** | Sediment present in the planting area/curb cut(s) | 50 | 49% |
| Gravel Cleaning ** | Gravel needs cleaning | 53 | 53% |
| Weeding *** | Weeds are present | 40 | 39% |
| Cutting Back Perennials and Grasses *** | Plants require pruning | 11 | 11% |
| Supplemental Planting *** | Rain garden needs plants | 31 | 30% |
| Soil Replenishment ** | Soil appear eroded in the planting area | 31 | 30% |

*Affects rain garden appearance; ** Affects rain garden function; *** Affects both appearance and function (according to DEP's Manual).¹⁴

See *Appendix III* for a complete list of sampled rain gardens with associated audit inspections results.

As noted in Table I, we found that 65 percent of sampled rain gardens contained trash or litter and 39 percent contained weeds—creating unsightly conditions.¹⁵ In general, plant health in the sampled rain gardens was satisfactory; however, sparse planting appeared to be an issue in 31 (30 percent) of the sampled rain gardens.

In addition, 67 (66 percent) of the sampled rain gardens we inspected were impacted by inadequate maintenance—two or more conditions such as accumulated sediment, gravel needing cleaning, weed growth, and soil needing replenishment—that, alone or in combination, would hinder them from functioning properly.

¹⁴ In the Table I, gravel conditions were not applicable in two cases. Therefore, the issues found for gravel cleaning at 53 rain gardens resulted in 53 percent (i.e., 53/100 not 53/102).

¹⁵ In response to the trash and litter we reported to DEP that we observed during our inspections, DEP stated that the abundance of litter and trash on NYC streets is a global issue that needs to be tackled by multiple city agencies and with the help of NYC residents and businesses and that while DEP is working on tackling this huge effort, it does not fall solely on that agency to reduce or eliminate street litter in the City. DEP added that unfortunately the rain gardens capture street litter very well and so it has fallen on DEP to remove it. Furthermore, DEP stated that minor to moderate litter and weeds will not affect the primary function of stormwater management.

Example - DEP Failed to Maintain a Rain Garden with Multiple Deficiencies

As an example of a DEP rain garden that was inadequately maintained, during our inspection on September 14, 2018, we noted accumulations of trash, litter, leaves and weeds in the rain garden located at 63 Mother Gaston Blvd & Hull Street in Brooklyn (*Site ID# 0266a*; photo at right). We also noted that the curb at this location was sinking. When we reviewed the relevant DEP-BWSO maintenance logs, we noted that no maintenance tasks had been performed in this rain garden in the three-week period coinciding with our inspection (the weeks preceding, including, and following our inspection). When we questioned that lack of maintenance, the Brooklyn G2 informed us that the G2s decide where the field staff should concentrate their efforts based on priorities. However, that practice is inconsistent with the weekly or twice-weekly maintenance schedule specified in the Manual.



Specifically, according to the Manual:

Field crews work in each rain garden *once or twice a week* to remove trash. During each visit the crew may also pull weeds, remove sediment, water plants and take note of any damage done to the rain gardens. During these visits crews also informally assess the condition of plants and structural parts of the system and document any special needs or action items. [Emphasis added.]

As the Manual also notes:

The accumulation of trash can create [a] negative perception of green infrastructure from nearby residents, businesses and communities. Unmanaged trash can promote further littering and dumping. It can also damage plants or block the flow of water, and in some cases even become a health hazard.

Moreover, we found that DEP's maintenance logs do not contain any notations of the Brooklyn G2's decision to forgo maintenance at the site in question or signatures that would indicate a managerial review of the records. (Inaccurate and incomplete maintenance records are discussed in a subsequent section of this report.) As a result of DEP's undocumented deviation from its own prescribed maintenance cycle, this rain garden did not receive the required maintenance for at least three consecutive weeks, and at the time of our audit inspection, its appearance was unsightly, and its capacity to function properly was questionable.

Example - DEP Failed to Address Multiple Deficiencies in a Second Rain Garden

In another example, during our inspection on September 19, 2018, in the rain garden located at 34 4th Avenue and Dean Street in Brooklyn (Site ID# B-6a; photo at right), we noted conditions of trash, litter, weeds, sparse planting, poor soil health and permeability, and the flow path partially filled with sediment. DEP's maintenance logs for this rain garden indicated that trash was removed from it in the weeks preceding, during, and after our inspection. According to the maintenance logs, weeds were also removed the week after our inspection. No other notations were present on any of the maintenance logs for the three-week period we reviewed. Based on our inspection, and the requirements specified in the Manual, the need for soil replenishment and planting should have been recorded on the maintenance logs, but neither was. BWSO does not use photographs to document rain garden conditions during its routine maintenance visits;¹⁶ therefore, we cannot comment on the actual conditions of this rain garden during the week before and the week after our inspections.



According to the Manual, plants are important to how the rain garden's system works—in addition to how it looks and how it is perceived by the community. Sparse plantings allow more trash to blow into the rain gardens, and weedy plants that are not removed can spread seeds and unwanted vegetation to other sites, such as parks and private property. Additionally, sediment that is allowed to accumulate can damage plants by burying the stems and coating the leaves and can also clog the gravel strip and soil bed, leading to less infiltration of storm water, while sediment-laden rain gardens may also be perceived by the public as unkempt.

DEP Failed to Secure and Report Rain Gardens with Structural Damage as Required

In addition to the maintenance issues summarized in Table I above, according to the Manual, tree guards and curbs are considered safety measures to protect rain gardens as well as the public. Accordingly, the Manual, at Section 3, stipulates that problems affecting such rain garden structures that may require further coordination and follow-up to correct, or that may simply require equipment and materials that are not normally carried during routine maintenance, must be documented in the maintenance logs on the dates they are observed and that photos and notes are recommended. Moreover, the staff is required to secure the site when a tree guard is broken, crooked, slumped, fallen over, or has sharp edges exposed. Similarly, if the sidewalk surface is buckled, cracked, or heaving, or if the curb along or beyond the rain garden's edge is broken, DEP's staff is required to secure the site and call 311 to report the issues so that appropriate City agency or department will be informed.

Notwithstanding those requirements, however, during our inspections, we found sinking or damaged tree guards and curbs at 15 locations in Brooklyn, Queens, and in the Bronx.¹⁷ None of those sites

¹⁶ After the exit conference, DEP informed auditors that it only uses photographs to document the conditions when slow drainage or ponding conditions are confirmed.

¹⁷ The site #s were A-3, B-4, B-5, B-7b, B-9, B-9a, B-11, B-16, B-44, F-2, 0235a, 0266a, 4380a, 4420a, and 4463.

were secured at the time of our inspections, none of the structural damage was recorded on the 311 complaint log BWSO provided to us except for one site (Site B-11 in Brooklyn), and none of the maintenance logs we reviewed for the 15 sites reflected the deficient condition of the tree guards and curbs.¹⁸ (Photos in the next section of this report depict examples of damaged and sinking tree guards and curbs.)

Conclusion: DEP's Routine Maintenance of the City's Rain Gardens Is Inadequate

Although DEP aims to perform required weekly maintenance, including weeding, soil raking/replenishment, and gravel cleaning, it was evident that those tasks were not performed and/or adequately performed at the locations cited above.

Additional photos of conditions noted during audit inspections at select sampled locations are shown in *Appendix IV*, categorized by issue(s) associated with Section 6 maintenance tasks. See *Appendix III* for a complete list of the 102 sampled rain gardens and the specific deficiencies we observed at each of them.

Recommendations

DEP should:

1. Perform required maintenance in accordance with the Manual, at every rain garden, to maintain each rain garden's appearance and proper functioning.

DEP Response: DEP did not directly respond to this recommendation.

2. Ensure that G1 supervisors examine each rain garden after they and their crews have performed maintenance and that they prepare, review, and initial each maintenance log to indicate that it has been accurately and properly completed with all necessary information, including both the tasks they performed and the follow-up maintenance and repair work, if any, that the rain garden still requires to address conditions that need further attention.

DEP Response: DEP appears to have agreed with the recommendation.

Auditor Comment: Please see Auditor Comment following DEP's response to Recommendation 3.

3. Establish performance targets for G2s to increase their field visits to independently assess and record the condition of the rain gardens they oversee, verify the G1s' maintenance log-reports, and follow up to address deficient conditions in the rain gardens and document those efforts.

DEP Response: DEP appears to have agreed with recommendations 2 and 3. In its response, DEP stated, "Since the time of the audit, DEP has distributed the Rain Garden Maintenance Manual to supervisory and field staff, and maintenance practices are now performed in accordance with those new standards. The critical Tasks and Standards for both the Gardener Level 2 [G2s] and Gardener Level 1 [G1s] titles have been re-written to strengthen accountability and improve performance. The G1 gardeners are focusing more on the inspection of assets and ensuring that all maintenance logs are completed accurately. The G2 gardeners are refining existing performance targets to expand their field visits to better assess field conditions and more efficiently deploy field staff."

