Alley Creek Watershed Management and Habitat Restoration Plan
2015

Prepared by: NYC Parks Natural Resources Group

NYC Parks

City of New York Parks & Recreations
Forestry, Horticulture, and Natural Resources
Bill de Blasio, Mayor,
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Executive Summary

The Alley Creek-Little Neck Bay watershed, in northeastern Queens, is a developed urban/sub-urban landscape with considerable natural features that make it an important ecological system and a valuable resource for the many people who live and visit there. Most of the contiguous natural area in the watershed falls within Alley Pond Park. This 645 acre park includes forest, a riparian stream corridor, ponds and freshwater wetlands, and a tidal wetland and salt marsh complex at the confluence of Alley Creek and Little Neck Bay the at western end of Long Island Sound Estuary. The bay, the waterfront, and the parks in the watershed are cherished by the community for the opportunities they provide: the beautiful views, hiking, bird-watching, botanizing, fishing, exercising, environmental education, stewardship, and a cool reprieve from heat in the summer.

Purpose of the Plan and Vision for the Watershed

The purpose of the Alley Creek and Little Neck Bay Watershed Management and Habitat Restoration Plan (the Plan) is to protect and restore the resources of the watershed by characterizing the existing conditions, identifying threats, articulating goals, and suggesting comprehensive management strategies and specific actions to address issues of concern. The plan is intended as a road map for ongoing responsive management, advocacy, stewardship and restoration actions by agencies, community groups, and other stakeholders that will lead to a healthier watershed. The Plan has been developed by the New York City Department of Parks & Recreation (NYC Parks) with input from the community, including an initial meeting during which the following vision statement was agreed upon:

> *The Alley Creek Watershed is an ecologically healthy urban system where clean water, wetlands, fish, water birds, and other native species are valued and protected from the headwaters to the bay. It is a place where water-sensitive practices, policies, and environmental stewardship help maintain and improve water quality and diverse native habitat, as well as public health, recreation, and a high quality of life for local and adjacent communities.*

To serve as a tool to help achieve this vision, the Plan is laid out in two main sections. The first section describes the existing physical, ecological and social characteristics and conditions in the watershed, including the current values and threats to these values. The second section identifies goals for a healthy watershed, as well as strategies and recommendations to help meet these goals.

Existing Conditions

Physical and Ecological Conditions and Characteristics

The approximately 10 square mile watershed is dominated by residential urban development, a population of over 100,000 people, and infrastructure that includes several major highways and an extensive combined and separate sewer and stormwater pipe network. Alley Pond Park is a significant, continuous area of open space in the center of the watershed. The surrounding landscape surface is less densely developed than much of NYC, yet is still over 40% impervious surface land cover.

In large part due to the presence of extensive parkland, the watershed includes a diverse range of habitats. These include approximately: 440 acres of upland forest, 90 acres of freshwater wetlands, 40 acres of grassland meadows, 15 acres of riparian forest and freshwater wetlands, 3 acres of spring fed aquatic systems, 50 acres of salt marsh, 3 miles of public shoreline, and 1,400 acres of open water and marine habitat. A particularly high value habitat, for both wildlife and people, is the Alley Pond Park Southern Forest at the top of the watershed, known to have a diverse native bird population including scarlet tanager and wood thrush. Within the Southern Forest, the picturesque Kettle Ponds also support spotted salamander, wood frog and many other freshwater wetland species rare in NYC. The abundant springs along the Alley Creek corridor supply clean cool groundwater to streams and wetlands, enhancing these habitats for amphibians seeking refuge during long periods of hot weather and offering surprising beauty for park visitors.

Along the shores of Little Neck Bay (LNB), at the mouth of Alley Creek and Udalls Cove, the expansive salt marsh provides gorgeous views of the Bay while helping to filter the water and provide forage, nursery, and nesting habitat for fish and wildlife. Hundreds of species of birds and fish migrate through, overwinter or breed in the watershed and the Bay, one of only five such embayments on the north shore of Long Island that have been designated a Significant Coastal Fish and Wildlife Habitat by the New York State Department of State. The inter-tidal waters, salt marsh, and adjacent forest and freshwater wetlands have also been identified in the NY-NJ Harbor Estuary Program and the Long Island Sound Coastal Management Program as critical for helping to meet goals for target ecosystem characteristics and habitat restoration. The wildlife of the watershed is a significant part of the overall experience for residents who enjoy boating, swimming, clamming and fishing along the shore, as well as for visitors to the forests and wetlands.

Management and Stewardship Context

Multiple stakeholders – from community groups and local private and public land owners, to state and federal agencies – have recognized and worked to protect the resources of this urbanized watershed over many decades. Following the end of unregulated salt marsh filling and highway expansion in the 1950s, when the watershed was almost fully developed, the City and local citizens embarked on numerous programs and projects to manage and enhance the parks within the watershed. Since the late 1990s, city investments in improving and enhancing natural resources in the watershed have included: $22 million in salt marsh restoration (28 acres), $110 million in sewer upgrades to improve water quality and reduce combined sewer overflows by 54%, $1.5 million in tree restoration (9,355 trees planted over 15 acres with another 15 acres prepared for additional plantings in Fall 2015), 145 acres of forest management, 9 acres of freshwater wetland enhancement, approximately 3 acres of stormwater management projects, ongoing forest restoration and maintenance in the headwaters of Alley Pond Park and adjacent to the tidal Alley Creek, and salt marsh assessment and restoration planning.

An important characteristic of habitat management within the watershed is the historical and present day environmental stewardship by the community. Today there are four environmental stewardship groups whose focus is entirely within the watershed, and many more community groups who incorporate environmental stewardship in their activities. Their work includes invasive plant control, native plant re-vegetation, and erosion control around the Alley Creek Environmental Center near the mouth of Alley Creek and along the forested shorelines and upland ravine and ponds of Udalls Cove Park.

Governance and Regulatory Context

Over the past decade, the NYC Department of Environmental Protection (DEP) has focused on improving the water quality of the Bay and meeting state and federal standards. Under current water quality regulations, the Bay is designated as water quality Class SB, which indicates the best usage is "primary and secondary contact recreation and fishing" whereas Alley Creek is Class I, which has a best use of "secondary contact recreation and fishing." Both of these classes indicate the water quality must be suitable for fish, shellfish, and wildlife propagation and survival. To attempt to meet water quality standards, DEP has conducted extensive monitoring in the Bay and Alley Creek to characterize the water quality conditions and assess sources of impairments. These impairments include combined sewer overflows (CSOs), stormwater runoff, illicit discharges, and seepage from septic tanks. In June 2014, DEP submitted a draft of the Long Term Control Plan (LTCP) for Alley Creek, which is required by Order of Consent with NYS Department of Environmental Conservation (DEC) to identify appropriate controls on combined sewer overflows necessary to achieve waterbody-specific water quality standards. The LTCP presents the results of numerical models used to evaluate opportunities for reducing pollution and attaining water quality standards. Recent improvements in grey infrastructure – particularly the CSO retention facility – have reduced outfalls by over half and succeeded in meeting the water quality standards for Class I. The LTCP assessed additional CSO control measures to determine how attainment could be reached in Alley Creek if it was re-classified to Class SC - limited primary contact recreation and future primary contact water quality criteria (2012 EPA RWQC).

Threats to Watershed Resources

Despite the significant efforts and successes in environmental protection and management, the ecological resources of the watershed are still significantly impaired compared to pre-development conditions and still face multiple threats associated with a highly developed urban landscape. Earthmoving, land filling, development, storm and sewer infrastructure construction, and other ongoing human activities have irreversibly altered the soil, hydrology, and biological interactions in the watershed. Consequently, ongoing management and planning is needed to counteract these stressors and maintain the ecological characteristics we value.

In the upland forest and meadows, for example, non-native fill soils, heavy foot traffic, and associated disturbances such as trampling of vegetation and soil erosion create conditions which are favorable to invasive exotic biota and disturbance tolerant species, and are generally unfavorable to a diverse native vegetation community. Within Alley Pond Park there are approximately 60 acres where invasive plants are prevalent or dominant, 5 acres where gaps in the tree canopy make the forest vulnerable to exotic plant invasion, and 2 acres total of downed wood that facilitates exotic vine growth and needs to be managed. The integrity of the forest and the kettle ponds is also undermined by excessive and redundant trails (over 3 miles), which can fragment the forest system adjacent to the ponds where amphibians complete stages of their breeding cycles. Too many heavily used trails leads to compaction, increased runoff, and erosion, all of which can potentially damage sensitive vegetation and degrade water quality within the ponds. In addition, there are over 2 acres where dumping and illicit activities are a concern. Newly created meadows, valued by the community, are also vulnerable to invasion by non-native plants.

The three riparian corridors in the watershed – Oakland Ravine, Alley Creek and Gabbler's Creek – are also impaired by invasive vegetation and a significantly disturbed hydrology. The development and paving of the upslope stormwater contribution areas to these former stream systems, as well as the re-routing of rainwater into storm sewers, have resulted in loss of headwater streams and associated vegetation complexes. Instead of being intercepted by vegetation and absorbed by the soil in the uplands, rainwater now flows across roads and parking lots, collecting nutrients, particulate matter, heavy metals, and other pollutants as it is rapidly shunted to drains and pipes. In the combined sewer system, this high volume of stormwater runoff overloads the system and contributes to combined sewage and untreated stormwater discharges. In the separated stormwater and direct drainage systems, this untreated stormwater delivers runoff to the stream network more frequently and in greater volume than under pre-development conditions. This concentrated, polluted stormwater runoff has resulted in deep gullies and severe bank and channel erosion, particularly in Alley Creek. In addition to truncating the stream network and extensively straightening, armoring, and piping stream channels, urban runoff has resulted in a stream system characterized by low diversity, pollution tolerant biota.

Even along lower gradient and spring fed streams, *Phragmites australis*, an exotic invasive wetland reed that outcompetes native species, dominates the stream channel. Features typical of healthy riparian habitat, such as large woody debris and overhanging banks anchored by native vegetation, are absent. Freshwater wetlands, particularly those associated with constructed ponds, are also often dominated by *Phragmites*. Water bodies suffer from a variety of water quality impacts, such as high fecal coliform levels at Oakland Lake and untreated stormwater runoff carrying pollutants from the street and high nutrient loads from fertilized lawns to Alley Pond.

Along the shoreline the salt marsh, one of the defining features of the watershed, is at risk. As estimated from aerial photo analysis, the watershed has lost about 10 acres of salt marsh since 1974. An ecological assessment conducted in the marsh in 2013 indicated that the marsh along the shoreline has a weaker soil and root network than other Long Island Sound marshes. This characteristic, together with wave action and large amounts of marine debris, may be a factor in the high rate of salt marsh loss. Further upstream in the tidal portion of Alley Creek, freshwater inputs from springs, high nutrient freshwater inputs from storm and CSO outfalls, historic fill, and a potentially more restricted tidal flow may also be limiting salt marsh extent and contributing to the dominance of *Phragmites*. In recent years DEP and Parks have, in total, invested over $20M toward 16 acres of wetland mitigation and restoration and currently are in the process of identifying additional wetland restoration opportunities.

Goals for the Watershed

To help ensure continued collaboration between all stakeholders and achieve the vision for the watershed, the Plan articulates four over-arching goals. These goals are intended to be consistent across plans and projects, to consider existing watershed characteristics and constraints, and to address current and future threats to the resources.

Goal I. Protect, restore and enhance habitat to maximize areas of diverse, native ecological communities.

Upland forests, meadows and streetscapes -Forests should exhibit structural and functional characteristics typical of healthy native forests, and not be dominated by invasive plants. Meadows should consist of native herbs and grasses in areas of sufficient size to support grassland dependent birds. Streetscapes, from the public owned right of way to private yards, should consist of diverse trees species, gardens should feature native herbs and grasses, and impervious area should be minimized to the maximum extent possible.

Riparian and Freshwater wetland --Riparian areas should support native plants tolerant of inundation, be of sufficient width to absorb flood flows, provide buffers for pollution, and provide shade, organic matter inputs and habitat structure. Freshwater wetlands should be fed by rainwater and groundwater, and receive stormwater runoff only after it is treated and detained. Constructed, stormwater-fed wetlands should be integrated into the Plan.

Coastal wetlands –Salt marsh loss should be abated and identified restoration projects implemented. These projects include but are not limited to removal of fill and marine debris, and pilot projects to re-construct recently eroded vegetated marsh.

Goal II. Manage stormwater to improve water quality downstream and establish a more natural hydrology.

Water Quality –The Creek and Bay should, at a minimum, meet water quality standards for best use designations. For Alley Creek this is fishable (Class I); for Little Neck Bay this is fishable and swimmable (SB). Other small water bodies should be protected from impairments to water quality through the best land management practices available.

Hydrology – Stormwater runoff to habitats sensitive to erosion (riparian channels, freshwater and tidal wetlands) should occur only after larger storms. Specifically, maximum permitted discharges should follow the channel protection standards of the 2015 New York State Department of Environmental Conservation Stormwater Management Design Manual. Stormwater should be intercepted, infiltrated, re-used, detained and treated, while impervious areas should be effectively disconnected from receiving waters, where possible.

Goals III. Maximize Public Engagement to increase community awareness, facilitate sustainable use, and ensure that natural open space landscapes will promote healthy living and invite stewardship.

Access -Access to natural areas should be safe and managed to provide enjoyment to community members and visitors without damaging the ecological resources.

Stewardship -A coordinated network of community groups and individuals should provide effective and meaningful stewardship for all ecological systems in the watershed.

Education - The educational potential of the watershed should be fully reached and utilized as a strategy to engage the public, build a new generation of stewards, and progress management objectives.

Goal IV. Improve Resiliency of watershed resources. Natural ecosystem restoration and management projects should be planned and designed to accommodate continued or increased disturbance through sea level rise, extreme storm events, and higher temperatures with their threats to significant coastal fish and wildlife habitats, people and infrastructure. The design and further development of these projects in the watershed should ensure its ability to absorb disturbance and return to desired conditions.

Management Recommendations

To achieve the four overarching goals described above, ten broad strategies are identified in the Plan (Executive Summary Table 1). Each of these broad strategies will help achieve one or more goals. Multiple actions or recommendations are identified as a part of these broad strategies. Some recommendations are site specific while others are programmatic, or applicable on a watershed-wide basis. In total, the Plan gives 79 programmatic or watershed-wide recommendations, identifies over 60 sites where stormwater management recommendations could be explored, and lists 70 sites where habitat and other management actions should be considered.

A subset of actions can be implemented by various stakeholders and through partnerships to make progress towards achieving specific goals. The actions proposed for implementation are cost effective, have stakeholder support, will protect existing healthy habitats, provide opportunity to expand habitat through existing restoration programs, move toward providing co-benefits (such as educational opportunities, will increase stewardship, serve to improve access and resiliency) and can be maintained to ensure success of investments. Actions deemed feasible in the short term (0 -2 years) and long term (>2 years) are presented in summary tables 24-34 at the end of the Alley Creek Watershed and Habitat Restoration Plan.

Executive Summary Table 1. Summary of Strategies and Recommendations

Strategy	Recommendation	Goals met			
		I	II	III	IV
1. Protect and Restore Habitat	1.1. Complete ecological assessment of salt marsh 1.2. Close redundant trails 1.3. Update parks salting practices 1.4. Plan "phase 3" forest restoration 1.5. Continue invasive plant and forest maintenance program 1.6. Manage and track management actions at restoration sites 1.7. Design vernal pool for inclusion in phase 3 reforestation 1.8. Complete ecological assessment of freshwater wetlands 1.9. Progress designs for salt marsh restoration 1.10. Coordinate marine debris removal at "Alley Outer" marsh 1.11. Progress conceptual design of "Alley Outer" water-ward restoration.	X			X
2. Manage Stormwater Using Best Practices	2.1. Develop conceptual designs and raise funds for priority green infrastructure projects 2.2. Advocate and fundraise for Oakland Ravine restoration 2.3. Continue to use the Alley Creek CSO Retention facility 2.4. Continue to implement the Green Infrastructure program 2.5. Develop protocol for prioritizing GI on co-benefits	X	X	X	X
3. Fix Illicit Connections and Unmanaged Septic Systems	3.1. Identify and remove all dry weather illicit discharge		X	X	
4. Promote Partnerships and Interagency Collaboration	4.1. Continue city interagency collaboration on the development of the citywide stormwater management program and associated plan. 4.2. USFS, NAC & NRG partnerships 4.3. Integrate stewardship activities with maintenance needs at Oakland Lake ball field meadows 4.4. Partner with APEC in landscape planning at new APEC building		X	X	
5. Review and Update Regulations and Codes	5.1. Assess development size thresholds for MS4 permit	X	X		X
6. Engage the Public	6.1. Carry out park stewardship survey 6.2. Hire staff to coordinate outreach 6.3. Identify key issues which require, or would benefit from, educational programs	X		X	
7. Training and Professional Capacity	7.1. Update standard operating procedures and train staff who work at facilities within MS4 catchments			X	
8. Research and Adaptive Management	8.1. Identify knowledge gaps for watershed management 8.2. Continue and expand collaboration with universities 8.3. Salt marsh restoration assessment for adaptive management	X			X
9. Track and Monitor Plan Progress	9.1. Continue forest restoration inspections 9.2. Track forest planting and management 9.3. Continue monitoring at established sites	X	X	X	X
10. Communication of Progress and Plan Updates	10.1. Hold annual meetings			X	

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Introduction

The Alley Creek Little Neck Bay Watershed and Habitat Restoration Plan (the Plan) is intended to serve as a road map for coordinated and responsive management, advocacy, and regulatory actions by agencies, community groups, and other stakeholders that will lead to a healthier watershed. The Plan development, which was funded by the New York State Department of State (DOS) and led by the NYC Department of Parks and Recreation (NYC Parks) Natural Resources Group, began with the formation of a Watershed Advisory Committee and a public community meeting (Appendix 1) to generate a vision statement for the watershed.

> *The Alley Creek Watershed is an ecologically healthy urban system where clean water, wetlands, fish, water birds, and other native species are valued and protected from the bay to the headwaters. It is a place where water-sensitive practices, policies, and environmental stewardship help maintain and improve water quality and diverse native habitat, as well as public health, recreation, and a high quality of life for local and adjacent communities.*

This Plan to help achieve the vision of the watershed consists of three main sections. The first section provides the context and shared understanding of the existing physical, ecological, and social characteristics and conditions of the watershed (Section 1). This includes an understanding of the functions of our natural resources and the services they provide, how we value them, the impacts to and on-going threats facing these resources, and the constraints in addressing these impairments. It also includes an awareness of the stakeholders in the watershed, their impact and role in managing our resources, as well as the regulations that currently influence how our land and water is managed and protected.

Next, the Plan identifies goals for ideal watershed conditions that consider existing watershed characteristics, conditions and constraints (Section 2). Finally, the Plan provides ten general strategies, with many more specific recommendations, for achieving goals for habitat protection, water quality, natural resource management, and restoration in the watershed (Section 3). Programmatic (watershed-wide) and site-specific recommendations are identified that can be implemented over the short and long term by various stakeholders and through partnerships to make progress towards achieving specific goals (Section 3.2).

In the Appendices to the Plan, references and information are provided that were used to summarize existing conditions in the watershed and establish goals. Draft protocols are provided that explain the process and criteria used to propose certain recommendations. The Appendices also include preliminary information on restoration and green infrastructure projects concepts currently being developed.

In sum, the Plan is intended to complement and integrate numerous planning and management efforts targeted to the same resources or broad areas that overlap with the same geographic extent of the watershed (see Section 2.6 - 2.7). An example of this is the Long Term Control Plan (LTCP) for Alley Creek, under preparation by the New York City Department of Environmental Protection (DEP). DEP's LTCP, focusing on strategies for meeting regulated water quality standards, is a mandated plan, required by the New York State Department of Environmental Conservation (DEC) under a consent order. The DEP LTCP was initiated at roughly the same time as the Alley Creek Little Neck Bay Watershed Management and Habitat Restoration Plan. NYC Parks and DEP have been coordinating planning and outreach efforts to reduce duplication and maximize utility of both documents. Other regional plans, citywide initiatives by NYC Parks, and local efforts by other stakeholders are also incorporated into the Plan to provide a comprehensive road map of actions intended to protect and restore the watershed and water resources.

1.Watershed Characteristics and Existing Conditions

This Plan encompasses the land that naturally or artificially drains to Little Neck Bay (LNB) within New York City boundaries, but focuses on the watershed of Alley Creek and its confluence with LNB. Little Neck Bay, in Northeastern Queens, is part of the western Long Island Sound near where it merges with the East River. The Alley Creek watershed (a subset of the Little Neck Bay watershed), is defined in this Plan by natural drainage to Alley Creek and encompasses 1,665 acres (~3 sq mi). The LNB watershed is defined in part by overland flow and natural topography, though it has also been extended artificially by the construction of stormwater conveyance systems. This creates straight-edged drainage boundaries based on the pipes and streets. A good example of this is the eastern boundary of the watershed, which coincides with the New York City border. For this Plan the topographic watershed boundary is shown, in order to include Lake Success, in Nassau County, which once drained to LNB (Figure 1 & 9).This combined natural and artificial watershed (5,284 acres or ~10 sq mi) is also referred to as the LNB "sewershed".

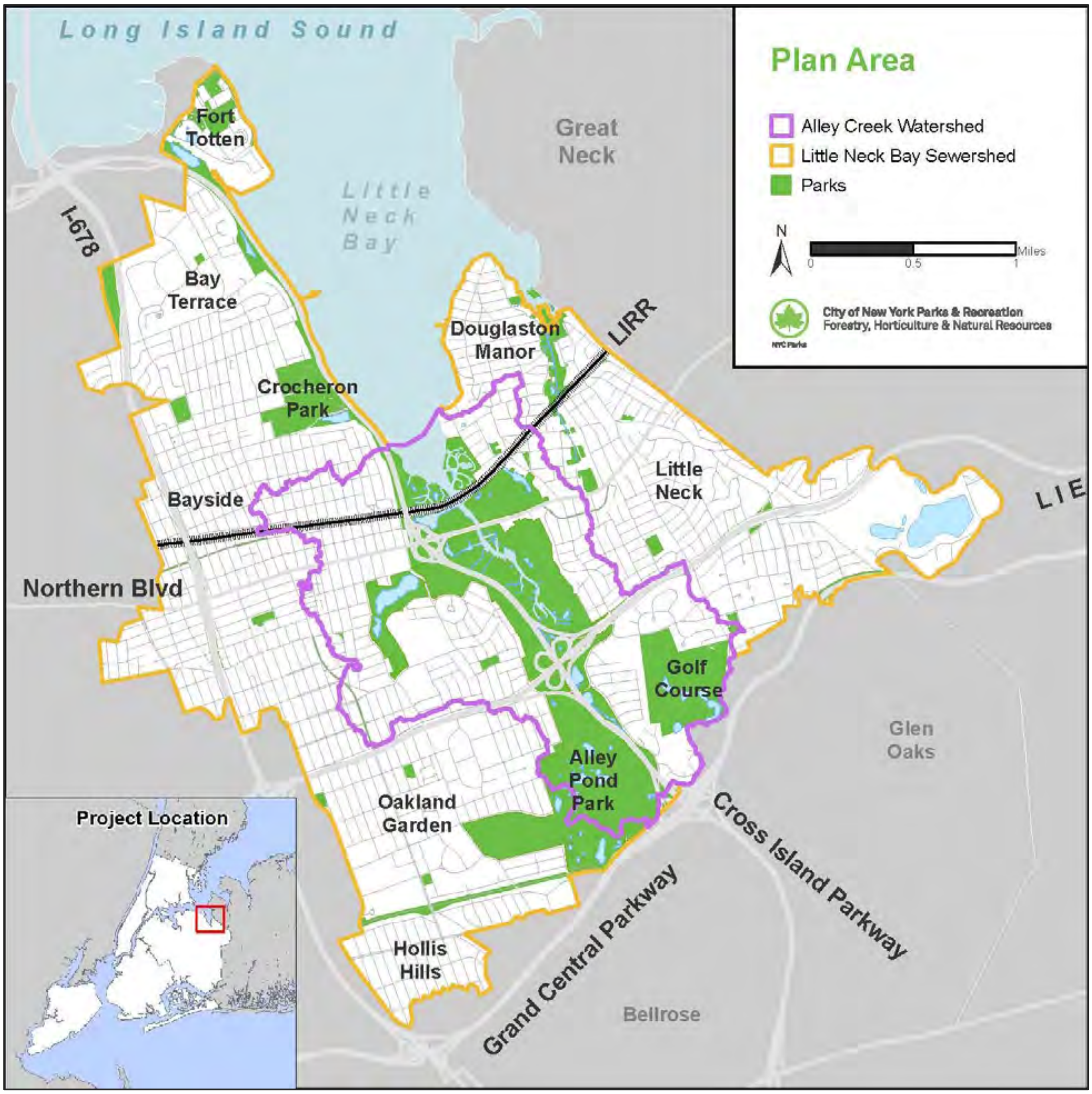

Figure 1. Locations of Little Neck Bay and Alley Creek watersheds.

1.1 Current and Historic Land Uses

1.1.1 History of Land Use and Management Changes in the Watershed

The watershed has been significantly altered by urban development, and now only few natural areas remain that have not been manipulated or indirectly altered by changes in the surrounding landscape. Documented changes in the landscape, extending back to at least the 1700's, provide the context for understanding how extensively the ecological and hydrologic system in the watershed have been altered (Table 1, Figure 2, Appendix 2).

Table 1. A history of key environmental and landscape alterations within the watershed

Date	Historical Event
1752	James Hedges dams Alley Creek and creates Alley Pond, a constructed mill pond altering the creeks normal flow patterns. Freshwater drains into Creek flows via sluice gates.
1800	Oakland Lake dammed to serve as a farming irrigation and water supply reservoir.
1850	Oystermen start using steam operated shovels to dredge LNB. Boats dump their coal cinders overboard creating a hard bottom on top of soft mud, possibly to help create oyster beds.
1870	Bayside Rail Station built, ending 'Alley Era' as boats can no longer sail up the creek.
1890	Sewer mains installed to replace outhouses with new sewer outflow feeding to Northern Boulevard and Alley Creek.
1895	Little Neck clam populations severely impacted by water pollution.
1904	Metropolitan Sewerage Commission created, studies the natural flushing patterns of tides and harbors and recommends construction of sewage plants.
1908	William Vanderbilt (1849–1920) builds his privately run Long Island Motor Parkway.
1910	Northern Boulevard Trolley Line is open and New Trolley Power station is built in Alley Creek landfilled wetlands; part of the North Side & Main Line Divisions of Long Island Railroad likely contributing to contamination of landfilled tidal wetland
1916	Bayside Hill removed for land-filling of 1939 World's Fair Site -- major reconfiguration of surface waterflows begins
1928	Trunk Sewer is planned along LNB shoreline to Tallman Island Sewage Treatment Plant. Only western section of watershed is sewered, with Eastern Douglas Manor retaining septic tank system (built ca.1880s).
1929	City of New York buys Alley Pond and surrounding farm fields. Reforestation process begins in today's Southern Forest.
1939	Cross Island Parkway built.
1941	Officials from the NYC Sanitation and Health Departments work with WPA workers to fill in wetlands in an attempt to control the mosquito population.
1951	Industrial-supply groundwater withdrawals decreased in Kings and Queens Counties.
1958	Horace Harding Expressway (now the Long Island Expressway) built around this time; drainage from Lake Success may have been diverted from Gabblers Creek (also referred to as Udalls Creek) into the Horace Harding Expressway storm drain system towards Alley Creek.
1963	NYC Parks Commissioner Newbold Morris appropriates $1 million for dredging of Little Neck Bay.
1970	NYC Sanitation Department uses Alley marshes to store salt. Dr. Andrew Greller, Queens College botanist, Jim Trent, Tom Schweitser and others protest and this practice is stopped.
1971	NYC Sanitation Department once again uses Alley marshes to store salt. Alley Restoration Committee gets a commitment from the city to stop landfilling salt marshes with garbage and construction waste.
1973	Further maintenance dredging of Little Neck Bay and Alley Creek by the US Army Corps of Engineers.

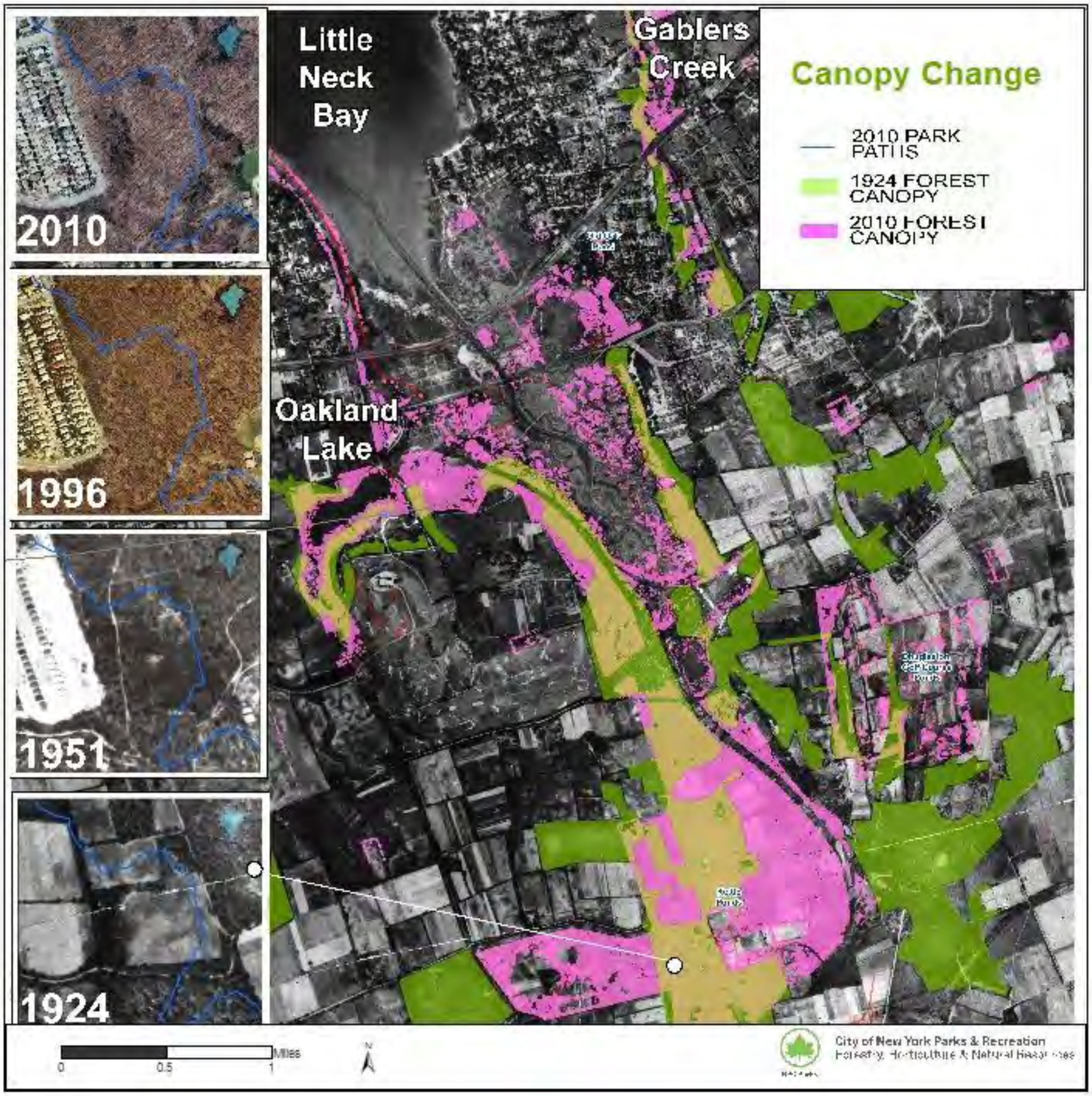

Figure 2. Historic change to tree canopy in Alley Pond Park.

1.1.2 Land Use and Zoning

The predominant land use zoning throughout the LNB watershed is residential (62%). Other land uses include open spaces and parkland (15%), vacant lands (8%), public buildings and institutions (7%), commercial zones (4%) and mixed and other (3%). Commercial zones are concentrated along Northern Boulevard and Bell Blvd (Figure 3). The majority of the parkland is situated in the valley and geographic center of the watershed.

The residential zones are primarily low density development, consisting of single family homes or townhouses with backyards and driveways. Typical residential lot sizes average around 4,300 square feet[1], with the average detached, single family home covering 25% of the lot. There are some clusters of multi-story apartments, with larger grounds and parking lots. The 2010 Census

[1]PlaNYC Stormwater Management Plan, 2008 (Appendix by eDesignDynamics)

reported the population in the Little Neck Bay watershed as 102,340 people living on 5,285 acres in 42,444 homes, giving an average population density of 19.3 people per acre and 2.41 people per home. The Cross Island Parkway (CIP) and Long Island Expressway (LIE) only account for 1% of the land use, but they bisect otherwise contiguous park lands and have substantial impacts on the landscape.

No major development projects or zoning changes are proposed in the watershed - only about 77,000 sq. ft. of new development is expected between 2010 and 2030.[1] However, the way landowners and developers re-build and renovate their properties can also have a significant impact on how stormwater is treated in the watershed. For example, a homeowner's decision to pave or install structures in their yard can increase the impervious surfaces without any changes in zoning. The DEP estimated that within the CSO portion of the sewershed over 3% of the building area of 630,000 sq. ft. will likely undergo major alterations.[2]

[2] DEP 2014 LTCP

Figure 3. Zoning.

There are 27 schools in the sewershed, with a total student population of 33,000 (kindergarten to college). The two largest schools are Benjamin Cardozo High School and Queensborough Community College, which had a 2012 enrollment of 13,150 students. The college is characterized by large parking lots, as many students commute to the college by car. School zones are distinguished from the residential areas because of their higher concentration of daily vehicular traffic and accompanying infrastructure impacts.

1.2 Stakeholders

1.2.1 Landowners

Most open spaces in the watershed are managed by public entities (75%) but there are some significant spaces managed by private concerns as well (Figure 5). While Parks manages 40% of the open space, some officially mapped parkland is actually managed by other entities (i.e. 15% of open space is privately leased golf courses).This includes the DEP, which manages sewer infrastructure facilities in parks, as well as wetland mitigation construction and monitoring projects until these projects are completed and revert back to Parks' management. The New York State Department of Transportation has jurisdiction over open space along state roads and the New York State Department of Environmental Conservation (DEC) owns natural area land parcels in Udalls Cove. Significant open space owned by private land owners includes lots in the Gabblers Creek ravine and Arleigh Beach, a private beach with adjacent fringe wetlands.

1.2.2 City Agencies and Administrative Bodies

The City's administrative entities, political representatives and local neighborhood community groups are key stakeholders and have a role in habitat protection, management and restoration. Key groups are described here.

Community Boards (CB)
CB11, which presides over the majority of the watershed, with CB7 in the northern section of Bayside, is a local representative body which meets to discuss community issues and makes nonbinding recommendations relating to zoning, land use, city budget and other community matters. CB11 has supported the community's interest in specific restoration objectives by advocating for land acquisition along Northern Boulevard for habitat restoration.

New York City Council (the Council)
The Council monitors the operation and performance of city agencies, makes land use decisions and legislates on a wide range of other subjects. The Council is an equal partner with the Mayor in the governing of NYC, including approving the city's budget, and has enacted legislation (expanded in section 1.6 & 1.7) related to water quality, habitat and natural resources on multiple occasions including, for example, mandating:

- The establishment of a Wetlands Transfer Taskforce (Nov 2007) to assure that wetlands on city owned properties are transferred to NYC Parks when feasible.
- The development of a stormwater management plan (Nov 2006), which became the Sustainable Stormwater Management Plan as part of PlaNYC.
- The development of a City Wetlands Strategy (2010).
- The establishment of Local Law 3 requiring restitution when trees are removed on NYC Parks' property.
- The establishment Local Law 11 requiring the maximization of native plants in all city owned property.

New York City Department of Environmental Protection (DEP)
DEP manages NYC's water supply, including water delivery and treatment. DEP provides more than 1 billion gallons of water each day to the 8.3 million residents of NYC from watersheds upstate, and manages a system that includes 19 reservoirs, three controlled lakes, and 303 miles of aqueducts and tunnels. DEP is also responsible for the treatment of 1.3 billion gallons of wastewater every day at 14 wastewater treatment plants.

As part of the 2012 Modified Combined Sewer Overflow (CSO) Consent Order between DEP and the DEC, DEP is in process of developing Long Term Control Plans (LTCPs) to reduce CSOs and continue to improve water quality in NYC's waterbodies and watersheds. The Alley Creek LTCP is the first of the 11 waterbody LTCPs that DEP is currently developing. In Alley Creek, DEP completed major infrastructure projects with a total cost of $110M, including pump station upgrades, storm sewer construction(including upstream sewers to alleviate flooding and convey flow to the CSO retention facility) and a 5 million gallon (MG) CSO retention tank. Together, these measures provide a projected 54% MG/year reduction in CSO volumes. In addition, DEP has constructed 16 acres of tidal wetlands and adjacent habitat for approximately $20M.

NYC Department of Parks & Recreation (Parks)
Parks is the largest landowner of open space and manages the vast majority of the forested and wetlands areas in the watershed, in addition to leasing large areas of public land to private concessions. Parks' Natural Resources Group (NRG) has been involved in the management of the ecological health of the watershed and Bay through planning, implementing and overseeing restoration and monitoring activities since the mid-1980s. Parks has also been involved with implementing restoration projects and collaborating with and providing oversight for restoration or mitigation projects initiated by DEP. Further explanation of Park's restoration and management activities in Alley Pond Park is provided below Section 1.5.

NYS Department of Transportation (DOT)
The DOT is the landowner of the Cross Island Parkway (CIP) and the Long Island Expressway (LIE) that bisect the Alley Creek watershed. NYSDOT completed a large modernization of the interchange between the CIP and LIE in 2004, which included upland and riparian forest restoration, stormwater wetland construction, and landscaping of the open space. DOT management of the right of way (ROW) landscape and the freeways, which drain directly to the creek and bay, impacts the health of the watershed.

1.2.3 Local Environmental Stewardship and Education Organizations

The Alley Creek watershed has a rich history of local environmental stewardship and activism (see Table 1). A number of local advocacy groups are active within the watershed and have been responsible for fundraising and implementation of restoration projects, decision-making on the community boards, and collaborating with city agencies and regional advocacy and planning organizations (Figure 4).

Alley Pond Environmental Center (APEC)
APEC is an influential nonprofit environmental education organization located along Alley Creek with a mission to educate the community, to protect and preserve Alley Pond Park's open spaces and water bodies, and to advocate for sustainable environmental policies and practices. Formed in 1972, APEC provides structure to community activism and stewardship as well as partnerships with city agencies.

Udalls Cove Preservation Committee (UCPC)
UCPC, founded in 1969, is a volunteer organization dedicated to the preservation, conservation and restoration of the remaining undeveloped wetlands and wooded uplands in the Udalls Cove catchment. UCPC has coordinated with city and state agencies in restoration planning and construction, engages volunteers, and promotes environmental awareness and education.

Douglaston Manor Environmental Association (DMEA)
The DMEA is a local group associated with the Douglaston Manor Home Owners Association that helps ensure environmentally sound management of the Associations' properties, including beaches and fringe wetlands along the Bay. The DMEA turf extends over the entire Douglaston Peninsula. As the organization responsible for providing DEP with water quality testing results at the DMA beach, the DMAE plays an important role in local water quality management.

Queensborough Community College (QBCC)
QBCC professors and students have participated in stewardship activities, such as invasive plant removal and hosting a nature blog to encourage interest in local ecosystems. The college has been awarded grants from the Long Island Sound Futures Fund and National Fish and Wildlife Foundation to plan, design, and implement stormwater best management practices on its parking lots that drain to the Bay.

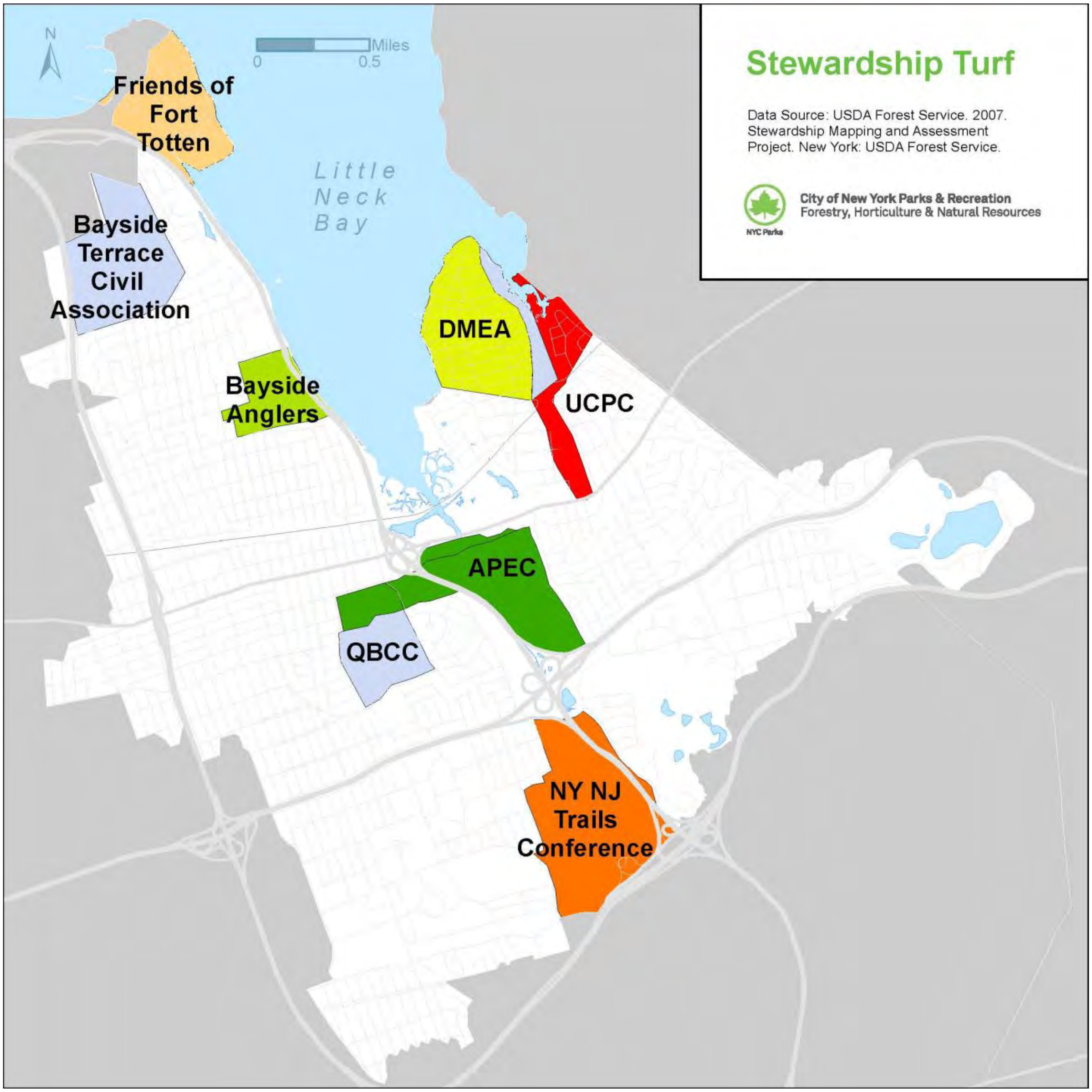

Figure 4. Approximate focal area, or turf, of local environmental stewardship groups.

1.2.4 Regional Environmental Stewardship, Advocacy and Management Organizations

There are numerous regional organizations who have either worked in the Alley Creek Watershed in the past or whose work could be relevant to meeting Plan goals in the future. Some of these key organizations are listed here.

National Fish and Wildlife Foundation (NFWF)
NFWF's goal is to preserve and restore the nation's native wildlife species and habitats. NFWF manages the Long Island Sound Futures Fund (LISFF) in partnership with the Long Island Sound Study (LISS). The LISS lists Alley Pond Park as one of 33 stewardship areas with exceptional ecological and recreational value. NFWF has funded several restoration and green infrastructure projects in the watershed.

Natural Areas Conservancy (NAC)
NAC is devoted to natural areas conservation and restoration in across the five boroughs in a public-private partnership with NYC Parks. Through advancing data-driven best practices for management and expanding community engagement, NAC works to conserve NYC's forests and wetlands, and promote the enormous environmental and social benefits they provide. NAC has conducted extensive ecological assessments in NYC, including over a thousand research plots in forests and wetlands, as well as over 1,600 interviews with park visitors in more than 40 parks.

New York City Audubon
New York City Audubon is a grassroots community group consisting of 10,000 members that works for the protection of wild birds and habitat in the five boroughs. Their conservation activities include collecting data about birds across NYC, advocating for and influencing public policy to protect wildlife, and running educational programs.

New York City Soil and Water Conservation District (SWCD)
In partnership with the U.S. Dept. of Agriculture Natural Resources Conservation Service, the SWCD conducts research, public outreach, and education related to urban soils, and has published reconnaissance level and detailed soil surveys of NYC. The NYC SWCD also plays a key role in community education about green infrastructure in NYC. They recently launched the Urban Soils Institute – a research, education, analytical services, and data depository organization.

NY-NJ Trails Conference (Conference)
Founded in 1920, the Conference is a federation of members dedicated to advancing hiking opportunities and interests. It is a volunteer organization committed to developing and maintaining hiking trails, protecting trail lands through support and advocacy, and educating the public in the responsible use of trails. The Conference has helped to maintain trails in the Alley Creek Forest and identify opportunities for trails improvement and stewardship.

Swimmable NYC – Storm Water Infrastructure Matters (S.W.I.M.) Coalition
Sponsored by the SWCD, S.W.I.M. comprises a steering committee that holds quarterly public meetings and focuses on four strategies for promoting green infrastructure in NYC: green roof tax credits, workforce development, public notification and fundraising. S.W.I.M. comments in detail on local regulations and policy affecting water quality.

Trout Unlimited (TU)
TU is a national conservation and fisheries organization that advocates for habitat for native trout and other fish. In Alley Creek, TU conducted a study to assess the potential for the stream to support stocked trout. Among other findings, TU observed that temperatures are too high for trout

1.2.5 Regulatory & Planning Agencies

NYC Mayor's Office of Sustainability and Mayor's Office of Recovery and Resiliency.
In 2014 The Mayor's Office of Environmental Coordination (MOEC) was merged with the Office of Long-Term Planning and Sustainability (OLTPS), becoming the Office of Sustainability. MOEC oversaw the City's environmental review process, administered the City's green building program and advised on other key environmental issues. The OLTPS is responsible for implementing PlaNYC, a comprehensive sustainability plan for the City's future. In 2008, OLTPS released the Sustainable Stormwater Management Plan for New York City, which laid out a strategy for significantly reducing stormwater runoff impacts – including the refinement of stormwater and wetlands regulations. Through PlaNYC, the OLTPS helped create the Green Codes Task Force and track the MillionTrees NYC initiative, which increased tree canopy across the city. MillionTrees NYC has funded invasive species removal, native forest plantings, and supported volunteer engagement efforts throughout Alley Pond Park.

The Mayor’s Office of Sustainability works in partnership with the new Office of Recovery and Resiliency (ORR), also formed in 2014. ORR is working to implement a citywide plan focusing on coastal resilience strategies to protect NYC against the risks of climate change..

New York State Department of Environmental Conservation (DEC)
DEC is the primary state agency responsible for administering regulatory programs to control water, land, and air pollution in order to enhance the health, safety, and welfare of the people of the state. In NYC, DEC regulates discharges from CSO outfalls and monitors DEP implementation of the terms of an Order of Consent to address CSO issues. DEC has the approval authority for the LTCPs currently being developed by DEP. Also, DEC is currently negotiating a SPDES permit with the City of New York for municipal separate storm sewer system discharges.

New York Department of State (DOS) Office of Planning and Development
As the state's coastal planning agency, DOS plays an important role in economic development and planning for natural disasters, and is also responsible for the administration of State's Coastal and Inland Waterways Program and Coastal Management Program (CMP). These Programs were developed to ensure the protection and best use of New York State's coastal and inland water resources and to promote the revitalization of waterfront communities. The program is administered by DOS and carried out in partnership with local governments and state and federal agencies. In addition to its role in federal and state coordination, the DOS serves as an advocate for programs and projects to protect and restore natural resources and communities. In addition to providing guidance and technical assistance through Title 11 of the Environmental Protection Fund, Local Waterfront Revitalization, the Department of State provides matching grants to eligible communities for planning and implementation projects that advance revitalization, including the funding for this Alley Creek Watershed Plan.

New England Interstate Water Pollution Control Commission (NEIWPCC)
NEIWPCC is a not-for-profit interstate agency that utilizes a variety of strategies to meet the water related needs of its member states. As an independent environmental monitor, NEIWPCC has been involved in reviewing the LTCP for Alley Creek and Little Neck Bay.

The NY-NJ Harbor Estuary Program (HEP)
HEP, established in 1987 by the EPA's National Estuary Program, focuses on protecting and restoring healthy waterways and habitats, managing sediments, fostering stewardship, educating the public, and improving safe access to our waterways. HEP was managed by the EPA until 2014 and is now managed by the Hudson River Foundation (HRF). HEP is a partnership of federal, state, and local governments, scientists, civic and environmental advocates, the fishing community, business and labor leaders, and educators. The area of HEP's focus includes the East River and western Long Island Sound.

U.S. Environmental Protection Agency (EPA)
The EPA administers the Federal Clean Water Act (CWA), which DEC is authorized to implement by setting appropriate standards and issuing permits to enforce compliance with those standards. EPA must approve DEC standards and ensure a level of national consistency. EPA sponsors the Long Island Sound Study (LISS), a bi-state partnership dedicated to restoring and protecting the Sound, and the Long Island Sound Futures Fund (LISFF). Restoration efforts funded by the LISFF are detailed below. EPA has also funded tidal wetland condition studies through its Wetland Program Development Grant that have included the salt marshes in the watershed.

U.S. Army Corps of Engineers (ACE)
ACE works in partnership with other federal and state agencies, non-governmental organizations and academic institutions to restore degraded ecosystems to a more natural condition through large-scale ecosystem restoration projects. The ACE, working with HRF and the region’s stakeholders, developed the Hudson-Raritan Estuary Comprehensive Restoration Plan (CRP),

which includes recommendations for ecological restoration and target habitat characteristics for various sections of the Alley Creek and Little Neck Bay Watershed.

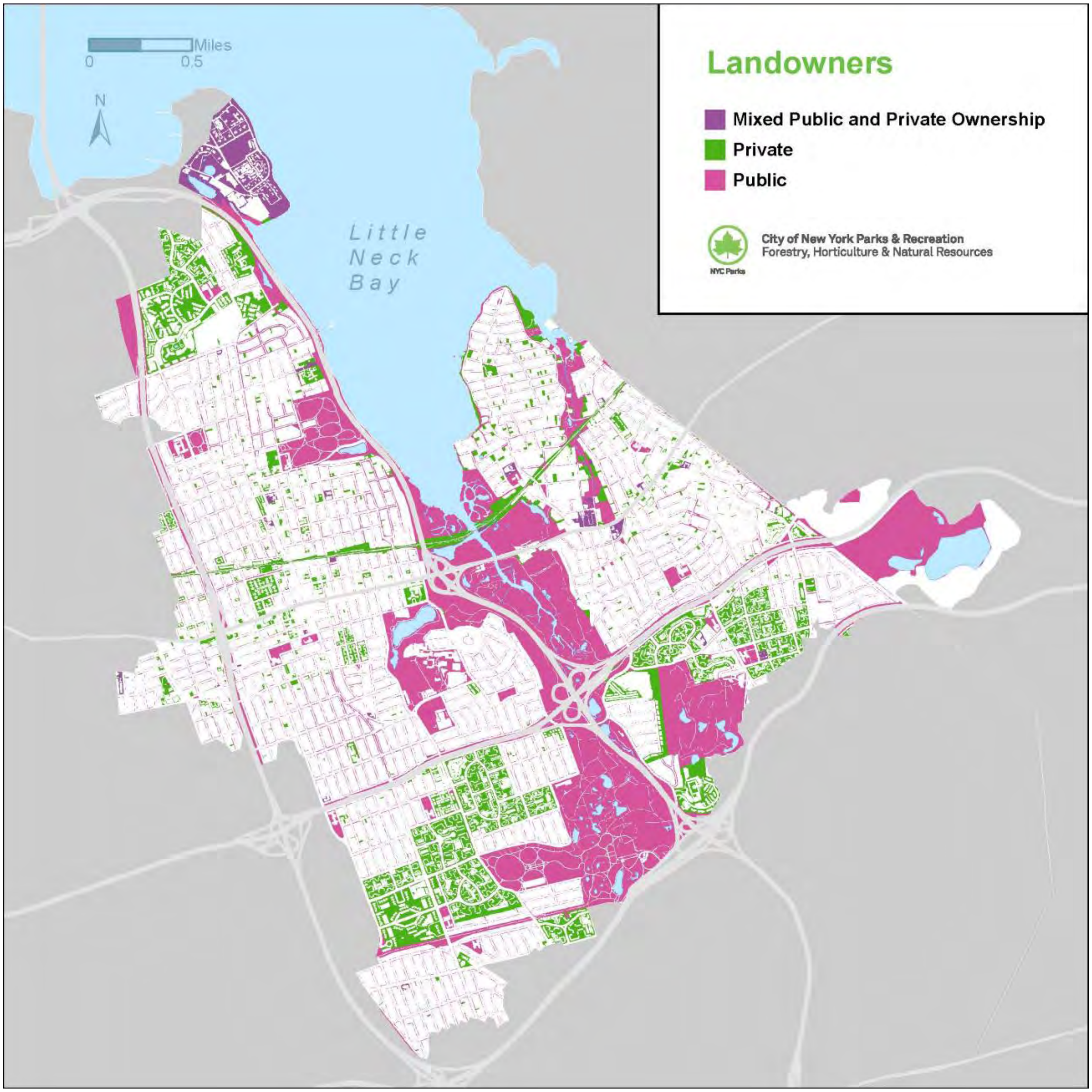

Figure 5. Open space landowners.

1.3 Physical Conditions

1.3.1 Climate & Topography

The watershed has a maritime climate typical of other coastal areas in the Northeast with warm, humid summers and cold winters. The average coldest month is January, with average daily highs and lows of 38°F and 26°F. The average warmest month is July when average daily highs and lows are 84°F and 69°F. The long-term median annual rainfall between 1970 and 2002 at LaGuardia Airport (4 miles away) was 44.73 inches, with little seasonal variability. Other key climatic measures include: average annual snowfall of 22 inches; an average growing season of about 190 days (April-September); and an average annual potential evapo-transpiration of 25.57 inches.