¹⁸ The 311 complaint log BWSO provided to us covered the period from December 2017 through June 2019.

Auditor Comment: DEP to its credit has recognized the need to establish performance standards for its rain garden maintenance supervisors and oversight staff that correspond to the Manual's standards. In addition, however, we urge DEP to ensure that the relevant tasks and standards for G1s and G2s are spelled out in sufficient detail to fully implement the recommendations, which include ensuring that G2s—whose job is to ensure that all rain gardens are properly maintained—increase their field visits, assess the particular rain gardens for which they are responsible, follow up to ensure deficient conditions are addressed, and document the results of all such efforts.

4. Increase the frequency of maintenance or specific maintenance tasks on specific maintenance routes and at specific locations, based on analyses of maintenance data.

DEP Response: DEP did not directly respond to this recommendation.

5. Ensure that the metal tree guard rails and curbs surrounding the rain gardens that were found either damaged or sinking at the locations cited in this report have been fixed.

DEP Response: DEP did not directly respond to this recommendation.

6. Appropriately secure and report rain gardens with structural damage as required.

DEP Response: DEP did not directly respond to this recommendation.

7. Incorporate and/or enhance community engagement as an alternative or supplemental means for improving rain gardens maintenance. In that regard,
 - a. Consider, partnering with the Department of Sanitation and City-contracted business improvement districts to better assess neighborhoods where trash and litter in rain gardens is a persistent problem and identify special events that should trigger additional cleaning.
 - b. Conduct community outreach to enlist community input and support to raise awareness on best practices, including the proper disposal of litter and the types of issues to report to DEP through 311, to maintain and improve the appearance and functioning of the rain gardens.
 - c. Consider approaching or partnering with businesses, home owners, institutions, and community associations to adopt rain gardens.

DEP Response: DEP did not directly respond to this recommendation.

DEP's Rain Garden Maintenance Record-keeping Is Incomplete and Inaccurate

Maintenance Logs Do Not Reflect Conditions Auditors Observed

BWSO's maintenance staff's work is tracked by use of a weekly, hard-copy checklist known as the maintenance log, for work performed at each rain garden by borough and, within each borough, by route. The log for each route contains pre-printed information for each rain garden on the route, such as the site ID number, the address, and the nearest cross street. The form includes three columns for the G1s to record the tasks performed at each site and one additional column for comments. In the first column, the G1 checks off boxes to denote the days trash was removed from each listed site. In the second column, the staff enters a pre-designated codes for any of four tasks—removal

of leaves, snow, and weeds and for watering—depending on the tasks performed on any specific day. In the third column, for each site, the G1 selects the codes that correspond to any of four tasks the staff performed—sediment removal, pruning, planting and painting. The last column provides a space for comments, which should include recording tasks and issues that could not be addressed during the routine maintenance that week and any other conditions that are not categorized in the first three columns, such as issues with tree guard rails and curbs.¹⁹ At the end of the week, the data from the hard-copy maintenance records is transferred into a BWSO spreadsheet.

We compared our observations with the BWSO maintenance logs for the corresponding sites to identify any discrepancies regarding the work BWSO reported as performed or needed. Based on our comparisons, we found the maintenance logs to be incomplete, inaccurate, and as used by BWSO, inadequate to ensure that the maintenance regimen and schedule set forth in the Manual is followed and that conditions requiring attention are documented to alert the responsible officials. Specifically, we noted the following inconsistencies:

- No work was recorded in the maintenance logs—which were blank—for 10 rain gardens on the Bed-Stuy2 route in Brooklyn – sites 0235a, 0214a, 0231a, 0233a, 0231c, 0248a, 0266a, 0261d, 0261b, and 0263d – during the three weeks ending September 7, 14, and 21, 2018. The absence of *any* recorded maintenance at those sites was contrary to the Manual's procedures, which at a minimum, require cleaning once or twice each week and an informal assessment of plant and structural conditions. When we asked the Brooklyn G2 why the logs for the 10 sites were blank, we were informed that no maintenance had been performed at the sites because they were not in need of it as some of the other rain gardens in his area.

However, during our inspections on September 14, 2018, we noted maintenance needs at all 10 locations, for work such as trash or sediment removal, gravel cleaning and/or replenishment, and/or soil replenishment.²⁰ For example, on September 14, 2018, we noted that rain garden site # 0261d located at 243 Hull Street, Brooklyn contained accumulated litter, sparse plant coverage, a gravel strip in need of cleaning, and a soil bed that needed replenishment and raking (photos below).



Rain Garden site # 0261d at 243 Hull Street in Brooklyn.

- We found 8 rain gardens with damaged or sinking tree guard rails, 6 with curbs that were damaged and/or sinking, and 1 had both issues at the time of our inspections—a total of 15 sites with those conditions, none of which were recorded in the DEP's maintenance logs. For example, on September 27, 2018, at rain garden site # B-11 on Shieffelin Avenue, Bronx, we

¹⁹ On the maintenance logs we reviewed, last updated dates varied from 2017 to 2018. According to BWSO, the forms have been revised numerous times to refine data collection.

²⁰ See *Appendix II* for specific issues found at each of the locations.

noted that the perimeter curb and the tree guard rails were sinking (photos below). None of these conditions were noted in the BWSO maintenance logs.



Sinking Tree Guard Rails and Perimeter Curb at Rain Garden Site B-11, 1930 Shieffelin Avenue, between E225 St. & E226 Dr., in Bronx.

- In addition, on September 19, 2018, we observed rain garden site # B-11 on Waverly Avenue, off Atlantic Avenue, in Park Slope, Brooklyn. As shown in the photos below, this site contained no plants and no tree—all of which were missing. In addition, its tree rail guards were broken and sinking; it contained trash; and the area was muddy with sewer-like odor, an indication of prolonged ponding conditions. However, none of those conditions/details were noted in the DEP’s maintenance log. According to the maintenance log for that week, the site had been cleaned of trash two days before our visit. *The log contained no indication that any additional tasks were performed or required*, notwithstanding its decimated condition and the Manual’s instruction that maintenance “crews informally assess the condition of plants and structural parts of the system and document any special needs or action items.” In addition, the BWSO files contained no documentation, and DEP did not provide any documentation including photographs, that would support DEP’s claim (after the exit conference) that BWSO followed a standard protocol for documenting, reporting and follow-up on slow drainage or ponding conditions—each of which is an indication that a rain garden is not functioning as designed.²¹



Rain Garden site B-11 at 551 Waverly Avenue in Brooklyn.

²¹ We also revisited this rain garden on May 16, 2019 and on June 21, 2019, and found that the conditions had further deteriorated.

- 65 percent of the rain gardens were littered notwithstanding the fact that the maintenance logs we examined for the three-week duration indicated that most of the rain gardens had been cleaned. It is possible that some of those sites had been cleaned and had subsequently become re-littered before we observed them. However, we DEP's maintenance logs did not contain notations of persistent litter conditions and so cannot be readily reconciled with the accumulations of litter we observed, including some litter that appeared to have been exposed to the elements for some time.

Without consistently and accurately recording *all* maintenance activities and issues affecting the rain gardens for which they are responsible, BWSO and DEP management cannot effectively track them or determine the resources needed to keep the rain gardens in good repair. In the absence of such information, management is hindered in its ability to monitor the agency's performance of its maintenance responsibility for the City's rain gardens, properly allocate resources, safeguard City assets, and ensure that management's directives are carried out, as prescribed by Comptroller's Directive #1, *Principles of Internal Control*.

Gravel Cleaning Task Missing from the Maintenance Log

We noted that "Gravel Cleaning," although required by the Manual at Section 6, is not listed on the maintenance log form as a required task to be performed during routine maintenance. Its absence from the log may have contributed to BWSO's failure to consistently clean the gravel at the sampled sites. We found that in 53 percent of sampled rain gardens, gravel conditions were inadequate. According to the Manual, the gravel strip in a rain garden acts as a permeable pre-filter for gravel filled gabion located below the strip, which helps store and allow infiltration of stormwater. If gravel cleaning is not performed, gravel strips, like other porous surfaces, can become clogged with sediment over time and lose their ability to infiltrate storm water optimally.²² Accumulated sediment can also promote weed growth in the gravel strip; the impacted areas may become mucky and slippery, making them unsafe for pedestrians getting in and out of cars. Further, accumulation of weeds and debris in the gravel strip may signal to the community that the rain garden site is under-maintained.

BWSO Does Not Photograph Rain Garden Conditions Requiring and Receiving Maintenance

We found that BWSO does not use photographs to help document the conditions in its rain gardens that require and receive maintenance. However, the Manual repeatedly recommends the use of photographs to document specific conditions such as issues that require special tools, equipment, or guidance, and unusual conditions such as discarded hypodermic needles in rain gardens.