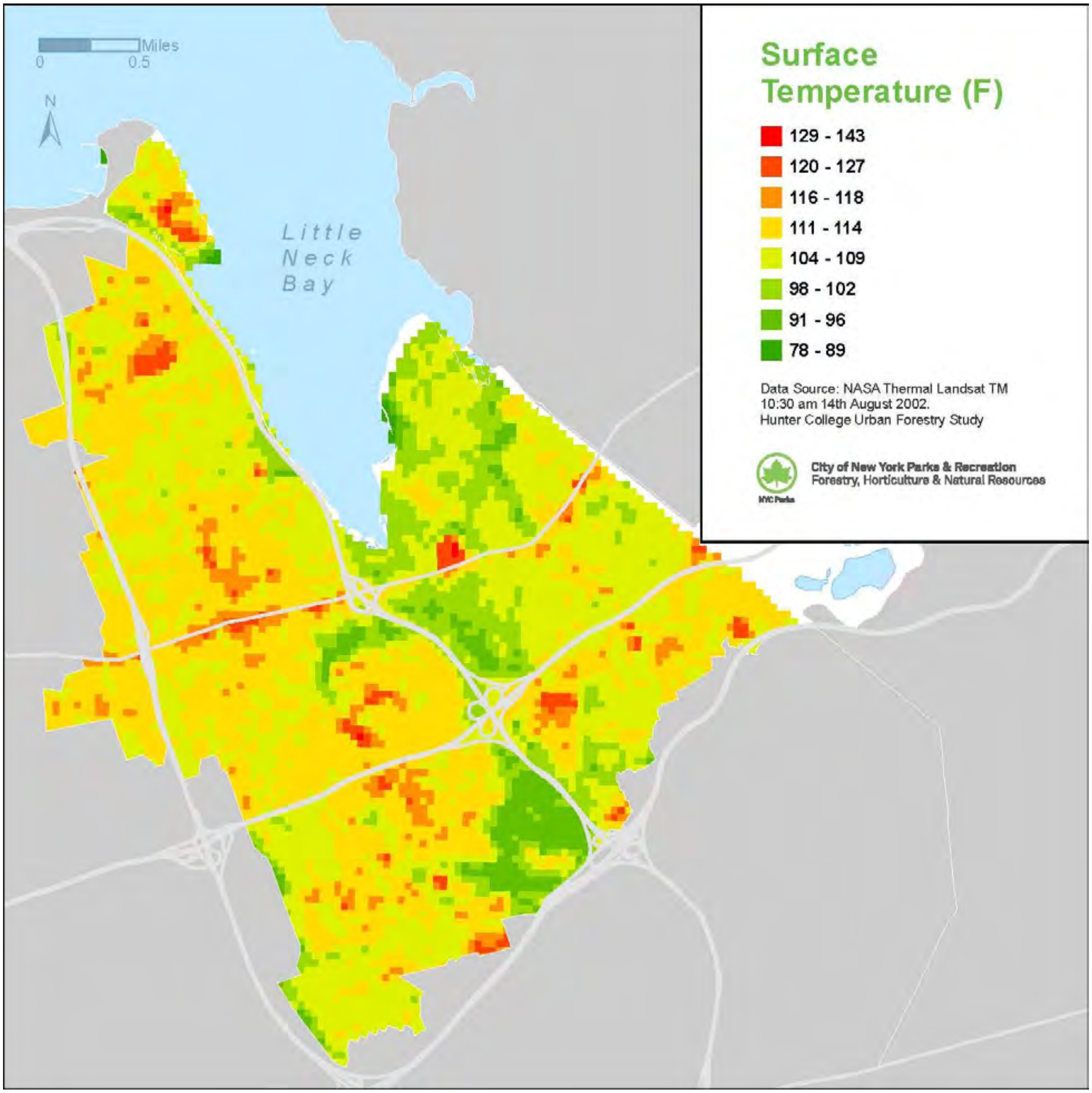

Figure 6. Surface temperature during a heat wave on August 14, 2002.

As expected for the New York City region, the urban heat island (UHI) effect is observed within the watershed. The UHI is a microclimate phenomenon resulting from heat being absorbed by buildings and hard surfaces and the urban area having measurably warmer surface temperature than adjacent areas with vegetated cover. For example in the Bay Terrace Shopping Center, surface temperature readings from satellites are 10 degrees higher than those in adjacent neighborhoods with mature trees, which in turn are 10 degrees higher than those in forested parkland in the Alley Creek headwaters (Figure 6).

1.3.2 Surface Geology

The surface geology of the watershed was formed by the retreat of glaciers nearly ten thousand years ago. The last glaciers left a massive ridge of rock, gravel, and soil, known as a terminal moraine, across Long Island, which forms the top of the watershed (Figure 7). Particularly on the terminal moraine, glaciation created a kettle and kame topography characterized by depressions where large ice blocks trapped in rock and sediment debris melted (kettles) and surrounding high ridges (kames). Alley Pond Park is one of the best examples in NYC of this natural topography caused by glaciers, and of the associated wetland ecosystems unique to this geomorphology. To the north of the moraine throughout the rest of the watershed, the surficial geology consists of glacial till, unsorted, heterogeneous sand, cobble, and gravel material tens of meters deep.

Figure 7. Regional surface geology for Little Neck Bay and Alley Creek watershed.

1.3.3 Soils

Across the watershed, the depth to bedrock is greater than 100 feet and there are no surface outcrops. The soils, formed from glacial till, consist of gravel and loamy sands derived from granitic material. Throughout the watershed, the soils are generally disturbed and intermixed with anthropogenic fill (Figure 8). The salt marsh feature mucky peats (Ispwich & Pawcatuck), while hydric soils are found in freshwater wetlands such as kettle ponds and along some sections of the riparian corridors. The soils in the woodlands are generally acidic with good infiltration (Charlton), although some have a high water table (Sutton) or a dense substratum (Montauk) and may be less suitable for green infrastructure. The southern part of the watershed are outwash soils (Riverhead complex) and have very good infiltration and permeability rates. Open spaces are typically either Greenbelt complex (generally clean), or LaGuardia complex (chunky fill). Fill soils are highly variable and soil assessments are important for habitat restoration and green infrastructure implementation planning.

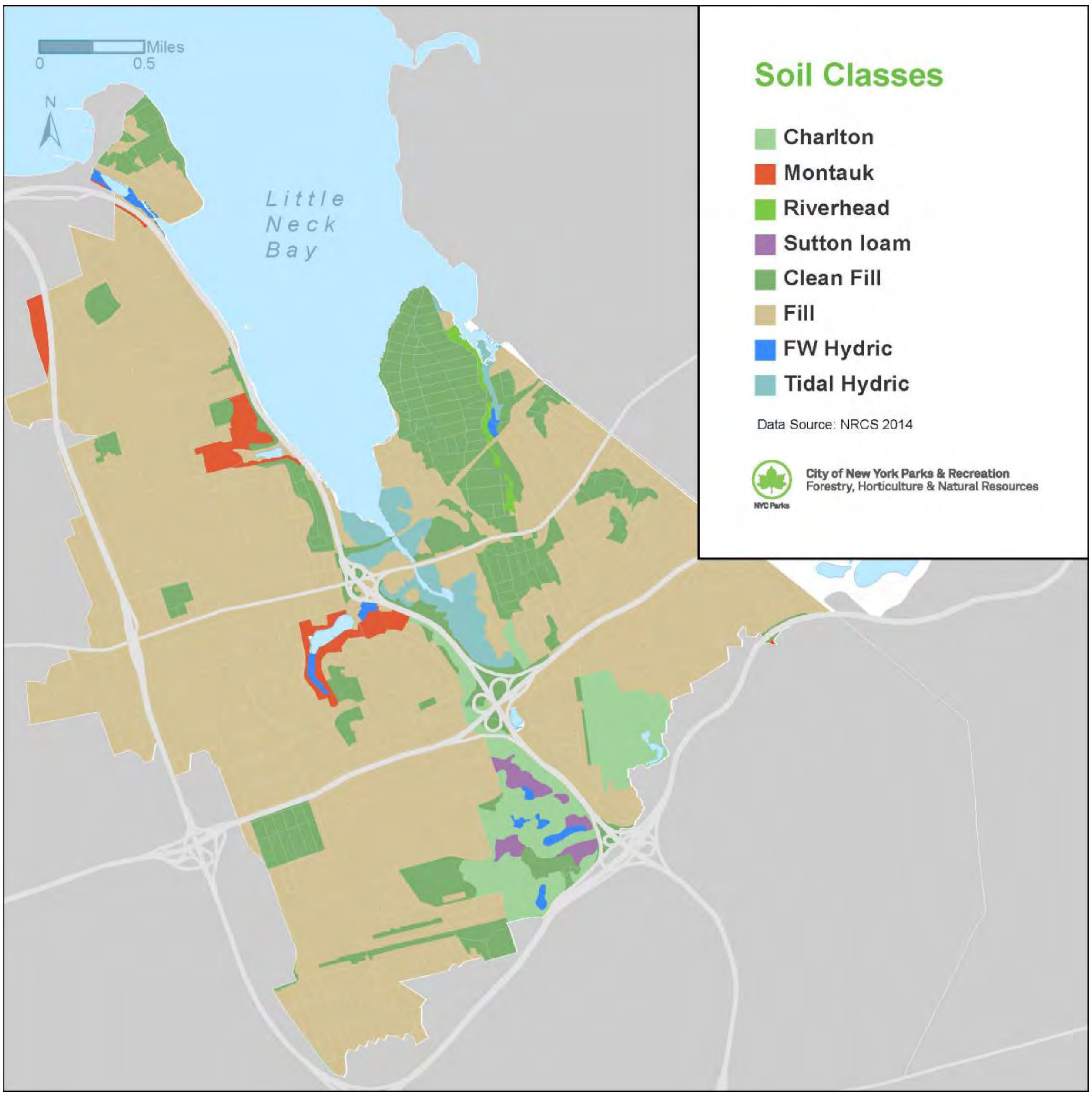

Figure 8. Soils of the Alley Creek / Little Neck Bay watershed.

1.3.4 Surface Water Hydrology and Water Quality

Despite having a large amount of parkland, much of it located around the two main stream systems, Alley and Gabblers Creeks, the hydrology of the Little Neck Bay watershed is extremely altered due to human development. Under natural, fully vegetated conditions, as much as 80% of the rain that historically fell on the watershed would have been retained[3]. The precipitation would have been intercepted by the tree canopy, infiltrated and stored in the soil, detained in ponds and depressions, and evapo-transpired by vegetation. In today's developed watershed, with approximately 40% impervious surface area, much less rainwater is retained (Figure 9). Runoff yield for an average precipitation year is estimated to have increased from approximately 500 MG (million gallons)[4] during the pre-urbanized condition (circa 1900) to approximately 3,000 MG under current conditions[5]. Throughout the watershed, today's stormwater runoff is routed through one of three systems: the combined sewer overflow (CSO) system, where stormwater mixes with sanitary sewage; a separate sewer system, where stormwater and sanitary systems are separate but the sanitary joins the combined system upstream of CSO outfall; or direct drainage areas where stormwater flows overland or is piped directly to receiving waters (Figure 10).There is 600% more runoff now than under pre-development conditions, with adverse impacts to stream habitat and the water quality of all downstream receiving surface waters.

The physical impacts of the altered hydrology of the watershed are most visible in Alley Creek and Gabblers Creek, the two main sub-watersheds within the LNB Watershed (Figure 11). Alley Creek and Gabblers Creek historically had their headwaters on the glacial moraine ridge. Today the creeks' headwaters are characterized by ephemeral (partially dry) channels reaches, which are fed primarily by surface stormwater runoff. The Alley Creek sub catchment is largely comprised of separate storm sewer areas, which efficiently channel stormwater directly to riparian corridors. This causes flow to concentrate quickly, resulting in the "flashy" hydrology typical of urban streams. This hydrology is characterized by a fast rise in the stream flow which erodes the stream bed, especially at the pipes where it enters the stream, as well as downstream, where the flow from multiple stormwater sources accumulates. These large flows then decline rapidly after storm events[6]. Furthermore, baseflow is typically diminished in urban streams due to a loss of groundwater recharge associated with increased impervious area. Indeed, both streams have only relatively short reaches where the stream base flow is perennial (continuously flowing). This is potentially in part a result of receiving less continuous groundwater contribution, because less precipitation is recharging the soil through infiltration.

Outfall TI 024 drains the LIE and as well as the area south of the LIE that includes Lake Success (750 acres)[7]. This large catchment yields total annual flows largely occurring during storm events of 122.4 MG/yr (Table 2).

[3]Water Sensitive Cities,2010
[4] DEP 2009 WWFP
[5]DEP, 2014 - draft LTCP
[6] Band, 1988
[7] Band, 1987

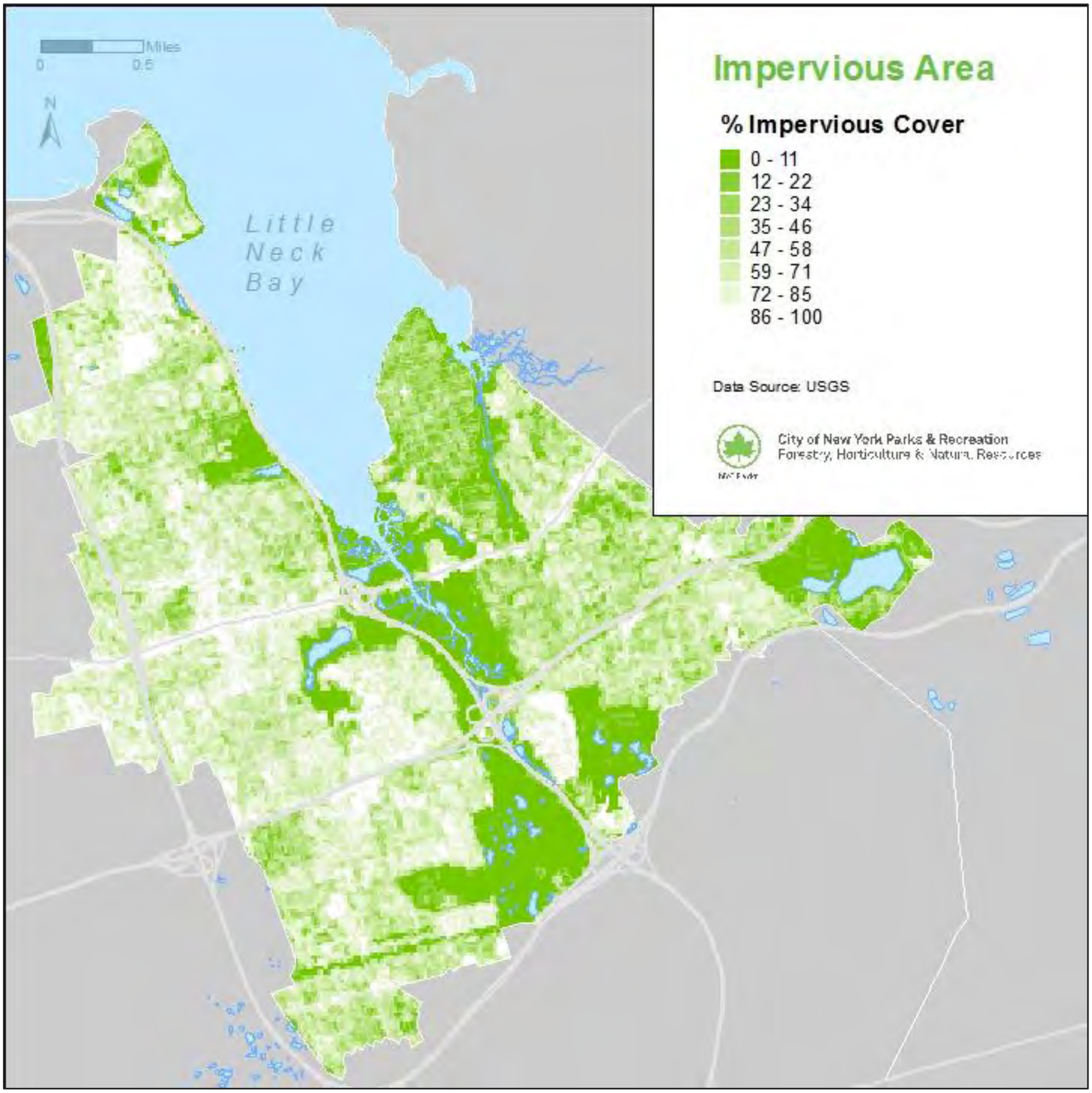

Figure 9. Impervious surface area.

In NYC, direct drainage systems are often found in open space, such as the parkland that surrounds Alley Creek. However large roadways also transect this open space. Much of the most extensive hydrologic alteration in the non-CSO areas that impacted the creeks occurred during the creation of the LIE. The expressway construction buried the stream in a culvert for hundreds of feet, as well as diverted the over flow from Lake Success, far east of the watershed in Nassau County. Historic maps (Appendix 3) suggest that Lake Success originally flowed into Gabbler's Creek, which drains into Udalls Cove (Figure 11). The diversion reduced the natural catchment draining to Gabbler's Creek by half. The storm sewer pipe infrastructure also appears to have resulted in a significantly larger catchment now draining to pipe outflow TI-024, which discharges to the upper tidal portion of Alley Creek. A separated storm sewer outfall, TI-024, enters Alley Creek just north of the LIE (near the confluence of the eastern and western tidal branches of the Creek).

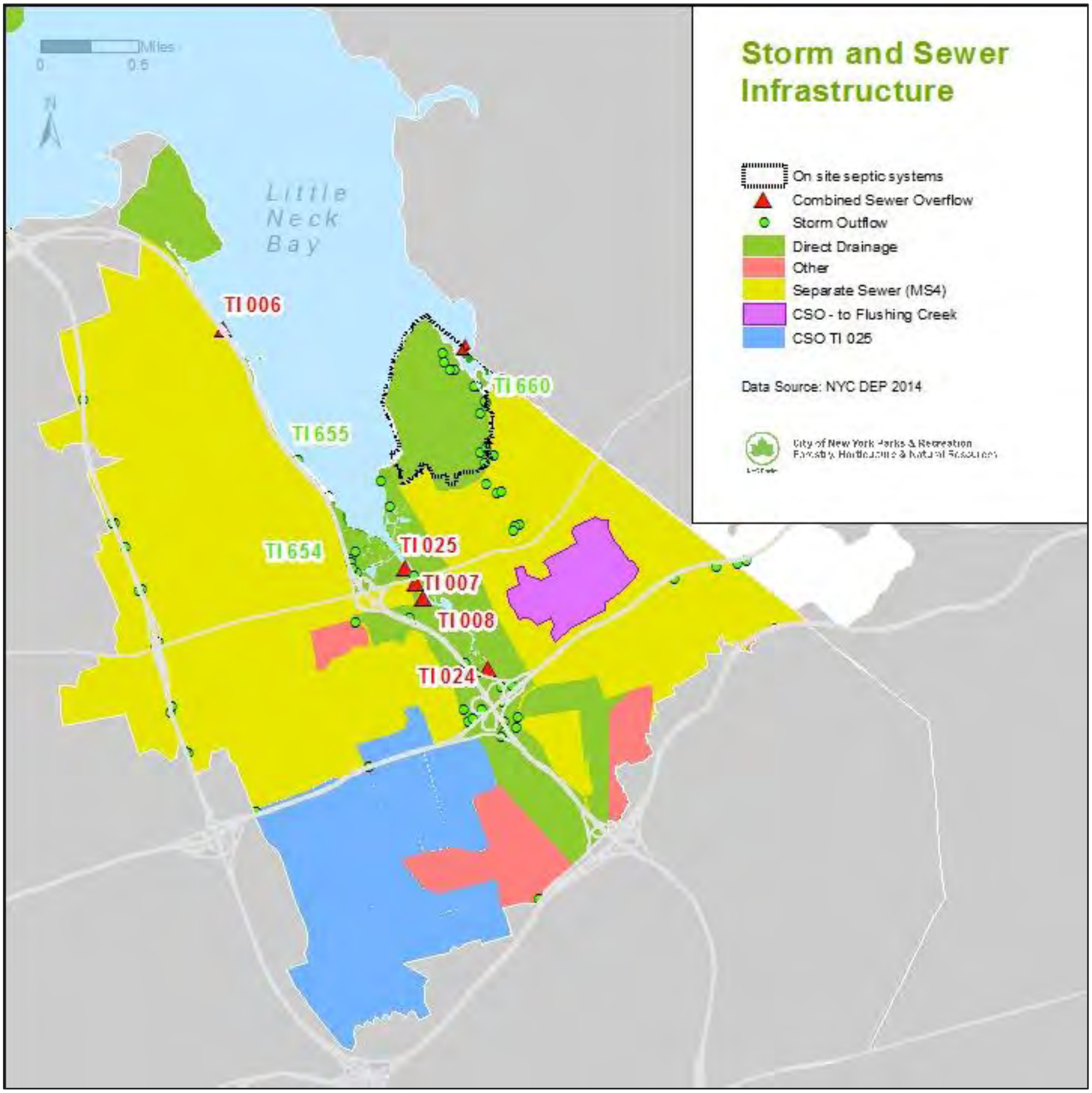

Figure 10. Storm and sewer infrastructure.

Other significant flows to Alley Creek include a series of smaller spring fed streams and ponds scattered around the edges of the tidal marsh. Oakland Lake contributes the largest freshwater flow to the creek, just upstream of its mouth, through a pipe and CSO outfall, TI-008 (Figure 10, Table 2). Alley Creek and Oakland Lake contribute the largest volume of freshwater to LNB (36%). The remaining inflow comes from stormwater (26%), CSOs (22%), the Belgrave treatment plant, which discharges treated wastewater from Nassau County (15%), and septic systems (1.5%)[8].

[8] DEP, 2009 - Alley Creek WWFP

Figure 11. Sub-watersheds and associated waterbodies and streams in LNB.

DEP's LTCP provides a detailed description of the surface stormwater and sewage infrastructure that determines the watershed hydrology. The CSO system (Oakland Gardens and Hollis Hills neighborhoods) pipes both sewage and stormwater runoff collected in catch basins in the street to the Tallman Island Waste Water Treatment Plant in Powell Cove, Queens. During rain events of typically one-half inch or more, however, stormwater exceeds the capacity of the combined stormwater and sewage system, and stormwater mixed with untreated sewage discharges into the receiving waterbody through combined sewer overflows. CSOs are the major source of water quality impairment in New York City. The modeling by DEP has shown that CSO discharges contribute 30% of biological oxygen demand to Alley Creek and 83% of total coliform loads[9].

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[9] DEP, 2009 - Alley Creek WWFP

The Alley Creek Little Neck Bay watershed includes a relatively high proportion of the urban landscape drained by separated sewer systems (Bayside, Douglaston and Little Neck neighborhoods) compared to urbanized watersheds in the rest of NYC. As a result, non-point source pollution, which is generated from impervious surfaces (Figure 11), is a significant source of water quality impairment, and not just CSOs.

Table 2. Major flow sources and rates within the watershed (MG = Million Gallons).

Site	Annual stormwater and CSO flow (MG/Yr)**
Alley Creek (fresh – west branch)	
Weir at spring fed pond east of TI024	
TI-024 (Alley Ck – tidal)	122.4
TI-007 (Alley Ck - tidal)	0.1 (CSO)
TI-008 (Oakland Lake, Alley Ck - tidal)	36.4
TI-025 (Alley Ck - tidal)	132.5 (CSO)
TI-655 (Alley Ck - tidal)	38.6
TI-654 (Alley Ck - tidal)	59.8
Gabblers Creek	
TI-660 (Gabblers Creek)	51.11

*USGS stream gauge data
** DEP, 2013 draft LTCP - based on 2.5 MG/Day for TI 008, and 0.2 MG/D infiltration for TI 024
*** Band, 1987

The hydrologic disturbance due to urbanization in the watershed affects various habitats differently. In the ephemeral stream reaches, the volumes and frequency of the runoff and the reduction in base flow lead to increased erosion and sedimentation, physical disturbance, pollutants that would otherwise be filtered by soil and plants, and delivery of floatable garbage. In the estuarine reaches of Alley Creek, and in Little Neck Bay, the more frequent runoff degrades water quality by increasing the volume of nutrients, oil, grease and other heavy metals, bacteria, pesticides, suspended solids, and floatables and other materials.

1.3.6 Water Quality

During the last three decades, water quality in NY Harbor has improved significantly, including in Long Island Sound and Little Neck Bay. Infrastructure improvements and the capture and treatment of virtually all dry-weather sewage are the primary reasons for this improvement. However, water quality is still impaired in Alley Creek and LNB, where regulatory standards for fishable and swimmable waters and target ecological conditions are not consistently met.

Alley Creek is Class I (suitable for secondary contact recreation and fishing) and Little Neck Bay is Class SB (suitable for primary contact swimmable/fishable) under the NYS classification for marine waters in accordance with the provisions of the Clean Water Act. Both SB and I classes are also defined as waters "suitable for fish, shellfish and wildlife propagation and survival." These water body classes have distinct standards, which include numeric criteria set for fecal coliforms and dissolved oxygen. Currently, Alley Creek meets the Class I standards of fecal coliform and LNB meets Class SB standards of fecal coliform. However, when DEP assessed the level of attainment for Alley Creek for the next higher use category of SC (limited primary contact recreation) the level of attainment decreased to 87% on an annual basis with fecal coliform (DEP, 2013).

In 2009, as part of a citywide consent order to bring impaired water bodies in line with federally regulated water quality standards, the NYC DEP produced the "Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan Report" which resulted in the recommendation to build a 5MG CSO retention tank to improve the capabilities of the sewage infrastructure and to reduce CSO flows to Alley Creek and Little Neck Bay. The retention tank went online in March 2011, and is estimated to have resulted in a 54% reduction in the volume of CSO overflows.

Despite improvements in water quality achieved by the CSO retention tank, other sources of water quality impairment are a concern. Alley Creek is impaired by floatables (Table 16). Bacteria concentrations have typically been elevated along the LNB peninsula, for example, at the Douglaston Manor Association (DMA) beach. These near shore pathogen concentrations cannot be accounted for by the Bay's ambient water quality conditions or pollutant loads from Alley Creek. The suspected sources of these pollutants are the septic systems in this unsewered drainage area of the LNB peninsula. These septic systems are likely contributing contaminants to the bay through shallow groundwater, and loads from this source may be exacerbated during rain events or periods when the groundwater table is elevated. Because this pollutant source does not fall under the jurisdiction of DEP under the LTCP, other regulatory mechanisms through DEC are needed to address the problem.

In 2012, water quality monitoring data in Alley Creek also showed elevated levels of bacteria concentrations that could not be accounted for by the DEP models. These were attributed to illicit connections to storm sewers in the TI-024 catchment, and DEP undertook a tracking and correction program to eliminate these connections. Consequent monitoring near Northern Blvd suggests that other illicit connections still exist and DEP is in the process of investigating these.

The water quality improvements to date have focused on water quality standards related to human health risk based on designated use and impairments associated with CSO. The water bodies currently do not have numeric standards set for nutrients, though eutrophication issues and dissolved oxygen relate strongly to these non-point source pollutants, and have been improved under the discussed CSO control efforts. In the future, all discharges from the City's separate storm sewers will be regulated through the Municipal Separate Storm Sewer Systems (MS4) Permit (see Regulatory section below). The process of coming into compliance with this regulation, for example through improving stormwater management practices, is anticipated to lead to reduced floatables, settable solids, nutrient loads and pathogens.

1.3.7 Groundwater

Groundwater in the watershed plays a significant role in supporting aquatic ecosystems by supplying freshwater to springs and streams. The depth to the water table varies topographically throughout the watershed from the terminal moraine to Little Neck Bay (Figure 12). The unconfined water table is hosted in the glacial moraine till, and may be underlain by the Magothy and Lloyd aquifers[10]. Groundwater wells within the watershed show some organic compounds[11] (indicating gasoline byproducts, chlorinated solvents). However it is unclear if water quality contamination is interacting with aquatic habitats. Since the city stopped pumping groundwater in Queens in the 1980's, the water table along all the north shore of Long Island has increased. An increase in precipitation (above mean rainfall each year over the past decade[12]) may be contributing to this, but the exact nature of this increase in water table remains unknown. Locally, the increasing water table might contribute to increased surcharge of freshwater in some of the lower lying lakes and increased base flow in the lower reaches of the creeks close to the Long Island Sound

[10]Misut and Monti, 1999, Buxton and Smolensky, 1999.
[11] USGS website - water quality sampling report
[12] USGS 1999

estuary[13].The only current groundwater usage in the watershed is at the golf course. A 300 ft deep well pumps water into a lined holding pond, and an estimated 35 million gallons (MG) is pumped over the summer golfing season.

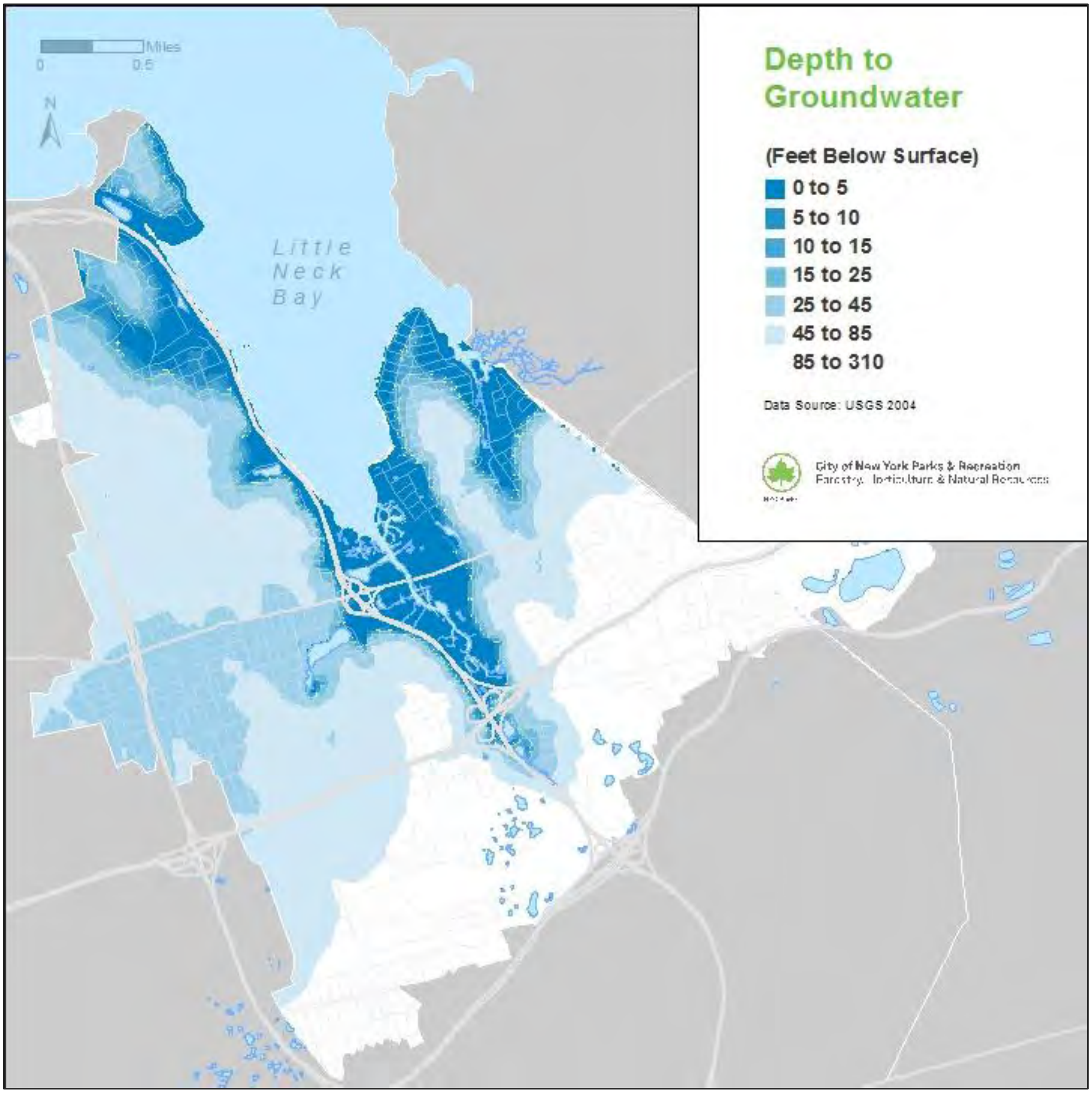

Figure 12. Depth to groundwater in the unconfined water table.

In theory, shallow groundwater discharges to streams may have been reduced in the watershed due to the high impervious surface area, decreased rainfall infiltration and potentially reduced groundwater recharge. However, since the relative proportion of above ground infiltration recharge versus recharge from deeper aquifers in the watershed is unknown, it is unclear what effect the increased impervious area has had on groundwater that supplies the base flow to the freshwater streams.

[13] Eaton, 2008

1.4 Habitat and Ecosystem Characteristics and Conditions

Within the Little Neck Bay watershed, the Alley Creek and Udalls Cove sub-watersheds feature a large park system with many diverse habitats, including salt marsh, estuarine mud flats, spring fed streams, freshwater wetlands and vernal pools, meadows and some of the oldest forest in Queens (Figure 13, Table 3). The watershed is an important home and migratory respite for many species, in part because of the diversity, relatively large size, connectivity, and distribution of the natural areas from the top of the watershed at the terminal moraine to the shoreline of the Bay. Alley Pond Park supports some of the last remaining habitat in NYC for locally rare animals, such as the spotted salamander, and for at least five plant species that are threatened or endangered in New York State[14]. The Bay also provides regionally significant waterfowl with over-wintering areas[15]. Despite substantial landscape alterations over the half century, including drastic changes to the hydrology, remarkable ecological richness can still be found. The following sections provide an overview of the characteristics and condition of habitat types and ecological systems in the watershed, why they are valuable, and what impacts, stressors, or actions pose a threat to their integrity. This basic summary of their condition provides the context for establishing management goals and objectives, as well as the strategies and recommendations for management and restoration provided later in the Plan.

Table 3. Extent of habitat type in watershed.

Habitat Type	Area in Watershed (acres)
Upland forests	440
Salt marsh (Spartina salt marsh and brakish marsh)	98
Freshwater wetlands (*Phragmites,* meadows, ponds/lakes)	50
Forested freshwater wetlands (kettle ponds, vernal pools)	8
Freshwater streams (riparian corridors, floodplain forest)	7
Marine (Little Neck Bay, beach and tidal mudflats)	6
Freshwater wetlands (springs)	<1

[14] NYS Natural Heritage Program, 2013
[15] NYS Department of State, 1992

1.4.1 Upland Forests

Location

Upland forests are found at the south end of Alley Pond Park (the Southern Forest), along the west side of the CIP north of the LIE (the Tulip Tree Forest), surrounding water bodies around Old Oak Pond (Figure 14) and Oakland Lake at the north end of the Park, and east of Alley Creek south of the LIE along Douglaston Parkway. Degraded filled sites, which are former tidal marsh, east are sites of active forest restoration of Alley Creek.

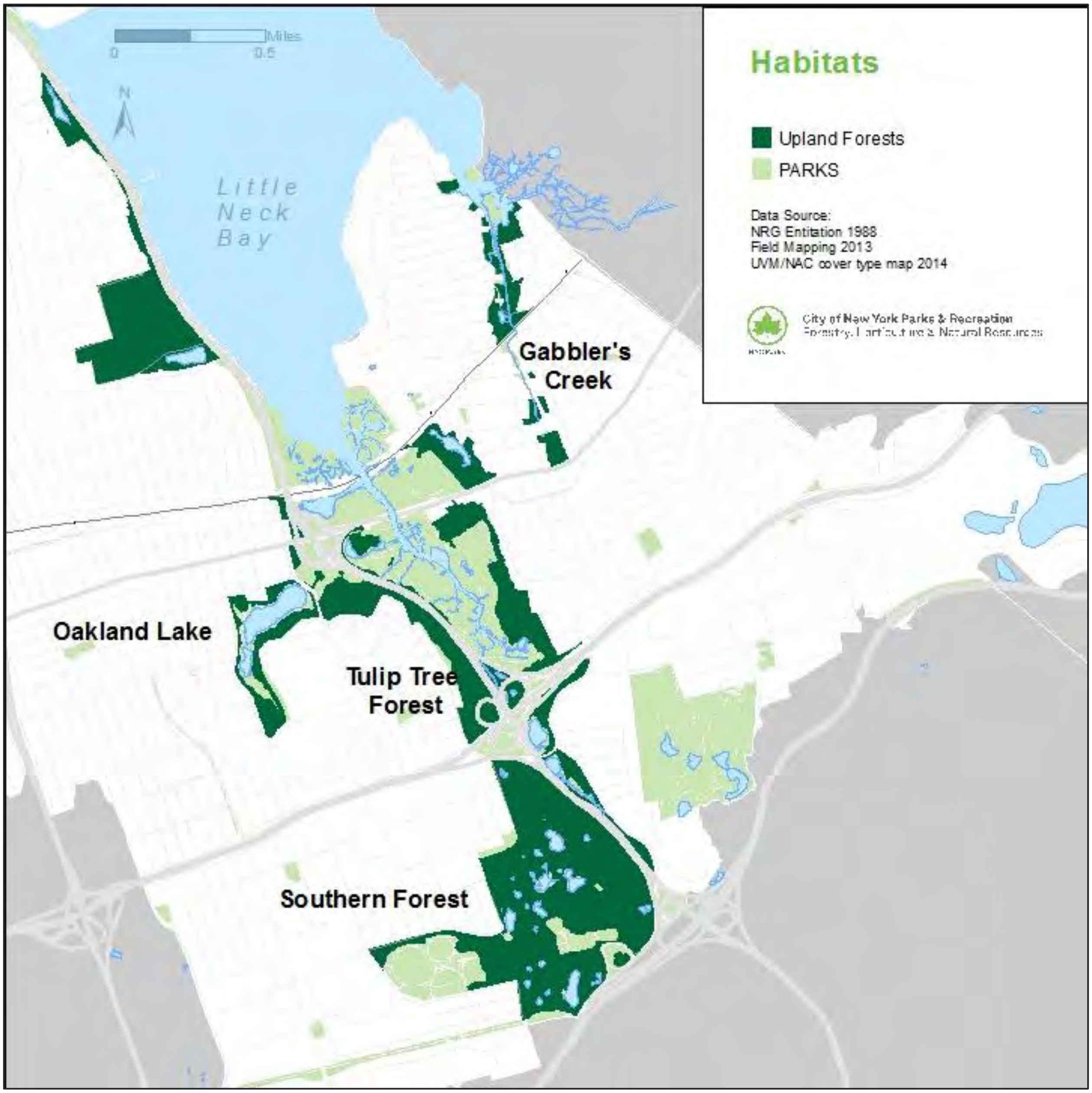

Figure 13. Upland Forest Habitat

Existing Characteristics and Conditions
The majority of the present day forest grows on the slopes and upper reaches of the watershed (Figure 13). Some areas had been farms at the beginning of the 20th century, but steeper slopes were not suitable for farming or other development and contain older oak-hickory-tulip tree forest. In addition to historic natural forest regeneration of abandoned farmland, Parks began large-scale forest restoration on filled areas adjacent to Alley Creek in 2007 (Figure 18).

The Southern Forest, in the upper watershed, is a relatively intact forest with many features of a relatively undisturbed ecosystem, such as populations of early spring wildflowers and other sensitive species (Table 4). However, large canopy gaps with invasive vines persist within the Southern Forest and northern sections of the Tulip Tree Forest. These areas may represent, in spots, a source of invasive non-native seeds which impede recruitment and regeneration of native species. The Southern Forest has undergone periodic maintenance by NRG since the 1990s to remove dumped cars and other trash, manage invasive plants, and replant native forest species.

Functions and Values
The Southern Forest is one of two best birding places within the watershed for spring and fall migrating songbirds according to the Audubon Society[16]. The kettle ponds and adjacent upland forest have the richest biodiversity in the Park, including nesting wood thrush and scarlet tanager, which is listed as a 'Species of Greatest Conservation Need' by DEC. Other macro fauna, such as rare vernal pool obligate amphibians, attest to the quality of the surrounding forest because they spend most of the year in the forest away from water[17].

Threats
Invasive vines can suffocate and put structural stress on trees, while shading the forest floor and decreasing native tree and shrub regeneration. These can make native forests very vulnerable to disturbances. Invasive non-native vines, trees, and shrubs alter forest composition, degrading habitat for forest-dependent wildlife species. Lack of a native shrub layer in many portions of the forest creates ideal conditions for early succession invasive species, especially Japanese honeysuckle and multiflora rose, which take advantage of open spaces and light gaps in the canopy. Japanese stilt grass and mile-a-minute are both relatively new to the area but rapidly gaining a foothold, especially along paths and in disturbed high light conditions. Mowing equipment and foot traffic can actively spread both of these invasive species.

[16] New York City Audubon, 2013
[17] NRG, unpublished data

Table 4. Select Native and invasive species typical of upland forests in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna	**Flora**[18]	**Fauna**	**Flora**
• spotted salamander (*Ambystoma maculatum* • bull frog (*Lithobates catesbeianus* • scarlet tanager (*Piranga olivacea* • wood thrush (*Hylocichla mustelina*) • warblers, prothonotary (*Protonotariacitrea*), Kentucky (*Oporornis*formosus), Connecticut (*Oporornis agilis*), hooded (*Wilsonia citrina*) • rose-breasted grosbeak (*Pheucticus ludovicianus*) • great horned owl (*Bubo virginianus*)	• early meadow rue (*Thalictrum dioicum*) • spring beauty (*Claytonia virginica*) • Solomon's seal (*Polygonatumbiflorum*) • false Solomon's seal (*Maianthemum racemosa*) • rue anemone (*Thalictrum thalictroides*) • cut-leaved toothwort (*Cardamineconcatenata*) • spotted wintergreen(*Chimaphilamaculata*) • trillium (*Trillium cernuum*) • bloodroot(*Sanguinariacanadensis*) • yellow giant-hyssop[19]* (*Agastache nepetoides*) • highbush blueberry(*Vaccinium corymbosum*) • oaks (*Quercus alba, Q. rubra, Q. velutina*) • hickories (*Carya glabra, C. ovata*) • tulip tree (*Liriodendron tulipifera*)	• earthworm (*Oligochaeta*) • emerald ash borer(*Agrilusplanipennis*) • Asian longhorned beetle (*Anoplophora glabripennis*) • viburnum leaf beetle (*Pyrrhaltaviburni)* • Starlings (*Sturnidae*) • feral cats (*Felis catus*) • Deer (Cervidae)	• garlic mustard (*Allaria petiolata*) • mugwort (*Artemisia vulgaris*) • Japanese siltgrass (*Microstegiumvimineum*) • multiflora rose (*Rosa multiflora*) • Japanese honeysuckle (*Lonicera japonica*) • Japanese knotweed (*Polygonumcuspidatum*) • mile-a-minute (*Polygonumperfoliatum*) • porcelain berry (*Ampelopsis brevipedunculata*) • kudzu (*Pueraria lobata*) • Oriental bittersweet (*Celastrus orbiculatus*) • English ivy (*Hedera helix*) • callery pear (*Pyrus calleryana*) • Norway maple (*Acer platanoides*) Japanese maple (*Acer palmatum*)

Informal trails called "desire lines" in the uplands of the Southern Forest, surrounding the kettle ponds and vernal pools, threaten these sensitive habitats. The compaction of soil from foot traffic increases the risk of runoff, which can result in erosion and sedimentation in these wetlands. Desire lines also fragment habitat, which disturbs wildlife, inhibits the germination and growth of native plants, and can facilitate invasive species introduction by increasing light and disturbance to the forest floor. Though frequently leading to the water's edge, desire lines can also lead to "party spots" where litter, broken glass, fire pits and illicit, unsanctioned patterns of use are prevalent, impacting plant and animal health as well as public enjoyment of the park.

Invertebrates provide crucial services in forests, including decomposition, nutrient cycling, pollination, food for predators, seed dispersal, and soil aeration. However, some non-native

[18] Greller, 2008, NRG, 1987
[19] NYS Natural Heritage Program, 2013
* Listed as endangered in New York State

species threaten forest health. Non-native earthworms are found in Alley Pond Park and increase leaf litter decomposition rates, which inhibits a stable healthy soil organic layer and reduces carbon sequestration. Other invertebrates that threaten forest health are the emerald ash borer and the viburnum leaf beetle, which feeds on arrowwood viburnum. Emerald ash borer threatens the survival of ash and maple trees. While it has not yet been found in NYC, it is regarded as a potential threat, posing long-term management concerns within the watershed and throughout the region.

1.4.2 Upland Meadows

Location

Upland parkland meadows are found on the west side of Alley Creek adjacent to the interchange between Northern Boulevard and the CIP and adjacent to the ball fields across from Oakland Lake. Meadows maintained by the community exist east of Alley Creek, south of Northern Blvd.

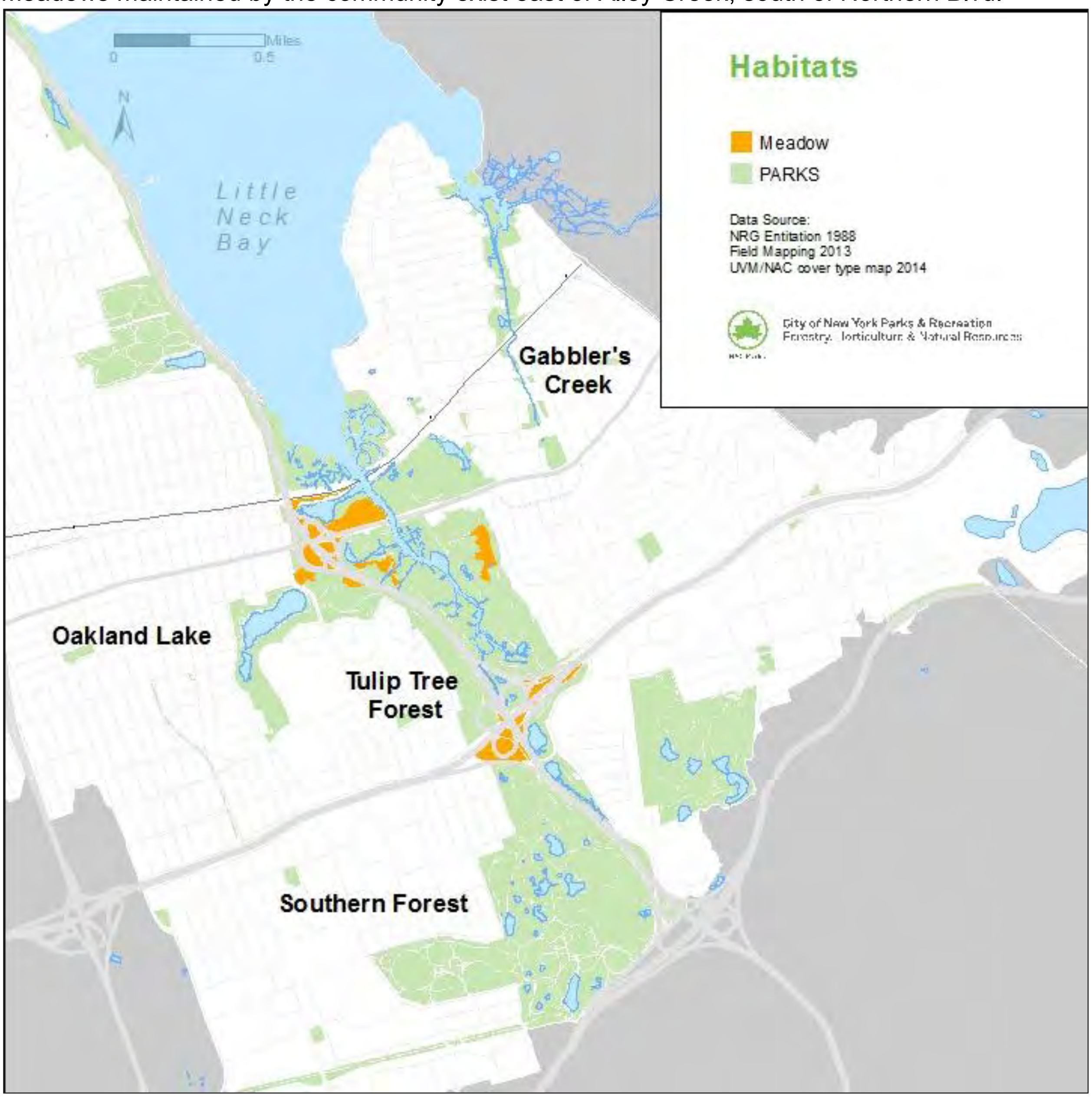

Figure 14. Upland Meadows Habitat

Existing Characteristics and Conditions

The newly restored or constructed meadows in the watershed predominantly consist of seeded native grasses and herbs. Prior to the restoration work at these meadows, however, mugwort, *Phragmites*, sweet clover, porcelain berry, and other invasive vines and herbs dominated these sites[20]. The meadows still require maintenance due to ongoing invasion from mugwort, *Phragmites* and other species, particularly along the site edges.

The upland meadows east of Alley Creek, known as the "bluebird" meadows, are located on urban fill soil complexes within larger Parks' forest restoration sites. Community members actively maintain these meadows though mowing and weeding.. The meadow opposite Oakland Lake was constructed by DEP at the same times as the CSO holding tank, which was completed in 2011.. This meadow is currently maintained by community members associated with the QBCC blog "nature on campus".

Functions and Values

Dominated by grasses and wildflowers, meadows provide habitat for wildlife that prefer an open canopy (Table 5). Meadows also provide welcome open spaces with scenic views. In general, meadows are under-represented throughout the city and region compared to their historic extent. This is largely due to the ease with which meadows can be farmed or developed, and how quickly they can be re-forested by colonizing trees. Historically, fire or grazing probably played a significant role in keeping woody species from colonizing meadows.. Today, mowing is a more feasible vegetation management technique.

Table 5. Select Native and invasive species typical of meadows in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna	**Flora**	**Fauna**	**Flora**
• American woodcock (*Scolopax minor*) • willow flycatcher(*Empidonax traillii*) • warbling vireo (*Vireo gilvus*) • yellow warbler (*Dendroicapetechia*) • Baltimore oriole (*Icterus galbula*) • orchard oriole (*Icterus spurius*)	• goldenrods (*Solidago rugosa, S. nemoralis, S. juncea, S. speciosa*) • asters(*Symphyotrichum laeve, S. oolentangiense*) • black-eyed Susan (*Rudbeckia hirta*) • common milkweed(*Asclepias tuberosa*) • switchgrass (*Panicum virgatum*) • little bluestem (*Schizachyrium scoparium*)	• brown headed cowbird (*Molothrus ater*) • starlings (Sturnidae)	• mugwort (*Artemisia vulgaris*) • common reed (*Phragmites australis*) • black locust (*Robiniapseudoacacia*)

Threats

Due to disturbed high-nutrient urban soils and ample sunlight from a lack of tree canopy, meadows are very vulnerable to invasion by mugwort, multiflora rose, porcelain berry and other exotic upland plants[21]. In contaminated or disturbed soil, it often takes several years for climax perennial grasses to germinate naturally from seed, thus increasing the potential for invasion. In addition, if not

[20] NRG, 1987
[21] Davis et al., 2000

mowed regularly, mugwort and woody species will invade, and meadows will convert to early successional forests.

1.4.3 Lakes/Ponds, and Surrounding Freshwater Wetlands and Wet Meadows

Locations

Oakland Lake, Alley Pond, Aurora Pond, Little Alley Pond, Golden Pond (Crocheron Park), and Old Oak Pond are all constructed, or significantly reconfigured, open freshwater bodies. Most have wet meadows or *Phragmites* along their shores to various degrees. Additional freshwater wetlands fed by springs and creeks are located around the APEC (Figure 14). The largest subclass is the expansive phragmites fields which are adjacent to tidal brackish marshes and presumably sustained by subsurface fresh water tables. To the far east of the Park in this reach is another artificial pond, called Old Oak Pond, which is brackish. This was created by the construction of a berm during widespread land filling of the salt marshes, which restricted tidal inundation and resulted in the ponding of local surface runoff.

Like all large ponds in the watershed, Oakland Lake was historically fed in part by surface water from a stream that formed what is now known as Oakland Ravine. The ravine is now dry, since the surrounding watershed has been developed, and all runoff is routed to storm drains. However at the foot of the ravine, along the edge of the lake, groundwater feeds a wetland and a short braided stream channel forms. Oakland Lake once drained to a stream, but the drainage is now piped directly to the tidal estuary at outfall TI-007, adjacent to the Alley Pond Environmental Center.

Existing Characteristics and Conditions

Most of these water bodies were originally formed by glaciation, but over time have been extensively altered and reconstructed, originally as impoundments for irrigating farmland, and later to manage stormwater runoff and flooding. These waterbodies have little or no connection to Little Neck Bay today, as the streams that once connected them have been diverted and piped underground. For example, there are no freshwater stream reaches that allow fish to migrate to upstream freshwater ponds.

Vegetation structure and composition varies in and around each waterbody and is largely controlled by water quality, the depth, duration and frequency of inundation, and the amount of other disturbance in the area. Freshwater wetland plants that grow in saturated soil or standing water are found around the margins of ponds, creeks, and in depressions (Table 6). Pond shore emergent freshwater wetlands consist of plants that can thrive in standing water, while wet meadows along pond edges consist of plants that only tolerate saturated soil during a fraction of the growing season. In general, water quality varies between each of the water bodies. Alley Pond features relatively good water quality, whereas Oakland Lake has been found to have high fecal coliforms and high biological oxygen demand[22]. *Phragmites australis*, which thrives in high nutrient systems, dominates the shores of most of the water bodies, along with a few other hardy wetland species such as willows and cattails[23].