For example, Section 3 of the Manual, *Asset Evaluation and Issue Response*, states,

Issues that cannot be addressed during routine maintenance visits need to be reported to the administrative staff. In some cases it may be necessary to coordinate with other agencies to fix the issue, or the task may simply require special tools, equipment, or guidance. *Typically it is best to document issues using photos and notes.* [Emphasis added.]

Reinforcing that point, the Manual itself uses photographs to illustrate the standards of well-tended conditions and conditions requiring maintenance. Further, the Manual at Section 2 lists key points

²² In newer DEP rain garden designs, porous concrete pavers are used as a replacement for top gravel strip.

for DEP staff in engaging with community members. One expressly advises that community members use photographs as a means to document and report a problem with a rain garden to DEP via e-mail (RainGardens@dep.nyc.gov).

It thus appears that DEP recommends and uses photographs for various communications concerning rain garden maintenance, *except* for directly requiring that its own maintenance and supervisory staff use them to document field conditions as part of their routine maintenance activity and reporting. Had DEP used photographs for that purpose, many of the above-cited conditions might have been addressed. Photographs could have helped the G2s to identify actual site conditions and take appropriate and timely corrective action. Documenting “before and after” maintenance conditions with photographs would help DEP better assess, effectively troubleshoot, and address problem areas and refine its rain garden maintenance program.

Subsequent to the exit conference, DEP informed the auditors that BWSO staff have followed a standard protocol that entail observations to determine whether a rain garden may be draining slowly or holding water. These observations are made immediately after a rain event and, if confirmed, are documented with photographs and reported to supervising gardeners through the field chain of command.²³ As stated previously, however, the BWSO files we examined contained no photographs, and DEP did not provide documentation, including any photographs, that would support its abovementioned statement.

Management Analyses of Maintenance Data Can Be Enhanced

According to Comptroller’s Directive #1, *Principles of Internal Control*, Section 5, under Management Review at Functional or Activity Level, states that

Management, throughout the organization, should be comparing actual functional or activity level performance data to planned or expected results, analyzing significant variances and introducing corrective action as appropriate.

As stated earlier, BWSO captures maintenance data involving rain gardens on a spreadsheet. We asked DEP officials whether BWSO uses its maintenance data for any management analysis and reporting and, if so, whether the agency used it for troubleshooting and program refinement. In response, DEP officials acknowledged that the current record-keeping system is very basic and cumbersome, and although DEP uses the data for maintenance assessment and staff monitoring, the existing reporting does not facilitate advanced reporting.

DEP officials said that they are in the process of automating the rain garden maintenance work-flow and reporting functions with a view toward using them for refining the maintenance program, troubleshooting, and advanced reporting, for example, by generating “heat maps” of specific maintenance-need trends (similar to a software application on tablet devices that another DEP division uses for fire hydrant inspections). DEP informed us that its anticipated deployment date for this solution is 2020, without providing a more precise date. In connection with DEP’s proposed solution, we believe that creating a functionality to capture site-condition photographs would help management facilitate more complete and accurate record-keeping and could enable DEP’s G2s and other managers to perform the kinds of management analyses needed for program refinement.

²³ DEP stated that at the limited sites where DEP had observed standing water or other potential functionality issues, DEP conducted testing and took appropriate action to remedy the issues. DEP added that in fall 2018, 10 sites had soil replaced and are now functioning.

Recommendations

DEP should:

8. Ensure that the G1s clearly understand the maintenance and recordkeeping requirements.

DEP Response: DEP did not directly respond to this recommendation.

9. Ensure that all maintenance staff clearly understand the maintenance requirements and consistently perform the required tasks.

DEP Response: DEP did not directly respond to this recommendation.

10. Ensure that maintenance records of all rain garden sites are complete and accurate.

DEP Response: DEP did not directly respond to this recommendation.

11. Establish performance targets for G2s to increase their field monitoring of the conditions of rain gardens and the accuracy of maintenance log data.

DEP Response: DEP did not directly respond to this recommendation.

12. Establish protocols for verification and quality control of rain garden maintenance data.

DEP Response: DEP did not directly respond to this recommendation.

13. Document the existence of each maintenance issue every time the rain garden site is visited, until the issue is resolved, so that a record of how long the condition has existed and the time taken to correct each of the various issues can be tracked.

DEP Response: DEP did not directly respond to this recommendation.

14. Revise the maintenance logs so that all nine of the required maintenance tasks prescribed by Section 6 of the Manual are included as part of the routine maintenance checklist. In connection with that revision, designate codes to capture conditions of the tree guard rails and curbs in and surrounding the rain garden.

DEP Response: DEP disagreed with the recommendation, stating, “GI Maintenance has revised and simplified the maintenance logs to record only routine maintenance. Tasks such as pruning, replanting, gravel replacement, soil replacement and tree guard repairs are recorded on separate assessment sheets. These data are recorded as work orders and tracked in the IPS system.”

Auditor Comment: DEP states that it has devised a new mechanism to initiate work orders when certain work needs are determined and track them in the agency’s IPS (Infor Public Sector) system. We note, however, that the Manual says nothing about that new procedure.

Moreover, DEP also states that it has made two important procedural changes to its maintenance regimen and recordkeeping, i.e., (1) removing certain assessments and tasks from its routine maintenance regimen; and (2) using two forms, where it previously used one, to record those assessments and the tasks performed. However, we note that the current 2019 Manual does not reflect those changes. Rather, the 2019 Manual (page 36) continues to refer to a single, standard maintenance log (checklist) that will be used to document the type of maintenance done at each rain garden. We urge DEP to ensure that all of the checklist items, observations, and maintenance tasks specified in the 2019 Manual are performed

regularly and that all maintenance needs and issues observed are recorded in the relevant maintenance records accurately and completely at the time they are observed. In addition, we continue to recommend that DEP include both gravel cleaning and soil replenishment in the tasks that are performed as part of routine maintenance to address gravel and soil conditions before they deteriorate to the point where gravel replacement and soil replacement are necessary.

15. Use photographs to document “before and after” conditions observed each time a rain garden receives maintenance, routine or otherwise, by a DEP maintenance team.

DEP Response: DEP disagreed with the recommendation, stating, “As noted earlier, GI Maintenance currently manages 3,105 rain gardens that are in some form of maintenance, either supplemental or full. Taking pre and post-maintenance photos of each asset during each maintenance visit would be cumbersome and time consuming.”

Auditor Comment: Based on our experience during inspections of over 100 sampled sites, we estimate that taking photographs of a rain garden to document its “before and after” conditions would add no more than two to three minutes on average to each maintenance visit. The benefit—enabling DEP’s oversight staff, including G2s, and central management to readily check the condition of multiple rain gardens from their offices—would likely outweigh the additional time needed to take the photographs. In addition, the G1s who are currently required to document rain garden conditions solely by writing, or soon by keying-in their descriptions in text or narrative form, could save time by abbreviating those written descriptions and referring instead to the relevant photographs. Conceivably, the recommended photographs could be taken with City-issued cameras. Moreover, DEP plans to deploy new tablets to its maintenance staff to record inspection and maintenance activity electronically, an opportune time to incorporate photographs into the electronic records.

Photographs would provide DEP with visual proof and validation of the condition of its rain gardens and the quality of maintenance performed. In addition, photographs could help DEP evaluate and prioritize complaints, inquiries, and service requests concerning rain gardens that the agency may receive from the public and public officials. Had DEP used before and after photographs as a practice during the audit period, management would have had the opportunity to proactively identify issues and timely mitigate the maintenance deficiencies cited—and depicted photographically—in the audit report.

Finally, addressing DEP’s point that implementing this recommendation would require it to manage and store some 260,000 photographs per year, we estimate that the agency would need to allocate less than 1 terabyte of additional memory, at a cost of less than \$50, to manage that data, provided that DEP also establishes an appropriate record-retention period for the photographs.

Therefore, we urge DEP to reconsider its rejection of this recommendation.

16. Use the collected maintenance data for management analyses to aid in troubleshooting maintenance issues (such as trash, planting, soil health and permeability) and for maintenance program refinements.

DEP Response: DEP did not directly respond to this recommendation.

17. Incorporate a functionality to capture site conditions photographs in the planned technology solution.

DEP Response: DEP did not directly respond to this recommendation.

Other Issue

An Absence of ID-tags on Rain Gardens May Lead to Service Uncertainty

We observed that DEP affixes a bright blue “NYC Environmental Protection Rain Garden” decal to a corner of the rain gardens’ tree guard rails. The decal identifies the rain gardens as being property of New York City Environmental Protection and advises the public, “Questions? Call 311,” which would include calls concerning maintenance issues. However, we found that DEP assigns, but does not mark the rain gardens with, unique ID numbers, for example, by using asset-control ID tags. Doing so could improve the public’s ability to report maintenance issues concerning a specific rain garden. Precise reporting would help BWSO to easily identify the specific rain garden and facilitate its ability to route the issue to the appropriate unit and track its resolution.²⁴ In absence of a specific identification number, when the public wishes to report an issue with a rain garden to DEP or through 311, the address in question is estimated using either crossing streets or the address of a nearby building. However, situations exist where a reported location could allow confusion in identifying a specific rain garden, leading to uncertainty over which rain garden should be serviced and by whom.