[22]DEP, 2014 - draft LTCP
[23]Minchinton and Bertness, 2003

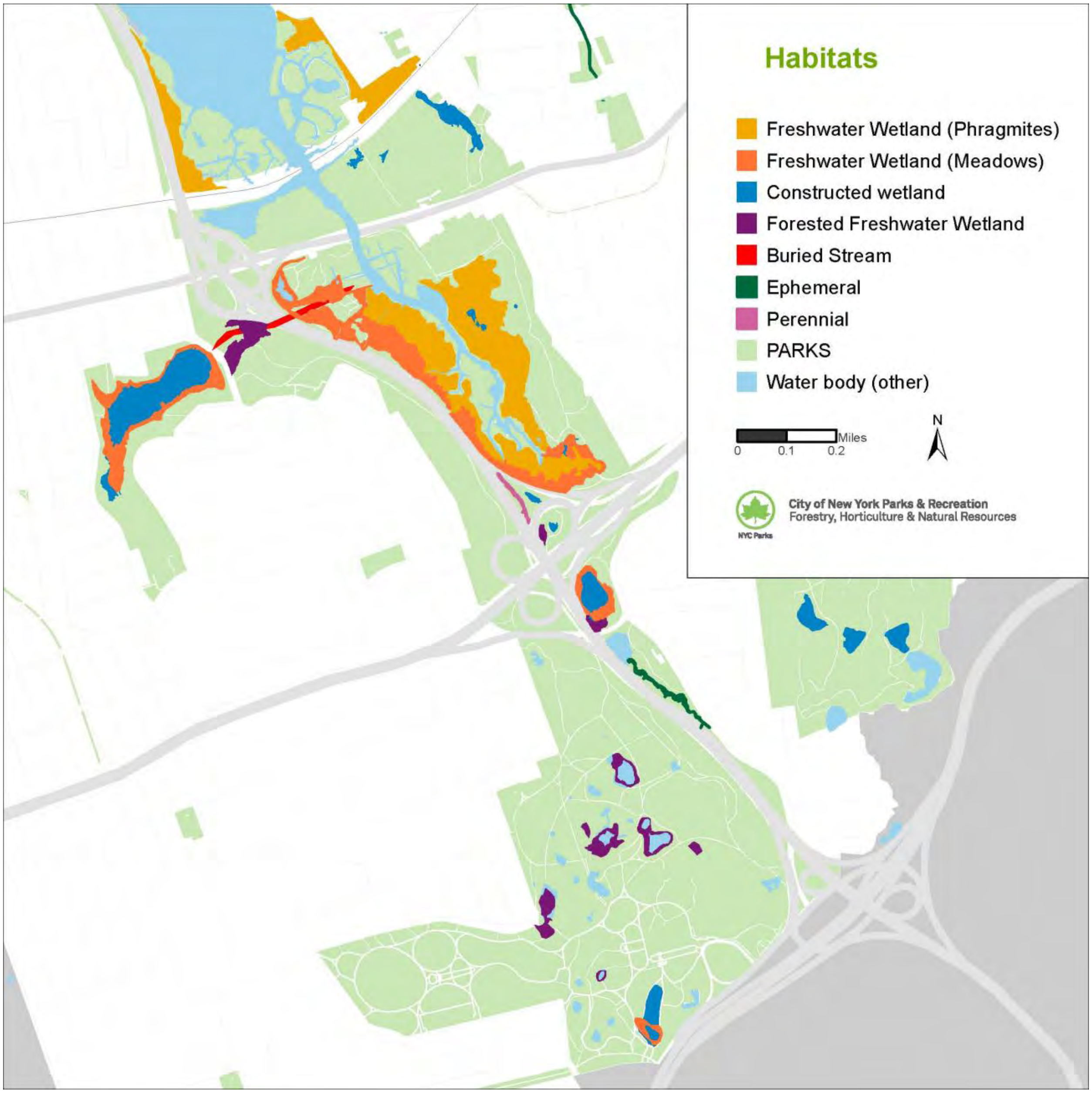

Figure 15. Lakes/Ponds, and Surrounding Freshwater Wetlands and Wet Meadows.

Functions and Values

Ponds and lakes, with the associated freshwater wetlands and wet meadows along their perimeter, serve as resting points for migratory birds, feeding grounds for water birds and other species, and essential habitat for fish, turtles, odonates and benthic invertebrates. Ponds and lakes also provide nutrient cycling, stormwater retention and filtration, and recreational outlets for fishing, boating, and walking for the local community. Differing water levels in these systems allow for many microhabitats, which increases biodiversity.

Table 6.Select Native and invasive species typical of freshwater wetlands and wet meadows in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna[24]	**Flora**[25,26]	**Fauna**	**Flora**
• blue gill (*Lepomis macrochirus*) • perch (*Perca* spp.) • willow flycatcher (*Empidonaxtraillii*) • yellow warbler (*Dendroicapetechia*) • common yellowthroat (*Geothlypistrichas*) • red-winged blackbird (*Agelaiusphoeniceus*) • herons (Ardeidae) • blue-winged warbler (*Vermivora cyanoptera*)	• Valdivia duckweed (*Lemna valdiviana**) • arrowhead (*Sagittarialatifolia*) • pickerelweed (*Pontedariacordata*) • water plantain (*Alisma subcordatum*) • blue flag (*Iris versicolor*) • bulrushes (*Scirpus americanus, S. pungens S. tabernaemontani*) • rice cutgrass (*Leersia oryzoides*) • swamp loosestrife (*Decadon verticellatus*) • black willow (*Salix nigra*) • red maple (*Acer rubrum*) • sweetgum (*Liquidambar styraciflua*)	• red-eared slider (*Trachemysscriptaelegans*)	• Carolina fanwort (*Cabombacaroliniana)* • mugwort (*Artemisia vulgaris*) • common reed (*Phragmites australis*) • multiflora rose (*Rosa multiflora*) • Japanese honeysuckle (*Lonicera japonica*) • Japanese knotweed (*Polygonumcuspidatum*)

Threats

The hydrology of these waterbodies has been severely altered, making siltation, erosion, and eutrophication common concerns. Oakland Lake is known to have high fecal coliform levels and nutrient loads from unknown sources[27]. Little Alley Pond, which lies directly adjacent to the LIE, is impacted by direct discharge of stormwater runoff from the highway. This road runoff affects other ponds as well and, in the winter, road salt increases salinity. This salt influx can benefit invasive species such as *Phragmites,* which can tolerate low levels of salinity that will kill native freshwater wetland plants.

Freshwater wetlands and wet meadows are threatened by poor water quality from pollutants in runoff and erosion, which facilitates *Phragmites* invasion on the banks and in shallow waters. Monocultures of *Phragmites* degrade the habitat structure and species complexity in these wetlands, which reduces habitat and food sources and decreases the biodiversity of wildlife, invertebrates, and pollinators that can inhabit the watershed.

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[24]NRG, unpublished data
[25]NRG, unpublished data,Kiviat and Johnson, 2013, NYS Natural Heritage Program, 2013
[26] NYS Natural Heritage Program, 2013
* Listed as endangered in New York State
[27] DEP, 2014 - draft LTCP

1.4.4 Forested Freshwater Wetlands: Kettle Ponds, Vernal Pools

Location

The Southern Forest is interspersed with freshwater wetlands, including the Turtle, Decadon, Muskrat, and Lilypad kettle ponds. Two more kettle ponds in the Douglaston Golf Course feature semi-permanent water, while three additional ponds along the Grand Central Parkway have been retrofitted as stormwater wetlands and now contain permanent standing water as a result of the increased catchment area. Several unnamed vernal pools are also present in the forest (Figure 14).

In the Southern Forest, the most hydro-geomorphic features are the kettle ponds. These kettle ponds are fed by surface runoff from their own small catchments, and may dry out, depending on annual rainfall. Freeway runoff is diverted to one kettle pond at the far south of the Southern Forest and as a result it has standing water most of the year.

Existing Characteristics and Conditions

Kettle ponds and vernal pools are both forested freshwater wetlands with similar plant communities. They are typically dominated by hardwood trees such as red maple and sweetgum. These communities are more accurately distinguished by their differing understory structure and composition, and their respective hydrology and geomorphology (Appendix 4). Broadly speaking, kettle ponds are characterized by semi-permanent standing water created during glacier retreat, when large ice blocks trapped in the glacial till melted and formed depressions, or “kettles.” Water and clayey, organic sediment collected in these depressions, often combined with decomposing vegetation and algae, forming a semi permeable substrate that led to ponding and standing water[28]. Kettle ponds usually have an open canopy and shrubby vegetation with some herbaceous groundcover (Table 7).

The vernal pools are found in smaller depressions and may not be associated with the distinct "kettle" topography. They are typically sparsely vegetated, though shrubs may be present along the perimeter. Typical vegetation may include fetterbush, high bush blueberry, and various sedges. Vernal pools have standing water that can vary from 1.5 - 3 feet deep in spring from precipitation, snowmelt, and some local groundwater, but they usually dry in the summer through evaporation and transpiration, exposing a substrate composed of dense, black, water-stained leaf litter[29]. The kettle ponds and vernal pools in the Park typically contain few invasive plants and provide quality habitat to pollution sensitive wildlife, such as salamanders and frogs (Appendix 5). The kettle ponds are susceptible to exotic plant invasion encouraged by sunlight through canopy gaps. However *Phragmites* is currently only a significant problem in the constructed ponds and lakes discussed in the previous section.

Functions and Values

These freshwater wetlands provide some of the only breeding habitat for spotted salamanders and wood frogs, whose populations are very limited in the City. These species depend on, and are known to breed in, both vernal pools and kettle ponds; however vernal pools are preferred because their drying regime inhibits fish that eat amphibian larvae. Due to their isolated hydrologic configuration and forested canopy, shady conditions and low pollution loads often contribute to relatively low invasive plant dominance at these small wetlands. The resulting high diversity of native species (Table 7) and relatively open views, unobstructed by tall dense stands of *Phragmites,* make these sites particularly valuable ecologically and aesthetically.

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[28]Band, 1987

[29] Edinger et al., 2002, Stanley, 2012

Table 7. Select Native and invasive species typical of forested wetlands in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna[30]	**Flora**[31]	**Fauna**[32]	**Flora**
• fairy shrimp (*Anostracan* spp.) • Baltimore oriole (*Icterus galbula*) • common yellowthroat (*Geothlypis trichas*) • yellow warbler (*Dendroicapetechia*) • swamp sparrow(*Melospizageorgiana*) • great horned owl (*Bubo virginianus*)	• skunk cabbage (*Symplocarpus foetidus*) • jewelweed (*Impatiens capensis* • Jack-in-the-pulpit (*Arisaema triphyllum*) • lowland yellow loosestrife* (*Lysimachia hybrid*) • brown bog sedge* (*Carex buxbaumii*) • buttonbush (*Cephalanthus occidentalis*) • arrowwood (*Viburnum dentatum*) • common elderberry (*Sambucus Canadensis*) • silky dogwood (*Cornus amomum*) • sweet pepperbush (*Clethra alnifolia*) • spicebush (*Lindera benzoin*) • highbush blueberry (*Vaccinium corymbosum*) • red maple (*Acer rubrum*) • sweetgum (*Liquidambar styraciflua*) • black tupelo (*Nyssa sylvatica*)	• earthworms (Oligochaeta)	• purple loosestrife (*Lythrum salicaria*) • common reed (*Phragmites australis*) • porcelain berry (*Ampelopsis brevipedunculata*) • Japanese knotweed(*Polygonumcuspidatum*)

Threats

One of the greatest threats to these wetlands is the heavily trafficked surrounding trails, many of which are informal. Informal trails and desire lines have led to forest fragmentation and loss of native understory vegetation, as well as poor management actions, such as placement of excessive loads of wood chips for trail maintenance. Spotted salamanders live underground much of the year and migrate from the forest to the pools on rainy spring nights to breed. This important stage in their life cycle can be threatened by soil disturbance or degradation of understory

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[30]NRG, unpublished data
[31] NRG, 1987,Kiviat and Johnson, 2013, NYS Natural Heritage Program, 2013
[32]NRG, unpublished data
* Listed as endangered in New York State

vegetation. These trails can also lead to soil compaction, which can cause erosion and siltation in the wetlands. Extensive sedimentation can lead to shallower pool depths, faster drying and altered hydrologic regimes that can impact wildlife, though there is no confirmation that this is occurring currently at the kettle ponds. In addition to more nutrients contributed by added sediment, increased turbidity can also increase eutrophic conditions. Both kettle ponds and vernal pools can be impacted by high nutrient loads from the landscape, resulting in duckweed and algal blooms in the warm summer months. These conditions deplete the water of oxygen and can be detrimental to aquatic wildlife.

1.4.5 Freshwater Wetlands: Springs

Location

Wetlands created by groundwater springs and seeps, or where the water table intersects the surface, are mainly found along the stream valleys and lower elevations in the watershed. Examples are found at the toe of hills on both sides of Alley Creek in the tidal reach, at the edge of the lakes, and at the perimeter of the salt marsh from north of the LIE to the shoreline of Little Neck Bay.

Existing Characteristics and Conditions

Some springs sustain sizable pools and perennial streams, while others create small isolated wetlands. At Oakland Lake, there are dispersed spring seeps (Figure 13) along the perimeter of the lake where the springs meet the toe of the surrounding hill slopes, discharging directly into the lake with little impact on the surrounding soils or vegetation. Upstream, along the valley and former tributary to the lake, there are multiple springs that sustain perennial stream flow and a larger wetland on the valley bottom characterized by *Phragmites* and skunk cabbage (Table 5).

The largest spring fed habitats are two small perennial streams north of the LIE fed by springs at the foot of the slope valley slope that join to become the "east branch" of the tidal section of Alley Creek. *Phragmites* and willows dominate the vegetation along these streams, creating the wet meadows described previously. Other smaller spring fed streams exist under wooded canopy areas and thus have fewer invasive plants.

Figure 16. Springs Fed Habitats

Functions and Values

Springs supply water for wildlife in winter when other sources are frozen, provide habitat for salamanders and invertebrates sensitive to salt, temperature and other water quality parameters, and contribute to biodiversity. Springs also feed larger streams[33], and reduce water temperatures in the summer months, discharging ~55° F water year-round. The eastern branch has a relatively high diversity of macro-invertebrate species and has been considered for trout reintroduction[34]. Seeps and springs serve as the primary habitat for the Northern two-lined salamander, listed by DEC as a NY State "Species of Greatest Conservation Need." They are also home to state endangered dragonflies, mocha emerald damselflies, and green frogs[35] (Table 8).

[33]Kiviat and Johnson, 2013
[34] Trout Unlimited, 2001, 2002
[35] NYS Natural Heritage Program, 2013,Kiviat and Johnson, 2013

Many of the springs adjacent to the Alley Creek salt marsh show signs of frequent visitation and informal community stewardship, such as cutting of *Phragmites*, informal boardwalks, stepping-stones and informal signage. They are clearly prized as local natural treasures.

Table 8. Select Native and invasive species typical of springs in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna[36]	**Flora**	**Fauna**	**Flora**
• scuds (Amphipoda) • midges (Chironomidae) • snails (Gastropoda) • moths (Lepidoptera) • mayflies (Ephemeroptera) • green frogs (*Ranaclamitans*) • Northern dusky salamander (*Desmognathusfuscus*)[37] • Northern two-lined salamander (*Euryceabislineata*)	• sensitive fern (*Onocleasensibilis*) • jewelweed (*Impatiens capensis*) • skunk cabbage (*Symplocarpusfoetidus*) • mannagrass (*Glyceriastriata*)		• common reed (*Phragmites australis*) • watercress (*Nasturtium officinale*)

Threats

Dense stands of *Phragmites australis* threaten habitat diversity in the east branch and prevent the expansion of any other riparian vegetation. Invasion by *Phragmites* reduces overall biodiversity and displaces fauna that inhabit native vegetation. It is especially prevalent outside of managed areas, directly around springs.. There are some springs elsewhere in the watershed that are not yet over run by *Phragmites*, but canopy gaps and adjacent stands of the plant suggest it might spread. Watercress (*Nasturtium officinale*) is also an increasing risk, as the water never freezes.

One of the two springs that had two-lined salamanders in the late 1990s is apparently now dry[38]. The cause is unknown, indicating how little is known about these sites. Lack of federal or state regulation to provide protection to these poorly understood and studied habitats also makes them more vulnerable. Due to this lack of legal protection, many springs may have been filled or piped, and the locations of remaining springs are not well known.

1.4.6 Freshwater Streams, Riparian Corridors, and Floodplain Forest

Location

Freshwater stream and riparian habitat is found along Alley Creek directly east of the Cross Island Parkway, beginning 2,500 ft south and 700 ft north of the LIE. Remnant riparian habitat, where former surface flow contributions from the watershed have been largely diverted, also remains in Oakland Ravine, the former headwaters of Oakland Lake. Similarly, Gabblers Creek has a riparian area severely reduced by alterations to the upstream watershed hydrology. Its length isis limited today, from approximately 250 ft south of the LIRR (at about Depew Avenue), to Aurora pond (Figure 14).

[36]NRG, unpublished data
[37] Once found in the watershed, but no longer: NRG, unpublished data
[38] NRG, unpublished data

Existing Characteristics and Conditions

Alley Creek and the smaller Gabblers Creek are both highly altered urban streams within open space corridors that retain some important riparian characteristics. These streams are associated with upland floodplain forests dominated by dogwoods, river birch, pin oak, and sugar maple that can tolerate periodic flooding (Table 9). The tidal reach is an exception, associated with wet meadows which were described previously.

Alley Creek Ephemeral Reach

Stormwater discharge feeds the upper reach of the creek, which has intermittent, ephemeral (seasonal) flow based on rainfall, channel substrate and slope. Surface water is evident year round where the stream becomes flatter. The stream is forced through a culvert below West Alley Road to Alley Pond below. Streams near the top of a watershed, or headwater streams, are typically classified as either ephemeral (flowing in response to storm events) or intermittent (seasonally wet/dry). These are critical and rare habitats, which are frequently filled or buried for urban development, as in the case of Alley Creek[39]. Today the CIP cuts off Alley Creek from its headwaters at the top of the watershed in the Southern Forest. The creek first appears at the end of a pipe near Douglaston Blvd and is fed by stormwater pipes under the CIP. It has little or no base flow for almost 1000 ft but the hydrology is flashy, meaning the channel fills quickly with flow in response to stormwater runoff from the pipes, which is typical of urban streams[40]. The impact of this flashy hydrology is evident by the severe bank erosion and gullies at the end of three major stormwater pipes along the CIP. These shear banks, dominated by invasive species, are over seven feet tall in some locations. At the furthest upstream pipe inlet, a rock revetment of boulders and cobbles was constructed to prevent erosion that was threatening to undermine the CIP. The smaller cobbles were washed downstream and are visible several hundred feet downstream of where they were originally placed. Severe incision, or down cutting, has also occurred in the main channel of the creek as a result of these stormwater inputs. But at some locations riprap, or concrete debris, is providing some grade control and down cutting seems to have slowed. In a few sections along the bank soil bioengineering techniques, including log crib-walls and dormant woody plant cuttings, were used to stabilize and re-vegetate the banks with native species. Due to the extensive disturbance in this stream reach, the stream benthic biotic community is highly impacted with low diversity and a high prevalence of pollution tolerant organisms, such as worms and midges.

Downstream along the ephemeral reach there is evidence of gravel and finer sediment where eroded material from upstream has been deposited. About 500 ft before the stream enters a culvert under West Alley Road, the flow becomes more persistent; perennial and chronic blockages of the culvert over the decades have caused flooding and contributed to formation of a *Phragmites* and vine dominated wetland.

Alley Creek Perennial Reach

The perennially flowing section of Alley Creek begins at the spillway for Alley Pond. The creek first flows through a culvert for over 500 ft before first emerging north of the LIE. The stream appears for approximately 150 ft in a relatively stagnant channel with a slight anaerobic odor, and then flows over a two ft high weir into another culvert. The stream emerges again for approximately 700 ft along the CIP and flows through a sand and silt-bedded straightened channel into a riparian area dominated by invasive vines with little overhanging vegetation or woody debris. The one season of water quality data collected in the reach suggested that total dissolved oxygen and nitrate, phosphate and ion concentrations were within the range adequate for trout habitat, though summer temperatures were not studied and macro-invertebrate populations indicated degraded habitat

[39]Kiviat and Johnson, 2013

[40] Walsh et al., 2005

conditions[41]. The culvert under the on-ramp to the CIP separates the freshwater reach from the tidal reach.

Alley Creek Tidal Reach

Between the LIE and Northern Boulevard, the creek becomes a tidally influenced narrow channel of about 4,500 feet in length, flanked on either side by *Phragmites* dominated marshes. Some salt marsh habitats occur close to the inlet with Little Neck Bay. The western sub-catchment of the Alley Creek watershed includes Oakland Lake, a large freshwater body which is essentially human-made.

Downstream of the CIP culvert, Alley Creek becomes increasingly brackish, or saline, until it merges with the estuary system at Northern Blvd. The vegetation consists mostly of a dense monoculture of *Phragmites australis,* with little native vegetation and low habitat diversity. The stream channel consists of fine, unconsolidated material with banks that are, at spots, terraced and undercut (Appendix 6). Slight changes in the channel bed material, e.g. the presence of a resistant clay, creates slight constrictions or grade controls that locally influence the creek morphology. Natural freshwater springs within the tidal reach, though sometimes obscured by historic fill, may still locally influence the salinity, substrate and vegetation. Much of this area was historically mudflat/tidal pool serving as the terminus to Alley Creek. The few *Spartina alterniflora* stands increase in extent further north towards the estuary, where *Phragmites* loses the competitive advantage it gains low salinity waters[42].

Gabblers Creek and other Historic Tributaries to Little Neck Bay

Gabblers Creek is primarily ephemeral, with a very limited section of perennial flow upstream of the tidal reach. Historically, the headwaters of Gabblers Creek likely included Lake Success in Nassau County. During the construction of the LIE, the drainage from this lake was likely re-routed. Runoff from the larger watershed feeding Gabblers Creek was similarly piped to other outfalls, leaving only a relatively small catchment of streets actually draining to the creek. The Gabblers Creek watershed lies east of the Alley Creek watershed. The diversion of Lake Success, the historical head waters of Gabblers Creek, in addition to the construction of storm sewers throughout its catchment, has depleted Gabblers Creek of all but intermittent base flow during winter months and after large rainfalls[43]. The current day Gabblers Creek begins just north of Northern Boulevard, at a stormwater outfall pipe, emerging beneath a large landfilled hill slope where the historic stream would have been. The ephemeral channel runs approximately 2,000 ft north toward a culvert under the Long Island Rail Road (LIRR). A short section of the creek, approximately 100ft, flows perennially just north of the LIRR, sustained by groundwater. Then the creek flows into and out of Aurora Pond, which becomes brackish at the highest tides.

The ravine in which Gabblers Creek is found today begins with a steep gully. A large patch of kudzu dominates the channel and banks where light enters through canopy gaps. Multiflora rose is dominant in areas with a more closed canopy and Japanese knotweed is prevalent throughout the understory. Further downstream, the ravine flattens and the floodplain becomes more pronounced while the channel becomes more braided and almost completely dispersed in sections. Near where Gabblers Creek flows through a culvert under the LIRR the stream becomes perennial, but is confined to a box-shaped armored channel which branches off to feed Aurora Pond.

Historic Tributaries to Little Neck Bay

[41] Trout Unlimited, 2002
[42] Medeiros et al., 2013
[43] Band, 1988

The headwater stream that originally fed Oakland Lake from Oakland Ravine no longer exists primarily due to the development and re-routing of stormwater in the catchment that fed it. Little remnant riparian vegetation exists in the ravine today. The stream that once flowed from Oakland Lake is in a pipe today, but still discharges directly into the estuarine reach of Alley Creek. This historic stream was probably fed by a spring-fed channel that remains today and is piped under the CIP to Alley Creek.

Functions and Values

Riparian corridors provide vital ecological and societal functions such as nutrient transport, erosion control, sediment trapping, pollution mitigation, flood abatement, and biodiversity[44]. Despite extreme alteration to the creek and watershed over the decades, the creek still supports freshwater species and stream aquatic habitat extremely rare in most of NYC (Table 9). Flood detention and sediment trapping functions are evident at the downstream end of the Alley Creek ephemeral reach, where a blocked culvert contributes to the storm water detention function of the creek. The detention area is dominated by *Phragmites,* which is presumably removing pollution from highway generated stormwater. Although the floodplain detention is the result of an anthropogenic alteration, historically beaver dams or log jams could have played a similar role in damming a channel and creating detention.

Even the ephemeral stream reaches help contribute to habitat diversity in the watershed by supporting species (Table 9) that do not require a perennial water source[45]. Fishes observed in Alley Creek include striped bass, elvers, eels, killie fish, and spined sticklebacks[46].

[44]Lowe and Likens, 2005,Naiman et al., 2005
[45]Edinger et al,. 2002
[46] Trout Unlimited, 2001, 2002

Table 9.Select Native and invasive species typical of riparian areas in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna	Flora	Fauna	Flora
• striped bass (*Moronesaxatilis*) • eels (*Anguilla rostrata*) • killies (*Fundulusheteroclitus*) • nine-spined sticklebacks (*Pungitiuspungitius*) • Northern two-lined salamander *(Eurycea bislineata)*	• white snakeroot (*Ageratinaaltissima*) • jumpseed (*Polygonum*spp.) • jewelweed (*Impatiens capensis*) • beggars ticks (*Bidens*spp.) • spicebush (*Lindera benzoin*) • dogwoods (*Cornusamomum, C. racemosa, C. sericea*) • maples (*Acer rubrum, A. saccharum*) • ashes (*Fraxinusamericanus*) • sycamore (*Platanusoccidentalus*) • oaks (*Quercusrubra, Q. alba, Q. palustris, Q. phellos*) • river birch (*Betulanigra*) • willow (*Salix nigra*) • hickories (*Caryaglabra, C. ovata*) • tulip tree (*Liriodendron tulipifera*)		• common reed (*Phragmites australis*) • Japanese knotweed (*Polygonumcuspidatum*)

Threats
The main threats to the stream and riparian corridor are continued erosion and bank instability, spread of invasive plants, and the effect of poor water quality on habitat. The ephemeral reach features the most dramatic impairments associated with unmanaged stormwater and has received the largest restoration investment.

The high degree of fragmentation and non-contiguous parkland within these reaches hinders faunal migration patterns. The largest barriers are roadways and infrastructure: West Alley Road culvert and the weir at Alley Pond separate the ephemeral reach from the perennial reach; the CIP separates the ephemeral reach from the Southern Forest headwaters; and culverts and weirs break apart the perennial reaches. Fish and amphibians that would use these corridors for migration are barricaded from up and downstream access, limiting the opportunity to move to more suitable habitat or away from disturbance. In addition, low base flow volumes inhibit fish from relying on these waterways for migration.

Water quality impacted by untreated stormwater runoff as well as the flashy hydrologic regime creates conditions that primarily support pollution and disturbance tolerant species in most of the creeks in the watershed. Channel stabilization is difficult and restoration of natural hydrology is not likely due to the level of development and impervious area in the watershed[47].

1.4.7 Salt Marsh

Location
Low and high salt marsh, as well as tidal mud flats and brackish tidal marsh, are located along Alley Creek and in Udalls Cove at the mouth of Gabblers Creek. Narrow fringes of salt marsh are also located along the shores of Little Neck Bay, on private property in Douglaston Manor, and scattered adjacent to the CIP.

[47]Booth et al., 2004

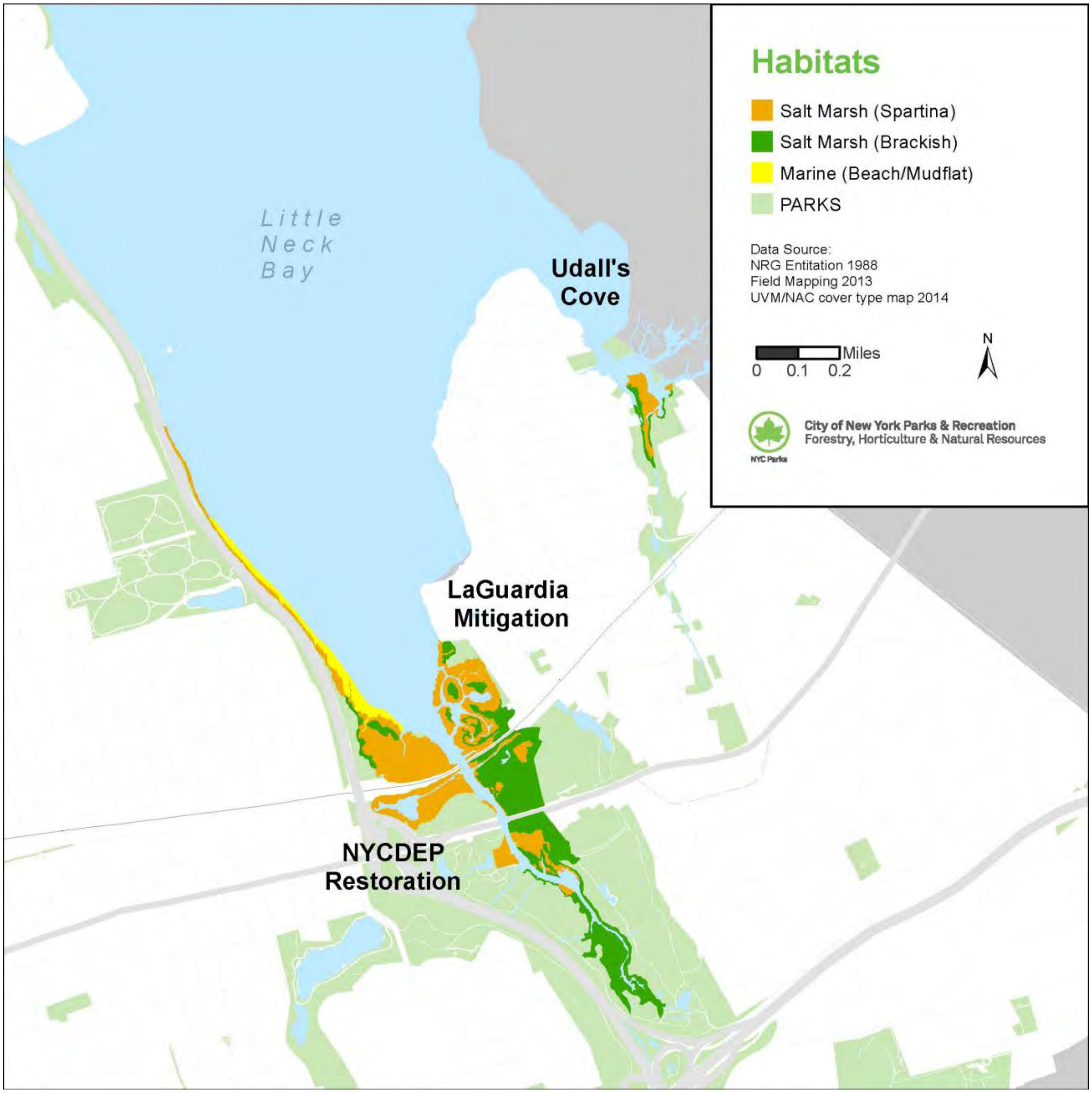

Figure 17. Salt Marsh

Existing Characteristics and Conditions

Historic aerial photography[48] shows salt marsh was once far more extensive in Alley Creek, covering almost the entire tidally influenced reaches. Some of the marsh lost to landfilling has been reclaimed in the last two decades under a number of large restoration projects. Salt marsh is defined as coastal grassland flooded daily by the tide. The low marsh, dominated by salt marsh cordgrass (*Spartina alterniflora),* floods twice daily, and the high marsh, dominated by salt grass and salt meadow cordgrass *(Spartina patens* and *Distichlis spicata)*, floods twice monthly at the new and full moons.

Most of the salt marsh loss along the bay was due to extensive landfill, particularly in the 1960s during the construction of the LIRR and Northern Boulevard. This fill may have also played a role

[48] Euler, 2007

in reducing the extent of the salt marsh by changing the tidal and salinity regime. Salt marshes, and wetlands in general, have historically served as a citywide dumping ground to facilitate development. In the 1920s and 1930s, salt marshes were heavily ditched for mosquito control and were filled with concrete and asphalt waste or used to dump household garbage. Most of the wetland filling loss ended with the Clean Water Act, which finally afforded protection to wetlands. This historical dumping has resulted in restrictions to landward marsh migration. As detailed in the historic landscape change summary (Table 1), extensive filling of salt marsh occurred in the mid-20th century. This filling promoted expansion of dense urban development, which has increased the watershed's vulnerability to sea level rise and other stressors. The tidal systems were further constrained by the construction of the Long Island Rail Road (LIRR) and Northern Blvd, which constricted tidal flux within upstream sections of the tidal reaches. This reduction of daily salt water inundation may have caused freshwater to become more dominant in this tidal reach compared to pre-development conditions[49]. This lower salinity is presumably further exacerbated by the concentration and direct discharge of stormwater catchment at the outfall TI-024 at the southern reach of the tidal system. This change from a brackish to a more freshwater regime will continue to have a large impact on the wetland habitats, which are sensitive to salinity gradients.

Today, the salt marsh is in decent health given local water quality. However, approximately 10 acres of salt marsh have been lost along the shoreline of the bay and Alley Creek alone since 1974. The exact cause of this loss is unknown. Preliminary results from a 2013 in-depth ecological assessment indicate that the tidally unrestricted portion of Alley Creek has weaker soil and root networks than many of the Long Island Sound marshes, which is likely contributing to its high rate of loss. Native marsh grasses dominate much of this portion, with *Phragmites* only dominating at higher elevations and lower salinities. Freshwater inputs from springs and storm and sewer outfalls result in a large portion of the tidally restricted section being almost freshwater, dominated by *Phragmites*[50].

Functions and Values

Though diminished from their previous extent, the salt marshes along the bay still provide ecological services such as water quality enhancement, wave energy dissipation from storms, and carbon sequestration. They also provide habitat for shellfish, crustaceans, fish, and birds, many of which depend on salt marshes for all or part of their life cycle. Fiddler crabs and ribbed mussels, for example, inhabit the intertidal area of the low marsh and have a mutalistic relationship with *Spartina alterniflora*. Fiddler crabs burrow in the low marsh and mudflat adjacent to water, where they help breakdown organic matter and aerate the soil. Mussels attach themselves to the bases of *Spartina alterniflora*, creating a reef-like structure, where they help filter water and stabilize grasses and shorelines[51] (Table 10). Songbirds, herons, birds of prey, and a variety of other water birds, depend on salt marsh for nesting or foraging habitat. Osprey, which hunt in tidal creeks and adjacent deeper water and had been absent for decades, now nest on platforms that have been erected at Udalls cove.

Particularly because of birds and fish dependent on salt marsh, these habitats are valued for recreation by birders, fisherman, kayakers and others.

The brackish tidal marsh generally does not provide as many of these habitat and recreational values, because it is dominated by *Phragmites australis,* which obscures views and out competes native species. However, *Phragmites* is effective at helping remove excess nutrients from the

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[49] Eaton, 2008
[50] NRG NYC Parks & NAC, 2013 draft NYC Citywide Salt Marsh Assessment report
[51]Kiviat and Johnson, 2013

water and does provide various ecosystem benefits and functions, such as sequestering carbon, nutrients, and heavy metals, and builds and stabilizes soils[52].

Table 10. Select native and invasive species typical of salt marshes in the watershed.

Select Native Species		Invasive Species of Concern	
Fauna	**Flora**	**Fauna**	**Flora**
• ribbed mussel *(Geukensiademissa)* • fiddler crab *(Uca*spp.*)* • sparrows, swamp (*Melospizageorgiana)*, salt marsh (*Ammodramuscaudacutus*), and seaside *(Ammodramusmaritimus)* • willet *(Tringasemipalmata)* • clapper rail *(Ralluslongirostris)* • egret,great *(Ardea alba)* and snowy *(Egrettathula)* • glossy ibis *(Plegadisfalcinellus)* • black-crowned night-heron *(Nycticoraxnycticorax)* • snowy owl *(Bubo scandiacus)*	• salt marsh cordgrass *(Spartinaalterniflora)* • salt meadow cordgrass *(Spartina patens)* • salt grass (*Distichlisspicata)* • black grass *(Juncusgerardii)* • marsh elder *(Iva frutescens)* • groundsel tree *(Baccharishalimifolia)*		• common reed *(Phragmites australis)*

Threats

The salt marsh at the mouth of Alley Creek, has been eroded by wave action, as shown by exposed roots and terracing. There is vegetation loss in the marsh interior as well, but factors driving interior loss are not well understood. Potential mechanisms involve changes in nutrient dynamics and cycling, sea-level rise or increasing inundation, interior pool formation, and others.

A section of the salt marsh between the LIRR and north of Northern Blvd east of Alley Creek contains extensive areas of asphalt and concrete from a former amusement park that operated at the site in the 1950s. Here, some salt marsh grasses persist in concrete cracks, but several acres of the marsh are impacted by artificial fill.

The tidally restricted section of the marsh south of Northern Boulevard along Alley Creek is brackish due to freshwater inputs from the creek, springs, and stormwater and CSO outfalls. This increased freshwater and nutrient input has created conditions which give *Phragmites* a competitive advantage over native tidal marsh plants[53]. Increased nutrient concentrations alter and accelerate nutrient cycling dynamics in the salt marsh and may contribute to marsh loss by weakening the root structure and soil[54]. In addition, much of the salt marsh was historically ditched to encourage the marsh to drain and reduce mosquito breeding. This has resulted in increased length of marsh that is prone to erosion and fragmentation, which may reduce overall marsh function and give *Phragmites* a further competitive advantage[55].

[52] Kiviat, 2013
[53] Mozdzer and Megonigal, 2012
[54]Deegan et al., 2012
[55]Tonjes, 2013

1.4.8 Little Neck Bay, Beach and Tidal Mudflats

Location
Little Neck Bay includes all the marine water from the mouth of Alley Creek and Gabblers Creek / Udalls Cove to the edge of Long Island Sound. Beaches (un-vegetated gradual sloping shorelines ranging from sand to cobble sized sediment deposits) are found on the west side of Little Neck Bay adjacent to the CIP and on private property on the east side of the bay. Mudflat is interspersed along most of the coastline.

Existing Characteristics and Conditions
The shoreline of the bay is significantly altered through filling and placement of riprap and other armor, so it is unclear how much of the shore would have been beach under natural conditions. Much of the sand beach is interspersed with tidal mudflats that are exposed at low tide. Historically, the bay was home to extensive populations of oysters, crabs, scallops, horseshoe crabs, and the prized Little Neck clam. In fact, Little Neck Bay was a critical nursery for oysters and Little Neck clams until 1893, when water quality impacted the populations and rendered them unsafe for consumption. At that time hard clams were removed and transplanted into approved waters. However, shellfish, and clams in particular are still present in the bay today, as evidenced by the ongoing informal and unsanctioned harvesting of shellfish.

Functions and Values
Juvenile and adult horseshoe crabs (*Limulus polyphemus*) are observed on the west side of the bay, suggesting this beach area and others along the shore may provide active horseshoe breeding grounds[56]. Shells of scallops, oysters, and clams are found in the intertidal mudflats on the east side of the bay. It is not clear how many of these shells are relics or how large the populations are today.

The bay is a striped bass nursery and feeding area and home to many other fish including finfish, scup, blue fish, Atlantic silverside, menhaden, winter flounder, and blackfish. The bay is also home to wintering birds such as scaup, canvasbacks, American black duck, mallard, common goldeneye, red-breasted merganser, bufflehead, gadwall, and Canada goose.

Oyster reefs, when they were present in the bay, may have helped attenuate waves during storm events, providing a buffer to inland development. Today clams continue to provide food for crabs and shore birds living in the bay. Little Neck Bay has been designated a "Special Natural Waterfront Area" by the Waterfront Revitalization Program, which gives it a higher level of protection due to "natural habitat features."[57]

Threats
Water quality impacts due to stormwater runoff, CSOs, and unmanaged septic tanks, pose the greatest threat to the bay, beaches and mudflats. All these sources contribute to high nutrient loads and low dissolved oxygen conditions detrimental to fish and shellfish. Particularly near the CSOs, dissolved oxygen concentration is reduced and creates hypoxic and eutrophic waters[58], which inhibits oyster spat development and growth of filter feeders, such as clams and mussels. Horseshoe crabs, which are listed as Lower Risk/Near Threatened by the International Union for Conservation of Nature, can withstand some hypoxia, but the effect on juveniles is not fully understood[59].

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[56] NRG, unpublished data
[57] WPS, 2012
[58] DEP, 2005
[59] Botton et al., 2010

1.4.9 Developed Upland

Location
Developed upland covers most of the watershed and consequently it is important to consider its habitat, ecological condition and value. This constructed landscape can roughly be divided into the public right of way, or the streetscape, and private residences (Figure 3).

Existing Characteristics and Conditions
The predominant developed land use is residential and largely medium density. The streetscape is typically a public owned right of way featuring conventional curbs, sidewalks, lawns, and street trees. Street trees are bound by concrete on the street side, which restricts root length, increasing their risk of falling in storms and reducing life expectancy. Private residences make up most of the developed land and are typically 30 - 70 percent impervious. In typical residences, landscapes are often homogenous and tend to feature a large proportion of lawns, ornamental plantings, and paved areas with minimal habitat value.

Functions and Values
The developed upland has adverse impacts but also connects natural areas and associated habitats throughout the watershed. Along the street trees and interspersed vegetated areas, such as Parks Greenstreets, provide canopy connectivity, encourage habitat for birds and small mammals, connect larger parks and green spaces, contribute to biodiversity, and help retain and treat stormwater. Vegetation cover and associated pervious surfaces in a watershed have been shown to play a significant role in determining the health of downstream aquatic systems, particularly when the impervious area (or effective impervious area) is less than10 percent[60].

Threats
Threats to the streetscape include threats to street trees and poor private landowner practices, such as paving lawns for additional parking, which reduces the potential of residential gardens to provide habitat and retain stormwater.

Threats to the broader watershed, originating even within the vegetated streetscape, include the use of chemicals in landscapes. Fertilizer can leach into groundwater or runoff in stormwater before plants can utilize it, causing nutrient increases in waterways and degradation of water resources and habitat. Pesticides and herbicides can also negatively affect waterways and wildlife. While lawns provide more ecological services, such as stormwater retention, than impervious areas, soils tend to be compacted, contributing to stormwater runoff[61].

Street trees can be affected by pollutants, limited root volume, soil contamination and compaction, slower growth rates, and limited pervious areas. In NYC, 15.3% of street trees are London planetree, 14.1% are Norway maple, and 10.9% are callery pear. The top ten tree species make up 74% of all trees. This lack of biodiversity makes street trees more susceptible to disease outbreak[62] as evidenced by the impact of Dutch elm disease, which decimated much of the NYC elm population[63].

[60] Booth& Jackson, 1997
[61] Schueler, 2000
[62] NYC Tree Census, 2006
[63] Poland and McCullough, 2006

1.5 Recent Restoration Projects

The current condition of the habitats described above reflects various levels of management, as well as restoration efforts that have been undertaken over the last two decades by NYC Parks. Since 1992, NYC Parks has initiated projects to restore and rehabilitate ecological communities within parks across the watershed. These projects, ranging from invasive plant species management to salt marsh construction, are described in the maps below.

Ecological restoration projects have been driven by various goals and funded through different mechanisms over the decades. NYC Parks restoration work began with forest management led by NRG through the Urban Forest and Education program (UFEP) from 1992 to 1996. The first erosion control projects around the kettle ponds were funded by the NYS Clean Water/Clean Air Bond Act of 1996 (CW/CA Bond Act). Since 2007, significant funding was allocated to forest restoration work through the PlaNYC program MillionTreesNYC.

Other restoration work in the landscape has been implemented through large capital construction projects, often to mitigate a disturbance in the landscape, such as the restoration work that was performed during the upgrade of the LIE and CIP interchange. Several large salt marsh capital restoration projects have also been constructed as mitigation for wetland impacts, including 16 acres of salt marsh restoration by DEP as mitigation for the impacts from the CSO retention tank construction.

Oakland Ravine and Lake enhancement and restoration projects have been largely funded as part of DEP's stormwater management program. In contrast, most of the restoration projects focused on stormwater management and forest restoration in the Udalls Cove sub-watershed have been funded by grants secured by community groups, as well as volunteer efforts. Other forest restoration projects, as well as green infrastructure projects, have been funded by the LISFF (Figures 15-19, Tables 11-15).

Table 11. Recent Restoration - Southern Forest

1	**Stormwater Management and Upland Forest Restoration and Maintenance (5.2 acres), 1964, funded by NYSDOT.** An unnamed historic glacial kettle pond was originally converted to a storm water wetland that captured road runoff during the construction and widening of the Grand Central Parkway in preparation for the 1964 New York World's Fair. Later, UFEP worked in conjunction with volunteers from Mineola High School to restore the vegetation understory around the pond. Using volunteer labor, NRG continued pond edge vegetation maintenance in spring 2010.	4	**Kettle Pond Shoreline Protection (1.5 acres), 2001-2002, funded NYS CW/CA Bond Act.** Using funds from the Alley Kettle Ponds Grant, NRG repaired approximately 2500 linear feet of paths and built traffic barriers around Decadon, Turtle, and Lily Pad ponds to reduce sediment runoff and slope erosion.
2	**Ongoing Forest Maintenance (8 acres), 1992-1999, funded by 1996 NYS CW/CA Bond Act.** Restoration and maintenance under the UFEP grant was the first public investment in the natural areas of Alley Pond Park. The restoration focused on high value forest which was threatened by invasive plants. Additional funding under the Bond Act allowed the expansion of restoration efforts in this area and continued maintenance. To reduce soil erosion and compaction, NYC Parks experimented with introducing conifer species into the predominantly tulip tree and oak dominated forest canopy. NRG has continued maintaining this part of the forest periodically, including planting additional trees.	5	**Forest Restoration (5.3 acres), 2002-2011, funded by NYS CW/CA Bond Act.** NRG performed invasive plant control, tree maintenance and canopy gap replanting in multiple sites ranging from 0.06 s to 1.1 acres in the western section of Alley Pond Park.
3	**Grass and Sports Field Restoration (7.2 acres), 1993-1994, funded by NYCDPR.** NYC Parks spent almost $1 million to restore landscape and facilities on the southern edge of Alley Pond Park. This included the removal of excess paved parking spaces dating from the 1950s and their conversion to green permeable surfaces. The Alley Pond Park forest edge was replanted with fruiting native trees.	6	**Ongoing Forest Restoration (14 acres), 2007-present, funded by MillionTreesNYC/NRG in house.** NRG has been doing extensive forest floor maintenance, tree management, and replanting throughout the eastern forest canopy section of Alley Pond Park. This has included extensive tree pruning and fallen tree clearance following multiple storms in 2012 and 2013.

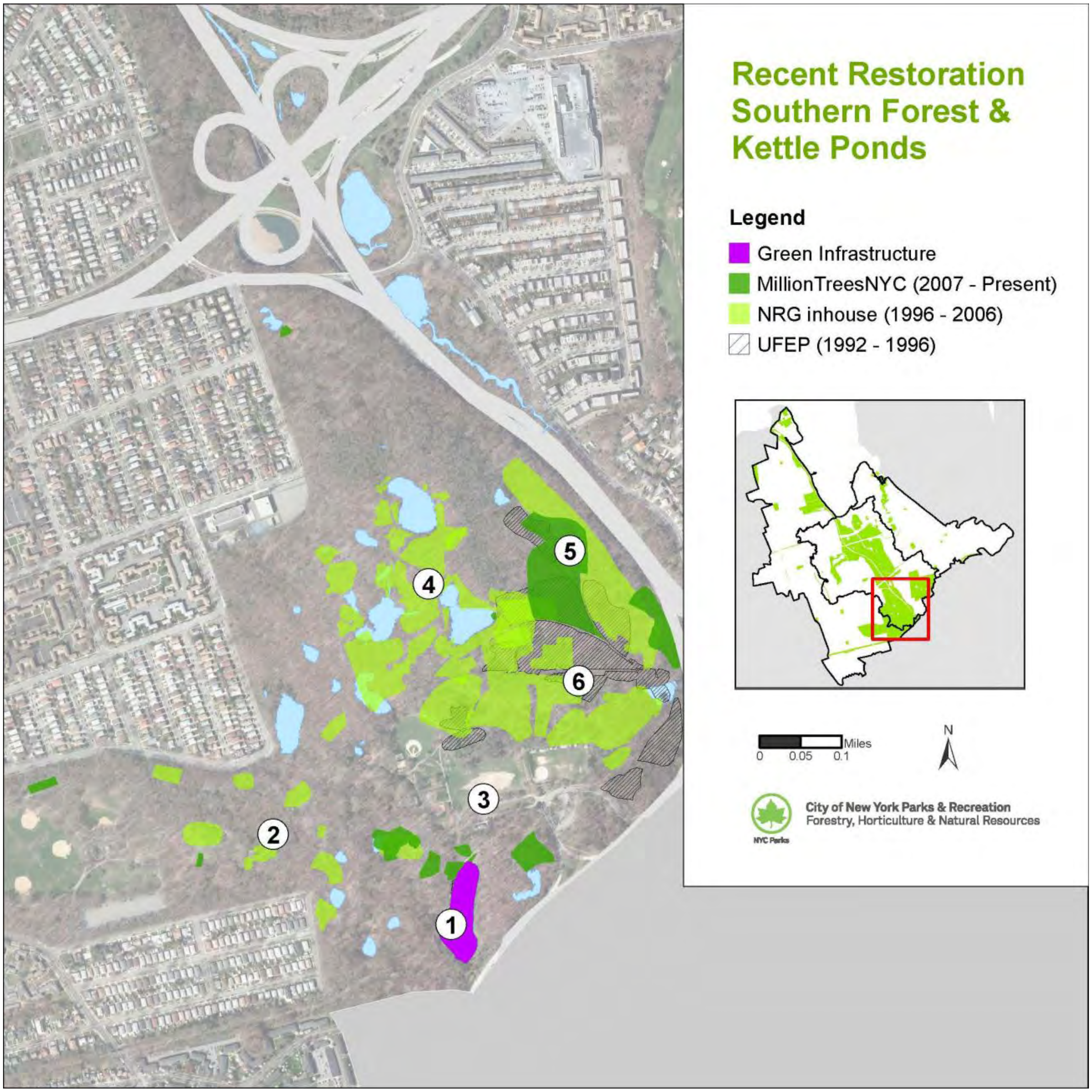

Figure 18. Recent Restoration - Southern Forest.

Table 12. Recent Restoration - CIP/LIE interchange & Douglaston Ephemeral Reach

1	**Erosion Control & Stream Bank Stabilization (0.6 acres), 2000-2002, funded by 1996 NYS CW/CA Bond Act.** DEP used large boulders to dissipate energy, fill, and stabilize gullies at two stormwater discharge pipes draining from the Cross Island Parkway to the Alley Creek ephemeral reach.	4	**Alley Pond Restoration (2.4 acres), 2005, funded by NYSDOT Cross Island Parkway/Long Island Expressway interchange.** NYS DOT removed sediment and *Phragmites* from Alley Pond and restored the waterbody. The project included wetland planting in the new and restored pond areas.
2	**Stream Bank Stabilization (0.5 acres), 2009-2010, funded by NYSDOS Erosion Grant.** Using volunteer labor, NRG used bioengineering techniques, including log cribbing and dormant brush layering, to stabilize stream bank along 500 feet of the upper ephemeral reach.	5	**Stormwater BMP (0.3 acres), 2005, funded by NYSDOT Cross Island Parkway/Long Island Expressway interchange.** NYSDOT installed two retention ponds and an oil separator to collect freeway runoff.
3	**Stream Bank Stabilization (0.5 acres), 2009-2010, funded by Long Island Sound Futures Fund.** NRG staff did invasive species control, underbrush clearance and dead tree removal along 1300 feet of Douglaston Parkways forested edge along the Alley Creek Ephemeral Reach. This included new tree, shrub, and herb planting.	6	**Forest Restoration (24 acres), 2005, funded by NYSDOT Cross Island Parkway/Long Island Expressway interchange.** NYS DOT reforested open grass areas. As part of the slope revegetation for the interchange improvements, numerous new trees were planted along the southern banks of Alley Pond, along the riparian corridor of the new creek, and the banks surrounding the new stormwater retention ponds. However the site was not maintained and the majority of the trees have failed. A predominately porcelain berry vine field has invaded the reforestation site. The project also included improvements in access, trail upgrades, and interpretive signage that connects existing walks at the southeast quadrant with nature trails in the northeast quadrant of the park.

Figure 19. Recent Restoration - CIP/LIE interchange & Douglaston ephemeral reach.

Table 13. Recent restoration - Oakland Lake

1	**Landscaping/Erosion Control (0.5 acres), 2007- 2011, funded by NYC DEP (Blue Belt).** Debris and historic dumping removed, eroded gullies restored and banks stabilized against stormwater runoff. Work included upgrades to the park edges and access to ravine, creating paths connecting the ravine to Oakland Lake.	**4**	**Pond Edge Restoration (2.0 acres), 2007-2011, funded by NYC DEP (Blue Belt).** A pond edge was restored and *Phragmites* removed at the Oakland Lake outlet structure.
2	**Stormwater BMP (0.3 acres), 2007-2011, funded by NYC DEP (Blue Belt)** DEP constructed a raingarden at 56th St. to reduce stormwater inputs into the ravine.	**5**	**Erosion Control, (0.5 acres), 2007-2011, funded by NYC DEP (Blue Belt).** A raingarden was constructed to capture street runoff and the park edge was rehabilitated.
3	**Forest Restoration (0.6 acres), 2007-2011, funded by NYC DEP (Blue Belt).** Catch basins were retrofitted at Springfield Boulevard and 46th St. An erosion gully and pathway adjacent to the retrofit were restored.	**6**	**Stormwater Management (0.2 acres), 2007-2011, funded by NYC DEP (Blue Belt).** Queensborough Community College (QBCC) installed pervious pavement to help manage stormwater.

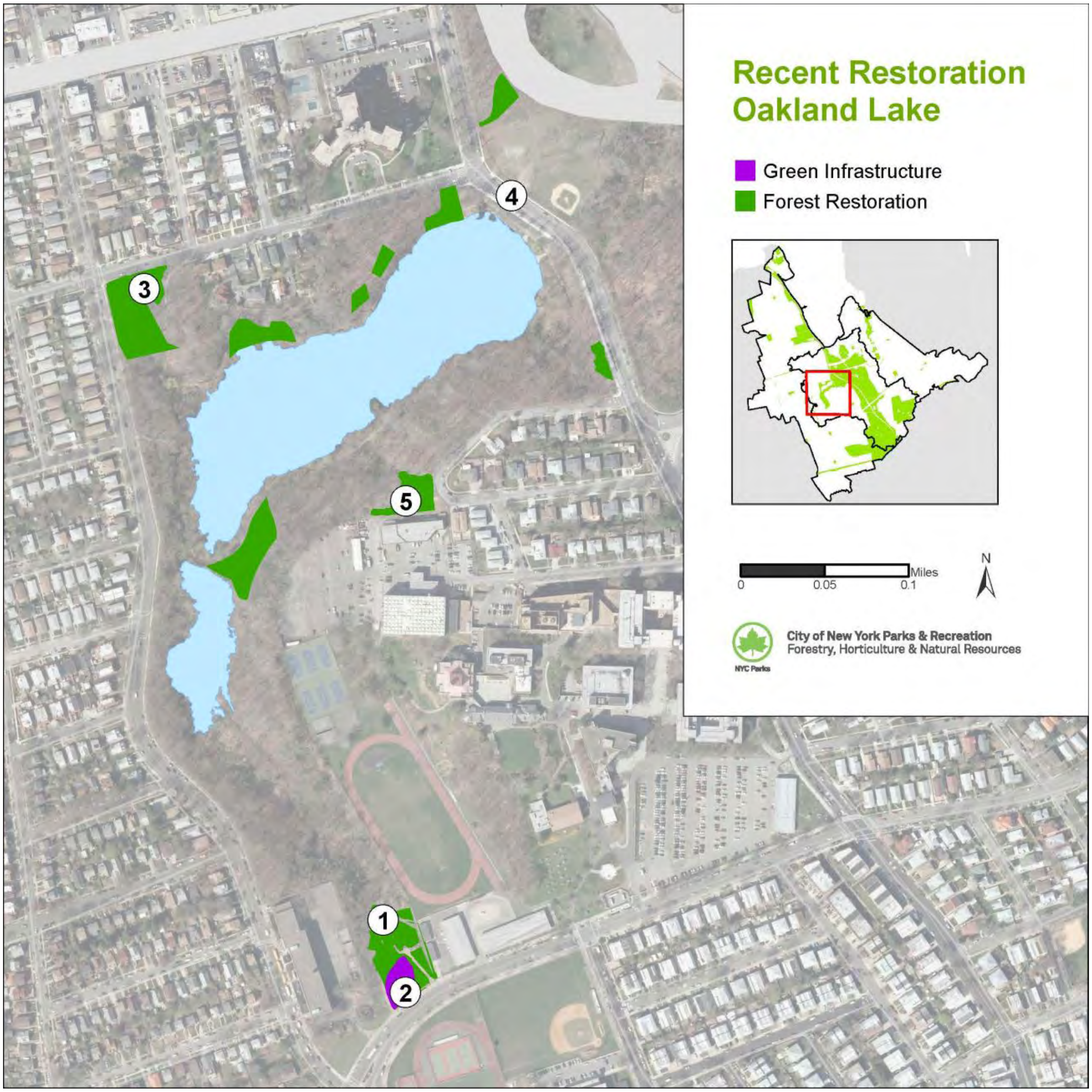

Figure 20. Recent Restoration - Oakland Lake.

Table 14. Recent restoration - Estuary

1	**Salt marsh restoration (15.7 acres), 1997, funded by NYNJ Port Authority, LaGuardia Airport Mitigation.** This salt marsh restoration was built with mitigation funds to compensate for tidal wetland lost to runway expansion at LaGuardia Airport. High marsh, low marsh, mud flats, and tidal creeks were restored.	**5**	**Windmill Pond restoration (1.4 acres), 2012, funded by NYS CW/CA Bond Act.** Working with the APEC environmental education programs, NYC Parks excavated a tidal stream connection to Windmill Pond, installed raised paths above freshwater wetlands, and planted trees.
2	**Salt marsh restoration (9.7 acres), 2009, funded by NYC DEP.** A salt marsh restoration of low marsh and tidal flats were built as mitigation for the construction of a CSO holding tank and CSO outfall constructed to improve water quality in Alley Creek and Little Neck Bay.	**6**	**Afforestation & mortality Study (0.7 acres), 2012, funded by PlaNYC.** Using volunteers, NRG planted trees on a historically filled salt marsh site. The restoration included invasive species removal and is an ongoing monitoring site for tree mortality and adaptive management studies in collaboration with researchers from The New School.
3	**Meadow restoration (6.5 acres), 2012, funded by NYC DEP.** Upland meadows were created in a previously unmanaged park land as mitigation for the new CSO holding tank and outfall.	**7**	**Afforestation (21.1 acres), 2012, funded by PlaNYC and LISFF.** Phases 1 and 2 of a large restoration project to control invasive species, remove decades' worth of debris and dumping, and replant native forest. Area is recently planted or cleared for planting.
4	**Salt marsh restoration (2.7 acres), 1998, funded by Consolidated Edison mitigation.** Salt marsh restoration, consisting primarily of low marsh (*Spartina alterniflora*), created through mitigation funding by Consolidated Edison.		

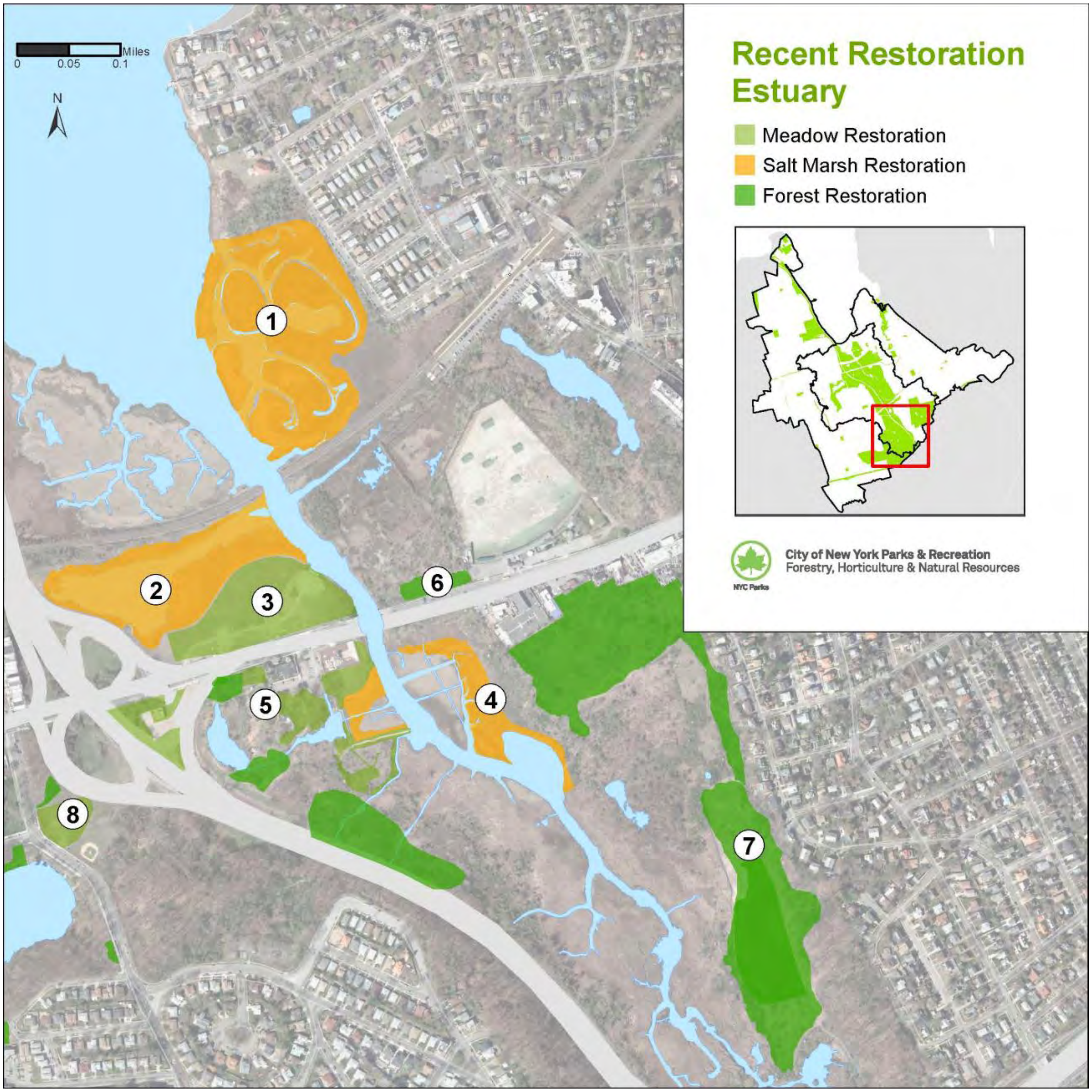

Figure 21. Recent Restoration - Estuary.

Table 15. Recent restoration - Udalls Cove

1	**Forest Restoration (0.5 acres), 2009, funded by UCPC.** Using volunteer labor, the UCPC installed paths, removed historic dumping of cement slabs, cleared non-native trees and replanted new trees site adjacent to Northern Boulevard and 244th St.	**6**	**Restoration (0.1 acres), 2012, funded by UCPC.** The UCPC Committee used volunteer labor to create paths through a reforested area on a historic dumping site, cleared out fallen trees and invasives, seeded new meadows, and planted native trees.
2	**Erosion control, freshwater wetland construction (0.4 acres), 2009, funded by NYSDEC.** Using volunteer labor, the Udalls Cove Preservation Committee installed new storm swales, a freshwater wetland, and planting to reduce erosion runoff into Gabblers Creek at 44th Avenue and 244th Streets.	**7**	**Forest Restoration (1.2 acres), 2012, funded by NYSDOT and UCPC.** The UCPC used volunteer labor to create paths through a reforestation site on a historic dumping area. They cleared out fallen trees and invasives, and built nesting platforms for ospreys.
3	**Forest Maintenance (0.8 acres), 2010, funded by UCPC.** Using volunteer labor, the UCPC organized new path layouts and forest management cleanout in the areas west of Aurora Pond.	**8**	**Salt marsh replanting (0.1 acres), 2007, funded by DMA.** As part of the mitigation for the reconstruction of collapsed sections of Shore Drive, the Douglaston Manor Association replanted *Spartina* wetlands along the shoreline of Udalls Cove.
4	**Pond Construction (0.3 acres), 2002, funded by NYC Parks.** With planning starting in 1991, Aurora Pond was dredged in 2002 to remove *Phragmites*. Gabblers Creek was diverted into a small tidally influenced pond to maintain water depth and now provides habitat for a wide range of species.	**9**	**Salt marsh replanting (0.1 acres), 2007, funded by DMA.** As part of the mitigation for the damage caused by floating winter docks at the Douglaston Marina, the Douglaston Manor Association replanted salt marsh along the shoreline of Little Neck Bay.
5	**Stormwater outfall BMP/salt marsh (0.1 acres), 2014, funded by NYC DEP.** As part of upgrades to local stormwater drainage, DEP constructed a stormwater BMP featuring a sediment pond and planted salt marsh species, integrating habitat and water quality treatment objectives.	**10**	**Forest Restoration (0.6 acres), 2012, funded by NYCDPR.** The city acquired land for the purpose of forest restoration as park land. This new park will provide upgraded access to the Old Oak Pond section of Alley Pond Park.

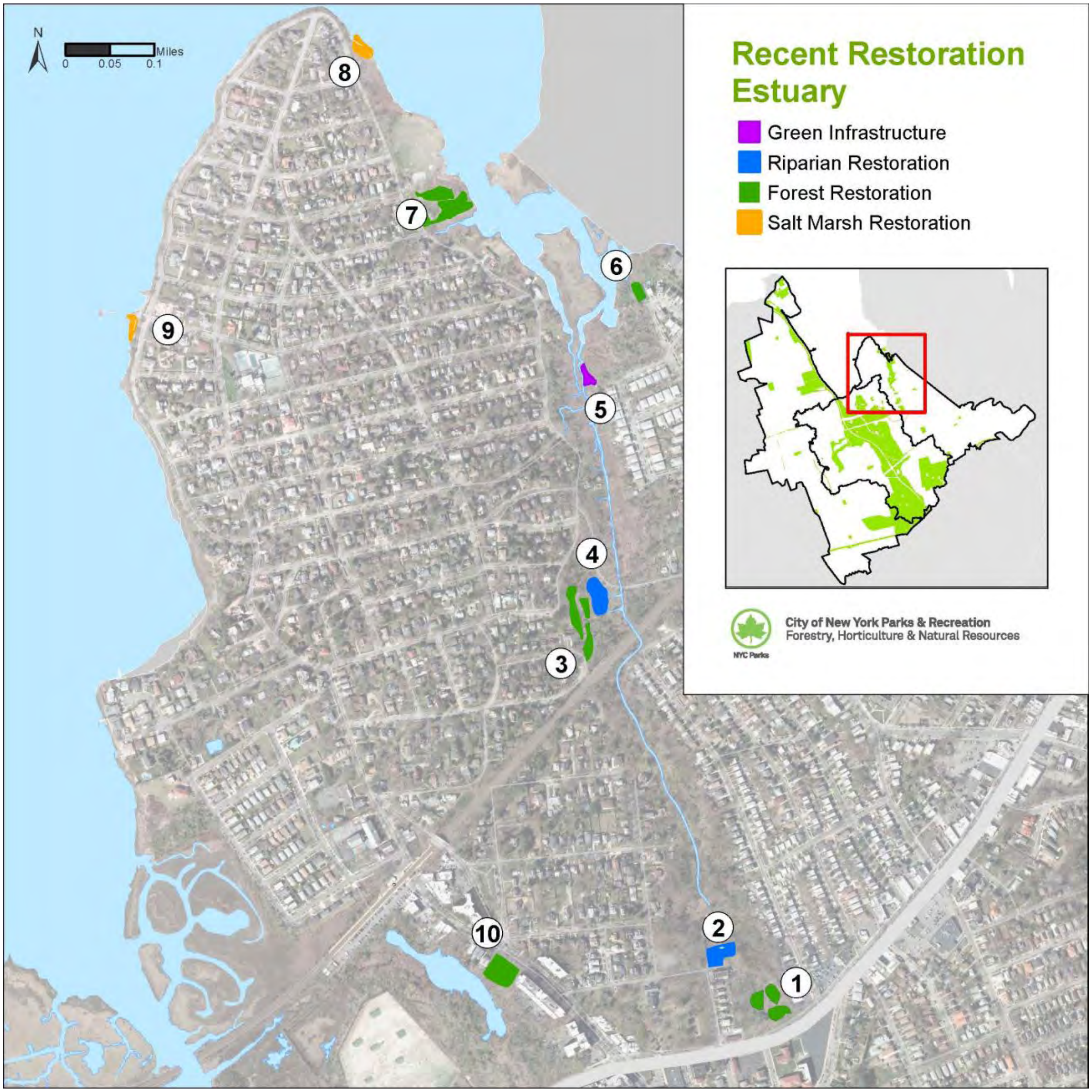

Figure 22. Recent Restoration - Udalls Cove and Douglaston Manor.

1.6 Regulatory Context Pertaining to Water Quality and Habitat

This section provides an overview of the regulatory environment governing water quality and habitat. The regulatory text is broken into two sections, the first covers regulation of water quality and surface waters, and the second reviews regulations and plans for protecting habitat and sensitive species.

1.6.1 Regulatory Context for Water Quality and Stormwater Management

The Federal Clean Water Act (CWA) of 1977 established the regulatory framework to control surface water pollution, and in Section 402 gave the US Environmental Protection Agency the authority to implement pollution control programs. The CWA requires that discharge permit limits are based on receiving Water Quality Standards (WQS) established by the state. Water Quality Standards define the goals for a water body by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. A water quality standard consists of four basic elements: designated uses of the water body (e.g., recreation, water supply, aquatic life, and agriculture), water quality criteria to protect designated uses (numeric pollutant concentrations and narrative requirements), an anti-degradation policy to maintain and protect existing uses and high quality waters, and general policies addressing implementation issues (e.g. low flows, variances, mixing zones).

Among the key elements of the CWA was the establishment of the National Pollutant Discharge Elimination System (NPDES) permit program, which regulates point sources that discharge pollutants into waters of the United States. CSOs and municipal separate storm sewer systems (MS4) are also subject to regulatory control under the NPDES program. In New York State, the DEC is the approved agency to oversee the NPDES program.

The city and DEC have entered into orders on consent to address CSO issues, including the 2005 CSO order on consent. The 2005 order on consent was issued to bring all DEP CSO-related matter into compliance with provisions of CWA and New York State Environmental Conservation Law and requires implementation of LTCPs. In March 2012, DEP and DEC amended the 2005 order to incorporate Green Infrastructure (GI) into the LTCP process proposed under the City's 2010 GI Plan and to update certain project plans and milestone dates. Accordingly, DEP is currently developing 11 waterbody specific LTCPs city-wide to control CSO discharges and improve water quality. The first of the LTCPs to be developed, the draft for Alley Creek/LNB draft was submitted to the State in June 2014.

The CWA also requires that a strategy be developed for water bodies such as Alley Creek and Little Neck Bay that do not meet their designated Water Quality Standards (WQS). Typically this is in the form of a total maximum daily load (TMDL) for pollutants of concern to the waterbody. TMDLs determine what level of pollutant load would be consistent with meeting WQS. TMDLs also allocate acceptable loads among sources of the relevant pollutants. In 1998, DEC listed Little Neck Bay as a high priority for TMDL development due to CSO pollution, urban stormwater runoff and pathogens. Later DEC listed Alley Creek and Little Neck Bay as waterbodies requiring TMDLs; however these have been deferred since the waterbodies are to receive a Long Term Control Plan through the SPDES program. In 2004, the “Alley Creek/Little Neck Bay tributary” was also considered a priority water body for oxygen demand, but in 2012 it was de-listed for oxygen demand and floatables since the LTCP efforts are expected to result in the WQS being met. Table 14 summarizes the 2012 DEC regulatory list of impaired waterbodies (303(d) list) and status for Alley Creek and Little Neck Bay, showing that only Little Neck Bay remained listed for not meeting, or being anticipated to meet, WQS under current or planned controls. Note that more recent updates to the 303(d) list are available on DEC's website[64]

Table 16. 2012 DEC 303(d) Impaired Waters Listed and Delisted, with Source of Impairment[65].

Water Body	Pathogens Sources	DO/Oxygen Demand Sources	Floatable Sources
Little Neck Bay	(1)Urban/Storm/CSO	(4a)Municipal/Urban/CSO	-
Alley Creek	-	(4b) Urban/Storm/CSO	(4b) CSOs, Urban/Storm

Definitions:
(1) Individual Waterbodies with Impairment Requiring a TMDL
(4a) Impaired Waters NOT INCLUDED on the NYS 2012 Section 303(d) List because TMDL development is not necessary since a TMDL has already been established for the segment/pollutant
(4b) Impaired Waters NOT INCLUDED on the NYS 2012 Section 303(d) List because a TMDL is not needed, other required control measures are expected to result in restoration in a reasonable timeframe.

The SPDES program authorized by the CWA also includes the MS4 permit regulation program. The MS4 is a permit submitted by municipalities to ensure no net increase in impairment occurs to a waterbody, to bring impaired waterbodies into alignment with designated use standards, and to regulate direct storm sewer runoff. New York City submitted a draft permit to DEC in 2014 which includes a three-year stormwater management plan to be formalized three years from the first round of the permit data. Through this process DEC and DEP will continue to negotiate the specific standards required under the MS4, and DEP will be required to develop a plan for managing any pollutants of concern (POCs) on the 303(d) list. As Alley Creek is currently on the 303(d) list for floatables, the development of the MS4 permit will require a stormwater management plan to control this pollutant. DEC issued a draft MS4 permit to the City of New York in Feb 2014 which requires control of discharges of pollutants of concern and illicit discharges of other pollutants to the maximum extent practicable. Under the draft permit, the City will submit a stormwater management plan three years from the effective permit date.

Current water quality regulations are focused on water quality standards related to human health risk (pathogens) and aquatic life (biological oxygen demand, or BOD). BOD standards are designed to address the issue of hypoxia. However, other pollutants, such as nitrate, may have other potential impacts (such as the allocation of resources in salt marsh vegetation) and are not covered under existing regulation. The water bodies in the Alley Creek watershed currently do not have any numeric nutrient standards. The western arm of Long Island Sound has numeric nutrient standards, but the Alley Creek watershed runoff has not be demonstrated to impact eutrophication in the Sound and is not included in TMDLs for the Sound. Therefore no regulatory mandate has arisen to address nutrients derived from non-point source pollution originating in the watershed. Narrative NYS water quality standards for nitrogen and phosphorous exist under the IEC (see below) and state that these nutrients should not be present "in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages". EPA intended to develop nutrient standards for NYC by the end of 2014[66]. These standards will include phosphorous for lakes and rivers by the end of 2014 and phosphorous for estuaries by 2018. Nitrogen standards are not proposed for NYC because phosphorous is believed to be the critical or

[64] See http://www.dec.ny.gov/docs/water_pdf/303dlistfinal2014.pdf for most recent 303(d) list
[65]DEP, 2014 - draft LTCP
[66] EPA, 2014

limiting nutrient[67]. The reverse is true for estuaries where nitrogen is the key nutrient, and its criteria will be set first.

1.6.2 Interstate Environmental Commission (IEC)

The States of New York, New Jersey and Connecticut are signatories to the Tri-State Compact that designated the Interstate Environmental District and created the IEC. In general, IEC water quality regulations require that all waters of the Interstate Environmental District are free from floating and settleable solids, oil, grease, sludge deposits, and unnatural color or turbidity to the extent necessary to avoid unpleasant aesthetics, detrimental impacts to the natural biota, or use impacts. Alley Creek and Little Neck Bay are interstate waters and are regulated by the IEC as Class A waters. The usage for Class A waters are "all forms of primary and secondary contact recreation, fish propagation, and shellfish harvesting in designated areas."

1.6.3 Regulatory Context for Habitat and Wildlife

Habitat protection is conducted through a variety of regulations that protect natural resources, wetlands, and specific species. The primary regulations and their pertinence to the Alley Creek sewershed are outlined in this section. A list of key Federal, State and City regulations that may apply to forest restoration projects in NYC are summarized in Appendix 7.

Wetland Regulations

DEC and the US Army Corps of Engineers (ACE) together are the regulatory authorities for the city's wetlands. Section 404 of the Clean Water Act (1977) established the regulatory framework for activity in wetlands. While the USEPA has veto power, the ACE was tasked with administering and enforcing wetland regulation and issuing permits. Federal wetland regulation is guided by the National Wetland Inventory (NWI). These maps, based on the US Geological Survey (USGS) topographic sheets, indicate both freshwater and tidal wetlands. All tidal wetlands are also federally protected under the Tidal Wetlands Act of 1972.

DEC has jurisdiction over tidal and freshwater wetlands under Articles 24 and 25 of the NYS Environmental Conservation Law, as enacted as part of the Freshwater Wetlands Act of 1975. Under these regulations the State is responsible for mapping the location of all wetlands, and maintains the official regulatory maps, although they have not been updated since 1976. For New York City, the State regulates up to 150 feet from the tidal wetland boundary (300 feet outside of NYC) and 10 ft above mean sea level as determined by a wetland delineation. Freshwater wetlands larger than 12.4 acres are protected up to 100 ft from their delineated edge. However, DEC can also identify individual freshwater wetlands less than 12.4 acres as having local unique importance to be protected under this regulation, and DEC has done so extensively in NYC. The freshwater portions of Udalls Cove Park Preserve, Aurora Pond, and some areas in Gabblers Creek are regulated under Article 24 and therefore up to 100ft of buffer adjacent area are regulated. However, the tidal portions of Udalls Cove Park Preserve are regulated under Article 25 and therefore have up to 150 feet of adjacent area regulated. A significant difference between the DEC (Articles 24 and 25) and ACE regulations (CWA, Section 404) is that the ACE regulates only the wetlands themselves; there is no buffer area recognized.

Environmental Review

The National Environmental Policy Act (NEPA) of 1969 requires environmental impact review of any project that is funded by the Federal government or is otherwise a listed action. Following this federal law, New York State has enacted a State Environmental Quality Review Act (SEQRA) that all listed projects in the state must comply with, and NYC has enacted City Environmental Quality Review (CEQR) regulations. Depending on the funding and the land on which a project is located,

[67] EPA, 2011

a project may be required to complete environmental review under NEPA, SEQRA, or CEQR. However, the City policy is that all projects in the city should complete CEQR, which in theory should also meet the State and Federal environmental review requirements. In addition, there are special regional conservation programs such as the New York-New Jersey Harbor Estuary, Hudson River Estuary, and Long Island Sound programs, and the Jamaica Bay Watershed Protection Plan, which afford extra protection and management opportunities.

1.7 Policy and Planning

In New York City, multiple tiers of planning and policy initiatives have evolved to manage New York City's waterfront, parks, and most remaining natural areas. Many of these initiatives have been integrated into PlaNYC efforts. More recently special attention has been placed on integrated shoreline resiliency in the wake of Hurricane Sandy.

1.7.1 Mayor's Office & PlaNYC

Wetland Protection Strategy
In 2009 as part of PlaNYC, a policy paper was published which analyzed regulatory gaps and other threats to wetlands protections in NYC.[68] The report highlighted that the majority of protection comes from Federal and State governance; there is weak local support and changes in Federal legislation may potentially weaken it further. . The paper also highlighted a need for updating wetland maps, which define protected wetlands, and pointed out gaps in local environmental review processes.

A follow up report in 2010 published preliminary updates of the city's wetlands maps. While the maps were not produced as new regulatory maps, they provide maximum and minimum extents of wetlands and will be an essential reference for comparison against existing regulatory maps. The updated maps will inform policy decisions and support moving forward with some of the recommendations outlined in the 2009 report.

In 2012 the City published a Wetland Strategy Plan to address the recommendations set out in the earlier white paper. This plan sets out goals and initiatives in four key areas: protection, mitigation, restoration and assessment Within these four key areas the plan proposes 12 initiatives in total, as well as a framework for tracking, monitoring and reporting implementation.

Stormwater Management Plan
Because TMDL were deferred for some water bodies, the State required the City to develop stormwater management plans. The NYC Council enacted Local Law 5 to develop a sustainable stormwater management plan to reduce the volume of water flowing into the city's sewer system and by extension the pollution loadings carried by stormwater into the city's waterbodies. The overall goals of the plan are to protect public health through the restoration and protection of the ecological health of the city's waterbodies, and to enhance their use and enjoyment for recreational activities.

The law also set a deadline of December 2008 for a final stormwater management plan to be presented, and required that a status report be completed every two years thereafter. This became the PlanNYC Sustainable Stormwater Management Plan. The same local laws also stipulated a number of reforms for building codes: setting thresholds for capital projects which are required to treat stormwater; requiring a revision of parks guidelines for tree pit design to increase stormwater detention and retention; and requiring investigation into updating building requirements to allow developers to more easily retain stormwater on site.

[68] PlaNYC, NYC Wetlands, 2009

NYC Green Infrastructure Plan
Building on the 2008 Stormwater Management Plan, NYC DEP's Green Infrastructure (GI) Plan was launched in 2010, in coordination with PlaNYC.. The GI Plan proposes strategies for individual CSO sewersheds and demonstrates the effectiveness of using GI to address water quality issues. The proposal to use GI to address regulated water quality issues reflects an evolving understanding from regulators (NYS DEC & EPA) on the legitimacy of GI as a solution to addressing the city's wastewater and water quality challenges. Many pilot projects have been built and monitored by DEP as part of a program to incorporate green infrastructure to manage stormwater, including the development and implementation of a standard design for right-of-way bioswales in priority CSO sewersheds. In July 2012, DEP developed design guidelines for stormwater management: "Guidelines for the Design and Construction of Stormwater Management Systems." As a result of these new guidelines, DEP now regulates the maximum flow leaving the property for new developments, which is only 10% of the flow rate permitted under the old standards.. The guidelines also provide the specifications required to meet local law standards which allow for onsite retention of stormwater. The anticipated outcome of these regulations and guidelines is a phased mechanism for reducing stormwater volume issued into the sewer systems. In the long term, redevelopment of properties in Alley Creek will be affected by these guidelines and they will lead to a reduction in CSO and direct drainage related issues.

Special Initiative for Rebuilding and Resilience (SIRR) - "A Stronger More Resilient New York"
After Superstorm Sandy, the Mayor's Office created the Special Initiative for Rebuilding and Resilience. This initiative resulted in a report entitled "A Stronger More Resilient New York" which was published in June 2013. It outlines ambitious goals with 250 specific recommendations to protect neighborhoods and infrastructure from future climate events. Recommendations include a combination of hard and soft engineering solutions to help protect the city against the threat from storm surge. The plan suggests basing design approaches, including for parks, on mapped typologies of the coastline and the anticipated threats from climate change. The plan did not list any site-specific recommendations for Alley Creek or Little Neck Bay, but does recommend to investigating ways to fund wetland restoration citywide.

Alley Park is mapped in the report as a risk for gradual and storm surge inundation. The west coast of Little Neck Bay is mapped as a risk for wave energy destruction (V zone). The plan promotes concepts that will mitigate the effects of storm surge: for example, waterfront park designs that allow flooding where there is a possibility of alleviating impacts on upland communities and by including flood barriers in park design to minimize flood damage to park assets.

Also published in 2013, the Urban Waterfront Adaptive Strategies is a study produced by the NYC Department of City Planning. The report presents coastal typologies and a framework of potential adaptive strategies for each typology. The framework can be used by communities to narrow the list of potential strategies for a given geography and to identify which strategies provide the greatest range of benefits with respect to direct and indirect costs.

1.7.2 Park Planning

Forever Wild Preserves and Natural Areas
The Forever Wild program is an initiative of the New York City Department of Parks & Recreation (NYC Parks) to protect and preserve the most ecologically valuable parklands within the five boroughs. The program advocates for permanent protection of Forever Wild's 10,000 acres of unique forests, wetlands, and grasslands which feature some of New York City's most rare plants

and animals. Alley Pond Park Preserve and Udalls Cove Park Preserve are both listed as Forever Wild sites.

1.7.3 City Planning

New York City Waterfront Revitalization Program, (WRP)

The New York City Waterfront Revitalization Program (WRP) is the city's principal coastal zone management tool and is implemented by the Department of City Planning (DCP), who is also the local authority for the Federal Coastal Zone Management Act. The WRP establishes the City's policies for development and use of the waterfront and provides the framework for evaluating the consistency of all discretionary actions in the Coastal Zone. The guiding principle of the WRP is to maximize the benefits derived from economic development, environmental preservation, and public use of the waterfront, while minimizing the conflicts among these objectives. The policies of the WRP address issues relevant to the ecological management in the Alley Creek Plan including coastal ecological systems, water quality, flooding and erosion, public access and scenic resources. LNB and the tidal wetlands of Alley Creek and Udalls Cove are considered a "Special Natural Waterfront Area" under the WRP, and the waters of Little Neck Bay are designated as "Significant Coastal Fish and Wildlife Habitats". Alley Pond Park in its entirety, including as far south as the Southern Forest, is included within the Coastal Zone Boundary.

On March 14th, 2011, *Vision 2020: New York City Comprehensive Waterfront Plan*, a 10-year vision for the future of city's 520 miles of shoreline, was released and has been subsequently incorporated into waterfront zoning. *Vision 2020* identifies four principal waterfront functional areas – natural, public, working and redeveloping – and promotes natural resources protection, public access, landmark preservation, water-dependent and other working waterfront uses, and new residential or commercial development in appropriate waterfront areas. The plan assesses local conditions and proposes short- and long-term strategies to guide land use change, planning and coordination, and public investment for each of the waterfront functional areas. Under the goal to improve water quality, Alley Creek is identified for gray infrastructure improvements to control CSO outflow, while Douglaston is mapped as an area for lowering residential zoning.

1.7.4 Regional Planning

Comprehensive Restoration Plan (CRP)

The Comprehensive Restoration Plan (CRP) is a living document prepared by ACE and the Hudson River Foundation. The CRP promotes protection and establishment of target ecosystem characteristics (TECs), which include coastal wetlands, habitat for waterbirds, coastal and maritime communities, oyster reefs, eelgrass beds, shorelines and shallows, fish crab and lobster habitat, tributary connections, enclosed and confined waters, sediment quality and public access. The NY-NJ Harbor & Estuary Program is currently updating the CRP and incorporating recommendations from this watershed plan. Table 15 summarizes opportunities included in the last CRP and their proposed status for updates, as well as whether the proposal is included in this Alley Creek Watershed Plan.

Comprehensive Conservation and Management Plan (CCMP)

In 1994, the states of Connecticut and New York and the United States Environmental Protection Agency approved the Comprehensive Conservation and Management Plan for Long Island Sound. Developed by the Long Island Sound Study, the plan identifies specific commitments and recommendations for actions to improve water quality, protect habitat and living resources, educate and involve the public, improve the long-term understanding of how to manage the sound, monitor progress, and redirect management efforts

NYS Open Space Plan
This plan serves as a blueprint for the State's land conservation efforts and guides the investment of land protection funds from the Environmental Protection Fund (EPF). It is jointly administered by NYS DEC and NYS Parks. It is revised every three years

Table 17. Proposed updates to Alley Creek and Little Neck Bay CRP opportunities.

Site	Currently Listed Opportunity in CRP	Proposed update to CRP	Status in Alley Creek Watershed Plan
Aurora Pond	Freshwater pond upgrades	List project as completed	Completed
Alley Creek	"Suspected hypoxic and anoxic" conditions	List objective as met by 2011 CSO holding tank construction	Completed
Little Neck Bay	Eelgrass bed creation	Not viable based on Jamaica Bay trials	Not recommended
	Oyster reef creation	No update needed	Recommended for review
	Coastal wetland restoration	Update project description	Recommended
Watershed	Fill removal	Recommend only at priority salt marsh restoration opportunities	Recommend in priority salt marsh restoration opportunity sites
	Wrack removal	No update needed	Recommended
	Phragmites removal	Recommended only for priority salt marsh and forest restoration opportunities	Recommended only for priority salt marsh and forest restoration opportunities
	Salt marsh restoration	No updated needed	Recommended
	Enlargement of openings under rail and road bridges	No longer recommended	Not recommended
	Establish native grasslands	No update needed	Recommended
	Possible dredging to allow for greater tidal penetration into head of Little Neck Bay	No longer proposed	Not recommended
	Freshwater stream restoration at head of tidal channel	No update needed	Recommended

2.1. Goals for the Watershed - Ideal Conditions

To achieve the vision for the watershed described at the outset of this plan, we need to articulate goals and objectives that can serve as a guide. The goals, which apply to the ecological, physical, and socio-political context in the watershed, describe target conditions. They are based on an understanding of the characteristics, existing conditions, and constraints in the watershed, as well as the values we place on our natural resources, and on recognition of the existing or potential threats to these resources.

Our goals are summarized here in four categories: Habitat Restoration, Hydrology and Water Quality, Public Engagement and Resiliency. Specific objectives are named for each of these goals. Strategies and recommendations for achieving these goals, including specific projects, are presented in Section 4. Ideally, projects should be planned and designed to meet multiple goals and objectives, and projects and programs should be prioritized according to their ability to achieve multiple goals and objectives.

Goal I. Habitat Restoration

Habitat should be restored to maximize areas of diverse native ecological communities to the extent possible throughout the watershed. Habitat fragmentation should be minimized, creating the greatest possible connectivity while maximizing the functions of these communities. Protected and restored habitats should support and sustain diverse populations of native species over time, be self-generating, and maximize the ecological benefits critical for the well-being of humans and the environment.

Table 18 - Benefits of Habitat Restoration

Benefits of Habitat Restoration		
Environmental	**Social**	**Economic**
Filtering air; providing shading and regulating temperature; intercepting, infiltrating evapo-transpiring rain water; improving water quality; reducing erosion; capturing and slowing stormwater runoff and flood waters; sequestering carbon, cycling nutrients; providing habitat for native fauna including rare and threatened species.	Providing active and passive recreation; improve public health; offering educational opportunities for youth and people of all ages	Attenuating waves and reducing wave energy; capturing stormwater; filtering and improving water quality; reducing flooding; supporting commercial fisheries; providing recreation opportunities; increasing real estate values.

The Goals for Habitat Restoration category is grouped into three subcategories: (1) Upland Forests and Meadows, (2) Riparian and Freshwater Wetlands, and (3) Coastal Wetlands and Adjacent Areas. These habitats and ecological communities are often placed at risk by related threats, impacted by similar stressors, provide some of the same values, and together offer many of the same ecological services. However, there are some notable differences in management objectives for different habitat types and differences in measures of success for their protection and restoration.

Goal I.a. Upland Forests, Meadows and Streetscapes
Upland forests in the watershed should, to the extent possible, exhibit structural characteristics of typical native mature forests. This structure should include healthy canopy trees (dominated by oaks and supplemented with hickory, tulip or beech trees), an understory of smaller trees (such as sassafras and black cherry) and a shrub layer (species such as low bush blueberry, spicebush, azalea, and maple leaf viburnum). In addition, the forests should support predominantly native groundcover consisting of grasses and herbs, including spring ephemeral plants such as Solomon's seal, mayapple, jack-in-the-pulpit, New York fern, meadow rue, and others.

Ideally, no significant areas of upland forest (e.g. greater than 1/4 acre) should be dominated by invasive plants (multiflora rose, porcelain berry, bittersweet, Japanese honeysuckle, or mugwort, for example) and all significant areas of invasive species that could provide sources of seed or expand vegetatively to other habitats should be managed[69]. Forests should also have sufficient native vegetation diversity and structure that they are resistant to invasions by exotic flora and fauna. Forest soils should have a distinct litter layer and stable profile, and the invertebrate community should not be dominated by exotic worms.

Meadows should consist primarily of native herbs and grasses, and should be of the size and distribution across the watershed to contribute to ecological community diversity and aesthetic values. They should also be of sufficient size to support grassland-dependent song birds and offer hunting grounds for birds of prey (such as the Northern Harrier, red-tailed hawk and possibly short-eared owl), that favor or depend on the low-growing vegetation structure and food (plants, insects and small mammals) found in meadows. Meadows should be actively managed by mowing regularly to prevent them from being overgrown by invasive species or colonized by early successional trees or shrubs.

Streetscapes should consist of a wide diversity of trees to improve resilience to disease and to increase diversity of habitat for fauna. Urban gardens would ideally feature native grasses, shrubs, and trees as per the forest and meadow goals and guidelines. The urban landscape should be designed in a water sensitive manner where stormwater is treated at the source and integrated with habitat landscaping. Land management in the urban landscape will be sensitive to the broader impact it can have on downstream aquatic systems and receiving water bodies.

Goal I.b. Riparian and other Freshwater Wetlands
Riparian areas in the watershed should be dominated by native species and exhibit a vegetation structure similar to adjacent healthy native upland forests, but with more inundation and disturbance tolerant species. Typical plants may include inundation tolerant shrubs, like dogwood, willow and viburnum, and understory, such as false nettle (*Boehmeria cylindrical*), and hedge nettle (*Stachys sp.*), rushes, sedges, ferns and skunk cabbage[70]. Riparian areas should be of sufficient width to buffer streams from polluted road runoff and should provide natural organic matter inputs and structure (such as large woody debris) to the streams.

Freshwater stream channels in the riparian areas should be shaded by native canopy trees, include well-vegetated banks, have diverse in-stream habitat including pools, riffles and large woody debris, and should have relatively stable beds and banks (not actively incising, scouring, eroding or filling with sediment). Wherever possible the channel should possess a geometry that allows large, infrequent flood flows (recurring every year or more) to spill over to an adjacent floodplain. Streams should be fed not only by untreated stormwater runoff, but by springs, sub-

[69]Anzelone 2013 & NRG 1987
[70]Edinger et al. 2002; Stanley 2013

surface flow, and flow over saturated vegetated lands. Stream water quality and habitat diversity should be sufficient to support a diverse number of benthic organisms and fish, not only pollution tolerant species.

Freshwater wetlands in the watershed should represent various sizes and hydro-geomorphic types of wetlands, all dominated by native vegetation communities. The majority of freshwater wetlands should be fed by groundwater and rainwater; they should not predominantly receive water from stormwater pipes that drain impervious surfaces, from drinking water sources, or from irrigation runoff. Wetlands should be separated from adjacent development or active land use by a buffer of native plants at least 100 ft wide. A 500 ft buffer should be used for kettle ponds and vernal pools that contain spotted salamanders and wood frogs. Freshwater wetlands should support a diverse array of native amphibians, herptivores, benthic invertebrate species, odonates and other insects, water-dependent birds, and where appropriate, native fish.

Goal I.c. Coastal Ecosystems

The salt marsh ecosystem along the coast of the watershed should continue to increase in extent. There should be no net salt marsh loss. Instead, salt marsh area should be expanded through restoration. Wherever possible, historic fill or construction materials and marine debris will be removed, and areas of eroded marsh will be reconstructed. Salt marshes will be large enough to support breeding habitat for birds, including salt marsh sparrow, and foraging and hunting habitat for herons and raptors. Vegetation in marshes will not be stressed by high nutrient loads, and causes of salt marsh soil (peat) collapse (such as physical erosion from boat wake, bio-turbation, or high decomposition rates), if evident, will be understood and responded to using appropriate measures. As sea level rises, salt marsh will ideally accrete at a comparable rate and will migrate landward with as little human-made interference as possible.

Mudflats and beaches will be clean and free of anthropogenic debris, and will provide key ecological services, including habitat for shellfish, prime forage opportunities for wading birds, and breeding grounds for horseshoe crabs.

Coastal scrub-shrub upland habitat will be dominated by native species, such as *Iva*, *Baccharis* and bayberry. These sites will be protected and managed as valuable components of the ecosystem and no longer be sites for dumping and neglect.

Goal II. Hydrology and Water Quality

Goal II.a. Goals for water quality

All receiving water bodies, from the Bay, to the creeks to the ponds, should meet water quality standards set by US EPA, NYS DEC, and enforced by NYC DEP. This is Class I for Alley Creek and SB for LNB. Moreover, the goal for the bay and the creek, in the long term, is to achieve water quality that is good enough (i.e. has low enough bacteria levels) to be safe for a wide range of recreational activities, including boating, wading, swimming, and fishing.

Water quality should also be adequate to support healthy native vegetation communities and meet physiological requirements of diverse native aquatic species that are not tolerant of high nutrients, low oxygen, or pollutants. For example, nutrient loads to receiving waters should be low enough to allow native emergent vegetation to compete with invasive plants. Dissolved oxygen should be high enough (usually over 6 mg/l) to support most stages of fish life cycles without causing stress. Floatable anthropogenic debris entering surface flow, or discharge pipes should be negligible, to protect the ecological, aesthetic and recreational value of the water body.

Goal II.b. Hydrology

To aid in achieving water quality goals, the hydrology of the watershed should be restored to the fullest extent possible. In this urban watershed, this means intercepting rainwater in a vegetative canopy; capturing, detaining, and retaining stormwater runoff in vegetative systems to maximize infiltration and evapo-transiration; and using coupled natural and constructed storage and detention systems at the surface and subsurface to promote infiltration and rainwater storage and re-use. The ideal measure of success of such green infrastructure approaches across the watershed is a runoff regime that is similar to that which would have occurred under undeveloped (fully vegetated) land cover conditions. One indicator of a restored or near-natural hydrological regime is infrequent surface water runoff (runoff only with large rain events; not small levels of precipitation less than an inch). Another indicator is an attenuated period of flow response to rainfall in a stream rather than an extremely rapid or "flashy" response. Forested headwaters that allow extended space for surface water flows to accumulate to gradually form stream channels, for example, help achieve this more natural hydrologic regime. Our goal is to install green-infrastructure that can re-route, detain, infiltrate, dissipate energy at, and "day-light" those hydrologic "short-circuits" where catch-basins and drain pipes route stormwater quickly from impervious surfaces to streams, ponds, the estuary, or even the CSO system.

Goal III. Public engagement (access, stewardship and education)

Our goal is to ensure healthy parks promote healthy communities citywide, and that stewards contribute to healthy landscapes. We aim for access into the park's natural areas in a safe and managed way for appropriate use and enjoyment by all community members and visitors. The educational potential of the watershed should be fully reached, and education fully utilized as a strategy to progress management.

The parks and waters bodies should be accessible in a manner that optimizes opportunities for passive recreation and enjoying the natural resources in an ecologically sustainable manner. Access should also facilitate stewardship activities that support habitat restoration, green infrastructure, and management. Access should be available to all people with all levels of disability. All opportunities to improve access should be identified and vetted with input from the community. The need for access, or the need to remove access where it is dangerous, unmaintainable or a cause of management problems, shall also be integrated into project planning and agency capital projects. The guiding criteria for modifying current access in the park is to be compatible with the other identified habitat and ecosystem, water quality, stewardship, and resiliency goals for the watershed.

Our goal is that a coordinated network of stewardship groups and individuals provide effective and meaningful stewardship for all ecological systems in the watershed. Stewardship groups and programs should have clearly articulated objectives and strategies, clearly identified geographic areas of work, and target members for their activities. Stewardship activities should be available for diverse and varied populations with different areas of interest, resources, and levels of commitment. Stewardship activities should align with the goals for habitat, ecosystem, and water quality restoration in the watershed as well as with the goals of land owners and managers.

Our goal is to ensure the full educational potential of the watershed as an environmental laboratory is achieved. We aim to utilize education as a strategy, where demonstrably effective and needed, to progress habitat, water quality, and resiliency needs. Stewardship should also function as an effective way to educate the public about how they may be affecting the habitat and water quality and what they can do to get involved to help achieve the overarching goals of watershed management.

Goal IV. Resiliency

Resilience can be defined as the capacity of an ecosystem or other system to absorb disturbance without shifting to an alternative state and losing function, or the ability to return to a stable state after a disturbance. All of the previous goals (for habitat and ecological systems, ecosystem, water quality, access and stewardship) should bolster the resiliency of the community as a whole. As our climate warms and coastal communities become more vulnerable to flooding and extreme weather events, the goal of increased resiliency, and the need for sound planning and design practices that incorporate data on projected changes in sea level, precipitation, and temperature should be made explicit. Parks should be designed to allow flooding if needed, and to be resilient to inundation and wave or flow energy. More resilient designs should consider the threats associated with increased extreme and overall average temperatures and employ green infrastructure techniques and plant selections. Projects on the coast and along inland waters should maximize features that help reduce risks of damage from sea level rise, waves, and flooding.

2.2. Strategies and Recommendations

Broad Strategies:

This section introduces 10 broad strategies proposed to achieve the goals for the watershed, as described in Section 2 of the Plan, and to address conditions and threats characterized in Section 1 of this Plan. These strategies range from guidelines for management,to specific recommended actions and are interrelated -- each strategy may help achieve one or more goals. Many of the recommendations are programmatic, or applicable on a watershed-wide basis, and these are described first. Even these widely applicable recommendations, however, should also be applied on a site specific basis -- we have listed site specific recommendations separately in maps with accompanying tables.

Table 19 - Strategies to Achieve Goals

Goals for the Watershed				Strategies to Achieve Goals
I. Habitat	II. Water Quality	III. Public Engagement	IV. Resiliency	
X			X	1. Protect and restore habitat
	X			2. Manage stormwater and other sources of water pollution using best practices
	X	X		3. Fix illicit connections and unmanaged septic systems
		X		4. Promote partnerships & inter-agency collaboration (government, advocates, stewardship groups)
X	X		X	5. Review and update regulation and codes that provide water quality and ecosystem protection
X		X	X	6. Engage the public (education, community outreach and stewardship)
		X		7. Expand training and professional capacity
X			X	8. Advance research and adaptive management
X	X	X	X	9. Track and monitor restoration progress
		X		10. Communicate ongoing progress and plan updates

Strategy 1. Protect and restore habitat (Goals I.a., II.b. & III.b.)

By protecting, managing and restoring habitat in ecological communities across the watershed, we are helping to maintain and establish vegetation, soil, and hydrologic conditions that protect our water resources and provide environmental and social benefits.

1.1 General strategies for habitat protection and restoration. These strategies apply across all ecological community types and natural areas.

- **Protect natural areas of high ecological function and biodiversity.** In the urban landscape even established high quality areas can experience disturbance that can impact their conditions. Resources are best allocated to maintenance and protection now rather than restoration later.
- **Design restorations for resiliency.** Guidelines for flood zone planning are being prepared by the Office of Resiliency and Recovery. These guidelines outline approaches to design which seek to optimize the long term sustainability of parks and also increase the ability of parks to provide broader community resiliency to environmental disturbances.
- **Acquisition of natural areas that are at risk of development.** A number of privately owned parcels within the watershed feature undeveloped natural areas. Their development would fragment otherwise continuous upland forests and where feasible should be acquired.
- **Maximize contiguous habitats and increase habitat connectivity.** Increasing connectivity will reduce fragmentation and habitat edges, which alter faunal migration patterns and are more susceptible to anthropogenic impacts.
- **Manage invasive plants.** Targeting species of concern and prioritizing treatment adjacent to previous investments, public access, and high biodiversity will maximize ecological benefits. Early detection and rapid response is critical to managing invasive species and increasing treatment success
- **Use native plant species in restoration and landscape plantings**. A diverse range of suitable native species should be used wherever possible to enhance the biodiversity of functioning ecosystems in NYC and provide increased food and habitat for native wildlife. Native species should be grown from seed collected from local ecotypes.
- **Maintain native plantings after installation.** Ensure invasive plants are managed around new plantings until natives have established a closed canopy, high shade, or sufficiently dense vegetation layers to outcompete invasive plants.
- **Identify and address management concerns such as:**
    - Human disturbance such as camping, dumping, and illicit recreation.
    - Informal access sites or trails which cause fragmentation or erosion.
    - Other soil erosion problems.
    - Path salting impacting salt intolerant species

In addition to these general strategies for managing our natural areas, specific approaches need to be pursued for different ecological communities in the landscape. Below, key strategies and associated recommendations are given for management of distinct habitat types in uplands (forests, meadows, streetscapes), in freshwater wetlands, and in tidal areas.

1.2 Upland Management

Forests:

Complete ecological assessment of upland forest. Completing the Natural Areas Conservancy (NAC) ecological assessment, which examines the biodiversity and health of uplands, will allow improved prioritization of conservation, protection, and management.

Expand habitat through management of vinelands, edge habitats and canopy gaps with woody plantings. Remove invasives and replant native trees, shrubs, herbs and grasses to encourage canopy closure and habitat connectivity. Without these kinds of plantings, these areas rapidly become dominated by invasive plants and invite dumping and other illicit uses. Opportunities for expanding habitat:

- **Target management to vinelands.** Invasive vines threaten young trees, prevent regeneration of native woody plants, and alter soil chemistry. Manage large areas of fruiting exotic vines and other invasive plants that act as seed sources for surrounding areas. Remove downed trees when they are likely to become trellises for vines.
- **Close redundant trails through forested areas.** Removing redundant trails and desire lines helps reduce forest fragmentation, improves wildlife corridors, and helps stabilize existing canopy throughout the landscape.
- **Manage canopy gaps.** Canopy gaps are susceptible to invasion by invasive plants that take advantage of light and disturbance.
- **Manage edge habitats.** Invasive plants are commonly found at the edge of forests where regular disturbance and abundant sunlight give these plants a competitive advantage.

Integrate forest restoration with regionally important aquatic habitats. Increase habitat diversity by constructing freshwater wetlands to support fauna that require both freshwater and forest habitat for their breeding cycles. Restore appropriate native vegetation in riparian corridors and appropriately manage woody debris in these locations.

Implement forest management and restoration actions consistent with accepted guidelines and strategies developed in NYC.

- Guidelines for Forest Restoration: NRG is publishing a comprehensive guidelines to forest restoration in NYC[71].
- Bronx River Riparian Invasive Management Plan provides species specific treatment protocols for some species also found in the Alley Creek watershed[72].

Meadows:

Convert existing lawn to meadow. Compared to lawns, meadows need less maintenance, have higher stormwater retention and increased biodiversity. Consider opportunities for meadows or grasslands where it does not conflict with recreational land uses and in large rights-of-way where maintenance is feasible.

Include meadows in large scale restoration or mitigation planning, designs and contracts where appropriate. Grasslands could be appropriate for any upland area that can be cleared, but where resources do not exist for large-scale installation or management of forest.

Plan meadows to feature wildflowers and install birdhouses with objective of cultivating stewardship. Meadows can be grassland or wildflower, but should be dominated by perennial species.

Develop designs and management guideline frameworks to optimize success locally. Use existing guidelines, citywide examples, and local experimentation with both species selection and management techniques. General guidelines for warm season grass meadows include:[73]

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[71] NRG, 2014
[72] NRG, 2012
[73] NRCS, 2013; Audubon New York, 2009, NYS DEC 2013, MD DNR s.d.

- Plant species and management regime should target certain grassland breeding bird species. Target bird species should be based on the available acreages that are suitable to support specific species.
- After seeding, mow weeds to 6 inches during the summer each time they reach a height of about 18 inches.
- After establishment, mow twice per year: in the late winter to 6-10 inches in height to reduce early spring invaders, and in late summer to at least 10 inches.
- Remove thatch, or accumulated organic grasses, every few years as needed for plants that will not inhabit or germinate in heavy thatch layers. Consider hardy species such as Verbascum and Solidago species as they are adapted to urban landfill disturbed soils.
- Plant plugs of perennial grasses (versus seeding) to maximize cover and minimize the risk of invasion by mugwort, Phragmites and multiflora rose.
- Split perennial bunch grasses (e.g. switchgrass, little bluestem, and Indian grass) after they are well-established and plant in bare spots as needed.

Streetscape -- right of way & private property:

Maximize opportunities to protect and establish habitat and ecological services in the Public Right of Way (ROW).

- Aim to plant only native species on City owned property as per Local Laws 10 and 11 (2013) to increase native biodiversity and underrepresented tree species. Where stormwater capture and retention is the objective, native species should be suited to inundation and also optimize diversity and transpiration.
- Utilize Street Tree Census and other sources of information to identify opportunities for and prioritize street tree plantings that will:
  - Increase canopy cover and connectivity through surveying existing street tree extent and condition.
  - Diversify street tree canopy as per tree species prescriptions developed by Parks' Forestry, Horticulture and Natural Resources division (Appendix 13) to increase wildlife value and resilience and reduce mortality risk from insect, storms and disease.
- Follow NYC Street Tree Planting Guidelines and Management guidelines. Select guidelines that are particularly relevant for maximizing habitat and ecological services including:
  - Perform early maintenance pruning and regular pruning to minimize tree damage and stress.
  - Protect root structure of street trees during construction projects to minimize tree damage or downed trees during storms.

Maximize potential of ecological and social value of vacant lots. Allow for temporary pervious structures such as community gardens and/or raingardens on both private and public lots that are expected to remain undeveloped for considerable time.[74]

1.3. Freshwater wetlands strategies: riparian corridors & streams, freshwater wetlands and ponds. Freshwater wetland habitats include riparian corridors and streams, and

[74] Kremer, 2013

freshwater wetlands and ponds. Protection and management of each requires distinct strategies and tactics.

Streams & riparian corridors:

Identify opportunities for upstream stormwater source control. Map outfall catchments and identify opportunities for at source interventions that will directly benefit in-stream conditions by reducing untreated runoff, scour, and erosion.

Restore in-stream flows where natural topographic runoff has been re-directed to the storm sewer or pipes. Implement projects that increase infiltration and groundwater recharge to increase stream baseflow and projects that directed treated storemwater runoff to streams. Reconstruct or day-light nature-like channels where former tributaries to Alley Creek are currently piped.

Where stormwater inputs cannot be eliminated or stream ecological functions are highly degraded, consider potential of different long-term reach specific options:

- Construct large scale stormwater detention wetland systems at ephemeral streams and former stream paths in ravines.
- Rehabilitate gullies at stormwater outfalls. For example, fill gullies to construct a simulated boulder-cascade channel that can withstand high discharge, but dissipate flow and filter stormwater through voids of a rock bed.
- Add in-stream grade controls to prevent further incision., Channel bank restoration work will be more sustainable above grade controls.
- Conduct feasibility studies and investigate institutional support for larger projects where new management objectives are proposed.

Where the stream channel is relatively stable (not actively eroding) improve channel and riparian habitat characteristics:

- Re-establish and maintain native woody riparian vegetation. Apply forest restoration practices with particular sensitivity to pesticides and sediment that could erode into channel and impact wildlife.
- Incorporate large woody debris and other in-channel habitat features into channel rehabilitation to improve habitat complexity. Integrate with management of woody species in the surrounding landscape.
- Stabilize, re-grade, and re-vegetate actively eroded or shear, high, and bare stream banks. Bank rehabilitation should be conducted where it will reduce downstream sedimentation and on-going disturbance and loss of native riparian species.

Freshwater wetlands & ponds:

Complete ecological assessment of freshwater wetlands. Completing the NAC ecological assessment, which examines the biodiversity and health of freshwater wetlands, will allow improved conservation, protection, and management.