For example, BWSO records lists five rain gardens with the same address of 108-07 65th Rd, Queens; however, those rain gardens have separate Site IDs (sites: 4413A, 4413B, 4420A, 4420B, and 4420C) on BWSO spreadsheets. For such locations, the lack of ID tags (corresponding to BWSO’s Site ID# or another unique ID#) makes the correct rain garden harder to identify and could lead to confusion and, for a person attempting to bring a problem to the City’s attention, that might discourage the reporting of rain garden maintenance issues. Enabling the public to more precisely identify the location by an ID tag number would facilitate accurate reporting and allow BWSO to deploy maintenance staff quickly to the correct site, and possibly take timely action to extend the life of the plants and ensure the site’s proper functioning and appearance. A timely City response, in turn, could help encourage the neighboring community to care for the rain garden.

Additionally, we foresee a potential for confusion in a situation when, at any given time, numerous rain gardens in full maintenance—DEP responsibility—adjoin rain gardens that are in contractor guarantee periods—contractor responsibility (a situation we encountered in Queens). As stated previously, during the guarantee period, the contractor is required to provide maintenance only once every other week. BWSO’s staff provides trash removal during the alternate weeks to augment contractor maintenance. In such cases, describing the garden solely by location could lead to uncertainty concerning the entity responsible for performing the required service or repair—contractor or DEP.

In that regard, we also had difficulty identifying certain rain gardens based on BWSO logs only, but we were able to accurately identify those rain gardens using supplemental information found in the GreenHub data, such as rain garden size and location coordinates. Finally, we found that despite common site ID numbers in both the BWSO maintenance logs and GreenHub system, rain garden addresses did not always match—a potential source of confusion when DEP staff from different

²⁴ Based on our inspections, we noted that nine rain gardens in the Bronx had the site ID number hand painted by DEP staff on tree guards. In effect, DEP staff are unofficially identifying the rain gardens by its site ID number which indicates their need to reference these rain gardens for their own internal purposes. However, once tree guard’s rails are repainted, the site ID number will disappear.

bureaus are communicating with contractors who perform contractual maintenance during the guarantee period.²⁵

Although no specific City standard applies explicitly to rain-garden identification, the City has developed and implemented standards that prescribe the use of appropriate ID-tags attached to a City asset. For example, DPR's *Street Tree Planting Standards for New York City (2016)* requires a maintenance tracking tag to be attached to a sturdy branch of each covered New York City tree to identify it. DPR's Forestry, Horticulture, and Natural Resources division uses its tree planting standards to *protect, restore, expand and manage* New York City's green spaces and natural areas to maximize the benefits for environmental and community health and resilience—goals that are nearly identical to those of the Green Infrastructure Plan that applies to DEP's rain gardens. Similarly, another analogous standard is found in Section 28 of the City of New York Department of Investigation's Standards for *Inventory Control and Management*, which requires City agencies to establish property-identification protocols, including the use of "[r]eadable, sturdy property identification tags (reading 'Property of the City of New York') with a sequential internal control number [that] are assigned and affixed to valuable items."

Considering that rain gardens, according to DEP, cost between \$35,000 and \$45,000 each to construct and are designed both to beautify neighborhoods and to help keep stormwater out of local sewers, improve street drainage, purify air, reduce temperature during hot weather, and reduce puddles and ponds, it would be prudent and reasonable to identify each rain garden individually to facilitate better maintenance and public engagement in protecting them.

Recommendation

DEP should:

18. Install rain garden ID tags with appropriate control number to effectively address maintenance needs reported by the public, effectively communicate with contractors, and for an additional efficiency measure when DEP deploys its planned technology solution.

DEP Response: DEP disagreed with recommendation, stating, "It is not practical to install signs with unique identifiers at each rain garden asset. Identification signs would require Public Design Commission approval and not all GI assets have uniform structural features (tree guards for example,) that would welcome the installation of signs."

Auditor Comment: DEP's objection is puzzling, considering the duplication of addresses and the potential for confusion in its current system for identifying its rain gardens. Other City agencies have devised practical ways to identify similar public assets, such as the ID tags DPR uses to identify trees.

Alternatively, DEP could complement its planned technology solution—the use of tablets to record rain garden maintenance—by incorporating machine-readable QR codes and corresponding, visible ID numbers, each unique to a given rain garden, in the design of the standard decal DEP currently uses to identify all rain gardens

²⁵ Of the 102 sampled rain gardens records, we found 71 cases in which addresses in GreenHub did not exactly match the addresses in the BWSO Excel spreadsheet and 11 cases in which addresses were not recorded in GreenHub. After the exit conference, in its written comments, DEP stated that rain garden addresses are simply guides for location because they could be adjacent to more than one building, around the corner from a building entrance with the closest address, or adjacent to a park or other open space with no obvious entrance. DEP also stated that the most accurate location information is the X, Y coordinates. However, during the audit, that system of location identification was not used either by the BWSO maintenance staff or in the 311 rain garden complaint logs; both used addresses to identify rain garden locations.

generally as DEP property. Those decals advise the public to call 311 with questions—adding the unique identifier would make that advice more meaningful.

We urge DEP to implement this recommendation to increase both the accuracy of the information 311 operators collect and refer to DEP concerning the rain gardens and DEP's efficiency in managing these valuable public assets.

DETAILED SCOPE AND METHODOLOGY

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. This audit was conducted in accordance with the audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The scope of this audit included rain gardens that were in “full maintenance” as of April 17, 2018 according to BWSO records for which DEP was responsible for performing maintenance to keep up their appearance and to ensure that they are functioning properly.

From DEP’s website, we obtained background information about DEP’s mission, how Combined Sewers function and its impact due to overflows on water quality in the waterbodies surrounding the City, and how DEP is implementing Green Infrastructure measures under the GI Program to reduce stormwater and thereby improve water quality in the waterbodies.²⁶ We obtained detailed information about rain gardens including how they work and their benefits. Further, we reviewed a prior audit issued by our office, entitled *Audit Report on the Department of Parks and Recreation’s Oversight of Construction Management Consultants* (SE16-062A), issued on June 15, 2018, and noted findings and conditions relevant to this current audit.

To understand DEP’s policies and procedures and existing governing structure for the maintenance of rain gardens, we obtained and reviewed:

- Relevant organization charts;
- DEP’s Rain Garden Maintenance Manual (Maintenance policies and procedures);²⁷
- A list of IT systems used by DEP for the audit subject;
- A list of all rain gardens based on GreenHub data. We also obtained user accounts and explored DEP’s GreenHub system, a web-based asset tracking system on which DEP maintains records of all green infrastructure projects, including rain gardens with associated information such as their size, location, and construction status; and
- A list of rain gardens that were in full maintenance from BWSO.

To understand DEP’s internal controls for administering the rain garden maintenance program, we interviewed appropriate key DEP officials, including:

- The Director of BEPA regarding DEP’s responsibility over rain gardens that are in jurisdiction of DEP;²⁸
- IT support staff in BEPA to understand GreenHub functionalities;
- The Chief and Deputy Chief of BWSO’s Green Infrastructure Maintenance unit to gain an understanding of Bureau’s role in the maintenance of rain gardens; and

²⁶ We also reviewed relevant consent orders on Combined Sewer Overflow and the City’s 2010 GI Plan to understand DEP’s responsibilities and goals of stormwater reductions in the waterbodies surrounding New York City.

²⁷ After the exit conference, BEPA officials claimed that the Manual provided to auditors was a draft version.

²⁸ BEPA is responsible for planning and implementation of the DEP’s GI program.

- The Chief of Project Management (BWSO) to obtain an overview of how rain garden maintenance data is managed, tracked and their record-keeping.

We analyzed the list of 2,511 rain gardens based on the BWSO data (as of April 17, 2018) provided by BWSO. The focus of the audit was 805 rain gardens under full maintenance only, as of that date. We conducted comparison tests of the GreenHub and BWSO lists of rain gardens in full maintenance to determine whether they were complete and accurate. We followed up with DEP to clarify or obtain additional information, when deemed necessary.²⁹ Initially, we accompanied the G1 supervisors on their maintenance routes in Brooklyn and Queens so we could observe and obtain an understanding of maintenance activities performed and documents used by the field staff to support the work performed and any additional maintenance needs. We also, obtained an understanding of how hard-copy field records are maintained at the BWSO's central office at Greenpoint in Brooklyn.

As criteria for audit inspections and evaluations, we used DEP's Rain Garden Maintenance Manual which provides a thorough description of the various types of maintenance procedures, standards with illustrations and equipment that is required so the rain gardens continue to retain their appearance and function properly. As secondary criteria, we used the BWSO maintenance log which is designed to record all maintenance work at each rain garden site.