Expand habitat by integrating the design and construction of new vernal pools in planned upland restoration projects that include significant earth-moving. In disturbed landscapes where earth or machine work will occur, incorporate additional diverse habitats in design and construction. Ensure that these are a sufficient distance from existing natural pools.

Verify that all freshwater wetlands and vernal pools are considered in adjacent management actions. Trail maintenance and invasive plant management surrounding freshwater wetlands can cause erosion and chemical inputs into water bodies. Potential impacts should be examined for all projects. Road salting practices can result in elevated salinity of wetlands, which can stress native species and can give a competitive advantage to salt tolerant invasive species such as *Phragmites*.

Manage ponds and lakes as receiving waterbodies, and not as treatment ponds.

- Seek opportunities to treat stormwater before it flows to lakes and ponds. Reducing fine sediment and nutrient loads to small waterbodies may help reduce turbidity and nutrients that contribute to algal blooms.
- Increase size of pond and lakeside buffer plantings. Wide buffers can help remove excessive nutrients adjacent to roadways or large managed landscapes where fertilizers are used.
- Reduce nutrient inputs in catchments contributing to ponds by reducing fertilizer use and mowed lawn areas that attract geese, or convert these lawns to meadows
- Monitor for invasive fishes, such as snakeheads, and remove if necessary.

In restoration plantings, consider using hardy species.

- Bullrush and cattails are likely candidates, as they are rhizomatous perennials and are more likely to successfully compete with *Phragmites*.

Be cautious in pursuing restoration projects to establish native plant communities where *Phragmites* dominates the freshwater or brackish wetland:

- Consider whether long term maintenance is available.
- Determine if tidal inundation is sufficient to suppress *Phragmites* at target elevations (with or without grading).
- Assess whether freshwater inputs will affect salinity regimes.
- Consider whether target species will provide dense enough vegetation cover to provide the same water quality polishing and sediment trapping functions as *Phragmites*.

1.4. Coastal habitat strategies: tidal wetlands, beaches, mudflats

Salt marsh:

Complete ecological assessment of salt marsh conditions. Compare results to city-wide conditions, consider historic marsh loss, and examine restoration opportunities.

Remove landfill, including asphalt, concrete, debris and rubble that have eliminated or constrain salt marsh vegetation and marsh functions. Excavate fill to appropriate salt marsh elevations where possible.

Remove marine debris from salt marsh and block informal trails where they are preventing marsh vegetation from growing. Mobilize volunteer groups, or where access or scale of debris is not suitable, utilize contractors to remove debris and replant. Access can be blocked with fences and/or signage.

Reconstruct salt marsh where it has been eroded and converted to mud flat in recent decades along shoreline, or where tidal pools are expanding. Consider factors that contribute to the salt marsh loss, such as wave action from boats or fetch, when designing salt marsh. Salt marsh should withstand sea level rise and resist erosion during establishment.

Strategy 2. Manage stormwater (Goals II.a, II.b)

Increased stormwater management is critical to the health and function of urban natural resources and improved water quality. Stormwater source control is a strategy for reducing the volume and treating the quality of stormwater runoff close to its source in the upland, before it enters storm sewers or receiving waters. Typical stormwater source control techniques involve capturing and collecting stormwater runoff in vegetated systems where it can be retained or eliminated (e.g. through infiltration, evapo-transpiration or re-use) or detained and stored and released downstream more slowly. These techniques are referred to in this Plan as Green Infrastructure (GI), and are a subset of stormwater best management practices (BMPs). They help reduce stormwater runoff generation in lieu of, or together with, more centralized grey stormwater infrastructure. Table 18 provides examples of different GI techniques for stormwater source control and examples of where they would be applicable in the Alley Creek/Little Neck Bay Watershed.

Table 20. Green Infrastructure (GI) Approaches for Stormwater Source Control.

GI Approach	Description	Potential Applications in AC/LNB Watershed
Bioswales	Bioswales are linear rain gardens along right of ways that feature engineered soils to enhance pollutant removal, macrophytic vegetation, and an extended detention component. In NYC, a bioswale specifically refers to the bioswale standard designs developed by NYC DEP and NYC Dept. of Design and Construction (DDC).	Sidewalks, street right of way (ROW), parking lots
Rain gardens	Depressed garden beds designed to capture rainwater. Rain gardens may have less standard designs than bioswales.	Residential homes, landscaped businesses, schools, parks, parking lots
Enhance tree pits	Tree pits which are retrofitted or designed to allow stormwater to drain into the tree pit.	Sidewalks, parking lots
Impervious cover reduction	Where not essential, substitute impervious surfaces with gravel, soil and vegetation, inter-locking concrete, or other measures.	Parking lots, playgrounds, in roadways where traffic allows
Porous pavement	Porous pavement allows some infiltration where a hard surface is needed.	Parking lots, parking spaces in ROW
Green roofs	Vegetated roofs with shallow substrates designed to retain 1.2" precipitation.	Schools, commercial buildings
Downspout disconnect	Disconnect downspouts to maximize retention and reduce stress on storm drains.	Residential homes
Rainwater harvesting/rain barrels	Capture and re-use of stormwater from roofs using tanks (surface or sub-surface) or rain barrels from which water can be drawn for irrigation or other non-potable water uses.	Residential homes, schools, businesses, community gardens

Follow stormwater management and source control guidelines for NYC. Information on technologies and strategies for implementing source controls on both private and public lands in the specific context of New York City have been detailed in a number of guidelines and reports:

- High Performance Landscape Guidelines: 21st Century Parks for New York City. A comprehensive guide to designing and constructing environmentally sustainable public parks and open spaces.[75]

[75] Design Trust for Public Space, 2011

- Guidelines for the Design and Construction of Stormwater Management Systems. A NYC DEP manual to assist with the implementation of Local Law 86, one of the nation's first green building laws. Included in the manual is theStormwater Performance Standard for Connections to Combined Sewer Systems.[76]
- Water Matters: A Design Manual for Water Conservation in Buildings. This DDC water conservation manual published in June 2011 describes and evaluates best practices for potable water use reduction and a hierarchy for implementing the methods. It triggered several professional educational events.[77]
- The New York State Stormwater Management Design Manual: This manual provides guidelines for sizing GI to meet standards set by the SPEDES permit process.[78]

Select GI site based on criteria such as water quality protection, or other environmental benefits or co-benefits which can be quantified and demonstrated. Set protocols and quantifiable approaches, such as numerical modeling, to help prioritize GI where it is likely to be most effective and implemented with community support.

- **Develop a protocol to prioritize GI where hydrology is better understood.** In locations where the hydrologic connection to the receiving waterbody is understood, environmental benefits can be demonstrated and co-benefits compared and weighed (see Appendix 14).
- **Use rainfall-runoff and receiving waterbody model outputs to inform GI planning.** A quantified approach, using calibrated numerical models, is important to ensure optimal environmental benefit is achieved by any investments in GI.

Advance GI designs for different objectives in sub-watersheds with different drainage infrastructure. MS4 sub-watersheds drain directly to a receiving waterbody, and thus are designed to maximize water quality treatment. In CSO-sheds, the treatment objective is to optimize volume retention (see Table 19).

- **Promote GI as best management practice in CSO.** Even though GI is not expected to have significant impacts on water quality standards according to DEP's LTCP, promote source control for all re-developments and new developments. Encourage GI retrofits that serve educational purposes, help mitigate high temperatures, and promote stormwater re-use, as well as stormwater runoff volume reduction.
- **Build GI for water quality protection in separated drainage (MS4) sewers.** These GI systems should be built with the design objective of water quality treatment.
  - Assess each drainage catchment for potential impacts from runoff on wetland health, stream channels, and sensitive downstream habitats.
  - Prioritize opportunities for stormwater source control where stormwater discharges to wetlands predominately composed of native plants, as opposed to those dominated by invasive plants.

- **Build GI to manage excessive runoff.** Manage high runoff volumes that cause erosion and impact riparian habitat, including water quality, through downstream

[76] NYC DEP, 2012
[77] NYC DDC, 2011
[78] NYS DEC, 2015

transport of eroded sediment. Consider designs that dissipate runoff energy and detain runoff volumes for channel and water quality protection.

Table 21. Applicability of NYS DEC Stormwater Design Standards in Alley Creek and Little Neck Bay CSO or MS4 Watersheds

	Applicability of Stormwater Design Standards		
Design Standards[79]	**CSOshed**	**MS4 draining to open water**	**MS4 draining to stream or wetland**
Runoff Reduction Volume (RRv)	Yes	Yes	Yes
Water Quality Volume (WQv)	No	Yes	Yes
Channel protection (CP)	No	No	Yes

Seek institutional support, progress designs and funding for large complex GI retrofit projects. Projects include assessing and determining the potential benefits of large scale projects that could transform degraded and difficult to manage landscapes impacted by hydrological alterations and rehabilitate them to improve habitat and provide significant stormwater management improvements (e.g. Oakland Ravine, Gabbler's Creek, the Alley Creek ephemeral reach). This requires working through jurisdictional issues surrounding the multi-agency property and maintenance required for these types of projects.

Periodic assessment of review systems to assure that all construction projects incorporate GI approaches and staff capacity developed in line with best management practice. At NYC Parks, for example, projects introduced through the Unifier construction manager system assure that the design has optimized stormwater management. However, this requires that staff is trained on best management and design practice regarding the evolving field of sustainable stormwater management.

[79] DEC, 2015

Strategy 3. Fix illicit connections and unmanaged septic systems (Goal II.a)

The AC/LNB watershed contains a complicated mix of different types of infrastructure constructed at different times. Some of these become sources of pollution where they have aged and no longer function, have inadequate management, or where illicit connections have occurred. Targeted investigations are needed to find the source of contaminates where there are no records or regular monitoring programs.

Identify and assess impacts of all dry weather illicit discharges. DEP has a program to investigate illicit discharges, which should be supported and used to target locations where sources of water quality impacts in the watershed are not completely understood.

Remove all dry weather illicit discharges. Engage with property owners through education and regulatory mechanisms to disconnect and properly treat sewer or other discharges entering tributaries, ponds or the bay.

Further quantify the impact of septic tanks on water quality in the bay. DEP's data collection for the LTCP suggested a plume of high nutrient, high fecal coliform discharge emanating from highly conductive glacial soils around Douglaston Manor. Additional data collection could narrow the source of the contaminant and help communicate the causal pathways between land management and water quality to relevant stakeholders.[80]

Establish inspection requirements for appropriate management of on-site waste water systems and enforce compliance.. No mechanism currently exists to enforce appropriate management of on-site waste water systems.

Ongoing monitoring to detect illicit connects. Water quality monitoring of receiving waterbodies at monthly frequency can detect anomalous events of water quality impairment that may be resulting from illicit connections.

Strategy 4. Promote partnerships & interagency collaboration (government, advocates, stewardship groups) (Goals I, II, III)

Implementing habitat protection, institutionalizing restoration approaches, and introducing stormwater source control technologies requires collaboration across property owners, agencies, stakeholder organizations and community groups. For example, an interagency task force and extensive coordination was created as part of the consent order commitment to progress implementation of GI in NYC and to develop guidelines for the Local Law 86 building codes.

Internal coordination within NYC Parks and Recreation. This could be facilitated by the development of a master plan which would allow the balancing of ecological and recreational needs and goals.

Partner with city agencies in the development of stormwater management program and plan. Develop standard operating procedures that are effective in reducing the risk of contamination entering stormwater and natural drainage systems.

Partner with stewardship groups, environmental groups, and homeowner and civic associations. DMEA, UCPC and APEC have all worked closely with NRG. Homeowner and civic associations and other groups (Appendix 18 &19) are currently untapped networks that can expand and strengthen stewardship within the watershed. Ongoing partnerships with these active groups allow for shared resources and important avenues of communication, ensuring that habitat management objectives are aligned amongall stakeholders.

[80] NYC DEP, 2013

Partner with DOT, DOE, DDC, DEP, and EDC to expand potential GI integration into capital projects. Ensure proposed developments implement meaningful stormwater best management practices and provide protection and enhancement of habitats through interagency task forces and CEQR reviews.

Expand targeted research partnerships between research and management agencies and organizations. NRG, NAC and the joint USDA Forest Service/NYC Parks Urban Field Station staff include professionals and researchers who can help develop approaches to answering critical questions and fill information gaps related to best stormwater and urban ecological management practices. Local universities also can be enlisted to help answer pressing research questions relevant to local watershed management.

Strategy 5. Review and update regulation and codes that provide water quality and ecosystem protection (Goals I.a-c, II.a, II.b, IV)

The continued enforcement of existing and development of new, appropriate, regulations, codes and policy is an essential strategy to ensure consistent implementation of practices that protect water quality and resources. PlaNYC and the Biodiversity Assessment Handbook[81] have identified needs for reform. Though this strategy must occur at a citywide level, stakeholders in the Alley Creek watershed, particularly in government, can help influence this process in the following ways:

Advocate for codes and regulations that achieve the best practicable water quality standards and habitat protection outcomes. Encourage cooperation between advocacy groups and agencies to identify the appropriate level of regulation that provides benefit without excessive cost.

Review regulations and codes for updates and progress as outlined in PlaNYC Advance the Sustainable Stormwater Management Plan (2008), New York City Green Infrastructure Plan (2010, 2011, 2012), NYC Wetlands Strategy (2012) citywide to contribute to water quality protection.

Expand stormwater regulations to separate sewer areas. Codes and regulations that help reduce runoff in CSOsheds will also benefit water quality and aquatic habitat in separately sewered and direct drainage areas.

Advocate that ponds and lakes are covered under MS4 permit regulation as receiving waterbodies to ensure best management practice is incentivized for these waterbodies.

Ensure standard operating procedures are up to date and reflect sensitivity to impairments associated with stormwater.

Review all relevant building codes that regulate or promote downspout disconnections. Update inconsistencies accordingly to promote at-source control of stormwater.

Work with NYC DEP to integrate strategies to address pollutants of concerns including nitrogen and phosphorus.

Update regulatory codes to allow for retrofitting drainage on streets. Many opportunities identified in the Alley Creek plan for GI are limited because city agency regulators do not want to allow piping and man holes in roads to bring water into parks.

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[81] Kiviat, Erik and Elizabeth A. Johnson. Biodiversity Assessment Handbook for New York City, Center for Biodiversity and Conservation.

These regulations should be updated through interagency discussion between DEP, DOT, and DPR to allow opportunities with large environmental benefits to proceed.

Create and enforce regulation of unmanaged septic tanks. Code violations should be enforced where they occur.

Provide support for implementation of local laws for tree protection and native species. Local Law 3 (2010) requires tree restitution when trees are cut on Parks property, and Local Laws 10 & 11 (2013), require the use of native species to help protect important resources and promote biodiversity. Consideration of these laws at the earliest stages of project planning is important to avoid delays in project implementation.

Strategy 6. Engage the public (education, community outreach and stewardship) (Goal I, III, IV)

Both a goal and a strategy, public engagement includes education, community outreach and stewardship.

Education is an important strategy for achieving habitat and water quality objectives. 62% of the watershed is residentially zoned, with some 102,000 residents. Increasing the knowledge base of individuals and the community can lead to adoption of and adherence to beneficial practices, increased stewardship, and more volunteer resources for local restoration projects. Residents might also adopt more environmentally sensitive land management practices and increase their involvement in city planning scale initiatives, such as the Long Term Control Planning and the MS4 permit processes.

The vision statement calls for the use of the park as a resource for passive educational activity, and the educational value of its natural resources is one of the park's greatest assets. Outreach to a wider audience and strengthened environmental programming are ways to tap into the watershed's large potential as an outdoor classroom exhibiting New York City's natural heritage. Education and outreach provide information to stakeholders and potential partners, building a wider pool of people who care about the park.

The strategy of increasing stewardship, which aids in the implementation of best practices and management, is a natural next step. . Broadly, the aim of stewardship is organizing volunteers to build meaningful community engagement to help care for the watershed's natural resources. Increased stewardship is essential to help manage invasive species in natural areas and help provide long term maintenance at restoration projects. The following sub-strategies are proposed to address specific or watershed wide issues which would benefit from educational outreach.

Identify key issues that would benefit directly from education, and educate stakeholders on these issues. Some habitat management issues are best addressed by educating key stakeholders on how their behavior and choices affect and can benefit natural resources. Key issues and educational messages identified include:

- **Importance of street trees.** Discourage vandalism and encourage neighborhood street tree stewardship. Promote tree stewardship via the TreeLC program.
- **Health risks for consuming fish.** Material developed by NYS is available and can be used for residents and visitors to communicate risks of consuming fish and shellfish harvested from the watershed.
- **Septic tank management.** This training for homeowners would be needed ahead of any planned standards and enforcement program development.
- **At-source control methods (downspout disconnect, rain barrels, etc.) on private land.** Private landowners account for the majority of impervious area.

Techniques that landowners and managers could implement include downspout disconnections, rain barrel installations, high performance landscaping and caring for raingardens. The watershed is a rare portion of the city where the lower density housing lends itself to this type of stormwater intervention. Education could directly target landowners or landscape contractors. (See Appendix 18)

- **Importance of and options for plant selection and lawn maintenance practices in Parks.** Increase and utilize the interagency review process for new projects and consult with GNPC early in projects to ensure plant material is available. Encourage native plant use in all landscapes, not just natural areas.
- **Proper park use. Redundant trails removal, effects of party spots, dumping, access**. Promote volunteer efforts that aid in improving trail conditions, help remove undesirable trails, and improve appropriate access. Trail work can be appealing to local stewards and volunteer based groups because they are easy to get to and the benefit to the local community is immediate. Civic and community groups may be able to “adopt” parts of trails where they can acquire a sense of ownership and responsibility.

Develop and distribute educational material. Utilize APEC, online platforms, and active outreach to community groups and schools. Leverage existing educational material aligned with priority educational messages and develop materials where existing materials are not available.

Hire dedicated staff to facilitate the training and integration of environmental stewardship groups and other volunteers in active habitat management.

Promote increased membership and more effective stewardship activities:

- **Recruit more individuals to join groups that provide stewardship.** Expand stewardship through active recruitment using strategies identified in the NRG Stewardship Plan such as connecting with established community groups, religious groups, sporting groups or others.
- **Promote educational volunteer programs through educational institutions and existing stewardship groups.** Provide APEC, high schools, colleges and stewardship groups (Appendix 19) with information about educational volunteer opportunities. These opportunities could foster stewardship and a broader awareness of the habitat values and threats, such as mowing, planting and invasive plant control, oyster gardens, demonstration projects, and educational resources for teachers.
- **Increase coordination between stewardship groups and agencies.** Encourage established stewardship groups to work outside their "turf," where they may be most needed for natural resource protection, for example, where there have been recent investments in restoration. Continue and increase engagement between NRG, NAV, Park Managers and active stewardship groups to align management objectives and site specific management strategies.

Develop a Stewardship Plan for the AC/LNB watershed. Identifying specific objectives for stewardship in the watershed based on an understanding of the population, communities, and local organizations will help expand and sustain stewardship going forward. The recommendations above propose what can be done based on current understanding of stewardship potential and educational needs. All of these can be further refined based on more in depth understanding of social networks, community interests and outreach methods (Appendix 18 & 19).

- **Develop specific environmental educational messages for target audiences.** These messages should be based on an assessment of educational needs paired with ecological management needs.
- **Employ effective methods that are sensitive to limits and opportunities for outreach to various demographics** Different populations in the watershed, for example, teachers, students, residents, landowners, businesses, fisherman, commuters, may all benefit from different information and educational resources. (Appendix 18 & 19)

Strategy 7. Expand training and professional capacity (Goals III, IV)

Training and development of professional capacity is essential to ensure that responsible agencies are continuously improving their knowledge of state of the art techniques and requirements for planning, design, construction, management, maintenance and operations, and monitoring..

Ensure that staff is adequately trained and receive professional development to carry out up to date procedures and approaches.

- Provide maintenance and operations staff of facilities within MS4 catchments training in stormwater best management practices and standard operating procedures.
- Train park managers in up to date invasive species identification and control, trail maintenance, sediment management, and tree, soil and water protection practices at all sites to ensure they are consistent with and support actions of other resource managers in Parks.

Provide training in green infrastructure design techniques to a broad range of government and industry organizations. Train at multiple levels in the agencies to ensure landscape architects, urban planners, project managers, senior staff, capital programs, engineers, and contractors understand green infrastructure concepts and design objectives. Advocate for workshops and technology exchange at the citywide level to:

- Share state of the art techniques, practices, and design objectives.
- Update designers on codes and regulations.
- Provide training for all Parks landscape architects, planners, ecologists, managers, administrators, and maintenance staff to assure a broad understanding of the goals and approaches of green infrastructure.

Structure pilot or demonstration projects to provide training opportunities. Where possible, pilot projects, such as construction of a vernal pool, should include workshops that can provide opportunities for city employees, community groups, or other interested professionals to learn and discuss restoration techniques and share expertise.

Strategy 8. Advance research and adaptive management (all goals)

Adaptive management is a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project.[82] To some extent, it is an inevitable iterative process as managers make decisions in the face of uncertainty based on observations of the results of previous actions. However, it is critical to embrace adaptive management explicitly by tracking actions and monitoring and assessing resulting conditions, so that uncertainty can be reduced over time. Adaptive management is flexible and includes mechanisms for being responsive to observed outcomes. Consequently, adaptive management benefits greatly from research aimed at helping assess the results of management action.

Research in the context of watershed management is a strategy for improving management decisions by answering questions that will benefit watershed management. Parks aims to work closely with research institutions, such as the Urban Field Station, to identify questions they are positioned to help answer. Below we list a number of questions that would help improve habitat management within the Alley Creek watershed.

Build in mechanism for ongoing assessment and evolution of management approaches in planning all projects. This approach applies to restoration, education, and stewardship projects.

- Develop white paper outlining an adaptive management framework to integrate stewardship coordination with NRG's ongoing restoration efforts both in planning and tracking in order to assess goals.
- Consider how to use an adaptive management framework to address changing government and community group resources and priorities.

Hold project close-out performance meetings to discuss approaches and outcomes. Meetings, including representatives from Parks Capital, Parks Interagency Unit, Contract Management, Forestry, Parks GI, and Maintenance & Operations, to discuss the best way to perform specific tasks based on design expectations and field experience could help ascertain if maintenance approaches need to change.

Identify knowledge gaps required for effective management. Pursue research to help understand more about the health of the watershed and the ecosystems it maintains. Encourage research that will help us assess attainment of objectives and effectiveness of strategies identified in the Alley Watershed Plan.

Integrate monitoring of ecosystem condition at established monitoring stations into long term adaptive management framework. Established monitoring systems include:

- Salt Marsh - Site Specific Intensive Monitoring (SSIM) (Parks)
- Salt Marsh - Surface Elevation Table (SET) (Parks)
- Flow gauging stations at Alley Creek and Gabbler's Creek (USGS)
- Water quality monitoring sites at Alley Creek and Little Neck Bay (NYC DEP)
- Southern Forest - Groundwater monitoring bore (NYS DEC)
- Southern Forest - Upland and Forest permanent plots (NAC)
- Southern Forest - Breeding Bird Surveys (Parks). Monitoring birds can provide information about condition of forests as well as success of restoration efforts, and

[82] Sacramento-San Joaquin Delta Reform Act of 2009
(Legislation on managing water resources in California)

can help adaptive restoration/management methods to create more fully-functioning forests.
- Southern Forest - Climate station (Drexel University)
- Southern Forest - Vernal pools amphibian monitoring (Parks?). Needs to be prioritized and standardized.

Identify and seek to answer potential key research questions and needs that will support decision making for habitat and ecosystem management.

- What is the long-term function and success of salt marsh restoration sites within the watershed?
- What is the effect of increased nutrients on marsh health and marsh loss?
- What are the threats from and how do we manage invasive animals (e.g. Asian long horned beetle)?
- What is the rate of natural regeneration in closed canopy forests? An assessment of regeneration will help determine if there is a need for management of germinating trees and shrubs.
- How do we develop resilient meadow designs based on research experience of meadow design and management in other NYC locations? Learn from experience at restoration projects where different soils were imported and grasslands were native or introduced.[83]
- What is the feasibility of incorporating oyster reef habitat construction as part of shore protection of eroding marshes?
- What is the feasibility and benefit of adding sediment to marsh to help increase low marsh elevation to increase the elevation capital in the face of sea level rise?
- What are the barriers to stewardship/citizen science opportunities (such as oyster reefs, milkweed, bees, and other popular citizen science activities)?

Identify and seek to answer key design and research questions that will support decision making for water quality protection.

- What is the best way to design end of pipe outfalls adjacent to or within tidal zones that minimize water quality and erosion impacts to salt marsh?
- What is the contribution of water fowl borne pathogens in waterbodies originating within MS4 catchments?
- Does the water quality of Lake Success preclude the recommendation to reconnect Lake Success to Gabbler's Creek?
- What is the impact of unmanaged septic tanks on Little Neck Bay water quality?
- What is the link between reduction of groundwater recharge due to urbanization and the hydrological conditions of freshwater wetlands, streams, and springs?
- What is the relative effectiveness of various strategies to increase stormwater source controls (regulation, code upgrades, community education).
- Is water salinity elevated to harmful levels in any freshwater wetlands as a result of road salting practices?

Expand collaboration with universities. Universities are actively researching within the watershed, such as Queensborough Community College, Drexel University and The New School. Continue to integrate with the USFS visiting researchers through projects such as

[83]Potential project sites for comparison include Hempstead Plains grasslands were restored at Gateway National Recreation Area, landfill sites restored by NYCDEP, and restoration projects in other Parks, including Gerritsen Creek Park in Queens, and Soundview Park in the Bronx.

the Yale Summer Research Fellows to promote a more thorough understanding of the science behind management decisions and recommendations supported by detailed research and studies.

Strategy 9. Track and monitor restoration progress (Goals I.a-c, II.a, II.b, IV)

Tracking and monitoring the Plan progress is important to demonstrate effectiveness, learn from experience, and provide measurable information on which to based adjustments to management decisions. Tracking projects and monitoring and assessing their outcomes can improve the delivery of future projects, while demonstrating where performance standards are being met and how conditions are changing. All aspect of projects should, ideally be assessed at every phase: from design and planning, to implementation, to management and maintenance.

Track forest planting and management actions in restoration sites. Continue to document citywide restoration work through NRG's Forestry Tracking Database.

Conduct annual inspections of forest restoration plantings. Continue to survey and document conditions at recent forest planting sites in order to guide timely management of these sites and ensure the plants become well-established.

Monitor conditions at freshwater wetland and coastal restoration sites. Planting and management actions should be tracked and maintained in a format so that the information can be shared and evaluated.

Monitor performance and condition of all restoration and green infrastructure projects of stewardship groups. Develop a system to track work of all stakeholders in a centralized system.

Strategy 10. Ongoing communication of progress, plan updates (all goals)

Ongoing communication about the implementation of Plan recommendations is an important strategy to assure the Plan as a whole is implemented, and specific strategies are implemented or adapted as needed. Ongoing communication is critical for expanding education and outreach and providing an entry point for new stewards and stewardship groups. Reporting on the progress of achieving objectives named in the Watershed Plan and demonstrating how projects align with the Watershed Plan vision is also important to building financial and political support for these projects.

Consider holding annual joint Watershed Advisory Committee and Community Meetings. This could be the venue for reviewing progress, exchanging ideas, and sharing information on the status of activities the watershed. The minutes of the meeting could serves as an update on status of the Plan.

Deliver updates through existing plans. Plan progress will be tracked and reported to the following local and regional planning initiatives:

- Restoration information and other programmatic efforts to HEP and LISS (Modified tracking forms Appendix 20)
- Water quality information through DEP reporting requirements to DEC for MS4 and LTCP. Include watershed planning and programmatic efforts under MS4.
- Reporting updates through PlaNYC/Mayors Office of Resiliency (i.e. Wetlands Strategy, Stormwater Plan and Green Infrastructure Plan)

Develop a plan or framework for communicating to all stakeholders about the status of the Watershed Plan. This status report would include project progress and updates to strategies and recommendations (such as new issues or citywide policies).

Consider need for and potential funding mechanisms for hiring a Watershed Coordinator. A Watershed Coordinator could be responsible for helping to improve coordination between various planning, restoration, stewardship, and education activities in the watershed, and communication between partners. Such a designated person could report to a board or committee of a formal watershed coalition that grows out of the Watershed Advisory Committee and interested local stewardship groups.

Provide information about technology, government programs and projects, volunteer or stewardship opportunities, or meetings through different communication sources to reach the appropriate audiences. Communication could occur through:

- Signage in the park
- Signage or flyers at community centers
- Government websites
- Social media
- Local papers
- Radio
- Flyer
- Other innovative communication venues

2.3 Site Specific Recommendations

The broad strategies outlined above ultimately need to be implemented through specific programs or projects in order to have an impact on the ground. For habitat restoration and stormwater management strategies, we have identified opportunities at specific sites throughout the watershed where restoration work and stormwater management is needed. These recommendations were identified through community input at community meetings, site visits and tours with active stewardship group leaders, consultations with land managers, desktop analysis, and field reconnaissance employing a number of field assessments.

Habitat restoration opportunity identification:

Distinct field assessments protocols were used in different habitat types in the watershed. In the salt marsh, a "restoration opportunity mapping" protocol was used to identify opportunities for marine debris removal, invasive plant management, marsh loss restoration, and fill removal (Appendix 10). In the freshwater riparian corridor, a rapid assessment was used to survey bio-physical condition, including bank and channel geometry, substrate character, and riparian vegetation condition. This rapid assessment noted opportunities for invasive plant control and bank stabilization needs. In adjacent uplands a "management concern" assessment (Appendix 8 & 9) of impairments to upland habitat mapped human concerns (party sites, access, dumping), erosion issues, canopy gaps, and invasive species. In addition, all of the trails within the park were mapped in 2013/2014, with a focus on identifying redundant trails that impair forest connectivity or impact freshwater wetlands. Community input on access needs in the parkland was obtained during a series of community meetings and translated to site specific recommendations. All of theopportunities identified are presented in the maps below and combined in Appendix 9.

Stormwater management opportunity identification:

A protocol was developed to identify and prioritize stormwater management, or green infrastructure retrofit opportunities (Appendix 14 - 16). The protocol was largely a desktop procedure, integrating various geographical datasets. The sites identified from the protocol were checked in the field to further screen the results.

The protocol has two desktop components. The first is the site selection/screening procedure which identifies potential sites. The base layer for this step is a cover type map showing canopy gaps, which is derived from a remotely sensed LiDAR (Light imaging and ranging) platform. In natural areas, it is assumed that the canopy gaps represent potentially unmanaged lands which are invaded by, or at threat from, invasive species. Canopy gaps in natural areas that contained meadows, wetlands or recent forest restoration were removed from consideration as potential green infrastructure sites through the screening process. In managed parklands, canopy gaps that coincided with a conflicting recreational use (e.g. basketball courts, baseball fields etc), were also screened from consideration.

After the screening, the sites remaining were first categorized based on how complicated it would be .to bring stormwater to the site. Retrofit complexity was estimated based on the site slope (derived from a digital elevation model) and an assessment of local drainage infrastructure to determine if costly catch basin retrofits and piping under roads were required. Sites were further categorized based on whether there was strong environmental benefit. Environmental benefit of the opportunity was assumed to be lower at sites with a shallow depth to groundwater or to bedrock, as these sites would have limited infiltration retention potential. However, no shallow bedrock was found in the watershed, and shallow groundwater depths had already been screened out as they correspond to protected habitats associated with wetlands. Potential sites that fall within sub-catchments draining to waterbodies dominated by *Phragmites australis* are considered to have existing water quality treatment and these opportunities were categorized as having a lower environmental benefit. Finally, sites were also categorized based on the drainage infrastructure type (CSO or MS4). The drainage infrastructure of the sub-watershed will determine the design objectives for the retrofit and will relate the opportunity to different programs and funding opportunities. Finally the opportunities were categorized by landowner, which determined the lead agency responsible for progressing the retrofit.

Field verification of the resultant opportunities was conducted to confirm conflicting uses, complexity of stormwater infrastructure, or obstructions to connectivity between adjacent impervious area and the proposed site.

In this Plan, the stormwater management sites proposed as the highest priority are those that are on parkland, do not require a complex retrofit, and do not have any existing treatment (via *Phragmites australis)*.

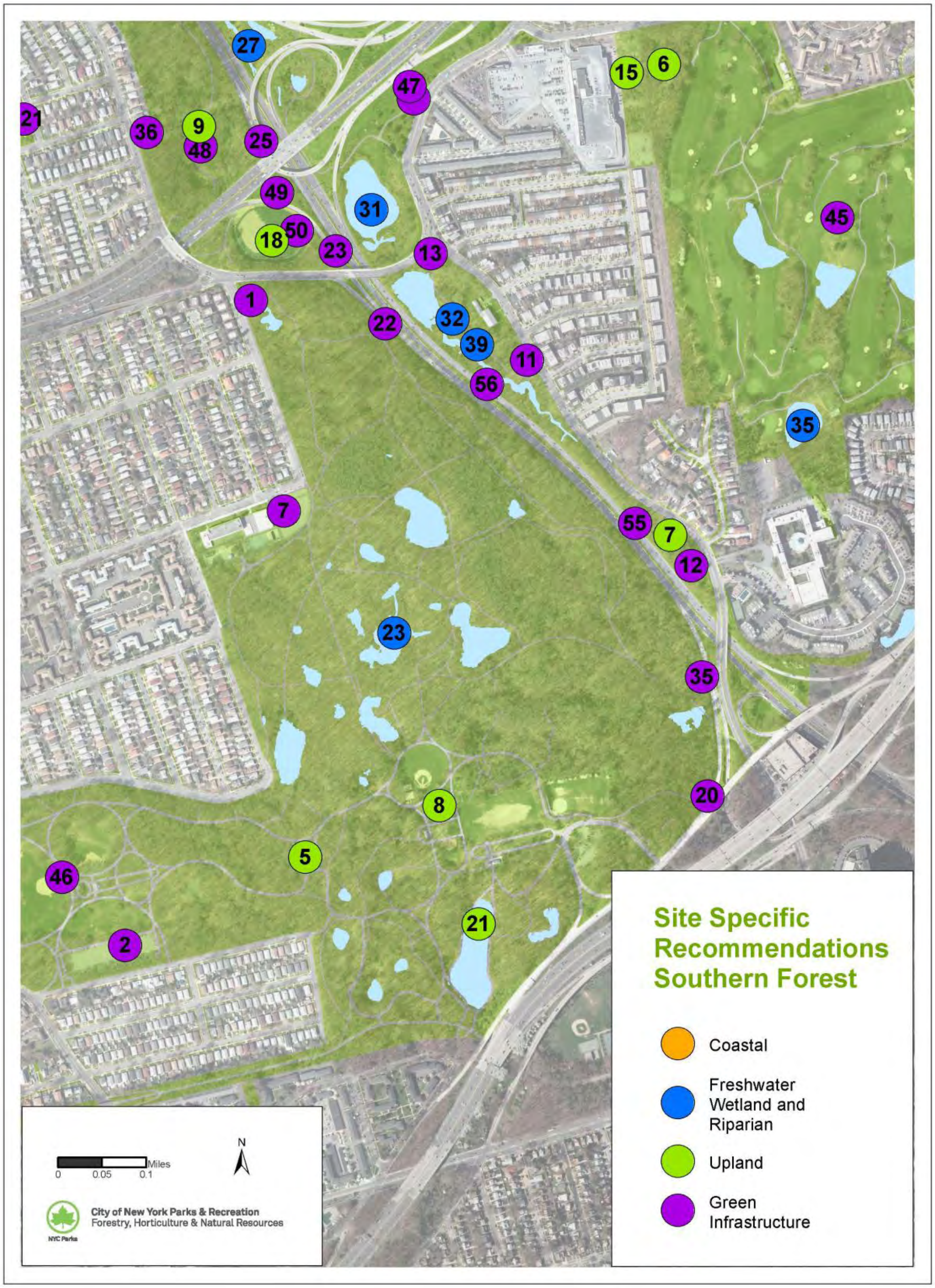

Figure 23. Site Specific Recommendations in the Southern Forest (Map 1)

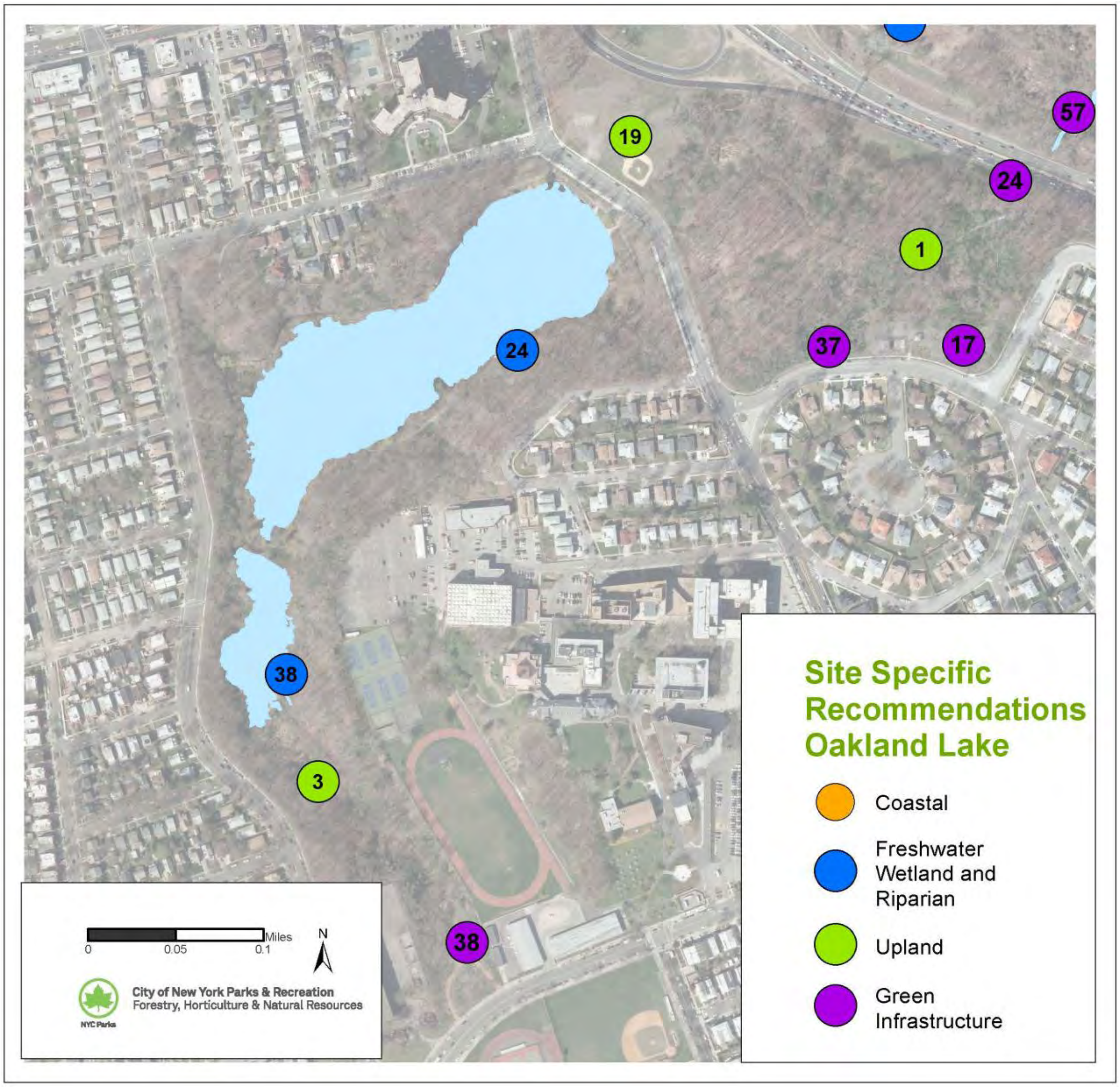

Figure 24. Site Specific Recommendations around Oakland Lake (Map 2)

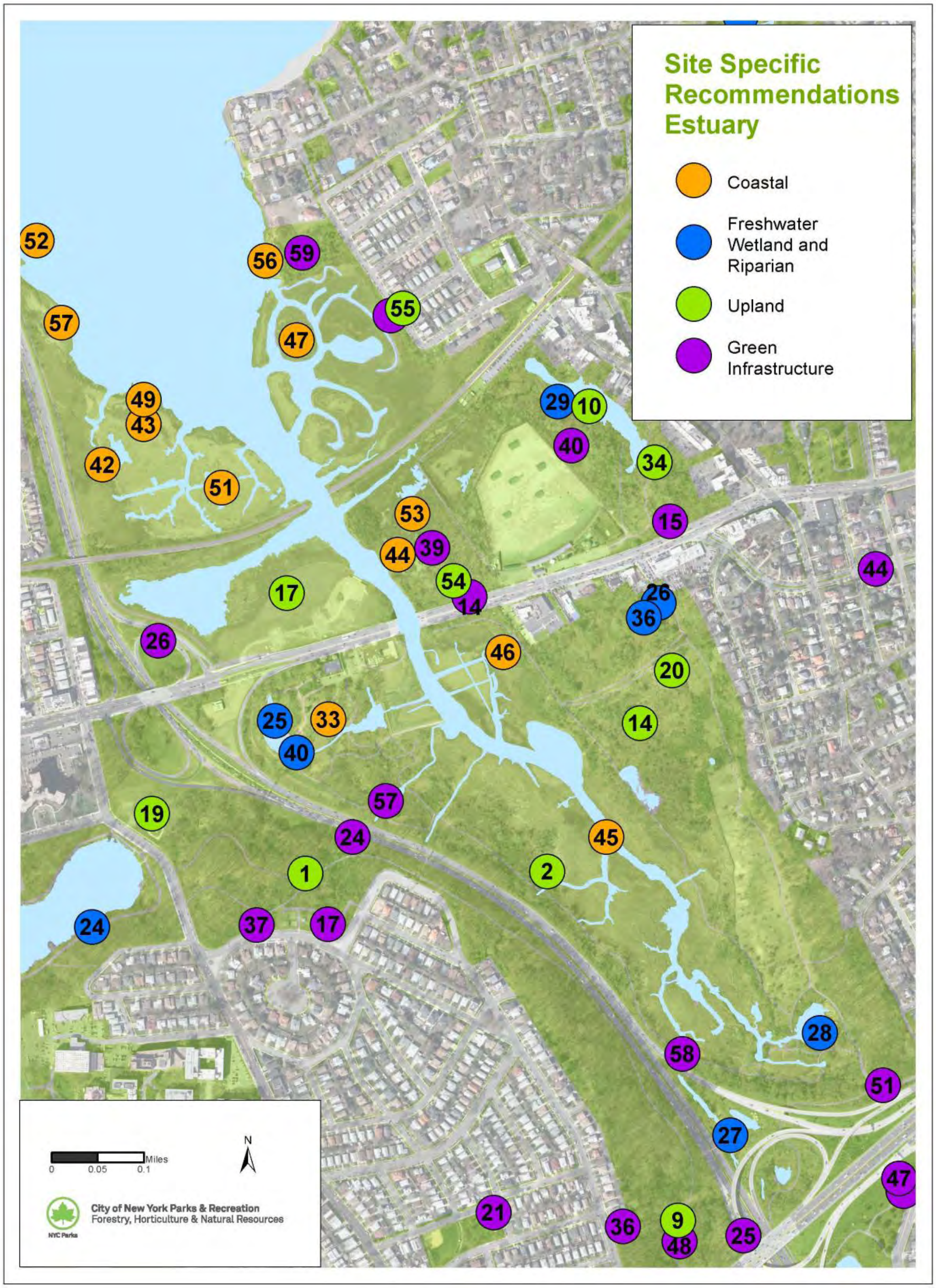

Figure 25. Site Specific Recommendations around the Alley Creek Estuary (Map 3)

Figure 26. Site Specific Recommendations around Little Neck Bay (Map 4)

Figure 27. Site Specific Recommendations around Udalls Cove (Map 5)

Table 22. Strategy 1 -- Protect and restore habitats -- site specific recommendations

Problem	Recommended action	Site location	Map #	ID
Invasive species have become dominant due to degraded or fill soils, disturbance, or canopy gaps.	Remove and control invasive plants (predominantly vines and herbs such as knotweed, mugwort, and garlic mustard). Plant native species in degraded sites where invasive plants have become dominant or where canopy gaps have formed. (1.1,1.2.2)	Tulip Forest North	3	1
		Alley Creek Adjacent Uplands	3	2
		Oakland Ravine	2	3
		Virginia Point	5	4
		Southern Forest	1	5
		Golf Course Forest	1	6
		Douglaston South	1	7
		Adventure Course	1	8
		Tulip Forest South	1	9
		Old Oak Pond	3	10
		Crocheron Park	4	11
		Osprey Landing	5	12
		Parkland along Little Neck Bay	4	13
		Alley Creek Adjacent Forest Restoration	3	14
Invasive species of specific concern (such as mile a minute or kudzu) have been identified.	Control new invasive species. (1.1)	Fairway parking lot	1	15
		Gabblers Creek	5	16
Rare meadow ecosystem is converting to forest or invasive plant vineland.	Implement meadow management plan and mowing and maintenance regime. (1.2.8)	DEP meadow restoration	3	17
		DOT cloverleafs	1	18
		Oakland Lake Ballfields / Horatio Park	3	19
		Alley Creek East Forest Restoration Sites	3	20
Road salting near salt intolerant forest species can kill plants.	Educate the borough on salting practices near roads. (1.1)	Pines near Southern Forest Adventure Course	1	21
Erosion on steep slopes.	Re-vegetation to control erosion with mosses or herbaceous ground cover. (1.1)	Aurora Pond	5	22
Invasive species, particularly Phragmites, take advantage of disturbance, poor water quality, and altered hydrology, becoming dominant in wetland and riparian ecosystems.	Remove invasive plants if success is feasible. Restore functioning hydrology if possible or close canopy gaps to help restrict colonization if need be.(1.3.10)	Kettle Ponds	1	23
		Oakland Lake	2	24
		APEC Windmill Pond	3	25
		Vernal Pool Creation at 234th St.	3	26
		Alley Creek Perennial Reach	3	27
		Spring Creeks, Alley Creek "East Arm"	3	28
		Old Oak Pond	3	29
		Aurora Pond	5	30
		Alley Pond - Interchange BMP	1	31
		Douglaston Parkway Ephemeral Reach	1	32
		APEC Freshwater Wetlands	3	33
Open water riparian wetlands, pools, or ponds have illicit trails leading to them, causing erosion and attracting trash and garbage.	Remove trash and garbage from the vicinity and manage erosion or formalize a trail based on desire lines. (1.1, 6.1)	Old Oak Pond Trail	3	34
Sensitive amphibians live in the historical kettle ponds within the golf course. Runoff from chemicals applied to the grounds may impact wildlife.	Coordinate with grounds keepers to negotiate a minimum buffer for wildlife protection. (1.1, 1.3.8)	Golf Course Ponds	1	35

Table 22 (cont.) - Strategy 1 -- Protect and restore habitats -- site specific recommendations

Problem	Recommended action	Site location	Map #	ID
Compacted soil has resulted in ponding and colonizing by wetlands vegetation. This inadvertently constructed vernal pool will be disturbed without intentional planning.	Protect existing vernal pool and create a vernal pool complex as a case study for urban vernal pool restoration in NYC. (1.3.6, 1.3.7, 7.3)	Vernal pool in forest restoration site at Alley Creek East	3	36
Ravines are dominated by invasive plants (Kudzu, Japanese knotweed, rose, Norway maple), which provide little soil and bank stability. Natural headwater channels are diverted, eliminating historical flow contributions. Piped and unmanaged stormwater causes gullying and bank undercutting, which destabilizes bank vegetation and large trees. Sanitary sewer in middle of ravine. No formal trails provide access.	Identify opportunities for stormwater source control to reduce volume, detain flow, and treat first flush to improve water quality. (1.3.1, 1.3.2, 1.3.3, 2.1, 2.5, 5.8) Dissipate energy at outfalls to reduce erosion. Build natural-like channel (e.g. step pool) systems at major gullies that can withstand high-energy stormwater discharge. (2.4) Integrate invasive plant control, reforestation, and access improvements into stormwater management and erosion control. (1.1, 1.2.2)	Gabblers Creek South	5	37
		Oakland Ravine	2	38
		Douglaston Parkway Ephemeral Reach	1	39
Buried stream results in lost riparian habitat.	Daylight stream and restore habitat. (1.3.2)	Oakland Lake Overflow at APEC	3	40
Invasive plants, of which >80% is knotweed, dominate plant cover (> 50%). Canopy gaps promote the spread of invasive plants and reduce biodiversity along stream.	Invasive plant control and reforestation along ephemeral stream riparian corridor. Manage knotweed, plant trees and shrubs to limit knotweed re-invasion. Continue coordination between Parks and stewardship groups (1.3.2, 1.3.4)	Gabblers Creek North	5	41
Floatables along the high water line smother native marsh grasses as a result of Sandy and other extreme high tides.	Remove marine debris through contractors or volunteer stewardship events and replant if needed to prevent Phragmites from colonizing. (1.4.3)	Alley Creek salt marsh north of LIRR	3	42
Phragmites is dominant above the high tide (between 5 ft and 8 foot elevation) and in lower salinity waters.	Lower elevation by removing historic fill to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides*, in lower salinity habitats. (1.3.11, 1.4.2)	Alley Creek salt marsh btwn LIRR & N Blvd	3	43
		Alley Creek salt marsh next to driving range	3	44
		Alley Creek tidal reach	3	45
		ConEd Mitigation site	3	46
		LaGuardia Mitigation	3	47
		Udalls Cove tidal wetlands	5	48
Approximately 10 acres of waterward salt marsh have been lost in Alley Pond Park since 1974.	Examine feasibility of piloting waterward salt marsh restoration with living shoreline to restore marsh area reduce shoreline erosion. (1.4.4)	Alley Creek salt marsh north of LIRR	3	49
		Udalls Cove salt marsh edges	5	50
Salt marsh and pool creation is occurring as a result of internal marsh loss.	Pools could be elevated, through replenishment or uplift with clean sand, to the adjacent elevations and replanted with native salt marsh grasses. (1.4.4)	Alley Creek salt marsh north of LIRR	3	51
Horseshoe crabs observed along the tidal flat and sandy beach along the CIP and in tidal creek within the DEP mitigation site lack protected habitat.	Investigate options through partnerships and volunteers for monitoring, expanding and protecting habitat. (6.6)	Alley Creek salt marsh north of LIRR	3	52

Table 22 (cont.) Strategy 1 -- Protect and restore habitats -- site specific recommendations

Problem	Recommended action	Site location	Map #	ID
Concrete and asphalt are present at the surface of the salt marsh from a former parking lot, limiting extent and function of salt marsh.	Remove concrete and asphalt, replace or cap with clean sand, replant Spartina alterniflora to restore low salt marsh. Restore coastal forest where fill removal is not feasible. (1.4.2)	Alley Creek salt marsh next to driving range	3	53
Japanese honeysuckle and *Phragmites* persist on well-drained fill material adjacent to marsh.	Manage invasive species and replant with coastal forest species (1.4.2)	Alley Creek salt marsh next to driving range	3	54
		LaGuardia Mitigation	3	55
Fringe marsh is trampled by fisherman or used for illicit recreation.	Formalize a trail to prevent wandering. Install signage and fencing if need be. (1.4.3)	LaGuardia Mitigation	3	56
		Alley Creek salt marsh north of LIRR	3	57
Thin salt marsh fringe with *Phragmites* exists on private property with community interest in restoration.	Consult and partner with DMEA to restore and expand fringing salt marsh along the Douglaston Manor Peninsula on private property. (1.4.4, 4.2)	Memorial Field - Douglaston Manor	5	58

Table 23 - Strategy 2 - Manage stormwater -- site specific recommendations

Problem	Recommended action*	Site location	Map #	ID
In CSO drainage areas, the added volume of stormwater runoff from impervious surfaces during rainstorms overwhelms the capacity of the combined sewer system and contributes to CSO events.	GI.1.Construct GI or stormwater BMPs on parkland that do not require pipe retrofits under road (no road retrofit design). (2.4.)	233rd St	1	1
		Parks' Car Park - Check IA protocol	1	2
		Cunningham Park 210th St / 69th Ave	A1	3
	GI.2.Construct GI needing no road retrofit design on DOT right of way.(2.3.1, 4.2)	Canopy gap - 210th St / 75th Ave	A1	4
	GI.3.Construct GI needing no road retrofit design on school playgrounds.(2.2, 2.3, 4.2)	Tall Oak Playground	A1	5
		Seven Gables Playground	A1	6
		Alley Pond Park	1	7
	GI.4.Construct GI on parkland that may require pipe retrofits under roads (road retrofit design).(2.2, 2.3,)	Cunningham Park - 210th St / 69th Ave	A1	3
		Brooklyn - Queens Greenway	A1	8
		Grand Central Pkwy / 218th St	A1	9
	GI.5.Take runoff from streets into parks by retrofitting catch-basins, grading, and pipe under roads as needed (2.3.1, 4.2)	Telephone Playground	A1	10

* At Alley Creek the problem of excess volume is primarily being managed by an underground detention facility, as described in DEP's LTCP. Nevertheless, recommended actions related to stormwater source control are provided here, because they have additional educational and environmental benefits.