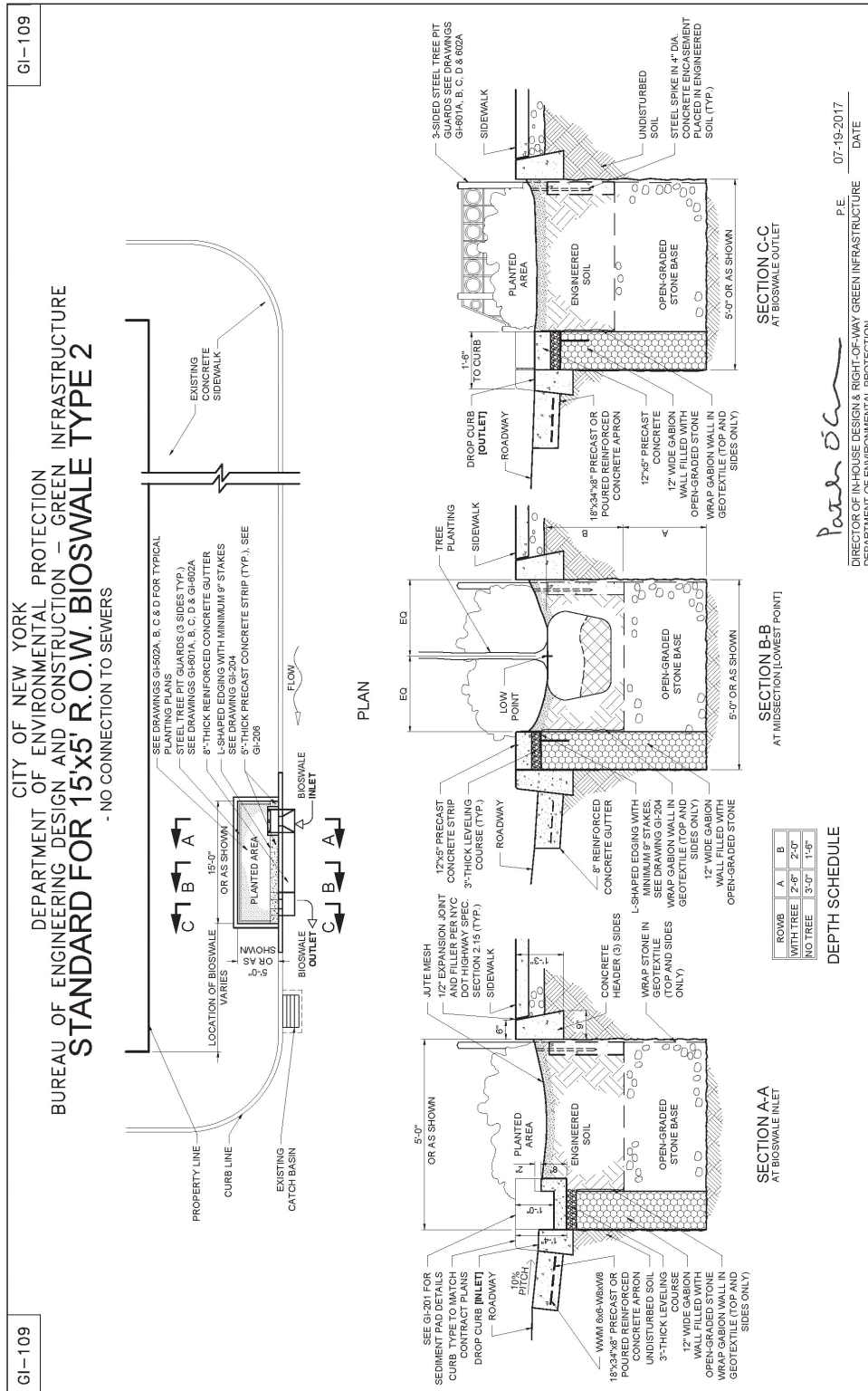
Subsequently, based on our assessment of DEP's internal controls and the requirements in its Rain Garden Maintenance Manual, we developed a field survey including a rain garden inspection checklist. Specifically, the survey was designed to evaluate the conditions of the rain gardens' hardscape, landscape, general conditions, and resulting maintenance issues based on the stipulated maintenance tasks. For an audit sample selection, we mapped the location of each full maintenance rain garden based on the address listed on BWSO maintenance log route sheets and identified where the majority of full maintenance rain gardens were clustered. Subsequently, we selected the areas with the four largest clusters of full maintenance rain gardens in three boroughs. The selection resulted in a sample of 102 rain gardens that were in full maintenance, on 4 different BWSO maintenance routes in three boroughs. The judgmental sample included rain gardens in the Bronx (1 route – 22 rain gardens), Brooklyn (2 routes – 44 rain gardens) and in Queens (1 route – 36 rain gardens).³⁰ We conducted visual inspections of the 102 sampled rain gardens and documented our inspections and took photographs. We also obtained BWSO's maintenance logs of the same rain gardens for the same week, a week prior and a week after. Further, we obtained 311 complaint logs for rain gardens from BWSO. The 311 logs provided to us covered the duration from December 2017 through June 2019.

After evaluating sampled rain garden conditions in the field, we compiled and assessed the information including photographs to determine DEP's compliance with the maintenance requirements. Additional information, clarifications, and documents (if any) were requested from DEP as needed during the audit and at the end of our fieldwork to ensure that DEP submitted all the documents utilized to track the maintenance of the rain gardens. We also conducted research on the Internet to obtain standards relevant to asset identification and tracking. The results of the above tests, while not projectable to their respective populations, provided a reasonable basis for us to evaluate the DEP's controls over the maintenance of the rain gardens.

²⁹ We deemed the BWSO list of rain gardens in full maintenance status to be the audit population rather than the larger list recorded in GreenHub. According to DEP, there was a 1-2-month administrative lag time before BWSO's records would be updated and we wanted to ensure that BWSO would have been aware of its responsibility for all of the rain gardens included in the audit scope.

³⁰ Three rain gardens in Manhattan, in full maintenance, were omitted from the audit sample due to nature of rain garden design and a different set of BWSO maintenance requirements. No rain gardens were constructed in Staten Island, according to BWSO records as of April 17, 2018.

A Standard DEP Rain Garden Design (15' x 5' Type 2)
(Source: https://www1.nyc.gov/html/dep/pdf/green_infrastructure/bioswales-standard-designs.pdf)



Section 6 Maintenance Tasks
(Effects and Importance, *per DEP Manual*)

1) Trash Removal

- The accumulation of trash can create negative perception of green infrastructure from nearby residents, businesses and communities.
- Unmanaged trash can promote further littering and dumping.
- It can also damage plants or block the flow of water, and in some cases even become a health hazard.

2) Sediment Removal

- Sediment laden rain garden may be perceived as unkempt by the public.
- Sediment can damage plants by burying the stems and coating the leaves. It can also clog the gravel strip and soil bed, leading to less infiltration of storm water.
- Accumulated deicing salts are toxic to plants and reduce soil quality.
- Reduced infiltration causes mud, muck, and unhealthy plants.

3) Gravel Cleaning

- Gravel strips, like other porous surfaces, can become clogged with sediment over time and lose their ability to infiltrate storm water.
- Accumulated sediment can promote weed growth in the gravel strip.
- They may also become mucky and slippery, making them unsafe for pedestrians getting in and out of cars.
- Accumulation of weeds and debris in the gravel strip may signal to the community that the site is under-maintained.

4) Weeding

- Both native and non-native plants can look “weedy” if they are overgrown.
- Weeds look messy and may be considered a nuisance by neighbors.
- Invasive weeds can out-compete desired plants for sunlight, water and nutrients.
- Invasive plants could harbor pests and diseases that can be harmful to desirable plants.
- Invasive plants allowed to grow in rain gardens may produce seeds that could spread to parks and private properties.

5) Watering

- Sufficient soil moisture is necessary for plant growth, which prevents soil erosion and compaction.
- Watering helps newly planted plants get established and maintains established plants during drought.
- Loss of plants caused by the lack of water can have a compounding effect—as vegetation becomes thinner in the rain garden there is less shade and temperature regulation for the remaining plants.
- Watering prevents wilting and browning, keeping rain gardens attractive looking for the community

Section 6 Maintenance Tasks (Cont.)

6) Cutting Back Perennials and Grasses

- Overcrowded conditions can cause poor air circulation which can promote disease.
- Shading of surrounding vegetation can cause weak, sparse or leggy growth.
- Top heavy or lopsided growth can collapse on surrounding vegetation, creating structural issues.
- Overgrown plants may block sight lines which can cause pedestrian and vehicular conflicts or create the appearance of hidden, unsafe conditions.

7) Supplemental Planting

- A healthy plant canopy shades plant roots and keeps the underlying soil moist.
- A full cover of desirable plants helps to prevent weed seed germination.
- A well vegetated rain garden helps create a positive perception of green infrastructure within the community.