Table 23 (cont) - Strategy 2 -- Manage stormwater -- site specific recommendations

Problem	Recommended action	Site location	Map #	ID
In **separate sewer areas,** stormwater is piped from roads, parking lots, and other impervious surfaces and is discharged to the receiving waters without treatment. This stormwater runoff carries pollutants such as nutrients, salt, and heavy metals directly into the downstream waters of Alley Creek, Alley Pond, Gabblers Creek, Oakland Lake and Little Neck Bay.	GI.6.Construct GI where no pipe retrofits are needed under roads to get street or impervious area runoff into parks (no road retrofit design). 2.3.2	Douglaston 68th St	1	11
		Douglaston 244th St	1	12
		Douglaston 66th St	1	13
		Northern Boulevard East - ROW	3	14
		Northern Boulevard / Old Oak Pond	3	15
		Kennedy Playground	A1	16
		Horatio Pkwy / 49th Rd Basketball Court	2	17
		Douglaston Pkwy - Fairway	1	18
		Nassau Blvd / Little Neck Pkwy Greenstreet	A1	19
		APP State Route / Grand Central Pkwy	1	20
		57th Ave & 230th St	1	21
	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	Cross Island Pkwy to Alley Pond - S	1	22
		Cross Island Pkwy to Alley Pond - N	1	23
		Cross Island Pkwy ROW - N	2	24
		LIE / Cross Island Pkwy interchange - S	1	25
		Northern Blvd / Cross Island Pkwy interchange	3	26
		Horace Harding Freeway / LIE ROW	A1	27
		Grand Central Pwky ROW	A1	28
	GI.8. Construct BMP (no road retrofit design) on DOE property.2.3.2, 4.2	Louis Pasteur Park	A1	29
		Marie Curie Park	A1	30
		Bay Terrace Playground	4	31
		Challenge Playground	A1	32

Table 23 (cont) -- Strategy 2 -- Manage stormwater -- site specific recommendations

<table>
<tr><th>Problem</th><th>Recommended action</th><th>Site location</th><th>Map #</th><th>ID</th></tr>
<tr><td rowspan="12">In separate sewer areas, stormwater is piped from roads, parking lots, and other impervious surfaces and is discharged to the receiving waters without treatment. This stormwater runoff carries pollutants such as nutrients, salt, and heavy metals directly into the downstream waters of Alley Creek, Alley Pond, Gabblers Creek, Oakland Lake and Little Neck Bay.</td><td rowspan="12">GI.9.Take runoff from streets into parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2</td><td>42nd Ave & Bell Blvd Greenstreet</td><td>A1</td><td>33</td></tr>
<tr><td>Bell Blvd & 56th St Greenstreet</td><td>A1</td><td>34</td></tr>
<tr><td>Douglaston Pkwy draining to APP</td><td>1</td><td>35</td></tr>
<tr><td>E Hampton Blvd</td><td>1</td><td>36</td></tr>
<tr><td>Horatio Pkwy / 49th Rd</td><td>2</td><td>37</td></tr>
<tr><td>Oakland Ravine</td><td>2</td><td>38</td></tr>
<tr><td>Northern Boulevard / Driving Range - W</td><td>3</td><td>39</td></tr>
<tr><td>Old Oak Pond</td><td>3</td><td>40</td></tr>
<tr><td>Crocheron Park - S</td><td>4</td><td>41</td></tr>
<tr><td>Crocheron Park - N</td><td>4</td><td>42</td></tr>
<tr><td>Gabblers Creek - 247th St / Willow St</td><td>5</td><td>43</td></tr>
<tr><td>Alameda Ave - Greenstreet</td><td>3</td><td>44</td></tr>
<tr><td rowspan="8">(Cont.) In separate sewer areas, stormwater is piped from roads, parking lots, and other impervious surfaces and is discharged to the receiving waters without treatment.</td><td rowspan="3">GI.9. Take runoff from streets into parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design). (2.3.2, 5.8)</td><td>Douglaston Golf Course</td><td>1</td><td>45</td></tr>
<tr><td>Open space Springfield Blvd / 73rd Ave</td><td>1</td><td>46</td></tr>
<tr><td>APP - between CIP& Fairway - TI 024 pipe surcharge</td><td>1</td><td>47</td></tr>
<tr><td rowspan="5">GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)</td><td>Horace Harding Freeway - Trail in Tulip Forest</td><td>1</td><td>48</td></tr>
<tr><td>LIE Off Ramp</td><td>1</td><td>49</td></tr>
<tr><td>LIE - Southern Forest</td><td>1</td><td>50</td></tr>
<tr><td>APP S - New Douglaston Pump Station</td><td>3</td><td>51</td></tr>
<tr><td>Clearview Expressway / Clearview Golf Course</td><td>4</td><td>52</td></tr>
<tr><td rowspan="9">In separate sewer areas, where pipes discharge to wetlands (e.g. Alley Creek ephemeral stream reach), the stormwater receives some treatment before entering receiving waters, but the wetlands are typically degraded and dominated by Phragmites austrails.</td><td rowspan="2">GI.11.Construct BMPs (no road retrofit design) on parkland. (2.3.2.)</td><td>LaGuardia Mitigation / 233rd St</td><td>3</td><td>53</td></tr>
<tr><td>Fort Totten Park</td><td>4</td><td>54</td></tr>
<tr><td rowspan="4">GI.12.Construct BMPs (no road retrofit design) on DOT property. (2.3.2,4.2)</td><td>CIP draining to Ephemeral - S</td><td>1</td><td>55</td></tr>
<tr><td>CIP draining to Ephemeral - N</td><td>1</td><td>56</td></tr>
<tr><td>CIP to APEC</td><td>3</td><td>57</td></tr>
<tr><td>CIP to Alley Tidal</td><td>3</td><td>58</td></tr>
<tr><td rowspan="3">GI.13.Take runoff from streets into parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design). (2.3.2)</td><td>LaGuardia Mitigation - SW outfall vineland</td><td>3</td><td>59</td></tr>
<tr><td>Waters edge Rd</td><td>4</td><td>60</td></tr>
<tr><td>Virginia Point - Udalls Cove</td><td>5</td><td>61</td></tr>
</table>

2.4 Implementation Strategy

Of the dozens of site specific and broad recommendations presented in the Plan, a sub-set are prioritized for implementation over either the short term (1-2 years) or the longer term (more than two years). Actions that were identified as highpriorities fall under an existing program, have strong community interest and support, or are needed to protect natural resources under critical threat. Actions for which a mechanism has been identified that will help ensure implementation are categorized as short term (Figure 28). The longer term actions are also priorities but are more complex, require more coordination, or lack funding. Fundraising is a recommended action that applies to most of the strategies.

Tables 24-34 below distinguish between short and long term high priority actions. Each action references the related recommendation number in the Plan , as well as the site specific ID if appropriate. Lead agencies have been identified to implement the action as well as potential partner agencies and organizations. Finally, rough estimates are given of the levels of implementation costs, based on the following categorization:

$ - (<$10,000)In kind contribution, staff time, volunteer/coordination
$$ - $10,000 - $50,000 - new hires, ongoing investments
$$$ - $100,000 - $1M - small capital programs, larger planning and coordination initiatives
$$$$ >1M - large capital projects

These tables provide the framework for tracking progress towards implementing recommendations and, ultimately, achieving the goals of the Plan. We will be able to track the status of these actions annually using a form presented in Appendix 20.

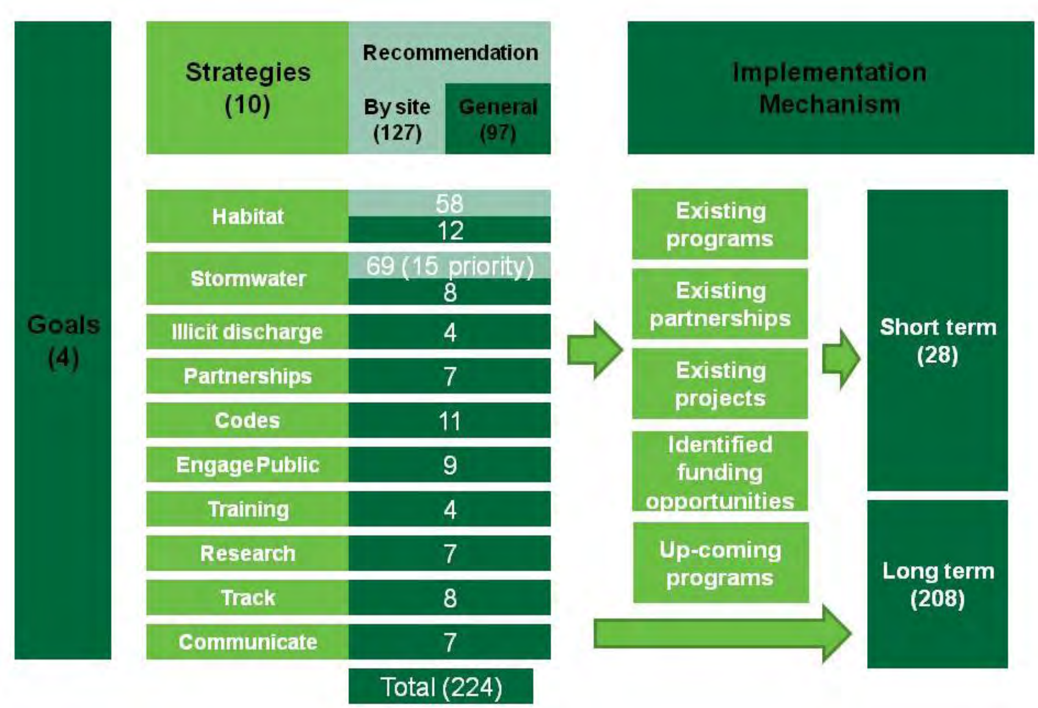

Figure 28. Implementation mechanisms for example recommendations.

Table 24. Actions for Implementation -- Protect and Restore Habitat

Strategy 1. Protect and restore habitat					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Upland Habitat					
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Complete ecological assessment of upland forests. **(1.2.1)**	NAC, (Parks)	$$	Acquire land at priority sites along Northern Boulevard and Gabbler's Creek and assess and address condition. (**1.1)**	Parks, (APEC, UCPC)	$$$$
Close redundant trails, replant with native vegetation, and update official trail maps. **(1.2.3 & 1.3.7)**	Parks, (NY-NJ Trails)	$$	Find funding sources or collaborations for mowing meadows. **(1.2.8)**	Parks	$$
Update Parks salting practices to protect salt intolerant plantings. **(1.3.8; ID 21)**	Parks	$	Conduct ongoing maintenance and tracking of forest restoration sites. **(9.1 & 9.2)**	Parks	$$
Plan next phase of forest restoration ("phase 3") between existing Million Trees restoration sites (phase 1 & phase 2) east of Alley Creek. **(1.2.2 - 1.2.4; ID 36)**	Parks	$$	Address all mapped management concerns (Appendix 8) and update restoration mapping as needed. **(1.2.2)**	Parks	$$
Review results of and quality control 2014 management concerns mapping (Appendix 8) and begin to address concerns through above actions. **(1.1)**	Parks	$$	Work with DOT to determine if meadows are suitable for ROW at interchanges. **(1.2.6)**	Parks, (DOT)	$
			Complete restoration of "phase 3". **(1.2.3 - 1.2.6/ ID 36)**	Parks	$$
			Identify new sites in need of restoration as identified through the ecological assessment. **(1.2)** Identify key research questions and needs. **(8.6)** Expand targeted research partnerships. **(4.4)**	Parks, (NAC)	$$
			Utilize information as appropriate from the most recent NYC street tree census. **(1.2.10)**	Parks	$

Table 25. Actions for Implementation -- Protect and Restore Habitat (cont.)

Strategy 1. Protect and restore habitat (cont.)					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Freshwater Wetland and Riparian Habitat					
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Design and construct vernal pool and integrate in planning for phase 3 of upland restoration east of Alley Creek. **(1.3.7; /ID 36)**	Parks	$$	Conduct feasibility assessment of daylighting Oakland Lake overflow. **(1.3.2)**	Parks, (DEP)	$
Complete ecological assessment of freshwater wetlands. **(1.3.5)**	Parks, (DEP)	$	Monitor for fish in creeks and lakes **(1.3.8).**	DEC, (Parks)	$$
Meet with golf course concessions to discuss buffer management around ponds. **(1.3.8// ID 35)**	Parks	$	Investigate feasibility of then design and construct alternative stormwater management system in degraded riparian corridors (Oakland Ravine, Douglaston Pkwy and Gabbler's Ck). **(1.3.3)**	Parks, (DEP)	$$$$
			Design and construct stream and riparian restoration projects in stable, least degraded reaches. **(1.3.4)**	Parks, (DEP)	$$
Coastal Habitat					
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Complete ecological assessment of salt marshes. **(1.4.1)**	NAC	$$	Construct salt marsh restoration north of Northern Blvd: remove fill (asphalt, concrete, rubble etc.), coordinate with DEP mitigation, and raise additional funds as needed. **(1.4.2)**	Parks, (DEP)	$$$$
Initiate salt marsh restoration north of Northern Blvd: collect site info; develop design & cost estimates; coordinate with DEP mitigation. **(1.4.2)**	Parks, (DEP, LISFF)	$$$$			
Coordinate marine debris removal north of RR with Natural Area Volunteers. **(1.4.3)**	Parks	$	Raise funds for construction of Alley Outer waterward restoration. **(1.4.4)**	Parks	$$$$
Progress concept design of salt marsh waterward marsh restoration and discuss regulatory implications with DEC. **(1.4.4)**	Parks	$$			

Table 26. Actions for Implementation -- Manage Stormwater Using Best Practices

Strategy 2. Manage stormwater using best practices					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Develop concept designs for "Parks priority sites"; seek funding for construction. **(2.3) (ID 1-3,11-21)**	Parks, (DEP)	$$	Construct three priority sites. **(2.3)**	Parks, (DEP)	$$$$
			Seek funding for and design all 15 priority sites. **(2.3) (ID 1-3,11-21)**	Parks, (DEP)	$$
Advocate for Oakland Ravine restoration for stormwater capture and pursue funds. **(1.3.3 & 2.5)** (ID 3)	Parks, (DEP)	$	Design and construct Oakwood Ravine BMPs. **(1.3.3 & 2.5)**	DEP, (Parks)	$$$$
Design and construct a new facility to disinfect stormwater during critical seasons. **(DEP LTCP 2014)**	DEP	$$$	Monitor water quality to assess result of water quality improvements; use results to review if site specific water quality targets need to be adjusted. **(DEP LTCP 2014)**	DEP	$$
Continue to implement the Green Infrastructure (GI) Program. **(DEP LTCP 2014)**	DEP	$$$$	Roll out GI across all drainage types in the watershed. **(2.1)**	DEP	$$$$
Develop protocol for prioritizing GI projects based on all co-benefits and environmental benefits. **(2.3)**	Parks, (DEP, Yale Fellows)	$	Assess potential for community engagement in private landowner disconnect. **(2.1 & 6.1.)**	SWIM, (Parks, DEP, Yale Fellows)	$$

Table 27. Actions for Implementation -- Fix Illicit Connections and Unmanaged Septic Systems

Strategy 3. Fix illicit connections and unmanaged septic systems					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Through the LTCP process, identify and remove all dry weather illicit discharges. **(3.1 & 3.2)**	DEC	$$	Quantify the effect of unmanaged septic tanks on water quality and integrate results in a refined management plan. **(3.3)**	DEP	$$
			Develop plan for septic tank management, including standards and enforcement mechanisms. **(3.4)**	DEP	$$
			Continue monitoring for signals of illicit discharge connections. **(3.5)**	DEP	$$

Table 28. Actions for Implementation -- Promote Partnerships & Interagency Collaboration (Government, Advocates, Stewardship Groups)

<table>
<tr><th colspan="6">Strategy 4. Promote partnerships & interagency collaboration (government, advocates, stewardship groups)</th></tr>
<tr><th colspan="3">Short Tem (year 1 - 2)</th><th colspan="3">Long Tem (year 2+)</th></tr>
<tr><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th></tr>
<tr><td>Participate in interagency working groups for MS4 permit. (4.1)</td><td>DEP, (Parks)</td><td>$</td><td rowspan="2">Coordinate implementation and expansion of stormwater BMPs across agencies. (4.3)</td><td rowspan="2">DEP (Parks, DOT, DOE, DDC)</td><td rowspan="2">$$</td></tr>
<tr><td>Expand USFS, NAC & Parks partnership to facilitate research and management. (4.3)</td><td>USFS, (NAC, Parks)</td><td>$</td></tr>
<tr><td>Integrate stewardship activities with maintenance needs of restored meadows at the ball fields near Oakland Lake. (4.2)</td><td>Parks</td><td>$</td><td>Link stewardship groups to habitat management (i.e. maintenance needs) for restoration projects as per recommendations from stewardship assessments. (4.2)</td><td>Parks, (Yale, USFS)</td><td>$$</td></tr>
<tr><td>Partner with APEC in planning designs for new raingardens within designs for the new APEC building. (4.2)</td><td>Parks, (APEC)</td><td>$</td><td>Work with DMEA to remove Phragmites and restore Spartina at memorial field. (4.2)</td><td>DMEA, (Parks)</td><td>$$</td></tr>
</table>

Table 29. Actions for Implementation -- Review and Update Regulation and Codes That Provide Water Quality and Ecosystem Protection

Strategy 5. Review and update regulation and codes that provide water quality and ecosystem protection					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Develop citywide stormwater management plan.(**5.1**)	DEC, (NYC)	$$	Review and update stormwater control codes for new developments. **(5.1)**	DEP, (SWIMM, Parks)	$
			Update regulations and codes as outlined in PlaNYC. **(5.2)**	DEP, (DCP)	$$
			Expand building codes to MS4 and include water quality requirements. **(5.4)**	DEP, (DCP)	$$
			Develop nitrogen and phosphorus voluntary targets through MS4 permit process. **(5.7)**	DEP, Parks	$$
			Review and update codes to allow street retrofit for GI. **(5.8)**	DEP, (DOT)	$$
			Create codes governing septic tank management. **(5.9)**	DEC	$$$
			Review building codes related to downspouts and develop recommendations. **(5.5)**	DEP, (DCP)	$$
			Issue MS4 permit **(5.1)**	DEC	$$$$

Table 30. Actions for Implementation -- Engage the Public (Education, Community Outreach and Stewardship)

<table>
<tr><th colspan="6">Strategy 6. Engage the public (education, community outreach and stewardship)</th></tr>
<tr><th colspan="3">Short Tem (year 1 - 2)</th><th colspan="3">Long Tem (year 2+)</th></tr>
<tr><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th></tr>
<tr><td rowspan="3">Working with Yale summer research fellows, identify key issues that require or would benefit from educational programs. (6.1)</td><td rowspan="3">Yale, (Parks, USFS)</td><td rowspan="3">$</td><td>Develop and provide educational materials and educational programs for key issues identified. (6.2)</td><td>Parks, (APEC)</td><td>$$</td></tr>
<tr><td>Through new hire, implement active recruitment campaign to increase stewardship and increase connection between stewardship groups. (6.4)</td><td>Parks</td><td>$$</td></tr>
<tr><td>Identify and execute one coastal and one upland restoration activity with community/volunteer coordination. (6.4)</td><td>Parks</td><td>$$</td></tr>
<tr><td rowspan="3">Seek funding for two forest restoration staff, part of whose responsibilities will be to strengthen relationships with QBCC, APEC, and local schools. (6.3)</td><td rowspan="3">Parks</td><td rowspan="3">$$</td><td>Create oyster garden and integrate stewardship in monitoring for viability. (6.4)</td><td>Baykeeper, (Parks)</td><td>$$</td></tr>
<tr><td>Develop a horseshoe crab monitoring program.(6.4)</td><td>ALS, (Parks)</td><td>$</td></tr>
<tr><td rowspan="2">Develop stewardship plan and link to citywide stewardship plan.(6.5)</td><td rowspan="2">Parks</td><td rowspan="2">$</td></tr>
<tr><td>Working with Yale summer research fellows, carry out park use stewardship survey and develop recommendations for expanding stewardship activities to target management needs. (6.5)</td><td>Yale, (Parks, USFS)</td><td>$</td></tr>
</table>

Table 31. Actions for Implementation -- Expand Training and Professional Capacity

<table>
<tr><th colspan="6">Strategy 7. Expand training and professional capacity</th></tr>
<tr><th colspan="3">Short Tem (year 1 - 2)</th><th colspan="3">Long Tem (year 2+)</th></tr>
<tr><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th></tr>
<tr><td rowspan="3">Identify education needs and training strategies for best standard operating procedures for city maintenance and operations in MS4 catchments.(7.1)</td><td rowspan="3">DEP, (Parks)</td><td rowspan="3">$</td><td>Train park managers in up to date invasive species identification. (7.1)</td><td>Parks</td><td>$</td></tr>
<tr><td>Provide more expansive stormwater management and GI design and management training for City employees. (7.2)</td><td>Parks</td><td>$$</td></tr>
<tr><td>Pilot projects and expand technical capacity to integrate stormwater management appropriately within natural areas. (7.3)</td><td>Parks</td><td>$$$</td></tr>
</table>

Table 32. Actions for Implementation -- Advance Research and Adaptive Management

<table>
<tr><th colspan="6">Strategy 8. Advance research and adaptive management</th></tr>
<tr><th colspan="3">Short Tem (year 1 - 2)</th><th colspan="3">Long Tem (year 2+)</th></tr>
<tr><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th><th>Action (Recommendation #/site specific ID)</th><th>Lead and (Partners)</th><th>Cost Level</th></tr>
<tr><td>Develop white paper outlining an adaptive management framework to integrate stewardship coordination with NRG's ongoing restoration efforts both in planning and tracking in order to assess goals. (8.1)</td><td>Parks</td><td>$</td><td rowspan="4">Develop restoration guidelines based on evaluation of salt marsh restoration assessment. (8.5)</td><td rowspan="4">Parks, (EPA)</td><td rowspan="4">$</td></tr>
<tr><td>Identify knowledge gaps for watershed management through the UFS research agenda planning. (8.3)</td><td>Parks, (USFS)</td><td>$</td></tr>
<tr><td>Continue tracking research and data requests from researchers through Parks permit program at the UFS. (8.3)</td><td>Parks</td><td>$</td></tr>
<tr><td>Continue monitoring at established sites. (8.4)</td><td>Parks</td><td>$</td></tr>
<tr><td>Continue and expand collaboration with Yale and other universities through visiting scholars programs at the UFS. (8.6)</td><td>(Yale, Drexel, New School, USFS, Parks)</td><td>$</td><td>Use adaptive management framework to make decisions in coordination with stewardship groups and integrate stewardship and ecological surveys. (8.5)</td><td>Parks</td><td>$</td></tr>
</table>

Table 33. Actions for Implementation -- Track and Monitor Restoration Progress

Strategy 9. Track and monitor restoration progress					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Inspect forest restoration sites annually. **(9.2)**	Parks	$	Track management actions and conditions at restoration sites. **(9.1)**	Parks, (DEP)	$$
Track forest planting and management actions. **(9.1)**	Parks	$			
Continue mortality study at Million Trees planting site. **(9.2)**	New School	$			
Monitor water quality in Alley Creek and Little Neck Bay. **(9.3)**	DEP	$	Develop framework to collate monitoring of all local restoration sites from all stakeholders. **(9.4)**	Parks, (APEC)	$$
Monitor salt marsh restoration success. **(9.3)**	DEP, (DEC, EPA)	$$	Construct vernal pool and monitor performance. **(9.3)**	Parks	$$

Table 34. Actions for Implementation -- Ongoing Communication of Progress, Plan Updates.

Strategy 10. Ongoing Communication of Progress, Plan Updates.					
Short Tem (year 1 - 2)			**Long Tem (year 2+)**		
Action *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**	**Action** *(Recommendation #/site specific ID)*	Lead and (Partners)	**Cost Level**
Hold periodic progress meetings with the Watershed Advisory Committee (WAC) and interested community members. **(10.1)**	Parks, (WAC)	$	Develop a communication plan. **(10.2)**	Parks, (WAC)	$$
			Hire watershed coordinator. **(10.4)**	Parks, (WAC)	$$
			Track water quality and watershed programmatic updates under MS4 and LTCP reporting to DEC. **(10.2)**	DEP, (DEC, Parks)	$$
			Report restoration updates and programmatic efforts to HEP and LISS. **(10.2)**	Parks, (DEC)	$
			Track restoration updates and programmatic efforts under PlaNYC updates (i.e. Wetland Strategy, Stormwater Plan, Green Infrastructure Plan). **(10.2)**	Parks	$
			Present progress reports, monitoring results, and implementation strategies. **(10.4)**	Parks	$

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Appendix Table of Contents

Appendix 1

Community meetings

1st Stakeholder Meeting Minutes - Alley Creek Watershed Plan -
6pm - 8pm, 31sh of January, 2013.
Venue: Alley Pond Environmental Centre

6:30pm - 7:00 pm - NYC DPR Presentation on the scope of the watershed plan and the planning process and components.

7:05 - 7:35pm - NRG presented vision statement and asked groups to edit the vision statement to capture additional elements.

7:40 - 8:15 - Attendees ask to annotate provided maps with site specific or watershed wide concerns regarding habitat and water quality.

"*"The Alley Creek Watershed is an ecologically healthy urban system where clean water, wetlands, fish, water birds, and other native species are enjoyed and protected from the bay to the headwaters. It is a place where water-sensitive practices, policies, and environmental stewardship help maintain and improve water quality and diverse native habitat, as well as public health, recreation, and a high quality of life for local and adjacent communities."*

Comments from groups fell into the following four categories:

1) Public Access (bought up by multiple groups):

  a. "like to see passive, light recreational use open to communities"

  b. "interested in access to increase educational opportunities within park"

  c. "for education, passive and active, and photographic uses".

  d. "active recreation".

2) Expand scope of the vision statement

  a. ensure vision statement explicitly includes Little Neck Bay, Udall's Cove, the estuary area and the Alley Creek watershed.

  b. To make sure it is inclusive of all wildlife. i.e. all birds, currently implies only water birds.

3) Groundwater and spring restoration

  a. concerns raised regarding significant loss of springs over the years due to a disconnecting between rainfall and groundwater due to increased impervious area.

Site specific Issues and Concerns for the watershed.		
Category	Goal/Concern	Location
Access (increase)	Better marked trails, especially in Southern Forest.	
	Better trails - consider boardwalks.	
	Encourage boating (kayaks, canoes) wherever possible.	
	Improve access to south of northern boulevard to Alley Pond Park, clean up this area.	
	Is there access here	North end of Oakland ravine
	More marked trails (south of Northern Boulevard on east side)	Alley Pond Park/ APEC wetlands
	Not in the watershed, but more soccer fields in Parks	General
	Oakland ravine trails - need better marking, wetland trails	Oakland Lake ravine
	Photography - duck blinds like those in Jamaica Bay wetland refuge	Alley Creek tidal
	Walking Trails Marked in other areas south of here	Alley Pond Park/APEC wetlands
	Water connections to the park	APEC at Alley Creek
	Wetland Trail system for year round visitor use	APEC at Alley Creek
Access (restrict)	There should only be a trail along the ravine	Oakland Lake Ravine
Invasive plants	Invasive plant species generally - priority concern.	Watershed wide
	Invasives and native species education and control. e.g. phragmites	Watershed wide
	Upland vegetation restoration is good but	

	doesn't address Phragmites	
City wide sustainable design	Climate change and higher shore line - flooding design and planning implications	
	Integration of (HEP & PLANYC) plan goals with new APEC expansion plans	
Capital Projects	Elevate Northern Blvd Causeway	Northern Boulevard Alley Creek Bridge
Capital Projects	Widen bridge over Alley Creek (to allow for greater salt water flushing) and improve wetland ecology. Aline Euler - originally suggested by Auora Garaiss	Northern Boulevard Alley Creek Bridge
Design and Planning - viewshed	Natural Screening around new pump station at APEC using vegetation and berms	APEC
Design & Planning - water quality - w		

Stakeholder Meeting Minutes - Alley Creek Watershed Plan -
6pm - 8pm, 30th of January, 2014.
Venue: Alley Pond Environmental Centre

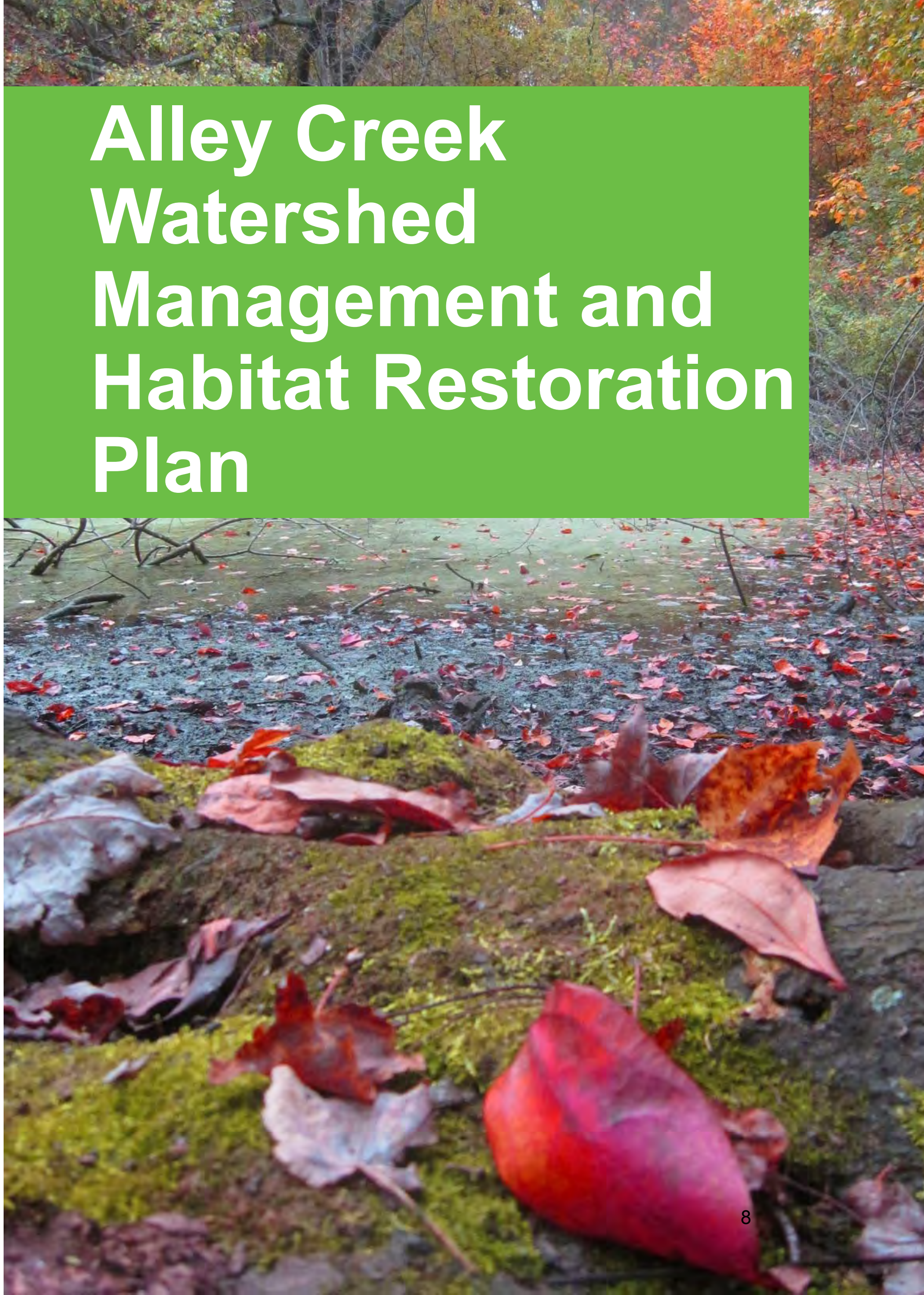
6:30pm - 7:20 pm - NYC DPR Presentation - Characterization and Proposed recommendation

7:20 - 8pm - Q & A

Q& A Minutes
Hiking club concerned about water flowing over path near Cross Island Parkway. Concerned it is a broken water main.
Comment made for more signage and interpretation needed. Specifically, with intent to communicate multiple facets of natural resources found in the park. I.e. birding, hiking, wildlife and ecologic systems.
Udall's (Virginia point) to Alley Pond Park trail desired as a priority by one community member.
Comment made by community member APEC to Alley Park Pond trail was once in better condition.
Desire to maintain a buffer between kettles and trails - concerns about erosion and resulting sedimentation in kettle ponds.
Desire to introduce local community college to stewardship opportunities around Oakland lake.
Comment made by community member that Oakland lake is not walkable at the moment due to mud. the park manager explains that rising groundwater in the area is causing issues with paths not previously seen. The Oakland Lake paths are set to be upgraded under a capital project in the next year.
Question was asked raising a concern regarding the possible adverse impacts of bringing stormwater into the parks. For example, will the kettle ponds be adversely impacted? Jennifer Greenfeld (NRG) explained that stormwater is only bought into parks in controlled volumes and only directed to green infrastructure systems which are engineered to contain and treat the volume of water diverted to the system.
Concern raised by community member that salt use is increasing within the watershed. Aurora pond water quality was tested in winter and found salinity comparable to sea water. NRG responded that a more detailed assessment of the impacts of salting on habitat will be included in the watershed plan, and the project team will also determine if a recommendation should be included in the plan to review and update policy on salting practices in collaboration with the Department of Sanitation.
Community member made a comment that they would like the community to have more say in the planning of combined sewer overflow control. NRG responded that the Department of Environmental Protection is agency responsible for planning investments for water quality improvement. A representative from DEP offered to follow up any specific concerns with relevant staff at DEP.

Comment from community member asking about the potential to acquire properties along Northern boulevard - Comment made that community prioritizes acquisition /habitat restoration along the car dealerships, restaurants, and driving range.
Comment by community board representative that the acquisition of northern boulevard is a priority for the community board, and is regularly discussed at meetings to review potential funding sources. Question by another community member as to what would be done if the properties were acquired? Response from community board representative was that the community would like to see salt marsh restored. The feasibility of this option was discussed and NRG responded that the area may be more suited to upland forest restoration than salt marsh restoration as that is deemed more feasible.
Comment raising concern about the potential impact the impervious area of the driving range is having on adjacent salt marsh. Can the impervious astro turf be retrofit to a pervious surface.
Comment by community member about light pollution from driving range impacting on wildlife. Interest in investigating if the light pollution can be addressed.
Comments about removing concessioner from golf course or directing profits from concessions to local restoration. NRG responded that it is understood the revenue ends up in a city wide funds and current financial structure complicates such an initiative.

Alley Creek Watershed Management and Habitat Restoration Plan



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December 10th 2014

3rd Community Meeting

This project is being funded in part through a grant from the New York State Department of State under Title 11 of the Environmental Protection Fund

Meeting overview

Meeting objective: *Present & review 10 strategies and associated priority recommendations*

Presentation (6:10 – 7:00pm)

Site specific recommendations

- Strategy 1 Protect and restore habitats
- Strategy 2 Stormwater management

General Recommendations

- Strategies 3 – 10 (Regulatory, engagement, other)

Questions and Discussion 7:00 – 7:30

Watershed Plan Development

Goals and Objectives

- **Draft vision statement / objectives**
- **Stakeholder & Community input,** (1st Community meeting)
- **FINAL VISION STATEMENTS**

Characterization and Assessment

- **Watershed & Ecological Context, Current conditions, Problem Identification**
- **Characterization report**

Opportunity Identification

- **Ecological mgmt & restoration, Stormwater Capture, Other (Education, outreach, Regulatory & policy reform, etc.)**
- **Prioritization** (feasibility/cost, environmental benefit)
- **<u>2nd community meeting to present priority recommendations</u>**

Implementation Strategy

- **Strategies for coordination, planning and fund raising. Monitoring and tracking planning.**
- **Feedback on recommendations and strategy** (3rd Community mtg)

Alley Creek Ecological Restoration and Watershed Management Plan

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“Vision statement”

The Alley Creek Watershed is an ecologically healthy urban system where clean water, wetlands, fish, water birds, and other native species are valued and protected from the headwaters to the bay. It is a place where water-sensitive practices, policies, and environmental stewardship help maintain and improve water quality and diverse native habitat, as well as public health, recreation, and a high quality of life for local and adjacent communities.

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Goals of the plan

I. Habitat Restoration

a. Upland Forest, Meadows and Streetscapes

b. Riparian and other Freshwater Wetlands

c. Coastal Ecosystems

II. Hydrology and Water Quality

III. Public Engagement

IV. Improve Resiliency

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Goals to Implementation

Goals (4)

Strategies (10)	Recommendation: By site (139)	Recommendation: General (97)
Habitat	70	12
Stormwater	69	8
Illicit discharge		4
Partnerships		7
Codes		11
Engage Public		9
Training		4
Research		7
Track		8
Communicate		7
	Total (236)	

Prioritization

- Spatial analysis
- Existing programs
- Existing partnerships
- Existing projects
- Identified funding

Implementation

- Short term (28)
- Long term (208)

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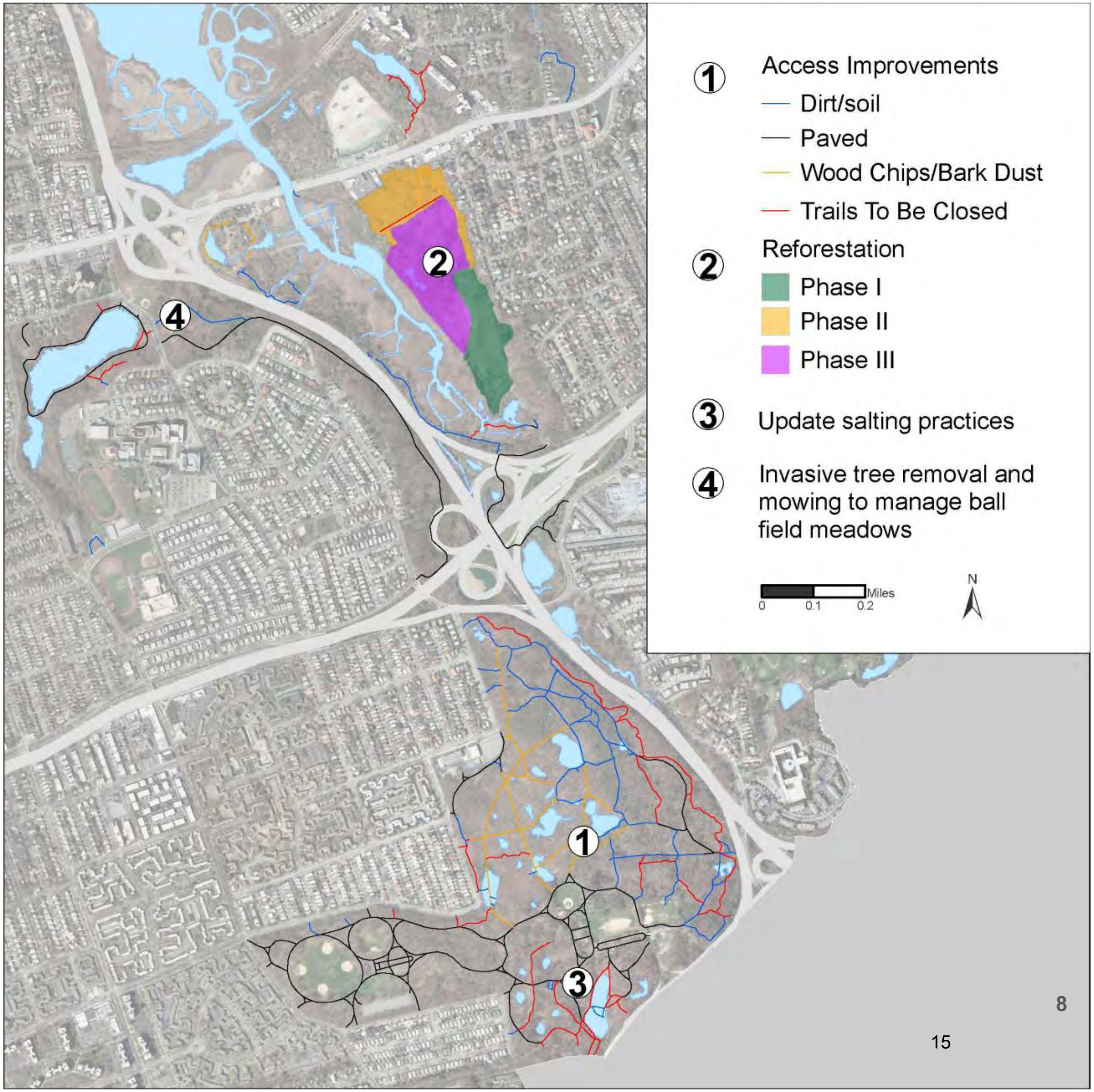
Strategy 1 – Protect and restore Habitat

1. **Protect and Restore Habitat**
   - **Upland recommendations**
   - **Freshwater & riparian recommendations**
   - **Coastal recommendations**
2. Manage stormwater using best management practice
3. Fix illicit connections and septic systems
4. Promote partnerships and interagency collaboration
5. Review & update regulation/codes
6. Engage the public
7. Increase training and professional capacity
8. Promote research and adaptive management
9. Track and monitor plan progress
10. Communicate progress and plan updates

Upland short term recommendations



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Upland long term recommendations

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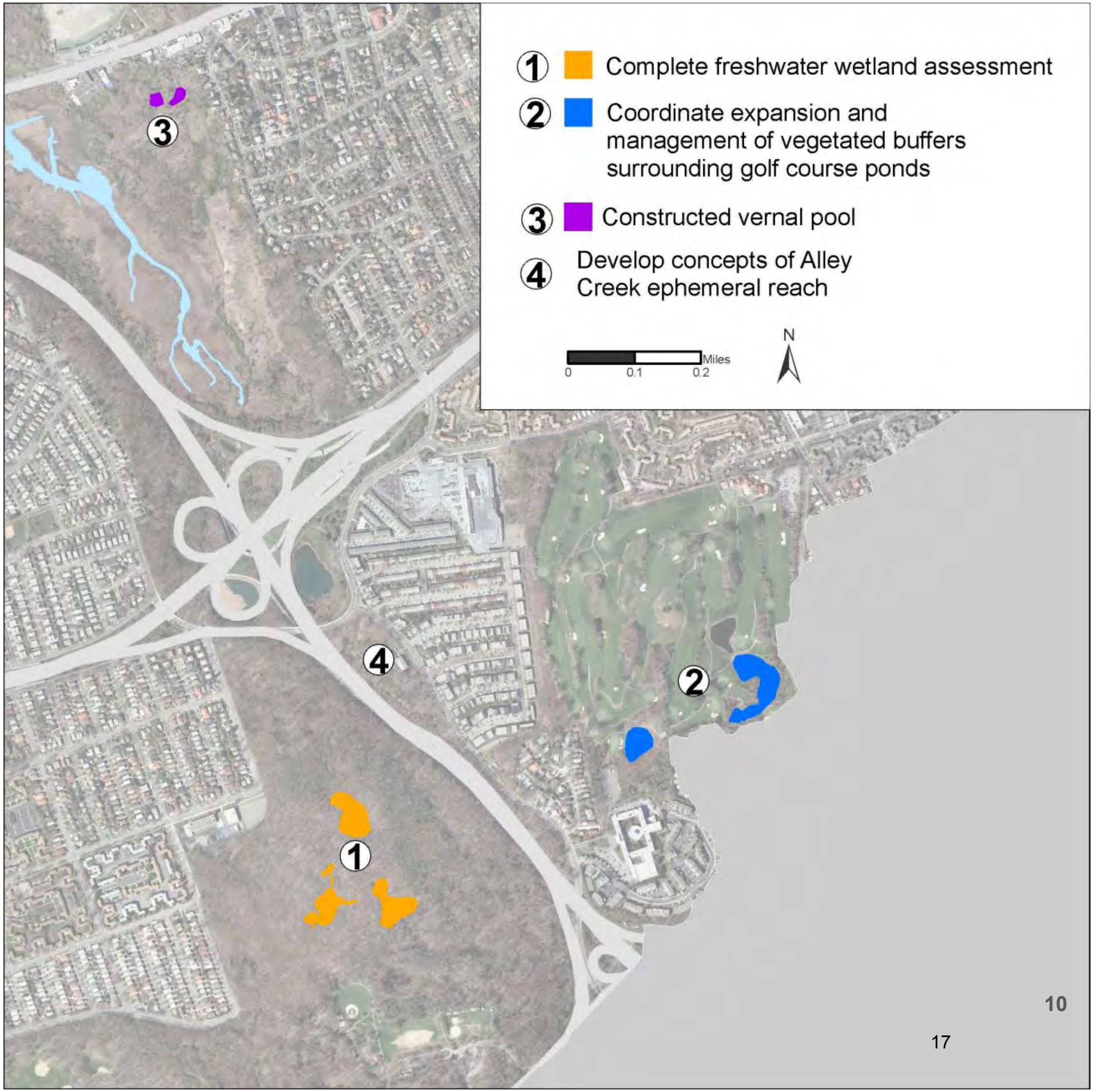
Riparian & freshwater short term recommendations



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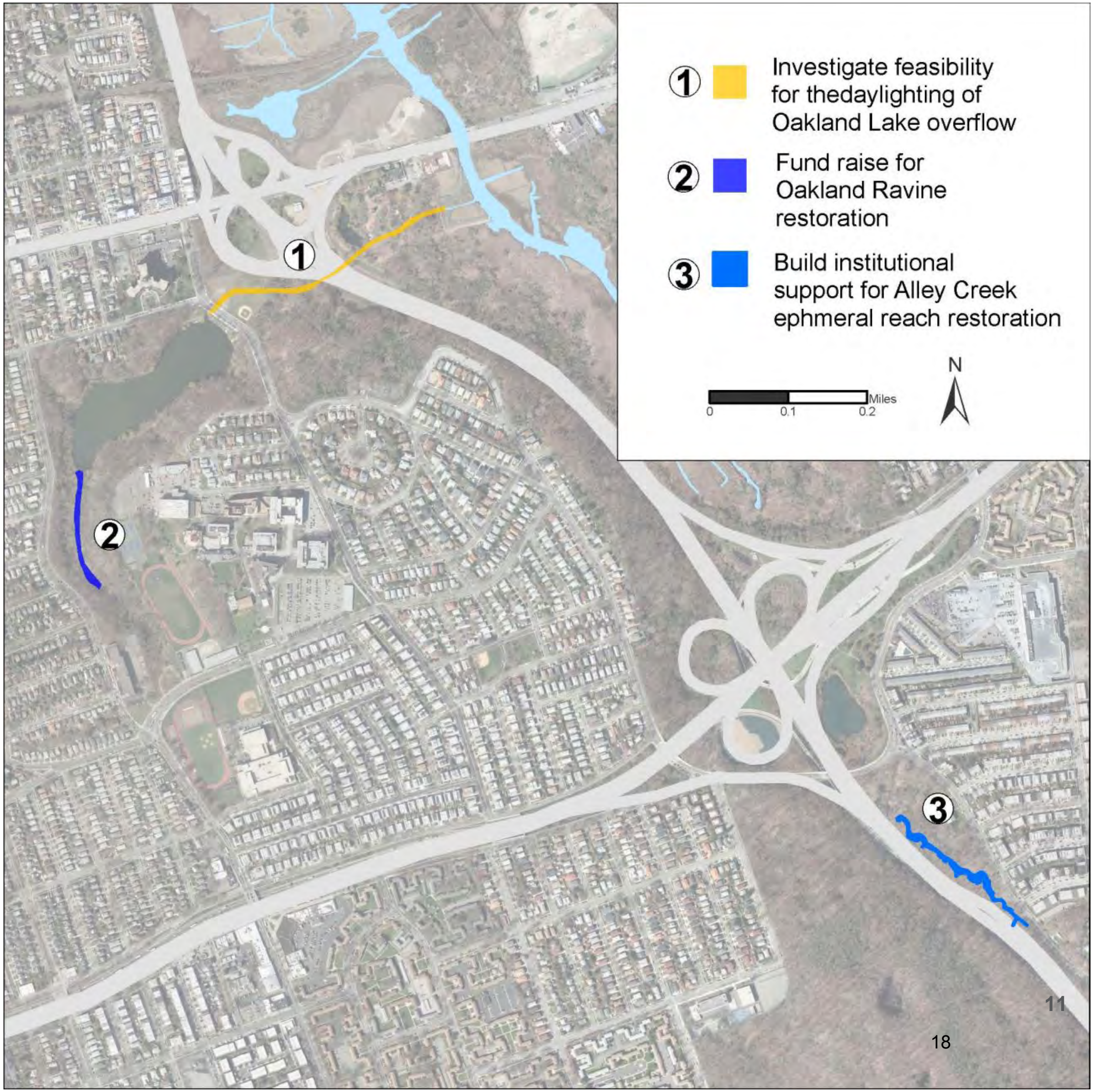
Riparian & freshwater long term recommendations



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Coastal short term & long term recommendations

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Strategy 2 – Manage stormwater

1. Protect and Restore Habitat
2. **Manage Stormwater using best management practice**
3. Fix illicit connections and septic systems
4. Promote partnerships and interagency collaboration
5. Review & update regulation/codes
6. Engage the public
7. Increase training and professional capacity
8. Promote research and adaptive management
9. Track and monitor plan progress
10. Communicate progress and plan updates

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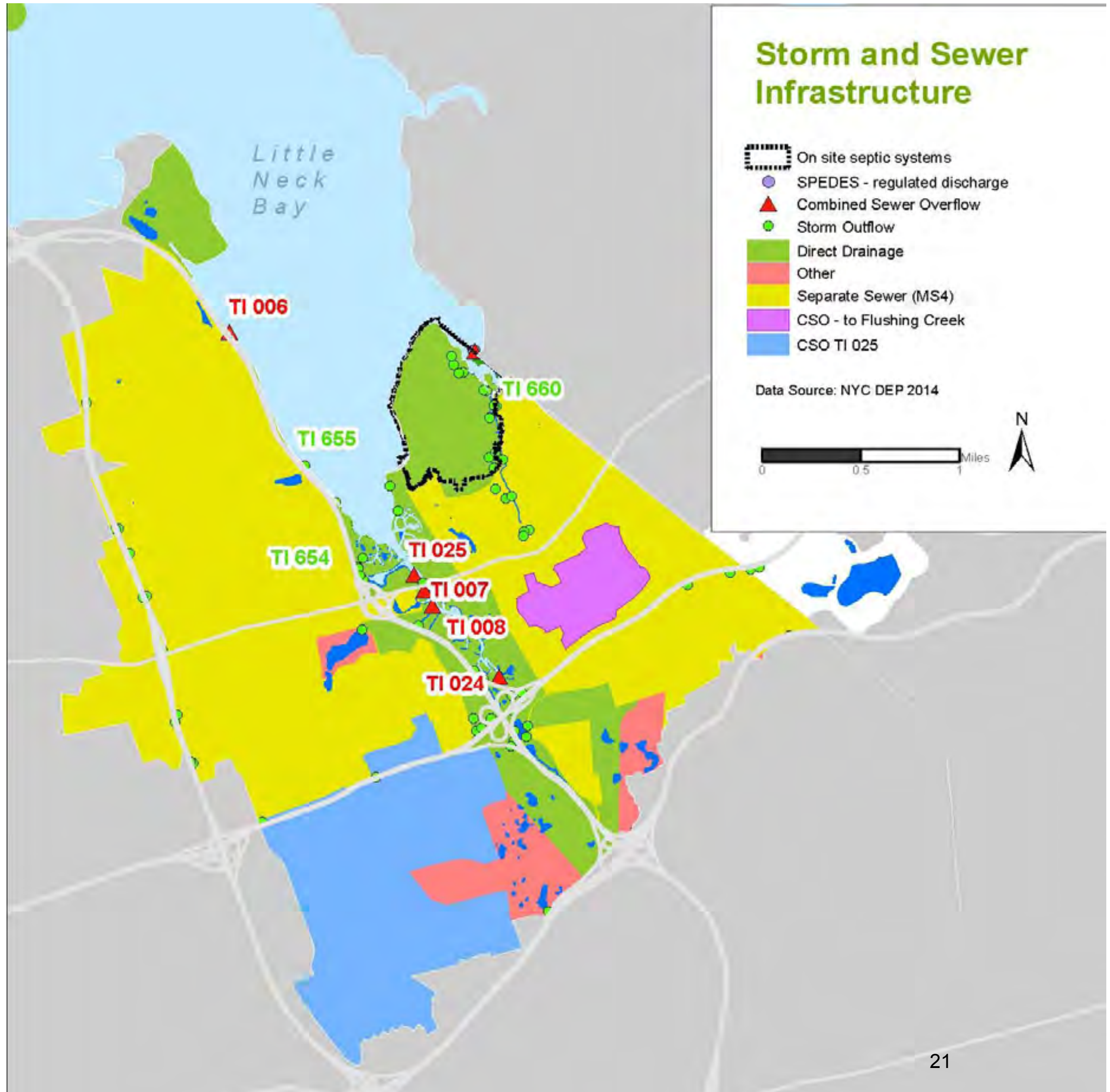
Stormwater infrastructure & outfalls in the watershed

Impacts of stormwater:

- water quality degradation at CSOs
- erosion at direct drainage outfalls
- habitat degradation at separate sewer outfalls



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Stormwater management opportunity identification

- Identified opportunities using GIS
- Prioritized opportunities based on location, property owner, complexity