8) Soil Replenishment

- Soil loss due to erosion changes the intended bowl-shaped soil surface of the rain garden and cause an uneven distribution of water to vegetation.
- Reduced soil coverage can lead to exposed roots and unhealthy, under-performing plants.
- Clogged surface layers of the soil can reduce infiltration capacity.
- Toxins in the soil can cause plant to die off.
- Sediment on the soil surface of the rain garden makes it look under-maintained.

9) Snow Removal

- During freezing condition, there is usually no storm water to be managed. Frozen ground infiltrates less water.
- As the ground thaws it becomes more important to ensure that water can enter and exit the rain garden.

Summary of Maintenance Deficiencies
(found at Sampled Rain Gardens)

Legend:

- A Issues that affect rain garden *appearance*
- F Issues that affect rain garden *function*
- A/F Issues that affect both *appearance* and *function*

| Queens | | Site Information | | | A | F | F | A/F | A/F | A/F | F | Total # of deficient conditions impacting | |
|----------|---------|------------------|------------------|------------------|---------------|------------------|-----------------|---------|-------------------------------------|-----------------------|--------------------|---|----------|
| Sample # | Site ID | Number | Street | Cross Street | Trash Removal | Sediment Removal | Gravel Cleaning | Weeding | Cutting Back Perennials and Grasses | Supplemental Planting | Soil Replenishment | Appearance | Function |
| 1 | 4486c | 67-09 | 67th Rd | 108th St | | x | | | | | | 0 | 1 |
| 2 | 4486b | 67-09 | 67th Rd | 108th St | | x | | | | | | 0 | 1 |
| 3 | 4486a | 67-09 | 67th Rd | 108th St | | x | | | | | | 0 | 1 |
| 4 | 4460a | 66-35 | 67th Ave | 108th St | x | | | x | | | | 2 | 1 |
| 5 | 4460b | 66-35 | 67th Ave | 108th St | x | | | x | | | x | 2 | 2 |
| 6 | 4452 | 66-20 | 108th St | 66th Ave | x | | x | x | | | | 2 | 2 |
| 7 | 4455a | 66-05 | 108th St | 66th Ave | x | | | x | | | | 2 | 1 |
| 8 | 4419a | 65-39 | 108th St | 66th Ave | x | | | x | | | | 2 | 1 |
| 9 | 4419b | 65-39 | 108th St | 66th Ave | x | | | x | | | | 2 | 1 |
| 10 | 4413a | 108-07 | 65th Rd | 108th St | x | | x | x | | | | 2 | 2 |
| 11 | 4413b | 108-07 | 65th Rd | 108th St | x | | x | x | | | | 2 | 2 |
| 12 | 4420a | 108-07 | 65th Rd | 108th St | x | | x | x | | | | 2 | 2 |
| 13* | 4420b | 108-07 | 65th Rd | 108th St | x | | x | x | | | | 2 | 2 |
| 14 | 4420c | 108-07 | 65th Rd | 108th St | x | | x | x | | | | 2 | 2 |
| 15 | 4377a | 64-51 | 65th Ave | 108th St | x | x | x | x | | x | x | 3 | 5 |
| 16 | 4381a | 64-48 | 108th St | 65th Ave | x | x | x | x | | x | x | 3 | 5 |
| 17* | 4380a | 64-28 | 108th St | 64th Rd | | x | x | | | | x | 0 | 3 |
| 18 | 4380b | 64-28 | 108th St | 64th Rd | | x | x | | | | x | 0 | 3 |
| 19 | 4376a | 64-27 | 108th St | 64th Rd | | x | | x | | | x | 1 | 3 |
| 20 | 4376b | 64-27 | 108th St | 64th Rd | | x | | x | | | x | 1 | 3 |
| 21 | 4369b | 64-02 | 108th St | 64th Ave | | | | | | | | 0 | 0 |
| 22 | 4369a | 64-02 | 108th St | 64th Ave | x | | | | | x | | 2 | 1 |
| 23 | 4337a | 63-54 | 63rd Dr | 108th St | | x | | | | x | | 1 | 2 |
| 24 | 4332a | 63-52 | 63rd Dr | 108th St | | x | | | | x | x | 1 | 3 |
| 25 | 4295b | 63-10 | 63rd Ave | 108th St | x | | | | | x | | 2 | 1 |
| 26 | 4295a | 63-10 | 63rd Ave | 108th St | x | | | | | x | | 2 | 1 |
| 27 | 4341a | 102-36 | 64th Ave | Yellowstone Blvd | | | x | | | | | 0 | 1 |
| 28 | 4365b | 102-36 | 64th Ave | Yellowstone Blvd | | | x | | | | | 0 | 1 |
| 29 | 4365a | 102-36 | 64th Ave | Yellowstone Blvd | | | x | | | | | 0 | 1 |
| 30 | 4367 | 102-35 | Yellowstone Blvd | 64th Rd | | | x | x | | | | 1 | 2 |
| 31 | 4366b | 102-35 | 64th Rd | Yellowstone Blvd | x | | | x | | | x | 2 | 2 |
| 32 | 4366a | 102-35 | 64th Rd | Yellowstone Blvd | x | x | x | x | | | x | 2 | 4 |
| 33 | 4447 | 66-10 | 66th Rd | Yellowstone Blvd | x | x | x | | | | x | 1 | 3 |
| 34* | 4463 | 105-10 | 66th Rd | Yellowstone Blvd | | | x | | | | | 0 | 1 |
| 35 | 4462 | 66-37 | 67th Ave | Yellowstone Blvd | | x | x | | | | | 0 | 2 |
| 36 | 4483 | 67-11 | 67th Ave | Yellowstone Blvd | | x | x | x | | | | 1 | 3 |

Summary of Maintenance Deficiencies (cont.)

| Bronx | | Site Information | | | A | F | F | A/F | A/F | A/F | F | Total # of deficient conditions impacting | |
|----------|---------|------------------|-----------------|----------------------------|---------------|------------------|-----------------|---------|-------------------------------------|-----------------------|--------------------|---|----------|
| Sample # | Site ID | Number | Street | Cross Street | Trash Removal | Sediment Removal | Gravel Cleaning | Weeding | Cutting Back Perennials and Grasses | Supplemental Planting | Soil Replenishment | Appearance | Function |
| 37* | B-44 | 1930 | Schieffelin Ave | E225 St & E226 Dr | x | | | | | | | 1 | 0 |
| 38 | B-11 | 1930 | Schieffelin Ave | E225 St & E226 Dr | | | | | | | | 0 | 0 |
| 39 | B-8 | 1925 | Schieffelin Ave | E 229 St | x | x | x | | | x | | 2 | 3 |
| 40 | B-22A | 1925 | Schieffelin Ave | E 226 Dr | | | | | | | | 0 | 0 |
| 41 | B-45 | 1925 | Schieffelin Ave | E226 Dr & E229 St | x | x | x | | | | x | 1 | 3 |
| 42 | B-43 | 1920 | Schieffelin Ave | E 226 Dr | x | | x | | | | | 1 | 1 |
| 43* | B-9 | 1920 | Schieffelin Ave | E226 Dr & E229 St | x | x | x | | | | | 1 | 2 |
| 44 | B-41 | 1920 | Schieffelin Ave | E226 Dr & E229 St | x | | x | | | x | x | 2 | 3 |
| 45 | B-10 | 1890 | Schieffelin Ave | E 226 Dr | x | | x | | | | | 1 | 1 |
| 46 | B-42 | 1890 | Schieffelin Ave | E 226 Dr | x | | | | | | | 1 | 0 |
| 47 | B-21B | 1890 | Schieffelin Ave | E 226 Dr | x | x | x | | | | | 1 | 2 |
| 48 | B-21A | 1880 | Schieffelin Ave | E 226 Dr | | | | | | | | 0 | 0 |
| 49* | B-9A | 1860 | Schieffelin Ave | E226 Dr & E229 St | x | | x | | | x | | 2 | 2 |
| 50 | B-21 | 1860 | Schieffelin Ave | E 226 Dr | | x | x | | | x | | 1 | 3 |
| 51 | B-27 | 1189 | Schieffelin Ave | E 229 St | | x | x | | | | | 0 | 2 |
| 52 | B-40 | 1189 | Schieffelin Ave | E 229 St | | | | | | | | 0 | 0 |
| 53 | B-25 | 1175 | E 229 St | 229 Dr S & 229 Dr N | x | | | | | | | 1 | 0 |
| 54 | B-26A | 1175 | E 229 St | 229 Dr N | x | x | | | | | | 1 | 1 |
| 55 | B-24 | 1170 | E 229 St | 229 Dr S & 229 Dr N | x | | x | | | x | | 2 | 2 |
| 56 | B-18 | 1175 | E 225 St | E 226 Dr & Schieffelin Ave | | | | | | | | 0 | 0 |
| 57* | B-16 | 1155 | E 225 St | E 226 Dr & Schieffelin Ave | x | | | | | x | | 2 | 1 |
| 58 | B-17 | 1155 | E 225 St | E 226 Dr & Schieffelin Ave | | x | x | | | | | 0 | 2 |

Summary of Maintenance Deficiencies (cont.)

| Brooklyn | | Site Information | | | A | F | F | A/F | A/F | A/F | F | Total # of deficient conditions impacting | |
|--|---------|------------------|---------------------|---------------------|---------------|------------------|-----------------|---------|-------------------------------------|-----------------------|--------------------|---|----------|
| Sample # | Site ID | Number | Street | Cross Street | Trash Removal | Sediment Removal | Gravel Cleaning | Weeding | Cutting Back Perennials and Grasses | Supplemental Planting | Soil Replenishment | Appearance | Function |
| 60 | 0305a | 1420 | Bushwick Ave | Moffat St | x | | | | | | | 1 | 0 |
| 61 | 0305c | 1420 | Bushwick Ave | Moffat St | x | x | | | | | | 1 | 1 |
| 62 | 0306c | 35 | Moffat St | Bushwick Ave | x | x | x | | | x | | 2 | 3 |
| 63 | 0310e | 41 | Cooper St | Bushwick Ave | | x | x | x | | x | x | 2 | 5 |
| 64 | 0303a | 1763 | Broadway | Chauncey St | x | | x | | | x | | 2 | 2 |
| 65 | 0299a | 1765 | Broadway | Chauncey St | x | | x | x | | | | 2 | 2 |
| 66 | 0299b | 1765 | Broadway | Chauncey St | x | | x | x | | x | | 3 | 3 |
| 67* | 0235a | 162 | Thomas S Boyland St | Hull St | x | x | x | | | x | x | 2 | 4 |
| 68 | 0214a | 170 | Thomas S Boyland St | Hull St | | x | | | | x | | 1 | 2 |
| 69 | 0231a | 74 | Hull St | Thomas S Boyland St | x | x | x | x | | x | x | 3 | 5 |
| 70 | 0233a | 74 | Hull St | Thomas S Boyland St | x | x | | | | x | x | 2 | 3 |
| 71 | 0231c | 103 | Hull St | Thomas S Boyland St | | x | x | x | | | x | 1 | 4 |
| 72 | 0248a | 205 | Hull St | Mother Gaston Blvd | | | | | | | | 0 | 0 |
| 73* | 0266a | 63 | Mother Gaston Blvd | Hull St | x | x | x | x | | | x | 2 | 4 |
| 74 | 0261d | 243 | Hull St | Mother Gaston Blvd | x | x | x | | | x | x | 2 | 4 |
| 75 | 0261b | 221 | Hull St | Mother Gaston Blvd | x | x | x | | | | x | 1 | 3 |
| 76 | 0263d | 228 | Hull St | Mother Gaston Blvd | x | x | x | | | x | x | 2 | 4 |
| 77 | 0268a | 86 | Mother Gaston Blvd | Somers St | x | | x | | | x | | 2 | 2 |
| 78 | 0245a | 109 | Somers St | Mother Gaston Blvd | x | x | x | x | | x | x | 3 | 5 |
| 79 | 0244b | 76 | Somers St | Mother Gaston Blvd | x | x | x | | | x | | 2 | 3 |
| 80 | 0244c | 68 | Somers St | Mother Gaston Blvd | | x | x | | | x | x | 1 | 4 |
| 81 | B-6a | 34 | 4th Ave | Dean St | | x | x | x | | | x | 1 | 4 |
| 82 | B-6b | 34 | 4th Ave | Dean St | x | x | | x | | | x | 2 | 3 |
| 83 | B-7a | 45 | 4th Ave | Dean St | x | | x | x | | x | x | 3 | 4 |
| 84* | B-7b | 45 | 4th Ave | Dean St | | x | | x | | x | x | 2 | 4 |
| 85* | B-11 | 551 | Waverly Ave | Atlantic Ave | x | x | | x | | x | x | 3 | 4 |
| 86 | B-7 | 547 | Clinton Ave | Atlantic Ave | x | x | x | x | | | | 2 | 3 |
| 87* | B-5 | 470 | Vanderbilt Ave | Atlantic Ave | | | | | | | | 0 | 0 |
| 88 | B-3 | 510 | Clermont Ave | Atlantic Ave | x | x | x | x | x | x | x | 4 | 6 |
| 89* | B-4 | 487 | Clermont Ave | Atlantic Ave | x | x | x | x | | | x | 2 | 4 |
| 90 | B-2 | 761 | Carlton Ave | Atlantic Ave | x | | | x | | | | 2 | 1 |
| 91 | B-1 | 329 | 3rd Ave | 3rd St | x | x | | x | x | | | 3 | 3 |
| 92 | A1 | 32 | 2nd Ave | 6th St | x | | | x | x | | | 3 | 2 |
| 93 | A2 | 32 | 2nd Ave | 6th St | x | | | | x | | | 2 | 1 |
| 94* | A3 | 32 | 2nd Ave | 6th St | x | x | | | x | | | 2 | 2 |
| 95 | C1 | 167 | 6th St | 3rd Ave | x | | | | | | | 1 | 0 |
| 96 | C2 | 167 | 6th St | 3rd Ave | x | | | | | | | 1 | 0 |
| 97 | C3 | 167 | 6th St | 3rd Ave | | x | | | x | | | 1 | 2 |
| 98 | C4 | 167 | 6th St | 3rd Ave | | x | | | x | | | 1 | 2 |
| 99 | F1 | 250 | 6th St | 4th Ave | x | | | | x | | | 2 | 1 |
| 100* | F2 | 250 | 6th St | 4th Ave | | | | x | x | | | 2 | 2 |
| 101 | F3 | 250 | 6th St | 4th Ave | x | | | x | x | | | 3 | 2 |
| 102 | F4 | 250 | 6th St | 4th Ave | x | | | x | x | | | 3 | 2 |
| Street on which rain garden is located | | | | | 65 | 49 | 52 | 40 | 11 | 31 | 31 | | |
| Address nearest to rain garden | | | | | | | | | | | | | |

Summary of Maintenance Deficiencies (cont.)



Rain garden found to be well-maintained with no visible deficiencies that DEP's Manual cites as affecting functionality or appearance, as well as well-maintained tree guard rails and curbs.

| Number of deficient conditions per rain garden | # of Rain gardens affected | | |
|---|----------------------------|----------|---------|
| | Appearance | Function | Overall |
| 0 | 20 | 14 | 8 |
| 1 | 29 | 22 | 13 |
| 2 | 41 | 29 | 24 |
| 3 | 11 | 19 | 27 |
| 4 | 1 | 12 | 16 |
| 5 | | 5 | 9 |
| 6 | | 1 | 4 |
| 7 | | 1 | 1 |
| | 102 | 102 | 102 |

| | | | |
|----------------------------|--------------|--------------|--------------|
| Total deficient conditions | 2 or more | 2 or more | 4 or more |
| | 53 | 67 | 30 |
| => | 53/102 = 52% | 67/102 = 66% | 30/102 = 29% |

Examples of Inadequate Rain Garden Maintenance
(in accordance with select Section 6 maintenance tasks)

****Bold & Italicized = Street on which rain garden is located***

Contained Trash and Debris



221 ***Hull St.*** & Mother Gaston Blvd.,
Brooklyn (Site ID# 0261b)

1175 ***E 229 Street***, Bronx
(Site ID# B-26A)

Needed Sediment Removal and Flow Path Cleared



34 4th Avenue & ***Dean Street***, Brooklyn
(Site ID# B-6a)



1925 ***Schieffelin Avenue***, between E226 Dr &
E229 St., Bronx (Site ID# B-45)

Needed Gravel Cleaning



63 **Mother Gaston Blvd.** & Hull Street,
Brooklyn (Site ID# 0266a)



1920 **Schieffelin Ave.**, between E226 Dr. &
E229 St., Bronx (Site ID# B-9)

Needed Gravel



487 **Clermont Ave.** & Atlantic Ave.,
Brooklyn (Site ID# B-4)



64-51 108th Street & **65th Ave.**, Queens
(Site ID# 4377a)

Needed Soil Replenishment and Raking



1765 Broadway & **Chauncey Street**, Brooklyn (Site ID# 0299b)



63-52 108th St. & **63rd Dr.**, Queens (Site ID# 4332a)

Needed Supplemental Planting



63-54 108th St. & **63rd Dr.**, Queens (Site ID# 4337a)



1155 E **225th Street**, Bronx (Site ID# B-17)

Needed Pruning



1420 Bushwick Ave., & **Moffat St.**, Brooklyn (Site ID# 0305a)



Photograph taken on 8/23/2018

64-27 108th Street & **64th Rd.**, Queens (Site ID# 4376a)



October 4, 2019

Ms. Marjorie Landa
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Re: Audit Report on the Department of Environmental Protection's
Maintenance of Rain Gardens – SE18-086A

Dear Ms. Landa:

Thank you for the opportunity to comment on the New York City Comptroller's draft report on the Department of Environmental Protection's (DEP) Maintenance of Rain Gardens (the Report). We have reviewed the Report and have significant concerns with the report's findings and recommendations.