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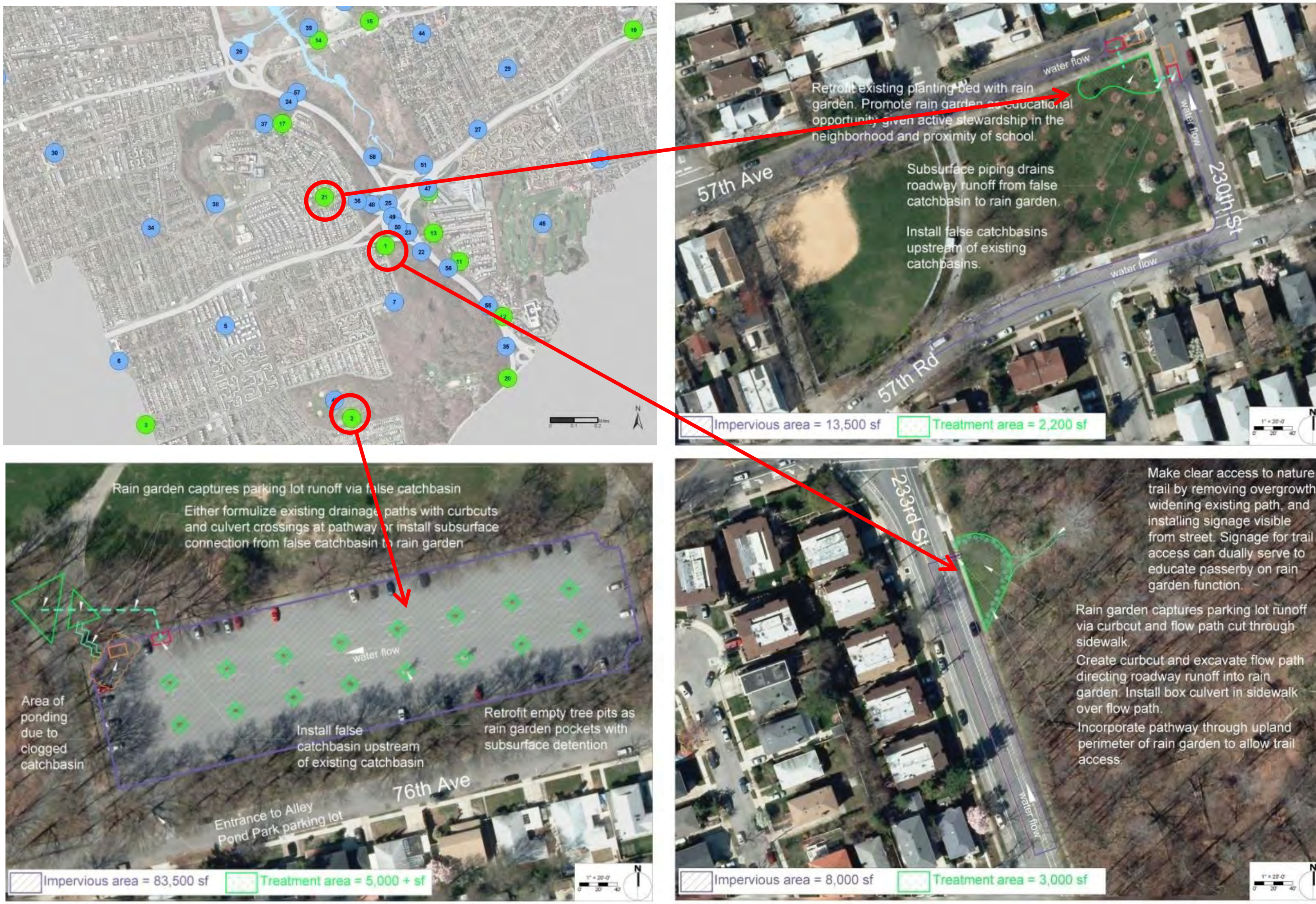
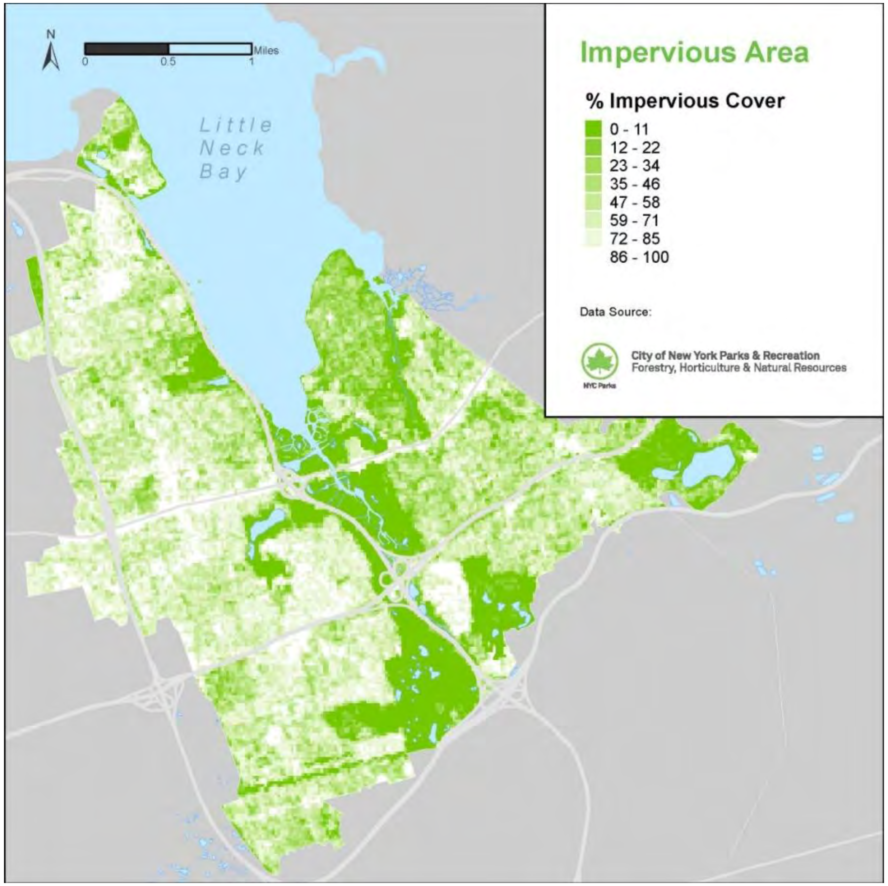
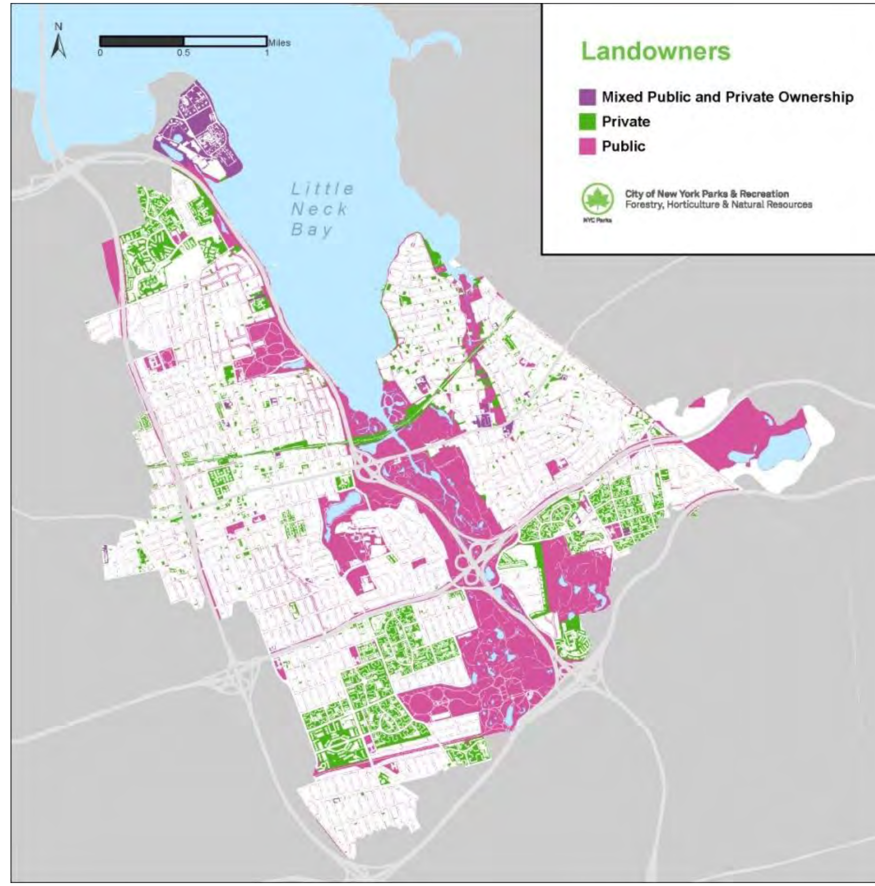
Short term stormwater management recommendations



General stormwater management recommendations





- Engage with private landowners
- Promote partnerships to develop & recommend a Stormwater Management Plan (SWMP)
- Design and construct recommendations from LTCP

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Strategies 3 – 10 (general recommendations)

1. Protect and restore habitat
2. Manage stormwater using best management practice
3. **Fix illicit connections and septic systems**
4. **Promote partnerships and interagency collaboration**
5. **Review & update regulation/codes**
6. **Engage the public**
7. **Increase training and professional capacity**
8. **Promote research and adaptive management**
9. **Track and monitor plan progress**
10. **Communicate progress and plan updates**

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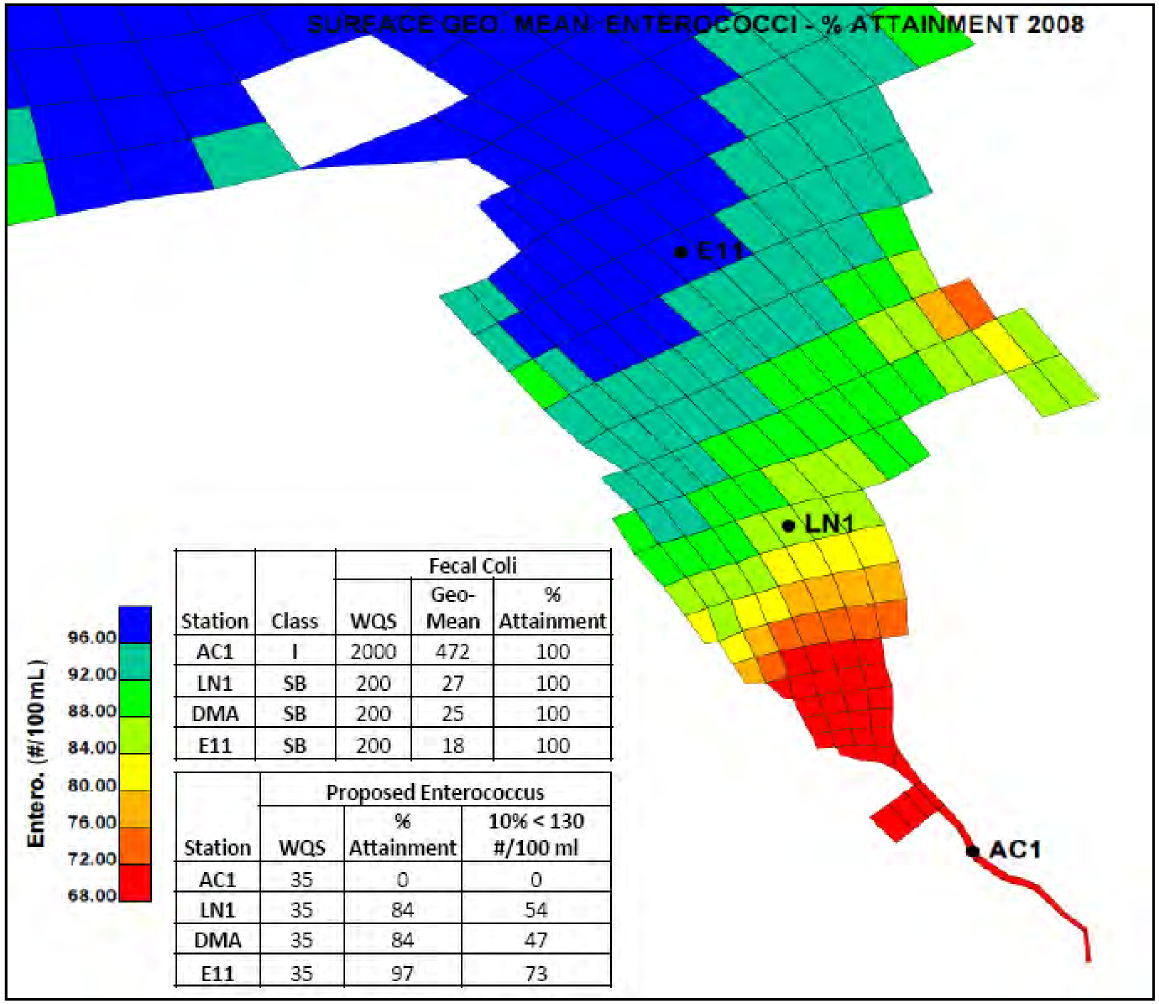
Strategy 3. Fix illicit connections and septic systems

- Ensure all illicit connections are tracked down and corrected.
- Work with state agencies to address localized sources of contamination



Station	Class	Fecal Coli WQS	Fecal Coli Geo-Mean	Fecal Coli % Attainment
AC1	I	2000	472	100
LN1	SB	200	27	100
DMA	SB	200	25	100
E11	SB	200	18	100

Station	Proposed Enterococcus WQS	Proposed Enterococcus % Attainment	Proposed Enterococcus 10% < 130 #/100 ml
AC1	35	0	0
LN1	35	84	54
DMA	35	84	47
E11	35	97	73

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Strategy 4. Promote partnerships and interagency collaboration

- Continue interagency collaboration to develop a SWMP
- Continue NRG, NAC, USFS collaboration and expand to other agencies
- Integrate stewardship activities with maintenance needs at Oakland Lake ball field meadows
- Partner with stewardship groups and organizations such as APEC, UCPC, and DMEA.

NYC Environmental Protection

Forest Service U S Department of Agriculture

Natural Areas Conservancy

NYC Parks

Strategy 5. Review & update regulation/codes

- Develop citywide SWMP working with stakeholders. The SWMP will include:
    - Address pollutants of concern (floatables)
    - Public engagement
    - Public involvement
    - Mapping
    - Illicit discharge detection and elimination
    - Post construction stormwater management
    - Pollution prevention/good house keeping

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Strategy 6. Engage the public – short term

- Identify key issues that would benefit from education programs (such as private landowner sustainable stormwater management)
- Carry out and analyze park stewardship survey (USFS)
- Seek funding for staff to help coordinate and strengthen outreach and engagement
- Identify an execute one coastal and one upland restoration activity with community/volunteer coordination

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Strategy 6. Engage the public – long term

- Through a new hire, regularly identify key ways the community can be directly engaged in active and proposed restoration projects, and support that engagement
- Using the stewardship survey as a base, support connections between and capacity of community groups surrounding the watershed

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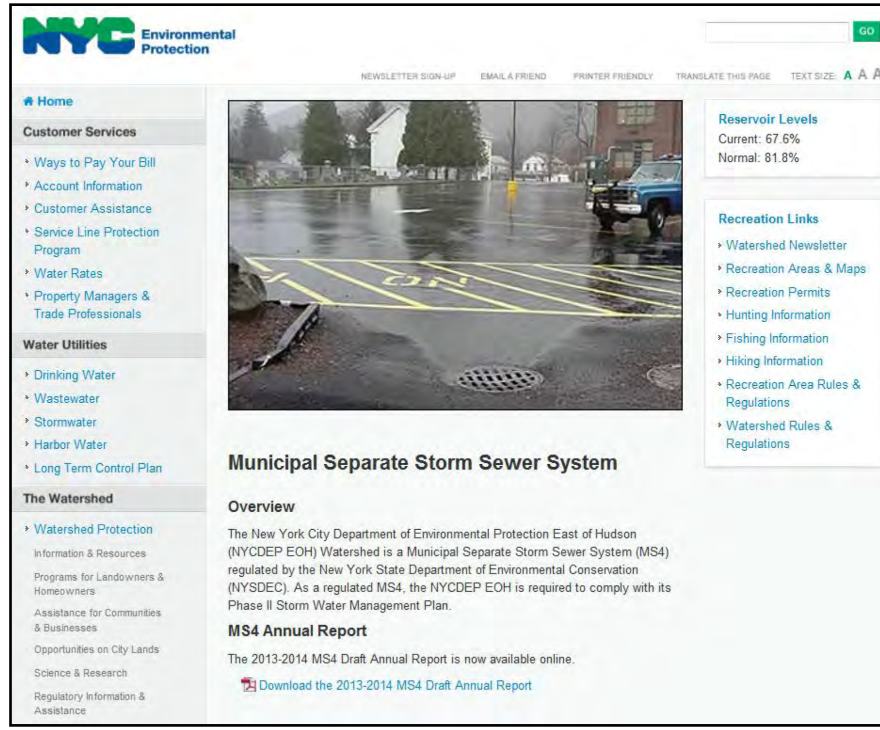
Strategy 7. Training and Professional Capacity

- Develop and implement a pollution prevention/good housekeeping program for municipal operations and facilities in NYC (e.g. sanitation, transport vehicles, snow and ice)

- Train park managers in invasive species and native species identification.



http://www.nyc.gov/html/dep/html/watershed_protection/stormwater_ms4.shtml

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Strategy 8. Research and adaptive management

- Identify knowledge gaps
- Continue to expand collaboration with universities
- Develop management recommendations based on (recently completed) forest and wetland assessments

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Strategy 9. Track and monitor plan progress

- Continue forest restoration inspections
- Track forest planting and management
- Track community engagement and stewardship
- Continue monitoring at established sites

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Strategy 10. Communicate progress and plan update

- Hold annual meetings.
- Potentially move the watershed plan online where progress and updates can be published.
- Track projects through existing programs such as Harbor Estuary Plan, LIS CCMP, NYC SWMP…

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Implementation mechanism	Strategy/recommendation (#)
Existing programs	• Forest restoration (Million trees) (S1) • Illicit connections (NYC DEP) (S3) • Codes (MS4 permit) (S5) • Public engagement (MS4 permit) (S6) • Training (MS4 permit) (S7) • Monitoring (NRG, NAC) (S9)
In house (DPR)	• Monitoring (S9) • Partnerships (S4) • Research (S8)
Awarded grants	• Marsh restoration design and construction (S1)
Future programs & grants	• Coastal build out (S1) • Riparian restoration (S1) • Stormwater (S2) • Public engagement (S6)
TBD	• Annual meetings (S10)

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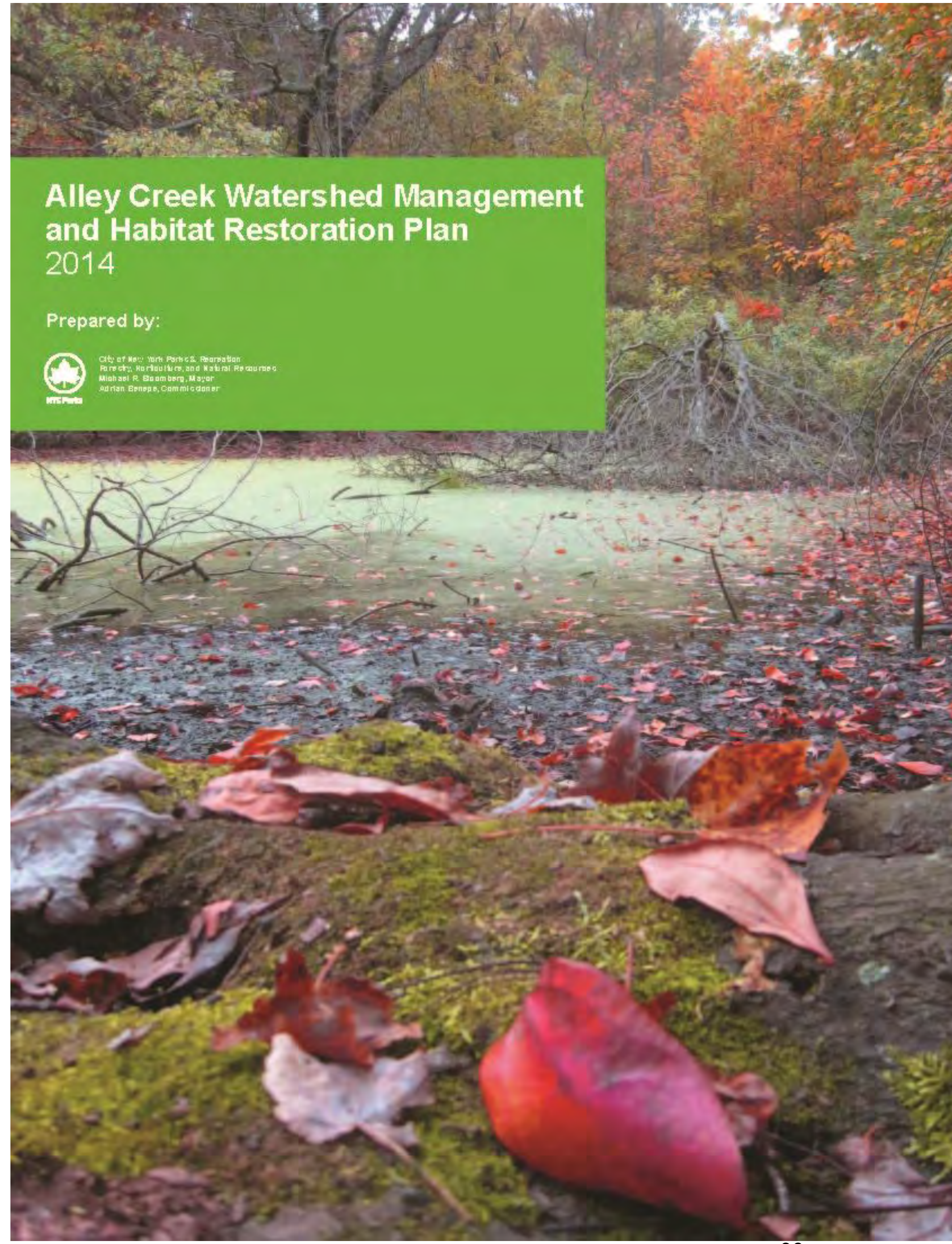
Opportunities for Feedback

- Public comment to 30th January 2015

- Plan is found here: http://issuu.com/alleycreek

This project is being funded in part through a grant from the New York State Department of State under Title 11 of the Environmental Protection Fund



Appendix 2

Historical changes

Appendix 2. A History of Key Environmental Events and Landscape Alteration Within the Watershed

Date	Historical Event
1752	James Hedges dams Alley Ck and creates Alley Pond, a constructed mill pond altering the creeks normal flow patterns. Freshwater drains into Creek flows via sluice gates.
1800	Oakland Lake dammed to serve as a farming irrigation and water supply reservoir.
1850	Oystermen start using steam operated shovels to dredge the Bay. Boats dump their coal cinders overboard creating a hard bottom on top of soft mud, possibly to help create oysters beds.
1870	Bayside Rail Station built, ending 'Alley Era' as boats can no longer sail up creek.
1880	Parsons Rare Plant Nursery Greenhouses opened next to Oakland Lake importing plants from distant lands into watershed and broader New York City.
1890	Sewer mains installed to replace outhouses with new sewer outflow feeding to Northern Boulevard and Alley creek.
1895	Little Neck clams populations severely impacted by water pollution.
1904	Metropolitan Sewerage Commission created, studies tides and harbors natural flushing patterns and recommends construction of sewage plants
1908	William Vanderbilt (1849–1920) built his privately run Long Island Motor Parkway.
1910	Northern Boulevard Trolley Line is open and New Trolley Power station is built in Alley Creek landfilled wetlands; part of the North Side & Main Line Divisions of Long Island Railroad likely contributing to contamination of landfilled tidal wetland
1913	U.S. Coast and Geodetic Survey recorded 5 foot deep dredge channel which allowed access to Alley Creek for boats.
1916	Bayside Hill removed for land-filling of 1939 World's Fair Site - major reconfiguration of surface waterflows begins
1927	First parts of Alley Pond Park mapped by City: 635 Acres.
1928	Trunk Sewer is planned along Bay shoreline and to Tallman Isl. Sewer Plant. Only western section of watershed is sewered, with Eastern Douglas Manor retaining septic tank system (built ca.1880s)
1929	New York City buys Alley Pond Land and surrounding farm fields. Reforestation process begins in today's Southern Forest.
1933	From 1928 onwards, aquifer pumping shifted from upper glacial to Jameco and withdrawals from all deep aquifers increased in Queens County. By 1933, as much as 16 million gallons per day were pumped from confined aquifers (mostly from Jameco).

Appendix 2(cont.). A History of Key Environmental Events and Landscape Alteration Within the Watershed

Date	Historical Event
1934	New York City acquires Oakland Lake.
1935	Alley Pond Park officially opened with ceremony attended by Mayor Fiorello H. La Guardia (1882–1947) and Parks Commissioner Robert Moses (1888–1981). Alley Pond Park Nature Trail is built - the first Park of its kind in the city.
1939	Cross Island Parkway built.
1941	Officials from the Sanitation and Health Departments worked with WPA workers to fill in wetlands in an attempt to control the mosquito population.
1947	Withdrawals for public water supply in Flatbush, Kings County were stopped, mostly in response to saltwater intrusion. Withdrawals increased in Queens County to compensate for shutdown of wellfields in Kings County.
1951	Industrial-supply withdrawals decreased in Kings and Queens Counties.
1958	Horace Harding Expressway built. Around this time drainage from Lake Success may have been diverted from Gabbler's Creek (also referred to as Udalls Creek) into the Horace Harding Expressway storm drain system towards Alley Creek.
1963	Park Commissioner Newbold Morris appropriates $1 million for Dredging of Little Neck Bay.
1969	2,000 people participated in a “Walk in the Alley”
1970	New York City Sanitation Department uses Alley marshes to store salt. Dr Andre Greller, Queens College botanist, Jim Trent, Tom Schweitser and others protest and get this practice stopped.
1971	NYC Sanitation Dept uses Alley marshes to store salt. Dr Andrew Greller, Queens College botanist, Jim Trent, Tom Schweitser and others protest and get this practice stopped. Alley Restoration Committee gets commitment from City to stop landfilling salt marshes with garbage and construction waste.
1972	Clean Water Act becomes law.
1972	City Planning Commission opposed a five-story motel proposed for the south side of Northern Boulevard. The Board of Standards and Appeals withdrew the application in March 1973.
1972	Alley Pond Environmental Center (APEC) founded by Joan and Hy Rosner and others to set up environmental education program.
1973	Further maintenance dredging of Little Neck Bay and Alley Creek by U.S.ACE.
1973	New York City appropriated more than $500,000 to restore Alley Pond.
1973	New York State North East Queens Nature and Historic Preserve Commission established to oversee and protect the Little Neck coastline.
1973	New York City appropriated more than $500,000 to restore Alley Creek wetlands.
1974	NYC Parks and City creating the Wetlands Reclamation Project to rehabilitate the park's natural wetlands, including restoration of 3 artificial ponds in the Alley/.
1976	Alley Pond Environmental Center built.
1977	New York City Local Tributary Study for Alley Creek written.
1980	Udalls Cove Preservation Committee founded by Aurora Gareiss and Ralph Kamhi.
1982	Gertrude and Ted Waldeyer found the Oakland Lake and Ravine Conservation Committee.

Appendix 2(cont.). A History of Key Environmental Events and Landscape Alteration Within the Watershed

Date	Historical Event
1987	Parks spent nearly $1 million to restore Oakland Lake amenities, including plants.
1988	Natural Areas Management Plan for Alley Pond Park prepared by NYC Parks.
1991	Continued reductions in withdrawals from Queens County. Water-table recovery in Jamaica area of Queens County in response to decreased withdrawals for public supply.
1992	New York State Department of State gives 1,400 acres of Little Neck Bay an "Irreplaceable" rating on its Coastal Fish & Wildlife Habitat Rating Form, based on its value as a fish and wildlife habitat.
1996	Continued reductions in ground-water withdrawals from Queens Cty, as NYCDEP takes over JWS; public-supply withdrawals are from former JWS wells in Jamaica.
2002	Water Quality Improvement Project and Alley Creek Project started by NYC Department of Environmental Protection.
2002	Alley Creek Trout Habitat Study completed by Trout Unlimited, a fishing restoration advocacy group.
2005	During reconstruction of Long Island Expressway a remnant of original Alley Pond dam is rebuilt in its approximate original location.
2006	Alliance for Little Neck Bay founded by Aline Euler.
2006	Long Island Sound Comprehensive Conservation Plan and Study issued. Goals include reducing the amount of nitrogen entering Long Island Sound.
2007	Long Island Sound Citizen's Summit.
2009	NYC DEP builds 5 million gallon Combined Sewer Overflow holding tank at mouth of Alley Creek reducing raw sewage flows into the creek.
2010	NYC DEP's Bluebelt Teambuilds raingardensat sites adjacent to Oakland Lake Park to demonstrate erosion control and stormwater runoff capture opportunities.

Appendix 3

Historic maps

Question:
Did Gabler's (Udalls) Creek Headwaters get diverted into Alley Creek during 1958 Horace Harding Expressway Construction ?
(base map: 1903 Long Island Waterworks Map)

Appendix 4

Forested wetlands table

Appendix 4 - Characteristics of kettle ponds and vernal pools in the Southern Forest[1]

Name	Vegetation	Hydrology	Ecological Values	Major Threats
Muskrat Pond (5,000 SF)	Formerly dominated by cattails, now largely *Phragmites.*	Semi permanent kettle pond. Pond holds water year-round, but may dry out in warmer years.	Frog habitat - habitat value has not been studied	Many trails surrounding the pond with high siltation risks. Many of the adjacent slopes are quite steep increasing erosion and sediment risk.
Decadon Pond (35,000 SF)	Open canopy with ~35 percent red maple and 10 percent sweetgum cover, Shrub canopy dominates with ~70 percent water willow. Some (~10 percent) duckweed present on surface waters.	Kettle pond likely shallowing with increased sedimentation from nearby erosion. Receives man made drainage from other ponds, and never fully dries.	Great horned owls; spring peepers	Sediment resulting from erosion and runoff from adjacent paths and trails. More shrubs are needed to control erosion and reduce access and removal of paths.
Turtle Ponds (8,000 SF; 33,000 SF)	Open canopy, ~45 percent red maple. Shrubs present along banks include water willow, ~ 40 percent; buttonbush, ~1 percent; and sweet pepper bush, ~10 percent. Duckweed covers the majority of the surface water. Few invasives are present in the buffer areas.	These are two kettle ponds hydrologically connected at high water. The smaller pond often dries out annually and the larger pond remains flooded year-round; though may dry in dry years.	Spring peepers	Surrounding informal trails are heavily used and contribute to sedimentation of the ponds. Duckweed blooms cover the majority of the surface water, possibly indicating poor water quality and reduced oxygen conditions.
Lilypad Pond (15,000 SF)	Canopy cover ~25 percent, dominated by sweetgum. Shrubs dominate with ~20 percent water willow and 75 percent button bush.	Semi permanent kettle pond. Pond holds water year-round, but may dry out in warmer years. This kettle pond is more hydrologically connected surficially to vernal pools.	Spring peepers	Oriental bittersweet is beginning to invade around the edges. but moving path would help not because of erosion.
Little Alley Pond (15,000 SF)	*Phragmites* dominated with about 80 percent cover; some cattails still remain. Tree canopy is low, with about 10 percent total cover of sweetgum and red oak.	Former kettle pond retrofitted to a stormwater BMP. Stormwater was diverted from the Grand Central Parkway to Little Alley Pond.	Hundreds of fowler toad and spring peeper tadpoles observed in summer 2013.	*Phragmites* is impacting the ecology, and poor water quality from stormwater runoff could potentially impact amphibian breeding.
Golf Course Ponds (40,000 SF; 40,000)	Cleared with some vegetated edge buffer. Most of the pond edge is turf grass.	Two former kettle ponds. Ponds have not been known to dry in the last decade but historically thought to have dried more frequently.	Some remnant frog populations found here.	Lack of protective buffer. Kettle ponds within the golf course, likely receiving high nutrient inputs from fertilizers used to maintain golf course turf lawn.
Wooded vernal pool (general description for region and watershed)	Fairly closed canopy dominated by maples and sweet gums and bank vegetation varies. Shrubs present are typical acidic freshwater wetlands, often in the heath family, including fetterbush and blueberries	Small shallow pools (1.5 to 3 feet deep), which dry annually in the summer months. Surface water is a mixture of groundwater, when the water table allows, direct precipitation, and snow melt in the winter and spring.	Fairy shrimp and spotted salamanders are obligate breeders to these sites, though frogs may also breed here.	Desire lines disrupt amphibian migration and cause bank erosion and siltation in pools, which alters the drying regime. If pools dry before the larval cycle of obligate amphibians and invertebrates completes, eggs will dry out.

[1] NRG, 1987; NRG, 2013, unpublished data, Susan Stanley, 2014, personal communication

Appendix 5

Freshwater assessment results

WETLAND SITES BY PARK	APP-1	APP-2	APP-3
WETLAND SITE NAME	Eggie Weggie	Lilypad	Turtle
Associated Waterbody/Stream	Lilypad pond	Eggie Weggie	
NWI	Y	Y	Y
DEC	Y	Y	Y
Land Use Intensity	0	0	0
Drainage Pattern	Modified	Modified	Modified
Position in Landscape	perched	perched	perched
Primary Hydrologic Indicators	Standing Water/Vegetation	Standing Water/Vegetation	Standing Water/Vegetation
Special Wetland Communities	vernal pool	kettle pond	kettle pond
Known Threatened/Endangered Species			
Invasives	0	0	Wine raspberry/CEOR/ Mugwort mainly in buffer
Score-Invasives % Cover(Entire Wetland)	0	0	0
Hydrologic Modifications/Score	Maybe historic but difficult to tell/1	Maybe historic but difficult to tell/1	Probably historic but turtle head and body connection modified/3
Sources of Sedimentation/Score	slope/0	slope/0	slope/0
Increased Nutrients/Score	0	Filamentous algae/1	Duckweed (Wolfia and Lemna)/10
Development Density w/I 30m/Score	0	0	0
Road Type/Score	Heavily used dirt path one side/4	Heavily used dirt path one side/4	Heavily used dirt path two sides/5
Vegetation Alteration/Score	Probably some trampling/compaction/1	Probably some trampling/compaction/1	Probably some trampling/compaction/1
Presence of Invasive Species w/I 10m/Score	0	0	0
Trails and Roads within site/Score	No roads within wetland/0	Heavily used dirt path one side/4	Heavily used dirt path two sides/5
Tree Layer/%	NYSA=30/ACRU=10/QURU=10	Liquidambar styraciflua=25	Acer rubrum=35
Tree Layer Total % Cover	50	25	35
Shrub Layer/%	Fetterbush=15/NYSA=10/ACRU=5/Vaccinium=1/Clethra alnifolia=10	Decadon verticulata=20/Cephalanthus occidentalis=75	Decadon verticulata=40/Cephalanthus occidentalis=1/Clethra alnifolia=10
Shrub Layer Total % Cover	30	95	51
Herb Layer/%	0	0	Grass=1
Herb Layer Layer Total % Cover	0	0	1
Vine Layer/%	0	0	0
Vine Layer Layer Total % Cover	0	0	0
Submerged/Floating Layer/	0	0	Duckweed/60
Submerged/Floating Layer Layer Total % Cover	0	0	0
Emergent Layer/%	0	0	0
Emergent Layer Layer Total % Cover	0	0	0
Comments	Vegetation not in bad shape at this site but moving path away from pool would probably help somewhat	Small amount of ceor in buffer.	Invasives only in apparent in buffer near nrg restoration area.
Management Recommendations	Move path.	Not an emergency but controlling CEOR now could benefit site later. Due to proximity to water, use hand/mechanical methods	Control invasives so vinelands do not develop-Due to proximity to water, use hand/mechanical methods

WETLAND SITES BY PARK	APP-4	APP-5
WETLAND SITE NAME	Decadon	Highway Phrag Pond
Associated Waterbody/Stream		?
NWI	Y	Y
DEC	Y	Y
Land Use Intensity	0	at one point/Paved Greenway/10
Drainage Pattern	recieves drainage (man-made) from other pools	Modified
Position in Landscape	perched	bottom
Primary Hydrologic Indicators	Standing Water/Vegetation	Standing Water/Vegetation
Special Wetland Communities	kettle pond	Phrag marsh
Known Threatened/Endangered Species		species=fowlers toads and spring
Invasives	0	PHAU
Score-Invasives % Cover(Entire Wetland)	0	10
Hydrologic Modifications/Score	Maybe historic but difficult to tell/1	Historic from paved roadways/3
Sources of Sedimentation/Score	slope/0	Highway slope/Bike path/1
Increased Nutrients/Score	Duckweed (Wolfia and Lemna)/5	0
Development Density w/I 30m/Score	0	greenway/10
Road Type/Score	Heavily used dirt path one side/4	greenway/10
Vegetation Alteration/Score	0	PHAU/10
Presence of Invasive Species w/I 10m/Score	0	PHAU/10
Trails and Roads within site/Score	Heavily used dirt path one side/4	Bike greenway goes up to pond edge/8
Tree Layer/%	Acer rubrum=35/Liquidambar styraciflua=10	rubra=5/Liquidamb
Tree Layer Total % Cover	45	10
Shrub Layer/%	Decadon=70	0
Shrub Layer Total % Cover		0
Herb Layer/%		Phragmites australis=80/Typha
Herb Layer Layer Total % Cover		86
Vine Layer/%		0
Vine Layer Layer Total % Cover		0
Submerged/Floating Layer/	Lemna=10	Grass=10/Small lilypads=1
Submerged/Floating Layer Layer Total % Cover	10	11
Emergent Layer/%	0	0
Emergent Layer Layer Total % Cover	0	0
Comments	Duckweed probably not sign of increased nutrients. Open, sunny pond.	Hundreds of fowlers toad and spring
Management Recommendations	Plant more shrubs on the adjacent slopes to control erosion and runoff into pond.	Balance the value of the site as amphibian breeding

Appendix 6

Habitat characterization photos

Appendix 6

Upland Forest

Healthy forest - Alley Pond Park "Southern Forest"

Erosion associated with trails.

Oakland Ravine - Vines and canopy gaps as an example of unhealthy forests.

Dumping and vinelands. typical heavily disturbed upland area adjacent to forest.

Upland meadows

Community ("bluebird") meadows. Meadow in good condition due to significant community attention.

Invasive mugwort which threatens the long term sustainability of the "Ballfield" meadows.

"Ballfield" meadows, predominately featuring native herbaceous species with mugwort towards the edges of the field.

Appendix 6

Lakes and ponds, surrounding freshwater wetlands and wet meadows

Alley Pond - Impacted pond edge featuring invasive *Phragmites and Porcaline Berry vines.*

Oakland Lake - Formalized

Old Oak Pond - features invasive *Phragmites* around the edge of this brackish pond.

Aurora Pond - features invasive *Phragmites* and compacted edges

Kettle ponds. Example of healthy conditions

Vernal pools. Example of healthy conditions.

Appendix 6

Spring Creek. Example of healthy conditions.

Spring creek. Example of poor conditions - dominated by phragmites and vines.

Appendix 6

Alley Creek (ephemeral)

Alley creek - significant undercutting and invasive plants along the bank.

Gabblers Creek flood plain forest. Dominated by invasive plants

Gabblers Creek (ephemeral)

Appendix 6

Healthy Salt Marsh

Salt Marsh plants (Iva) growing through asphalt of a historic parking lot

Marine Debris covering salt marsh habitat

Appendix 6

Spartina Alternaflora growing as a fringe marsh along the coast which has been armored.

This large outfall TI 024 directly discharges stormwater from a large portion of the watershed into the tidal creek.

Clams grow along the shore of Little Neck Bay

Appendix 6

Appendix 7

Forest restoration regulatory overview

APPENDIX 7: Regulations

Federal, state and city regulations that may apply to forest restoration projects in New York City are summarized in this appendix. More details can be found on the website of each of the agencies listed.

U.S. Army Corps of Engineers (USACE) – New York District

- Section 404/Nationwide Permit (NWP) 27
    - Section 404 regulates the discharge of dredged or fill material into waters of the United States, including wetlands. Most forest restoration activities within Section 404 regulated wetlands will fall under NWP 27 - Stream and Wetland Restoration Activities.
    - If a Section 404 and a DEC tidal wetlands permit are both needed, there is a joint application process.

New York State Department of Environmental Conservation (NYSDEC)

- State Pollution Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activities GP-0-08-001: Required for a single project with soils disturbances greater than one (1) acre of land.
    - An Erosion and Sediment Control Plan, including an inspection schedule that meets the requirements outlined in the construction stormwater permit, will need to be prepared.
- Section 401 Water Quality Certification: required for any discharge into the Waters of the United States and is generally limited to discharges of dredged or fill material regulated under Section 404 of the Clean Water Act. (See USACE permits above.)
    - It is not likely that these activities will apply to forest restoration projects, but if designated water bodies or wetlands are present on the project site, NYSDEC should be consulted.
- Freshwater Wetlands Permit: Required for activities where freshwater wetlands exist on or within 100 feet adjacent to the project site.
    - For many forest restoration, any impacts to freshwater wetlands will likely be small and may be considered "exempt" or "minor", but this depends on the location and scale of disturbance to the site, so DEC should be consulted early in the site planning process.
- Tidal Wetlands Permit: Required for activities in tidal wetlands or within 150 feet of tidal wetlands and below the 10-foot contour.
    - Any impacts to tidal wetlands due to forest restoration will likely be minor, but this depends on the location and scale of disturbance to the site, so DEC should be consulted early in the site planning process.
- Pesticide Applicator License: Pesticides must be applied under the supervision of a licensed applicator.

    - All pesticide label procedures must be followed, and application records kept by the licensed applicator. Reports on pesticide use must be reported to the State DEC annually.
- Aquatic Pesticide Permit: Required for the application of pesticides in aquatic areas to manage invasive species.
    - For pesticide applications in or within 100 ft of a wetland an aquatic pesticide permit is required and must be applied for to NYSDEC by a New York State Certified Pesticide Applicator.
- Protected Native Plants Regulation (6 NYCRR 193.3):
    - This regulation establishes lists of endangered or rare plants, which are illegal to collect or destroy without the permission of the landowner. Native plants on a site should be inventoried and if there are listed plants a protection plan must be established before any site work commences.

New York State Department of State (NYSDOS) Division of Coastal Resources

- Coastal Zone Consistency Assessment:
    - NYC Waterfront Revitalization Program Consistency Assessment Form: Required for any forest restoration project that falls within the city's Coastal Zone (see the NYC Coastal Zone Boundary Maps at www.nyc.gov).
    - Federal Consistency Assessment Form: Required for federal Coastal Zones.
    - NYC Waterfront Revitalization Program (WRP) Consistency Assessment Form: May cover both the Federal and State assessments.

New York's State Environmental Quality Review (SEQR)/ New York City Environmental Quality Review (CEQR)

- SEQR: Environmental impact assessment as prescribed by 6 NYCRR Part 617 State Environmental Quality Review (SEQR) Act. For forest restoration projects, if a State permit is required, an Environmental Assessment Form (EAF) is required to show that the project will not have significant adverse environmental impacts. Since the PlaNYC Reforestation Initiative does not result in any large impacts it will likely be classified as at Type II (minor) action. A determination of "no significance" (negative declaration) will then need to be prepared as part of the EAF. CEQR can be conducted in place of SEQR in NYC.
- CEQR: Identifies any potential adverse environmental effects of proposed actions, assesses their significance, and proposes measures to eliminate or mitigate significant impacts. Only certain minor actions identified by the state (known as Type II actions) are exempt from environmental review. Department of City Planning (DCP) may exempt the project from the CEQR process.
- Under CEQR the New York City Landmarks Preservation Commission (LPC) reviews areas of archaeological significance to ensure that if historical artifacts are discovered an archeological dig will be conducted to recover any artifacts of

cultural significance. Forest restoration sites sometimes overlap with areas of suspected archaeological sensitivity. Review of these sites must be coordinated with LPC through the CEQR process.

New York City Local Laws

Local Law 37 of 2005: encourages the reduction of pesticide use by City agencies by phasing out the use of certain pesticides, instituting new recordkeeping and reporting procedures, and providing prior notice to the public before many pesticide applications.

- Forest restoration sites need to have signage postage prior to pesticide application to notify the public of the application.

Local Law 3 of 2010: encourages the protection and retention of city-owned trees by requiring basal area replacement of any city-owned trees that are damaged or removed by any party.

Appendix 8

Management concerns acerages

Appendix 8 - Management concern mapping results.

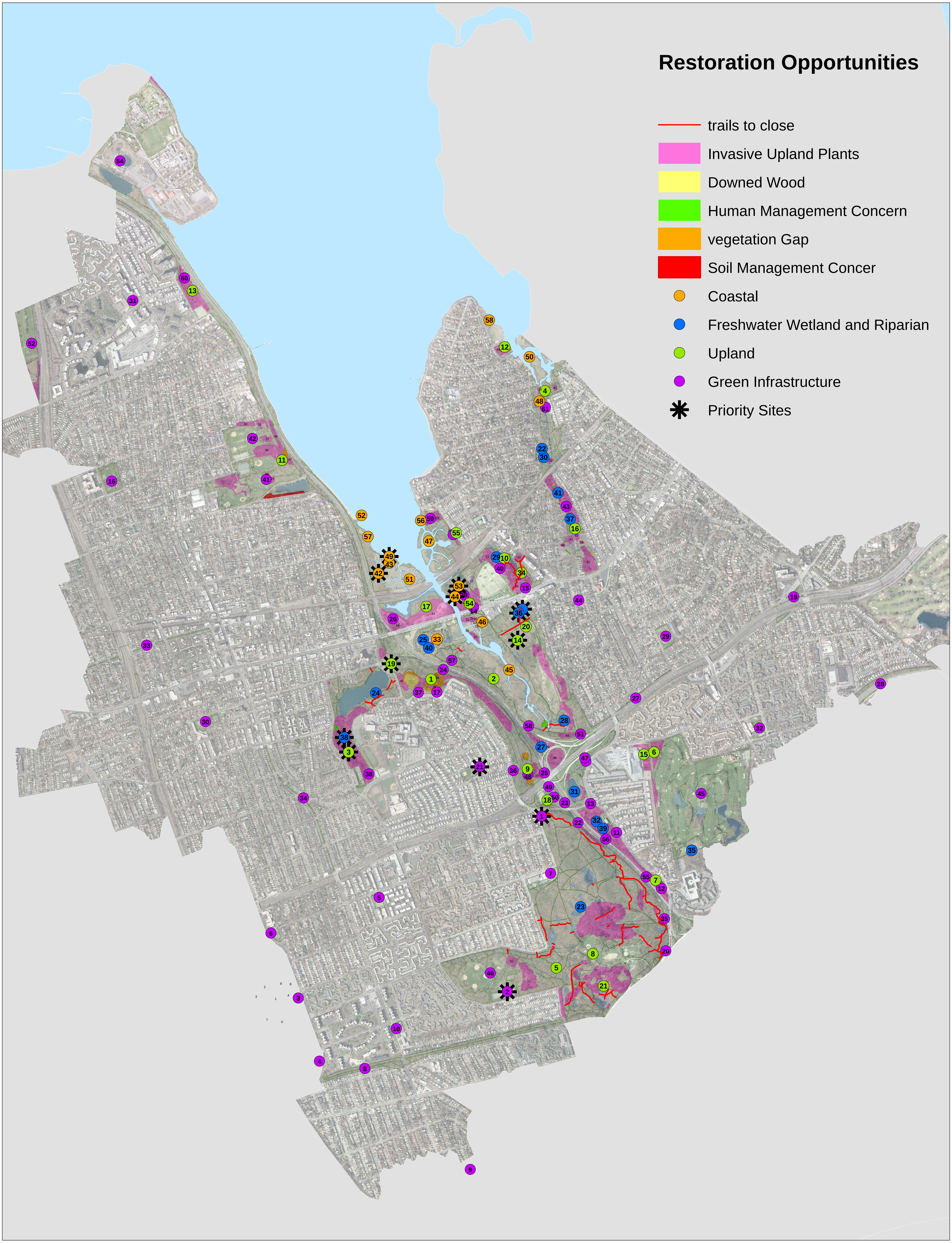
Management concerns were mapped for uplands and wetlands.

Concern class	Description	Acreage
Vegetation gap	Gap in canopy requiring intervention	5.3
Vegetation	Invasive plants mapped in the field	39.7
Desktop vegetation	Invasive plants missed in field mapping and mapped at desktop based on previous field visits.	47
Downed wood	Downed wood which can become trestle for vines and requires removal.	1.8
Tracking data base	Data on inspections and maintenance which indicates invasive plants currently managed.	2.0
Soil	Soil erosion issues.	0.65
Salt marsh restoration opportunity - phragmites removal	Restoration opportunities within tidal salt marsh	26
Marine debris	Wrack which requires removal to allow salt marsh plants to grow.	0.32
Salt marsh fill removal	Historic landfill on salt marsh.	4.6
salt marsh loss	Restore	11.8
Salt marsh habitat	Oyster reefs and horse shoe crab protection	5.7
Human management concern	Party sites and dumping sites. Require removal of trash or access blockage.	2
Redundant trails	Informal trails which need to be removed to reduce impact of human traffic on the forest or adjacent wetlands. Require blocking of paths and	3.3 miles

Appendix 9

Everything map

Restoration Opportunities



Appendix 10

Salt marsh restoration opportunities

Appendix 10 - Salt marsh restoration opportunities

ID	Location	Restoration typ	Restoration method
BQ7.1.7	AlleyOuter	Debris	Removal-Equipment
BQ7.1.1	AlleyOuter	Fill	Removal-Equipment
BQ7.1.2	AlleyOuter	Fill	Removal-Equipment
BQ7.1.3	AlleyOuter	Fill	Removal-Equipment
BQ7.1.16	AlleyOuter	Fill	Removal-Equipment
BQ7.1.18	AlleyOuter	Fill	Removal-Equipment
BQ7.2.7	AlleyInner	Fill	Removal-Equipment
BQ7.1.6	AlleyOuter	Invasive Species	Removal-Equipment
BQ7.1.13	AlleyOuter	Invasive Species	Removal-Equipment
BQ7.2.1	AlleyInner	Invasive Species	Removal-Equipment
BQ7.2.2	AlleyInner	Invasive Species	Removal-Equipment
BQ7.2.3	AlleyInner	Invasive Species	Removal-Equipment
BQ7.2.4	AlleyInner	Invasive Species	Removal-Equipment
BQ7.2.8	AlleyInner	Invasive Species	Removal-Equipment
BQ7.1.5	AlleyOuter	Marsh Loss	Fill In
BQ7.1.8	AlleyOuter	Marsh Loss	Fill In
BQ7.1.10	AlleyOuter	Marsh Loss	Waterward restoration
BQ7.1.11	AlleyOuter	Marsh Loss	Waterward restoration
BQ7.1.14	AlleyOuter	Marsh Loss	Waterward restoration
BQ7.1.15	AlleyOuter	Marsh Loss	Fill In
BQ7.2.5	AlleyInner	Marsh Loss	Waterward restoration
BQ7.2.6	AlleyInner	Marsh Loss	Fill In
BQ7.1.4	AlleyOuter	Target Species	Investigation
BQ7.1.9	AlleyOuter	Target Species	oyster reef protection
BQ7.1.12	AlleyOuter	Target Species	potential horseshoe crab habitat
BQ7.1.17	AlleyOuter	Target Species	oyster reef protection

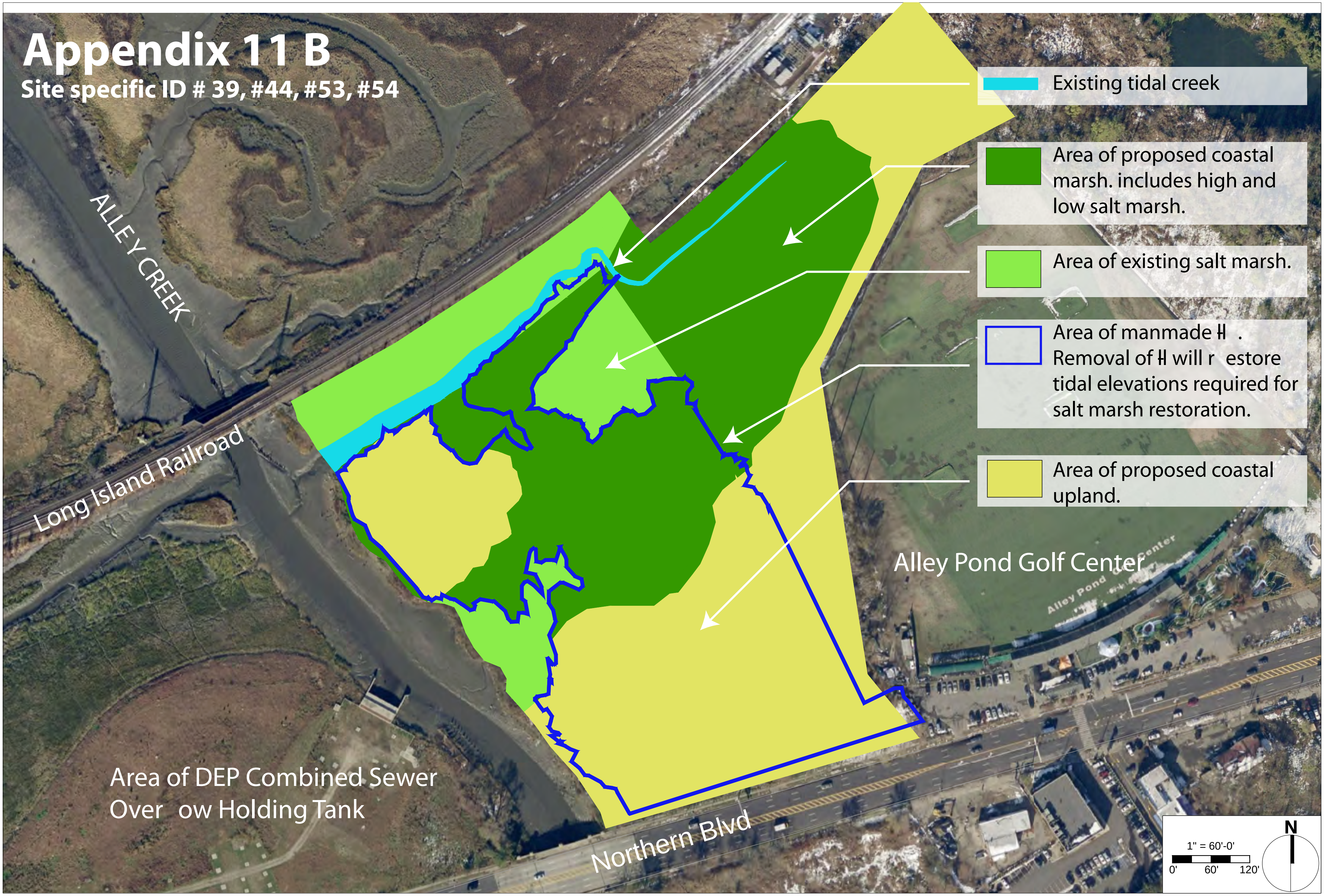
Appendix 11

Salt marsh restoration concepts

Coastal short term & long term recommendations

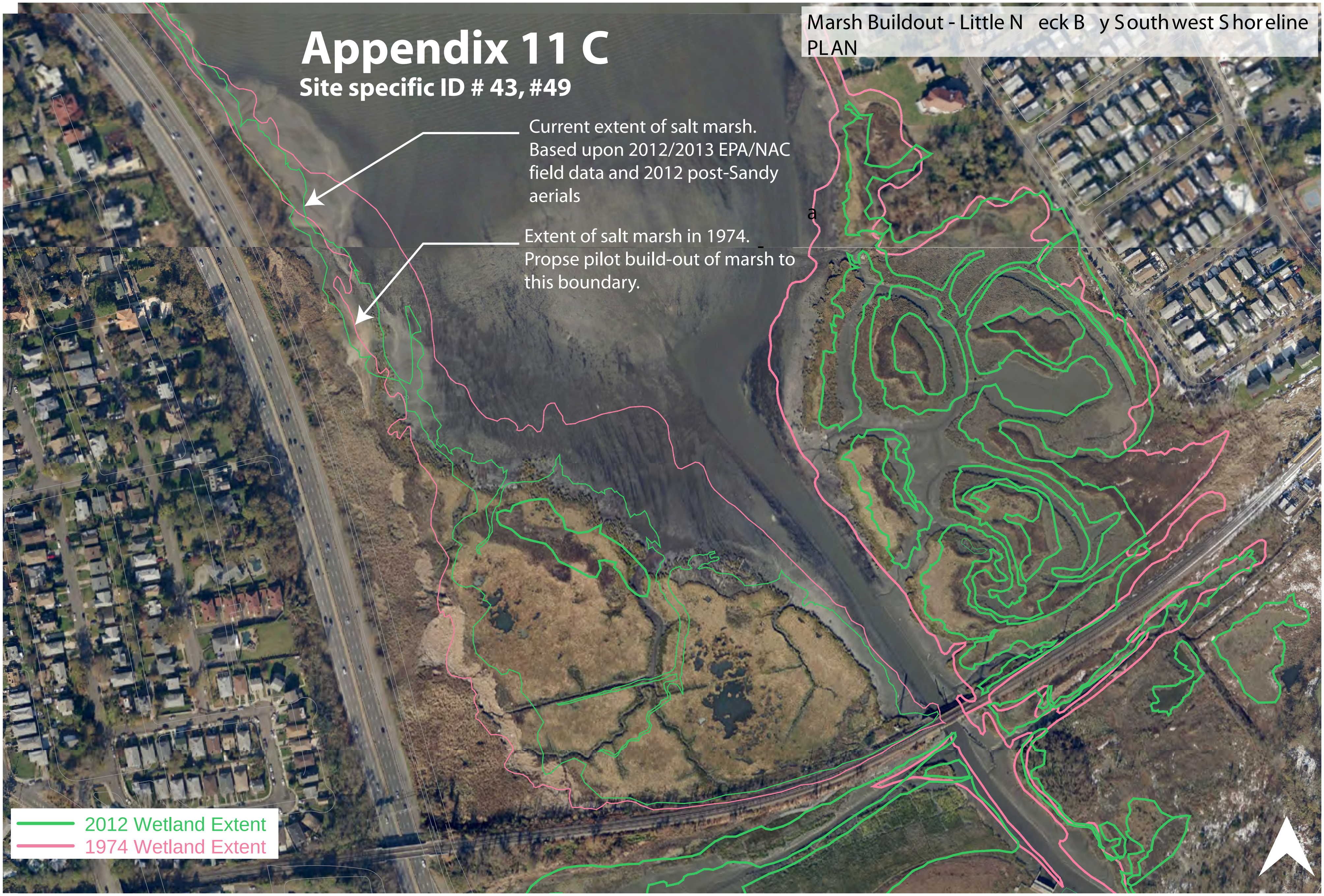
NYC Parks

Appendix 11


Appendix 11 B
Site specific ID # 39, #44, #53, #54
Existing tidal creek
Area of proposed coastal marsh. includes high and low salt marsh.
Area of existing salt marsh.
Area of manmade fill. Removal of fill will restore tidal elevations required for salt marsh restoration.
Area of proposed coastal upland.
ALLEY CREEK
Long Island Railroad
Alley Pond Golf Center
Area of DEP Combined Sewer Overflow Holding Tank
Northern Blvd
1" = 60'-0'
0'
60'
120'
N

Appendix 11 C

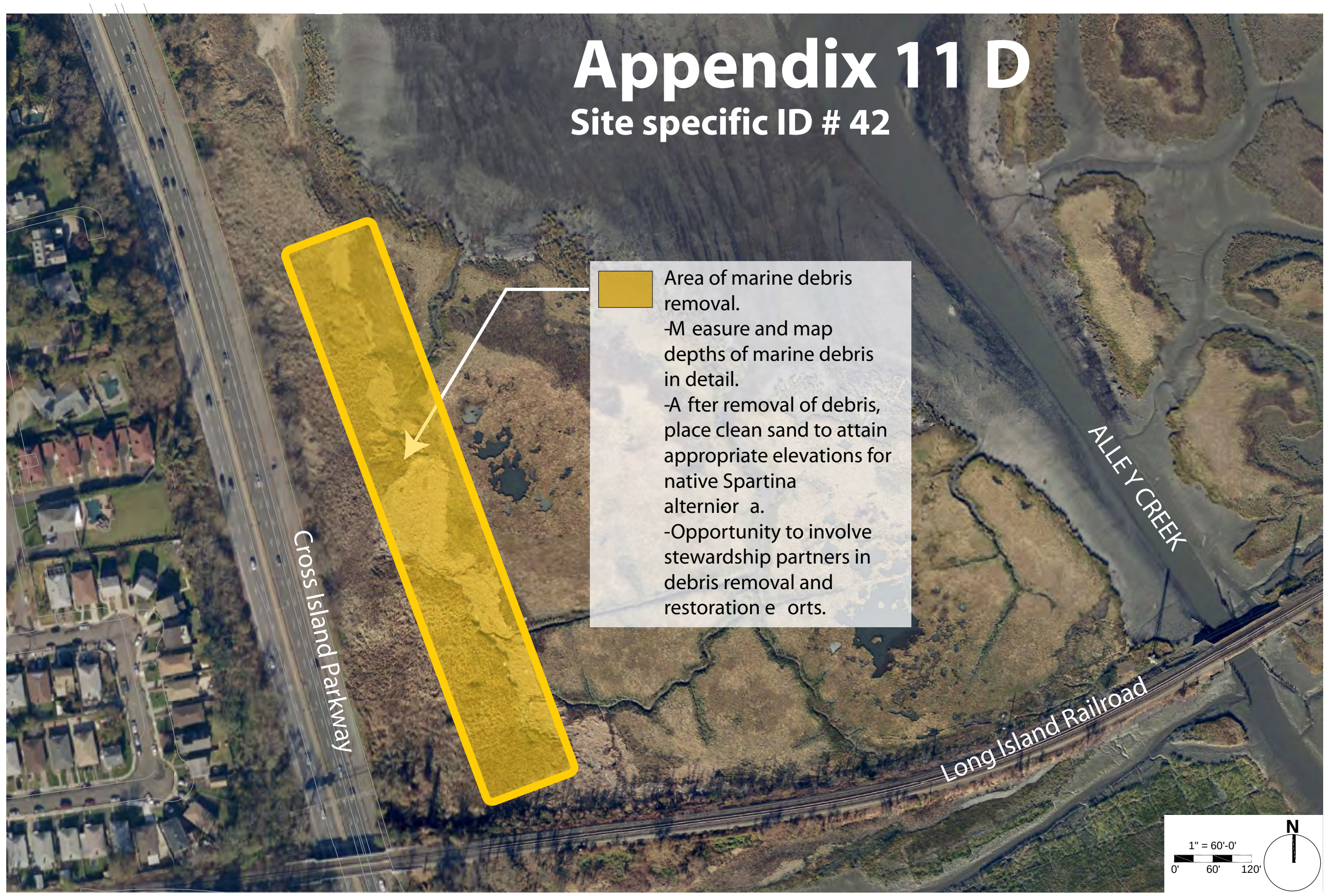
Site specific ID # 43, #49



Appendix 11 D

Site specific ID # 42

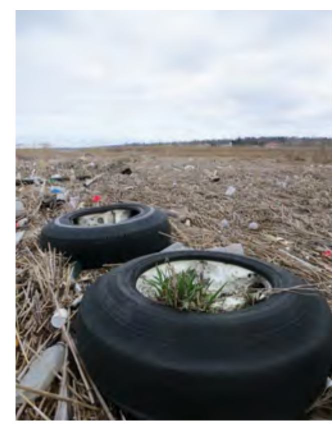
Debris Removal
Alley "outer" marsh



Jetski deposited in Phragmites

Scattered lumber within marsh

Tires and scattered debris



Appendix 12

Alley pond work plan (forest maintenance)

Appendix 12 - Work Plan for Restoration of Degraded Upland Forest Habitats in Alley Pond Park, Queens NY

Michael Morris
Natural Resources Group, NYC Parks
2/28/2014

Goals of Plan
The Overall goal of this plan is help guide future ecological restoration efforts and management of upland forested areas in Alley Pond Park. This Work Plan gives a brief overview of past restoration activities up to date and recommendations for future management and treatment of these sites.