Overall, the Report conflates surface appearance with functionality, which seems to indicate a fundamental misunderstanding by the auditors of how rain gardens are built to operate. The rain gardens are designed and constructed to absorb stormwater flowing down curb lines and to infiltrate that water through the soil and stone layers of the rain garden system, into the underlying soil below the rain garden. When DEP references the terms "rain garden functionality," "functioning rain garden," or "function as designed," in the Rain Garden Maintenance Manual (the Manual) we are referring to how rain gardens perform in the context of this specific purpose. While the plants and trees provide important co-benefits including reducing the urban heat island effect and carbon dioxide sequestration with some limited stormwater benefits such as evapotranspiration and erosion control of the soil, rain gardens would still function without them.

As described in the Maintenance Manual, and as was observed by the auditors during field observations with DEP staff, DEP's routine maintenance activities generally consist of surface level upkeep of the rain gardens including litter removal, sediment removal where needed, and long-term care of the plants and trees. While this surface level maintenance is important to ensure that community aesthetic expectations are met, there is no reason to assume a rain garden is not functioning as designed.

Please find below of listing several specific issues with the Report:

- Rain Garden Maintenance Manual – The report makes repeated references to the maintenance standards set forth in the DEP Rain Garden Maintenance Manual. As discussed at the exit conference, at the time of the audit the Maintenance Manual was in draft form and still

- being refined. It had not yet been distributed to field staff and the new standards for rain garden maintenance had not yet been fully communicated to supervision and field staff. The Rain Garden Maintenance Manual was distributed to staff in March 2019. Throughout most of the Draft Audit, reference is frequently made to the “standards in the Rain Garden Maintenance Manual,” yet the manual was not released to the green infrastructure (GI) maintenance staff until March 2019, six months after the field inspections by the audit team took place.
- Page 8, third paragraph “... (G2s) are managerial employees...” – G2s are labor class titles and not managerial employees.
- Page 11, fourth paragraph “...we observed damaged or sinking tree guards...or sinking curbs.” – This type of hardscape repair work often requires specialized contractors and is outside of the traditional maintenance duties performed by GI maintenance staff. As such, BWSO supplements GI maintenance work with contracts. DEP is developing a multi-million dollar contract to repair rain gardens; this is a successor to a previous contract utilized for similar hardscape repairs. In the interim, DEP is addressing necessary repairs with small purchase orders.
- At Page 14, last paragraph “...clogging of the soil bed or gravel strip...” – Cleaning the gravel strip often requires a complete rehabilitation of the gravel strip. This type of work is usually noted by a gardener on a separate form and then scheduled with other gravel repairs in multiple assets for efficiency purposes. Soil replenishment typically includes the removal of soil and the replacement of plants.
- Page 17, “DEP failed to address multiple deficiencies in a second rain garden” – This observation evidences a lack of understanding as to how GI maintenance staff perform their fieldwork. Weeding and planting are not routine maintenance. On a typical workday the work task priority is trash and sediment removal; weeding is typically performed by a separate crew working on multiple assets. Planting is similarly performed by separate crews and is subject to plant availability and the planting seasons.
- Page 18, footnote 16 “BWSO has not made available the complaint log for September 2018.” – In August of 2018, DEP transitioned its 311 complaint tracking from internal Excel spreadsheets directly to the bureau’s Hansen IPS system. On June 6, 2019, DEP provided the Comptroller’s office with 104 pages of Rain Garden related data, which included the period mentioned in the footnote.
- Page 18, Recommendations – Since the time of the audit, DEP has distributed the Rain Garden Maintenance Manual to supervisory and field staff, and maintenance practices are now performed in accordance with those new standards. The critical Tasks and Standards for both the Gardener Level 2 and Gardener Level 1 titles have been re-written to strengthen accountability and improve performance. The G1 gardeners are focusing more on the inspection of assets and ensuring that all maintenance logs are completed accurately. The G2 gardeners are refining existing performance targets to expand their field visits to better assess field conditions and more efficiently deploy field staff.
- Page 19, “DEP’s Rain Garden Maintenance Record-keeping is incomplete and inaccurate.” – As the number of assets in full maintenance have increased to 2,959 from the 805 at the time of the audit field visits, it has become cumbersome and difficult to manage the maintenance logs. DEP is developing a computer tablet to digitize the maintenance logs

and improve inspection and reporting efficiency. As that process continues, DEP has made efforts to simplify the maintenance logs to record more accurate field data.

- Page 19, last paragraph “...no work was recorded in the maintenance logs...” – During the week of September 14, 2018, work crews assigned to the zones in question were temporarily detailed to the Springfield Lake Bluebelt to perform weeding and invasive plant removal in response to complaints from the local council member, community board, and park activists. Routine maintenance was performed on the assets in question, but the maintenance logs were never properly completed by the covering work crew. The amount of litter noted in the photographs on page 20 is considerably less than would have been expected to accumulate during a three-week period.
- Page 20, first paragraph “We found 8 rain gardens with damaged or sinking tree guard rails...” – DEP recognizes that there are occasional deficiencies in some of the hardscapes associated with the rain gardens. Much of this repair work requires specialized contractors and is outside of the traditional maintenance duties performed by GI maintenance staff. As such, DEP supplements GI maintenance work with contracts. DEP is developing a multi-million dollar contract to repair rain gardens; this is a successor to a previous contract utilized for similar hardscape repairs. In the interim, DEP is addressing necessary repairs with small purchase orders.
- Page 20, last paragraph “However, none of those conditions/details were noted in the DEP’s maintenance logs.” – In April 2018, DEP simplified its maintenance logs. The original maintenance logs (used during the audit inspections) were complicated and contained too much information. The new maintenance logs are designed to record only routine maintenance activities such as trash, sediment, leaves and snow removal. Tasks such as pruning, replanting, gravel replacement, soil replacement and tree guard repairs, are recorded on separate assessment sheets by the G2s and G1s. These assessment sheets are converted into work orders in the IPS system.
- Page 21, Waverly Avenue – This particular rain garden, B-11, has been a problem asset for a number of years. Though it is cleaned regularly, it cannot be replanted because it does not drain properly. DEP is working to retire the asset.
- Page 21, “Gravel cleaning task missing from maintenance log” – The gravel cleaning data is kept separately by the G2s and G1s on a separate site assessment sheet. Gravel cleaning is not a routine maintenance task. The cleaning of sediment out of the gravel strips is a labor-intensive process and usually requires a complete gravel strip rehabilitation. This type of work is pre-scheduled and performed in bulk.
- Page 22, “BWSO does not photograph rain garden conditions requiring and receiving maintenance” – DEP does use photographs to document non-routine maintenance (illegal dumping, broken tree guards, damaged gravel strips etc.). It would be cumbersome, however, to photograph every rain garden before and after maintenance. Currently DEP has 3,105 rain gardens in some form of maintenance status. Taking pre and post maintenance photos of each asset would equal over 260,000 photos per year.
- Page 23, “Management analysis of maintenance data can be enhanced” – DEP agrees with most of the recommendations made, with the exception of recommendation to “use photographs to document before and after conditions...” DEP has rewritten critical tasks and standards for the gardener level 2 and 1 titles, implemented the new maintenance

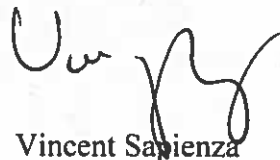
standards as outlined in the Rain Garden Maintenance Manual, and is advancing efforts to issue new Standard Operating Procedures for Green Infrastructure Maintenance.

- Page 24, "An Absence of ID-tags on Rain Gardens may lead to service uncertainty" – All of the rain garden locations are captured in DEP's Geographic Information System, including the unique identifier numbers for each asset. The maintenance tablet will be linked to GIS and allow field staff to identify specific rain gardens in the field.

DEP agrees with, and has largely implemented most of the recommendations contained in the Report. DEP disagrees with three of the recommendations as discussed below.

- Recommendation 14 – GI Maintenance has revised and simplified the maintenance logs to record only routine maintenance. Tasks such as pruning, replanting, gravel replacement, soil replacement and tree guard repairs are recorded on separate assessment sheets. These data are recorded as work orders and tracked in the IPS system.
- Recommendation 15 – As noted earlier, GI Maintenance currently manages 3,105 rain gardens that are in some form of maintenance, either supplemental or full. Taking pre and post-maintenance photos of each asset during each maintenance visit would be cumbersome and time consuming.
- Recommendation 18 – It is not practical to install signs with unique identifiers at each rain garden asset. Identification signs would require Public Design Commission approval and not all GI assets have uniform structural features (tree guards for example,) that would welcome the installation of signs.

Sincerely,



Vincent Sapienza

Cc: A. Georgelis
A. Licata
M. Ritze
W. Morris