Historical Context
Alley Pond park is the second largest park in Queens at 522 acres in size. The park has diversity in natural areas and habitats ranging from salt marsh, fresh water wetlands, tidal flats, meadows, to mature upland forest canopy. The park sits on a glacial moraine, a mass of sand and rock deposited by glaciers over 15,000 years old. Glacial movement left large boulders on the southern edges of the park and formed deep kettle ponds by leaving large chunks of ice which slowly melted.

The park and area surrounding it has been a hub of cultural and commercial activity for hundreds if not thousands of years. Likely inhabited by indigenous peoples for the past 10-12,000 years this area was a rich hunting ground for marine life, and game, supporting hunter gatherer communities. Some dispute remains but it is widely believed that the park is named for “The Alley”, the glacial valley which Alley Creek runs through and used as a thoroughfare moving east to west from long island to NYC. An 18th century commercial center was situated by the streams and ponds of Alley Creek, where the LIE and Cross Island parkway interchange sits today.

Much of the Park is divided into two major sections, low lying marsh and coastal forest and upland forest canopy. As with many of the larger surviving parks in NYC, Alley Pond has been divided and intersected by a number of busy parkways and streets. This fragmentation not only degrades the quality of park habitats by disrupting natural ecological processes such as water flow and use for animal habitat, but also helps to facilitate the spread and proliferation of invasive plant species which prefer the sunny disturbed areas and soils along these corridors.

History of Restoration Work in Park
Early restoration efforts date back to 1991 with the Urban Forestry Education Program or UFEP. UFEP worked in Alley Pond from 1991-1996. A division of NYC Parks, Natural Resources Group, resumed UFEP’s work in 1998 through the present. In total restoration efforts since 1991 have accounted for by conservative estimates over 60,000 trees being planted in the project areas detailed below. Since 2008, through funding by the MillionTrees NYC program, a crew leader and team were hired to work in Queens parks especially Alley Pond Park to continue restoration work and maintenance of past sites. Since 2002, NRG has worked with high school students from Mineola, NY, planting trees in the spring and fall seasons averaging 2-3000 trees a year. Mineola students have also assisted in important invasive species removals like weed and vine pulling.

Project Area Descriptions

Zone 1 A, B
Springfield Lot and Alley Athletic

Zone 1A is the section with least amount of restoration work, new or old. Recent plantings include 2008 contractor plantings consisting of small containerized and ball and burlap (B&B) trees on forest perimeters. Most of this section has mostly intact canopy with large specimens of beech, oak and tulip throughout but poor regeneration of younger native trees. Past maintenance issues have included illegal dumping and off-terrain vehicles. The two containerized plantings in this area are doing quite well but will need periodic vine sweeps and cut stumping.

Zone 1 B are also two additional container plantings in the lower athletic section of the park. These trees are performing well but are under immediate threat from encroaching Asiatic Bittersweet (celastrus orbiculatus) CEOR, Japanese honeysuckle vine (Lonicera japonica) LOJA
and Multiflora Rose (Rosa multiflora) ROMU

Both of these plantings are adjacent to the motor parkway and on woodland edges making them vulnerable to encroaching vines and invasive seed infestations. Perimeter areas surrounding these plantings could be future understory restoration sites and care should be taken when working around these plantings.

Primary Target Species :
CEOR, LOJA, ROMU,

Work Priorities:
Periodic vine sweeps and cut stumping of invasive plants in and around containerized planting sites at least once a year. Spot spray perimeters of containerized and B&B plantings to stop encroaching ROMU and CEOR and LOJA. Work should be focused on the containerized plantings and not B&B plantings as the container plantings are in wooded edges and have more exposure to invasive seed banks. All B&B plantings are in lawn areas and should be mowed by district staff.

SPRING	SUMMER	FALL	WINTER
Foliar ALPE, LOJA	Foliar ARVU, CEOR, ROMU	Cut Stump CEOR, LOJA, ROMU	Basal ROMU, CEOR, ACPL
Vine sweep CEOR LOJA	Sweep CEOR, LOJA, ROMU		
	Cut Stump CEOR, LOJA , ROMU		

Zone 2
White Poplar Kettle

This zone has a number of older UFEP and early NRG restoration plantings spread throughout from 2002-2004. Most of this zone is understory with one sizable clearing near the Springfield parking lot end which has been brush cut and basal sprayed once to knock back a developing vineland . This zone has numerous desire lines crossing it, and has had issues with damage due to motorized vehicle access and illegal dumping in the past. Care should be taken as there are numerous planted native sugar maple (Acer saccarum) close to invasive Norway Maple (Acer Platanoides), ACPL populations. Also present is a population of American Euonymous (Euonymous americanus) likely planted by UFEP. Small populations of Devils Walking Stick (Aralia spinosa)ARSP and Tree of Heaven (Ailanthus altisima) AIAL were spotted in the bottom of the kettle some in areas which appear to have dumped cinders. There is great variation in the soils found throughout the park, and many invasive plant populations are present in areas used historically for dumping and filling. Also present are Porcelain Berry vine (Ampelopsis brevipedunculata) AMBR, Glossy Buckthorn (Frangula alnus) FRAL, Japanese Stiltgrass (Microstegium vimineum) MIVI and Garlic mustard (Alliaria petiolata) ALPE

Primary Target Species:
Small CEOR vines and seedlings, LOJA, ACPL saplings, ALPE , AMBR, MIVI, ROMU and FRAL

Work Priorities:
Much of the work in this zone focuses on vine sweeps and weeding throughout older UFEP plantations, and suppressing small vines and their seedlings which are abundant. Recommended treatment would be to sweep site in late summer or fall to cut vine drape and weed, and return in winter for a spot spray basal application to various small vinelands. Cut stump and hand weeding will be needed for tightly girdling vines and larger vine and tree specimens. AMBR nodes will need to be cut stump as well. There is not much AMBR present but some has been seen growing on UFEP plantings in the 2002 plantings. Trail edges should be monitored for MIVI populations in early summer as they have been found in the past few years. Consecutive foliar sprays from 2008-2010 have reduced MIVI populations, but it has been returning in past two years.

SPRING	SUMMER	FALL	WINTER
Foliar ALPE, LOJA	Foliar MIVI	Cut Stump CEOR, LOJA, ROMU	Basal ROMU, CEOR, ACPL
Pull FRAL, ACPL , ARSP saplings	Pull FRAL, ACPL, ARSP saplings	Basal ROMU, CEOR, ACPL	Buck up snags on trees
	Cut Stump CEOR LOJA ROMU	Pull FRAL, ACPL , ARSP	

Zone 3
Little Alley Pond

This zone is comprised of both new and old planting sites but mainly those from 2010-2011 with Mineola High school students. The area is made up of a mix of intact canopy with large gaps and clearings. There is a large white pine planting by UFEP, adjacent to Little Alley Pond and the Grand Central Parkway. The area is close to the main facilities of the park, and is heavily used and crossed by numerous paved paths and roads. Vandalism has consistently been an issue in this zone. Fences and signage have been installed at numerous plantings in this zone and desire lines brushed in etc. These measures seem to be helping. There is also a strong steward presence in this zone, with the help of long time and very enthusiastic volunteer, Okja Cho. She is in the park several times a week and communicates issues on sites. This zone is a focus for the 2012 Alley Pond Stewardship program.
Also present in this zone are two plantings from the 2003 and 2004 seasons.
Primary target species:
AMBR, CEOR, LOJA, ROMU, ALPE , MIVI and ARSP.

Work Priorities:
These plantings are growing well but need periodic weeding and vine sweeps. This zone should be swept twice a year at minimum per site. Much of the priority targets are small CEOR and LOJA seedlings which are hard to effectively control with herbicide. Hand weeding is more effective in these areas in order to not cause collateral damage to native species especially young trees. Over time with consistent weeding, these trees can shade out most of the encroaching invasive plants and need less staff maintenance. The 2011 plantings have had the most consistent issues with reoccurring CEOR, and AMBR as there is a heavy seed bank of these species present in the planting site. 2003-2004 plantings should be swept for vines on an annual basis.

ARSP can be found in thick patches between Cloverdale Blvd and the UFEP Pine plantation adjacent to little Alley Pond especially in the kettle depressions. Past treatments of basal spraying with Pathfinder II at 100% in late winter were not very effective. Some hand pulling and cut stump has also been done with better results. These populations of ARSP should be addressed as they grow fast and are in perimeter areas of some plantings. There have also been patches of MIVI throughout this zone, and path edges should be monitored and sprayed in early summer.

SPRING	SUMMER	FALL	WINTER

Foliar ALPE, LOJA	Foliar MIVI	Cut Stump CEOR, AMBR, ROMU	Basal ROMU, CEOR in perimeter
	Cut Stump CEOR, AMBR, ROMU		

Zone 4
Kettle Ponds

This zone includes several older UFEP and early NRG restoration plantings and erosion control work around sensitive kettle ponds. The three kettle ponds included in this zone are Turtle, Lily Pad and Decadon. This zone is a focus site for annual salamander surveying by NRG science staff as a indicator species to monitor ecological heath of the area. Past management issues have included off road bike trails and motorized vehicle access. Early NRG work included installing cedar railings around the ponds, jute mat and coir log installation around pond slopes and shrub and plug plantings to mitigate erosion. This work is identified by the 2002 yellow polygons on the zone 4 map. Included in reforestation plantings in 2004, several American Chestnut (Castenea dentata) trees were planted in this zone. They have now reached around 3-4 inch DBH.

Zone 4 also includes the main infestation site of Mile-a-Minute (Polygonum perfoliattum) POPE vine known in Alley Pond Park. This area is adjacent to the chestnut tree planting and spreads towards the cross island parkway. At this time the area has not been sufficiently surveyed for the 2012 season. Successive weedings and vine sweeps have been done for POPE the past three years in this zone.
Also present in this zone is a small population if Black swallow-wort (Vincetoxicum nigrum) (VINI). This is located at the eastern most edge of Turtle Pond, in a UFEP planting site on an old cinder dump.

Primary target species:
POPE, CEOR, LOJA, ROMU, AMBR, MIVI, ALPE, VINI and AIAL.

Work Priorities:
Much of the maintenance work in this zone is weeding around larger planted trees ranging 2-5 inches DBH. These plantings should be hand weeded/vine swept first to clear vegetation from the trees and then cut stump or spot spray the invasive high stumps. Many of these early NRG/UFEP sites have not had maintenance on them since before 2008 and have large vines and invasive trees repopulating.
Zone IV should be swept for POPE in midsummer annually to make sure it is not spreading throughout the park. Due to the relative small size of this infestation so far, it is a worthwhile priority investment to keep this destructive and fast spreading plant from invading more of the park.
The patch of VINI by turtle pond should also be monitored and treated as necessary.
This zone has had populations of MIVI in past mostly along paths and around turtle pond. Consecutive foliar sprays from 2008-2010 have reduced its presence and the paths should continue to be monitored and sprayed if necessary in early summer.

SPRING	SUMMER	FALL	WINTER
Foliar ALPE, LOJA	Foliar MIVI	Cut Stump CEOR, AMBR,	Basal ROMU, CEOR in

		ROMU	perimeter
	Cut Stump CEOR, AMBR, ROMU		Buck up downed trees
	Weed POPE		

Zone 5
Cross Island Valley

This is one of the areas with the largest number of past UFEP restoration work and plantings mostly planted in 2004-2007. This area was originally focused on by UFEP as it was a concentrated area severely damaged by invasive species and was somewhat accessible from the park's main entry points. This complex has numerous successful examples of planted young forest canopy closing up gaps in mature forest thought there are still numerous issues with invasive plants. Many of the plantings of the past 10-15 years have now reached heights of 30-40 feet and are greatly reducing the amount of light reaching the forest floor. Problem species include thickets of ROMU scattered throughout, and abundance of LOJA and CEOR in more open areas with higher levels of light posing the greatest immediate threat to young saplings. POPE has been found immediately south of turtle pond and in smaller amounts east towards cross isle valley. Abundance of native plants like Rubus spp., physically hamper maintenance efforts as they grow dense and thorny and hamper access to -target species.

Primary target species:
POPE, CEOR, LOJA, ROMU, FRAL, AMBR, MIVI, ALPE and AIAL

Work Priorities
Due to the sensitivity of treatment options in this area, work with volunteers, hand weeding and cut stump application should be prioritized. Much of the work needed involves weeding small saplings and young trees by hand, carefully cutting the girdling vines away hand pulling roots from the base. Use of

herbicide in foliar applications should be done in the spring/ early summer months to minimize collateral damage from drift. Recommended foliar treatments are early summer sprays of a Glyphosate product to reduce populations of ALPE and LOJA before native trees are fully leafed out and susceptible to damage. Cut stump application can be used to treat larger vines like CEOR which leaf out later in the season. Bittersweet is also easy to locate in winter and can be treated effectively in these months. One of the largest concentrations of FRAL in the park can be found throughout this zone.

SPRING	SUMMER	FALL	WINTER
Foliar ALPE, LOJA	Foliar MIVI	Cut Stump CEOR AMBR ROMU, FRAL	Basal ROMU, CEOR in perimeter
	Cut Stump CEOR, AMBR, ROMU,FRAL		Buck up downed trees
	Weed POPE, CEOR, LOJA	Weed CEOR, LOJA	Weed CEOR, LOJA

Zone 6
Bathtub Site

This area has the most intensive concentration of past UFEP plantings and work from 2002-2005. Much of the plantings are well on the way to closing canopy gaps and have already shaded much of the forest floor, inhibiting regeneration of invasive plants. Problem species include thickets of ROMU scattered throughout, and abundance of LOJA and CEOR in more open areas with higher levels of light posing the greatest immediate threat to young saplings. POPE has been found in the northern and westerly portions of this zone, in small sunny clearings. Recent hurricanes from the past 3 years have caused dramatic blow-downs throughout this zone and left many plantings damaged. While these blow-down will facilitate some planted understory trees with ample light to push up to the canopy, it also left many trees damaged and crushed and the site is hard to access and maintain. In some areas the only existing remaining tree canopy are UFEP planted trees which were not crushed.

Primary target species:
POPE, CEOR, LOJA, ROMU, AMBR, MIVI, ALPE, VINI and AIAL

SPRING	SUMMER	FALL	WINTER
Foliar ALPE, LOJA	Foliar MIVI	Cut Stump CEOR AMBR ROMU	Basal ROMU CEOR in perimeter
	Cut Stump CEOR AMBR ROMU		Buck up downed trees
	Weed POPE CEOR LOJA	Weed CEOR LOJA	Weed CEOR LOJA

Work Priorities
Because of the concentrations of plantings in this area, hand weeding , cut stump and work with volunteers should be prioritized. This includes weeding small saplings and young trees by hand, carefully cutting the girdling vines away hand pulling roots from the base. Recommended foliar treatments are early summer sprays to reduce populations of ALPE and LOJA before native trees are fully leafed out and susceptible to damage. Cut stump application can be used to treat larger vines like CEOR which leaf out later in the season. Also present in the zone are small vinelands and rose thickets which can be spot sprayed in winter months with a basal spray application.
Special attention should also be given to POPE in this zone as it has been slowly spreading from its original site by adventure course towards Zone 5 and the Cross Island Valley.
Paths should be monitored in early summer and sprayed as necessary for MIVI.

Appendix of Invasive Primary Target Species throughout all zones including shorthand four letter code:

Norway Maple (Acer Platanoides), ACPL
Sycamore Maple (Acer pseudoplatanus), ACPS

Tree of Heaven (Ailanthus altisima) AIAL
Garlic mustard (Alliaria petiolata) ALPE
Porcelain Berry (Ampelopsis brevipedunculata) AMBR
Mugwort (Artemsia vulgaris) ARVU
Asiatic Bittersweet (celastrus orbiculatus) CEOR
Glossy Buckthorn (Frangula alnus) FRAL
Japanese honeysuckle vine (Lonicera japonica) LOJA
Japanese Stiltgrass (Microstegium vimineum) MIVI
Japanese Knotweed (Polygonum cuspidatum) POCU
Mile a Minute Vine (Polygonum perfoliattum) POPE
Black locust (Robinia psuedoacacia) ROPS
Multiflora Rose (Rosa multiflora) ROMU
Black Swallow-wort (Vincetoxicum nigrum) VINI
Devils Walking Stick (Aralia spinosa)ARSP

Appendix 13

Tree list prescriptions

New York City Species Prescriptions

The NYC species prescriptions are the culmination of years of analysis and tracking of what tree species should be planted throughout New York City. Species prescriptions were collaboratively developed with NYC Parks Urban Forestry staff during 2013. The prescriptions represent annual tree diversity planting rates organized by each of the five boroughs. These percentages represent the annual percentage of a given species, cultivar or variety of tree that will ideally be planted. There are slight variations in each borough due to the differences in infrastructure, current tree populations, and factors that effect tree growth and longevity.

Latin Name	The Bronx Species Prescription	Brooklyn Species Prescription	Manhattan Species Prescription	Queens Species Prescription	Staten Island Species Prescription
Acer campestre 'Evelyn'	0.7%	0.5%	0.0%	0.4%	0.5%
Acer ginnala 'Ruby Slippers'	0.8%	0.0%	0.0%	0.4%	0.0%
Acer griseum	0.3%	0.3%	0.0%	0.4%	0.6%
Acer rubrum 'Red Sunset'	0.8%	0.8%	0.8%	0.8%	0.8%
Acer tataricum 'Flame'	0.5%	0.3%	0.0%	0.2%	0.3%
Acer truncatum 'Norwegian Sunset'	0.5%	0.3%	0.0%	0.2%	0.3%
Aesculus hippocastanum 'Baumanni'	0.0%	0.2%	0.0%	0.4%	0.2%
Aesculus x carnea 'Fort Mcnair'	0.4%	0.3%	0.5%	0.2%	0.2%
Amelanchier canadensis 'Robin Hill'	0.7%	1.7%	0.0%	2.2%	3.0%
Betula nigra 'Duraheat'	0.3%	0.1%	0.0%	0.2%	1.0%
Carpinus betulus	1.0%	0.0%	0.0%	0.0%	0.0%
Carpinus betulus 'Fastigiata'	0.7%	0.5%	1.8%	0.5%	1.3%
Carpinus caroliniana	0.4%	0.4%	0.0%	0.2%	0.4%
Celtis occidentalis 'Magnifica'	4.0%	3.0%	3.0%	2.5%	2.1%
Cercidiphyllum japonicum	1.0%	0.8%	0.7%	0.7%	0.7%
Cercis canadensis	0.0%	0.0%	0.3%	0.0%	0.0%
Cercis canadensis 'Appalachain Red'	1.9%	1.9%	0.0%	2.1%	2.2%
Cercis canadensis var. Alba	0.0%	0.0%	0.0%	0.0%	0.5%
Cercis reniformis 'Oklahoma'	0.5%	0.7%	0.0%	0.6%	0.8%
Chionanthus retusus	0.2%	0.2%	0.2%	0.2%	0.2%
Cladrastis kentukea	0.0%	0.0%	0.0%	0.4%	0.0%
Cladrastis kentukea 'Sweetshade'	0.2%	0.6%	0.0%	0.4%	0.4%
Cornus florida	0.2%	0.0%	0.0%	0.0%	0.0%
Cornus kousa 'Summer Stars'	0.3%	0.6%	0.0%	0.8%	1.1%
Cornus mas 'Spring Sun'	1.0%	0.2%	0.0%	0.8%	1.1%
Corylus colurna	0.8%	0.8%	1.6%	0.8%	0.6%
Cotinus coggygria	0.3%	0.4%	0.0%	0.4%	0.4%
Crataegus crusgalli var. inermis	2.0%	2.0%	0.5%	3.2%	3.6%
Cryptomeria japonica 'Black Dragon'	0.2%	0.2%	1.3%	0.2%	0.2%
Eucommia ulmoides	2.6%	2.9%	3.0%	2.4%	0.9%
Fagus sylvatica 'Asplenifolia'	0.3%	0.3%	0.0%	0.4%	0.4%
Fagus sylvatica 'Dawyckii Purple'	0.2%	0.5%	0.0%	0.4%	0.4%
Ginkgo biloba 'Princeton Sentry'	3.0%	3.9%	5.4%	2.6%	2.5%
Gleditsia triacanthos var. inermis 'Skyline'	4.6%	4.8%	5.3%	3.9%	3.5%
Gymnocladus dioicus 'Espresso'	5.1%	4.9%	5.7%	3.9%	2.4%
Halesia carolina	0.0%	0.8%	0.0%	0.4%	0.6%
Hamemalis 'Helene'	0.0%	0.0%	0.0%	0.4%	0.0%
Koelreuteria paniculata 'Rose Lanterns'	2.8%	3.3%	2.7%	2.9%	3.1%
Lagerstroemia 'Natchez'	1.0%	0.8%	0.0%	0.7%	2.0%
Liquidambar styraciflua 'Cherokee'	2.4%	2.7%	3.3%	2.3%	3.5%
Maackia amurensis 'Starburst'	2.4%	2.7%	2.1%	2.9%	2.6%
Magnolia 'Elizabeth'	0.4%	0.4%	0.2%	0.4%	0.4%
Magnolia 'Moonglow'	0.0%	0.0%	0.0%	0.0%	0.8%
Malus 'Prariefire'	0.7%	0.4%	0.0%	0.7%	1.0%
Metasequoia glyptostroboides	2.4%	2.5%	2.6%	1.9%	3.0%
Nyssa sylvatica 'Red Rage'	0.4%	0.4%	0.0%	0.2%	1.2%
Ostrya virginiana	0.4%	0.4%	0.4%	0.4%	0.6%
Parrotia persica	0.5%	0.5%	0.4%	0.3%	0.5%

Latin Name	The Bronx Species Prescription	Brooklyn Species Prescription	Manhattan Species Prescription	Queens Species Prescription	Staten Island Species Prescription
Platanus x acerifolia 'Bloodgood'	4.3%	2.5%	8.0%	4.0%	4.0%
Prunus cerasifera 'Thundercloud'	0.2%	0.6%	0.5%	0.5%	0.6%
Prunus 'Okame'	0.9%	0.5%	0.0%	0.7%	1.0%
Prunus 'Royal Burgundy'	0.3%	0.0%	0.0%	0.4%	0.5%
Prunus sargentii	0.0%	0.0%	0.0%	1.5%	0.5%
Prunus sargentii 'Columnaris'	0.0%	0.5%	0.0%	0.2%	0.8%
Prunus serrulata 'Kwanzan'	0.5%	1.5%	0.5%	2.0%	2.5%
Prunus 'Snow Goose'	0.5%	0.0%	0.0%	1.0%	1.0%
Prunus subhirtella 'Autumnalis'	0.4%	0.5%	0.0%	1.2%	1.2%
Prunus virginiana 'Canada Red'	0.8%	1.1%	0.7%	1.4%	0.8%
Prunus x yedoensis 'Akebono'	0.8%	0.4%	0.5%	1.1%	0.8%
Pyrus calleryana 'Chanticleer'	0.5%	0.4%	0.7%	0.8%	0.0%
Pyrus calleryana 'Silver Ball'	0.0%	0.0%	0.0%	0.5%	0.5%
Quercus acutissima	2.7%	1.9%	1.6%	1.9%	1.5%
Quercus alba	1.2%	0.8%	0.0%	0.4%	0.8%
Quercus bicolor	2.1%	2.1%	1.4%	1.4%	1.6%
Quercus coccinea	0.5%	0.0%	0.4%	0.0%	0.0%
Quercus dentata	0.6%	0.6%	0.4%	0.4%	0.0%
Quercus imbricaria	0.8%	0.0%	1.1%	0.0%	0.0%
Quercus macrocarpa	1.2%	0.8%	0.4%	0.4%	0.5%
Quercus muhelnbergia	1.4%	0.8%	0.5%	1.0%	0.5%
Quercus palustris	1.6%	2.7%	4.1%	2.1%	3.0%
Quercus phellos	2.4%	1.5%	3.5%	2.8%	2.1%
Quercus prinus	0.0%	0.0%	0.5%	0.0%	0.0%
Quercus robur	1.7%	0.8%	2.1%	1.8%	0.8%
Quercus robur var. Fastigiata	0.2%	0.0%	0.0%	0.0%	0.0%
Quercus rubra	0.5%	0.6%	0.7%	0.8%	0.4%
Quercus shumardii	0.0%	0.0%	0.5%	0.0%	0.0%
Quercus texana	0.5%	0.4%	0.5%	0.0%	0.0%
Quercus velutina	0.0%	0.0%	0.5%	0.0%	0.0%
Stewartia koreana	0.3%	0.4%	0.0%	0.2%	0.6%
Styphnolobium japonicum 'Regent'	1.5%	2.5%	4.5%	1.3%	1.7%
Styrax japonica	0.0%	0.5%	0.0%	0.0%	0.4%
Styrax obbasia	0.0%	0.0%	0.0%	0.0%	0.4%
Syringa 'China Snow'	0.0%	0.0%	0.0%	0.0%	0.8%
Syringa reticulata 'Ivory Silk'	1.9%	2.9%	0.3%	3.1%	3.8%
Taxodium distichum 'Shawnee Brave'	2.7%	3.8%	3.5%	1.0%	3.4%
Tilia americana 'Redmond'	2.1%	2.7%	3.9%	3.9%	2.2%
Tilia cordata 'Glenlevyn'	0.8%	0.4%	0.7%	0.5%	0.4%
Tilia mongolica 'Harvest Gold'	0.4%	0.5%	0.0%	0.0%	0.5%
Tilia tomentosa 'Sterling'	2.5%	2.5%	3.5%	4.5%	2.7%
Tilia x euchlora 'Laurelhurst'	1.6%	2.2%	3.5%	1.9%	1.0%
Ulmus 'Accolade'	1.5%	1.3%	1.5%	1.1%	0.4%
Ulmus parvifolia 'Allee'	0.7%	0.7%	1.0%	0.5%	0.4%
Zelkova serrata 'Green Vase'	6.3%	6.8%	5.6%	6.0%	3.0%
Zelkova serrata 'Mushashino'	1.2%	1.0%	0.9%	0.9%	0.5%
Zelkova serrata 'Wireless'	0.8%	1.1%	0.0%	0.7%	0.8%
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Appendix 14

Green infrastructure protocol

Parkland Stormwater Management Green Infrastructure Opportunity Identification Protocol

The following is a protocol for identifying, screening and prioritizing green infrastructure opportunities on parklands. The protocol has two parts. The first part of the protocol involves identifying opportunities and screening out un-suitable sites. In the second part, the protocol categorizes the opportunities according to number of factors which can be used for prioritization.

The majority of the work NYC has undertaken in implementing green infrastructure has focused on the right of way (ROW). In certain watersheds only limited opportunities to implement GI in the ROW were found. Therefore there has been an interest in identifying opportunities to collect and treat stormwater within Parklands. A protocol, currently being developed by Parks and DEP, assesses specific opportunities for retro-fitting impervious areas following a separate protocol, which was developed specifically for priority watersheds, and relies heavily on in-field site investigations. Where funding can be assumed it is appropriate to invest in resource heavy field investigations.

The protocol presented here is aimed at identifying opportunities within in parklands largely at the desktop as is intended as a rapid method to identify opportunities at the planning level where funding opportunities and implementation pathways may not be clear. This protocol is aimed at identifying where stormwater from surrounding streets can be collected, detained, retained and treated in GI systems.

1. Site Selection and Screening

The first portion of the protocol identify potential sites of treating stormwater generated from parks, and non-park generated impervious area, in parkland open spaces. A canopy gap layer is the base layer which identifies all possible sites (as areas below a canopy are deemed unsuitable for disturbance). Screening removes unsuitable opportunities that are either programmed (conflicting uses such as protected habitats, recent restorations or active recreation such as basketball courts etc..) or some bio-physical ineligibility (such as suitably topography to bring stormwater to the park, if the opportunity is within the tidal zone, or an open water body). Some of these elements are applied automatically in GIS, whereas other screening elements require users to determine eligibility.

Table 1 - Site selection and screening.

	Description	Data layer Inputs	Results
a. Identify sites	Identify potential sites. Assign canopy gaps as unmanaged land with potential for GI intervention. Convert canopy gap polygons to points.	• Canopy gap (LIDAR)	• One point (potential GI) for each canopy gap
b. Automated screening	Remove sites not suitable for GI based that are: • regulatory delineations of protected habitats • ball fields/basketball courts/tennis courts • recent restoration projects • open water bodies (i.e. receiving waters) • within tidal range	• Open water (DOITT), • Programmed land (PLUTO), • Mean High High water level (SLAMM), • Habitat (NWI), • Recent restoration (NRG data)	• Refined opportunity list.
c. Manual screening	• Opportunities draining "direct drainage" sub-watersheds are removed. • One foot contours are manually examined to ensure that impervious area from surrounding streets naturally drains toward identified opportunities within the park.	• One foot contours • direct drainage layer from DEP MS4 maps	• Opportunity list further refined.

2. Site Categorization

Opportunities that remain after the screening process are then categorized based on factors which can be used to prioritize opportunities under different queries (such as lead agency, receiving water body, drainage infrastructure).

Step 2.1. Environmental Benefit Categorization

Opportunities are categorized against "environmental benefit" factors to prioritizing opportunities based on their potential treatment performance. An automated categorization determines those opportunities where the depth to bedrock or groundwater are within 10ft from the surface. These are deemed to have a lower infiltration capacity than opportunities with depths greater than 10 ft. A manual categorization identifies those opportunities that would treat stormwater that would otherwise discharge via outfalls to a stand of phragmites. Since it is assumed stormwater detained in phragmites stands will receive significant water quality treatment, those opportunities are deemed to have a lower environmental benefit.

Table 2.1 - Environmental benefit categorization.

	Description	Data layer Inputs	Results
a. Automated categorization for environmental benefit.	• Opportunities are categorized as a yes/no if site has depth to groundwater or bedrock <10ft because these opportunities are deemed to have a lower infiltration capacity.	• Depth to groundwater • Depth to bedrock	• opportunities categorized for depth to water table and depth to bedrock
b. Manual categorization for environmental benefit.	• If the opportunity is within an MS4 sub-watershed, and the corresponding outfall discharges to a phragmites marsh (not in a stream) then the opportunity is deemed to provide a lower environmental benefit than other opportunities discharging to a receiving water body.	• LIDAR (IA) needs to be manually traced using one foot contours to determine catchment. • phragmites (NRG field maps)	• Impervious area threshold (y/n) • impervious area estimate (SF) • each opportunity categorized by outfall (useful to cross reference against DEP modeling results).

Step 2.2. Feasibility and complexity categorization

This step will assess a number of feasibility criteria which results in opportunities being ranked at levels of feasibility. The protocol first tests for distance to impervious area, those found to be more than 100ft from an impervious area are considered high complexity since it is assumed that significant retrofit or piping will be required to bring the stormwater to the opportunity site. Next all opportunities that are on sites with a slope greater than 5% are also considered high complexity since additional retrofit is required to build treatments in steep areas. The protocol next determines who owns or regulates adjacent land or impervious area and in some instances, treatment area (i.e. where open space is not owned by parks). For the purposes of the Alley Creek watershed plan, any opportunity which requires lead by an agency other than parks is deemed a higher complexity.

Table 2.2 - Feasibility and complexity categorization

	Description	**Data layer Inputs**	**Results**
a. Automated desktop feasibility assessment;	• Proximity to impervious area: The canopy gap polygon for each opportunity is overlaid with a 100ft buffer from an impervious surface layer. Those that overlap are deemed a low complexity. • The DEM is run to classify areas with grades >5% as high complexity. • Categorize by lead agency/stakeholder.	• IA buffer • Opportunities polygons • DEM	• opportunities categorized for complexity

b. Manual desktop feasibility assessment;	• Desktop screening using available drainage maps for all sites to determine if piping or catch basin is required
	  • Access - restricted access from dealing with landowners or working on busy highways.
	  • "online" - if the opportunity is on a mapped drainage line with a natural area catchment with the potential to generate sediment fluxes then the opportunity will be deemed to have a "high complexity"
		• Drainage information (pdfs)
		• One foot contours
		• PLUTO
		• Hydro accumulation flow lines generated from one foot contours.
			• opportunities categorized for complexity

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Step 2.3. Field verification

This step screens and categorizes opportunities at the site level. It results in additional screening based on factors previously assessed at the desktop level (i.e. conflicting uses, formal connection of impervious area). Field verification can also result in some opportunities being categorization as high complexity if it is found that no simple retrofit opportunity exists.

Table 2.3 - Field verification

	Description	Data layer Inputs	Results
a. Field verification tasks	• DCI: Check that intended IA for treatment is connected. • Discharge grade (local scale grade to opportunity from IA • Conflicting use Check for any programming or conflicting use not picked up at desktop level. Community activity etc. • Design complexity	• Field observation • Drainage information/survey data	• Updated categorization for factors from steps 3 & 4, or remove opportunities which are not feasible.

Step 2.4. Management Objective Categorization.

This step results in a categorization of each opportunity under factors which relate to management objectives. The opportunities are first categorized based on receiving water bodies. The receiving water body will determine the GI design objectives . For example, opportunities discharging to streams and wetlands will have a treatment objective for flow frequency, volume and WQ. Whereas, opportunities discharging to open water will only have water quality objectives. As different water bodies have different levels of compliance status, categorizing by receiving water body is helpful in prioritization. The opportunities are then identified by sewer type which is required to determine the GI design objectives, and is an important attribute typically used by the city to link to various funding programs.

Table 2.4 - Management objective categorization

	Description	**Data layer Inputs**	**Results**
a. Receiving waterbody	Each opportunity is categorized by the receiving water body untreated stormwater would otherwise discharge to.	• Water body reference maps • DEP Outfall layer	• Opportunities categorized by receiving water body
b. Sewer type	The sewer type will determine the design objective for the GI and identifies the programmatic context for implementing the opportunity:MS4 vs. CSO vs. priority CSO.	• DEP sewer type/sub watershed maps	• Opportunities categorized by sewer type

Appendix 14

Appendix 15

Green infrastructure protocol - automation study

GIS and Green Infrastructure: Case Study in the Alley Creek Watershed and Sewershed, Queens, New York

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Introduction

In urban settings, stormwater runoff (precipitation flow over streets, parking lots, and roofs) finds its way into waterbodies in two ways: 1) municipal separate sewer systems (MS4s) and 2) combined sewer systems. MS4s collectsewage and stormwater in two separate pipes and only treat sewage before discharging.[1]Combined sewer systems collect and treat both sewage and stormwater into one pipe. Combined sewer overflows (CSOs) occur during periods of heavy rainfall, when runoff exceeds treatment capacity and untreated excess sewage and stormwater are discharged into the nearest receiving waterbody.[2]This untreated stormwater runoff from CSOs and MS4s causes water quality problems. Runoff from impervious surfaces can have a high velocity and entrain pollutants. For example, runoff flowing over roads can pick up oil and grease from cars. Redirecting flow away from sewer and storm drains and treating runoff through green infrastructure (GI) is one way of improving water quality.

Figure 1. Study Area and public lands within

In compliance with New York State's requirements to reduce CSOs, the NYC Department of Environmental Protection (NYCDEP) and the NYC Department of Parks and Recreation (NYCDPR) are building GI across NYC.[3] Efficacy of GI performance can be dependent on various factors, including location. This paper demonstrates how touse spatial analytics, specifically Geographic Information Systems (GIS),to identify GI locations in public lands within the Alley Creek watershed and sewershed (Study Area, see Figure 1) in Queens, New York. Of the various types of GI, NYCDPR is most interested, of the various types of GI, in rain gardens.

Rain gardens catch and detain runoff and allow for infiltration, evapotranspiration, and filtration.[4] Infiltration is the process by which water seeps into the ground – it slows down runoff velocity, diverts runoff away from the drains, and treats runoff through

[1]http://water.epa.gov/polwaste/npdes/stormwater/Municipal-Separate-Storm-Sewer-System-MS4-Main-Page.cfm
[2]http://water.epa.gov/polwaste/npdes/cso/
[3]http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml
[4]http://www.phillywatersheds.org/what_were_doing/green_infrastructure/tools

pollutant removal.[5] Evapotranspiration (ET) is the process by which plant roots uptake water and transpire it through their leaves.[6] ET reduces the runoff flowing into the sewer systems by moving water into the atmosphere. Plant material and soils filter out pollutants in runoff through absorption, microbial degradation, and other processes.[7] Rain gardens are composed of flood-tolerant plants in the center and drought-tolerant plants on the outer edges growing on permeable soils.[8] This ensures infiltration and evapotranspiration in wet and dry seasons. Using plants with a wide range of inundation tolerances also ensures that rain gardens will stay vegetated and functional. Figure 2 shows how stormwater can bediverted and contained in rain gardens.

Figure 2. Rain garden

Placing rain gardens in the appropriate locations maximizes these benefits. This paper uses a two-tier method for choos cal and programmatic. Biophysical variables can include surface type, depth to groundwater, and the presence of bedrock. These variables determine whether locations are physically suitable to rain garden placement. Programmatic variables depend on the regional, management, regulatory, and political context. These can range from design objectives to management priorities. These variables were selected based on fieldwork, collaboration with local and regional stakeholders, and input from the Natural Resources Group (NRG) housed within NYCDPR.

This paper presents a set of GIS methods for identifying and prioritizing locations for rain garden placement within public lands in the Study Area (Figure 1). A customized GIS model was created to show locations that meet both biophysical and programmatic criteria. Locations that meet biophysical criteria are then ranked by priority depending on how many programmatic criteria were met. This research provides NRG and NYCDPR with a tool that can allow for a systematic and clear way to manage stormwater by using GISfor rain garden site selection.

Objectives

The objectives of this work are to:

1. Create an automated approach to selecting optimal rain garden locations for stormwater management within the Study Area; and
2. Understand the limitations of and the extent to which this process can be automated and replicated for use outside the Study Area.

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[5] http://stormwater.pca.state.mn.us/index.php/Overview_for_Infiltration_trench
[6] http://www.phillywatersheds.org/what_were_doing/green_infrastructure/tools
[7] http://www.pca.state.mn.us/index.php/view-document.html?gid=7733
[8] http://cfpub.epa.gov/npstbx/files/MassAudubonRGBrochure.pdf

Methodology

First, all biophysical and programmatic variables are determined. These are described below. Regionally specific variables chosen for the Study Area are described below.

Biophysical Variables:

1. Surface type: All land within the Study Area is not suitable for GI construction. Lands with existing uses cannot be built upon and are excluded from analysis. 'Buildable' lands are all public lands within the Study Area. The following types of land are designated 'non-buildable' and will be removed:
   - Programmed land: lands with existing uses (e.g. buildings, basketball courts, drinking fountains, etc.)
   - Roads
   - Open water
   - Marshland
   - Habitat
   - Canopy
2. Flow from impervious surfaces (IS): Putting rain gardens in locations where there is runoff from IS will reduce CSOs and improve water quality through infiltration and detention storage. For this reason, only locations that receive flow from IS are considered.

Programmatic Variables:

1. Impervious surfaces runoff threshold: Capturing higher volumes of runoff means more stormwater can be treated. Areas that are draining runoff from impervious surfaces larger than 50 square feet will be prioritized.
2. Depth to groundwater: High groundwater tables may result in pooling of water and poor infiltration reducing rain garden effectiveness. New York State's 2010 Stormwater Management Design Manual requires that there be at least a 3-foot separation between the bottom of GI and seasonally high groundwater levels.[9] High groundwater levels can mean poor infiltration and drainage. Within the Study Area, the water table has been increasing since the 1980s thought to be due, in part, to increased flooding around Oakland Lake. For this reason, areas where the groundwater table is higher than 10 feet from the surface are excluded.
3. Proximity to IS: Proximity to IS will reduce the construction work and time required to reroute and divert water from storm and sewer drains to rain gardens. Areas that are within 100 feet of IS will be prioritized.
4. Slope: Steeper slopes increase the work and time required to construct rain gardens. Areas at 5% grade or lower (2.8624 degrees) will be prioritized over steeper areas.
5. Discharge to *Phragmitesmitesaustralis*(phragmites): Phragmites is a common invasive wetland reed that provides water quality improvement treatment.[10] Because runoff discharging to

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[9] New York State Stormwater Management Design Manual (2010), Chapter 5, pp. 5-76 – 5-85. http://www.dec.ny.gov/docs/water_pdf/swdm2010chptr5.pdf

[10] Muelman, A., Beekman, J., & J. Verhoeven (2002). Nutrient Retention and Nutrient-Use Efficiency in *Phragmitesmites Australis* Stands After Wasterwater Application. *Wetlands* (22), 712-721.

phragmites already receives treatment, areas where runoff is not discharging to phragmites will be prioritized.

6. Drainage type: NYC Department of Environmental Protection (NYCDEP) is required under a 2005 Order on Consent to reduce CSOs. In 2011, the CSO Consent Order was modified to include green infrastructure strategies.[11] Thus, CSO drainage areas will be prioritized over MS4 and direct drainage areas.
7. Land ownership: NYCDPR-ownedland will be prioritized over land owned by other government agencies.

Second, using the ModelBuilder tool in ArcGIS, a model was created to select locations in a two-part process. In Part 1, all rain garden locations that meet biophysical variables are identified, i.e. only lands that can be built on. These are referred to as 'buildable' lands while all locations that do not meet biophysical variables are discarded as 'non-buildable' lands. Locations must meet both biophysical variables to be considered 'buildable'. In Part 2, locations identified in Part 1 are ranked into high-, medium-, and low-priority sites. Locations that meet the most number of programmatic criteria are considered high-priority and locations that meet fewer programmatic criteria are ranked lower in priority.

<u>*Model*</u>

Part 1 categorizes all lands into 'buildable' and 'non-buildable'.

Step	Description	Data layer Inputs	Output
1	Identify all buildable parkland ('Build grid') and non-buildable, non-impervious lands('Non-build grid').Convert to raster, if necessary (Use Polygon to Raster tool, set cell size to '1').	• Build grid: Park • Non-build grid: Programmed land, roads, open water, marshland, habitat, and canopy	All inputs converted to raster file format
2	Remove the Non-build grid from the Build grid		
2.1	Give the Non-build grid pixels all values of '0' (Use Reclassify tool).	• Output from Step 1	Non-build grid pixels are given a 'non-build' value of '0'
2.2	Give the Build grid pixels all values of '1' (Use Reclassify tool).	• Output from Step 1	Build grid pixels are given a 'build' value of '1'
3	Determine which remaining Build grid pixels are draining runoff from impervious surfaces (IS)		
3.1	Give IS grid all values of '1' (use Reclassify tool).	• IS grid • DEM grid	IS grid with simulated rainfall of 1 unit on each pixel (IS-rainfall)
3.2	Calculate flow direction on DEM (Use Flow Direction tool). Using the output	• Output from Step 3.1	Grid showing where all the runoff from IS

[11] http://www.dec.ny.gov/chemical/77733.html

	from flow direction and weighting the IS-rainfall grid, calculate flow accumulation (Use Flow Accumulation tool).		drains (IS flow acc)
3.3	Multiply the Build grid pixels with the IS flow acc (Use Raster Calculator).	• Output from Step 2.2 • Output from Step 3.2	Grid showing how much IS runoff flows to Build grid pixels
4	Add the Build and Non-build grids together (Use Cell Statistics tool with minimum function).	• Output from Step 2 to 3	One grid showing all the pixels that can and cannot be built on

PART 1 OUTPUT: A grid showing all pixels that meet the biophysical variables (Figure 3).

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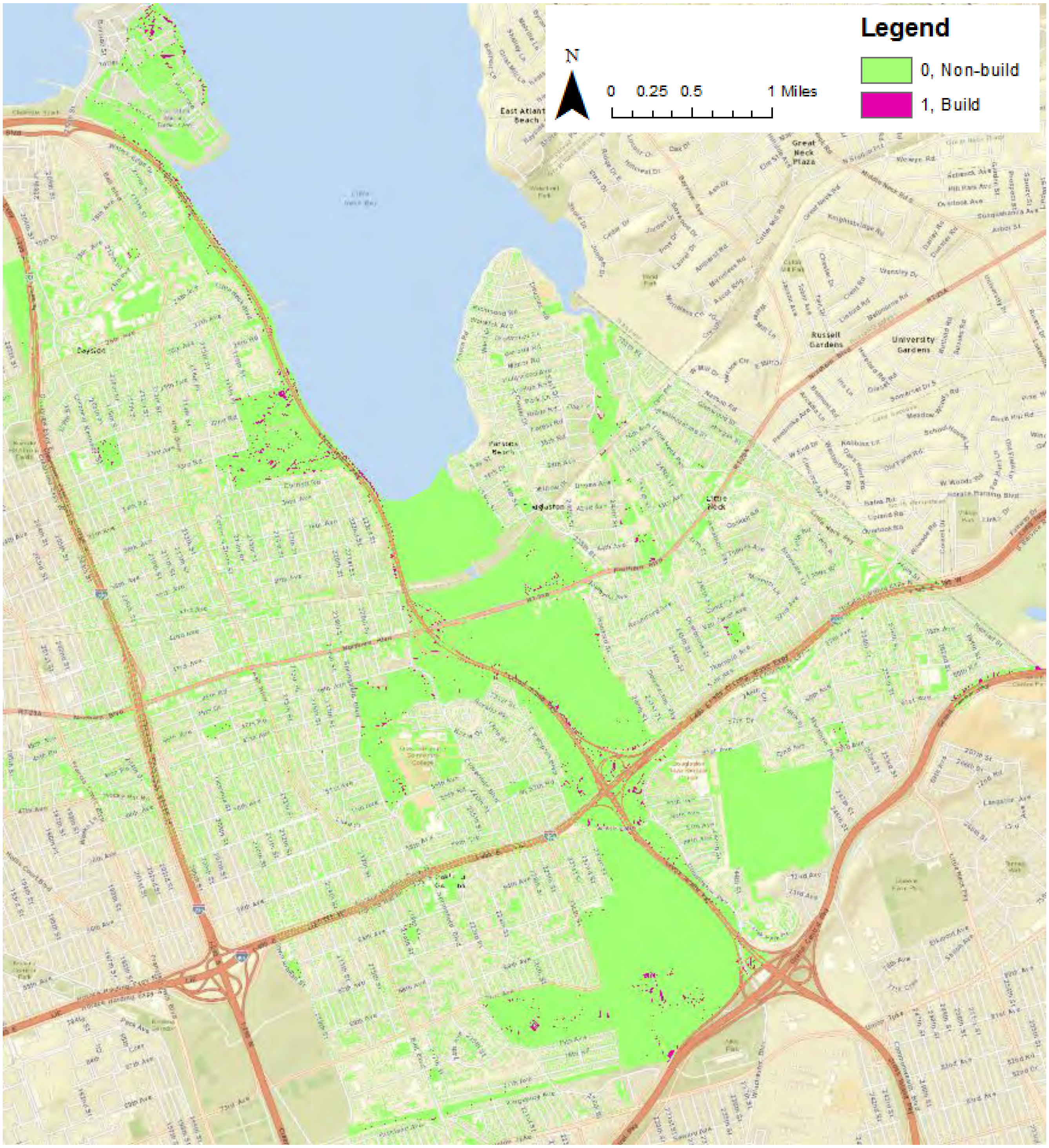

Figure 3. Map showing results of running model Part 1

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Part 2 ranks all 'buildable' lands into 'high-, medium-, and low-priority' sites depending on the number of programmatic criteria met.

Step	Description	Data layer Inputs	Output
5	Determine priority based on programmatic criteria. Convert all files to raster, if necessary (Use Polygon to Raster tool, set cell size to '1').	N/A	All inputs converted to raster file format
5.1	Take output from Step 3.3 (Build grid with runoff values from IS). Give all pixels with a value of 50 or more a value of '2' and all others a value of '1' (Use Reclassify tool).	• Output from Step 3.3	Areas that drain runoff from IS larger than 50 square feet are given priority
5.2	Find distances of Build grid pixels from IS (Use Buffer tool). Give all pixels that are within 100 feet away from IS a value of '2' and all others a value of '1' (Use Reclassify tool).	• Output from Step 2.2	All pixels within a 100 feet of impervious surfaces are given priority
5.3	Calculate slope using the DEM (Use Slope tool set to degrees). Give all pixels with a slope of 2.8642 degrees (5% grade) or less a value of '2' and all others a value of '1' (Use Reclassify tool).	• Output from Step 1	All pixels with a slope of 5% grade or less are given priority
5.4	Give all non-phragmites pixels a value of '2' and all others a value of '1' (Use Reclassify tool).	• DEM	All pixels that do not flow to phragmites are given priority
5.5	Give all CSO pixels a value of '2' and all MS4 pixels a value of '1' (Use Reclassify tool).	• CSO grid • MS4 grid	All CSO pixels are given priority
5.6	Give all NYCDPR-owned pixels a value of '2' and all other state-owned pixels a value of '1' (Use Reclassify tool).	• Park owned grid • Non-park owned grid	All NYCDPR-owned pixels are given priority
5.7	Give all pixels with groundwater depth at 10 feet or below a value of '2' and all others a value of '1' (Use Reclassify tool).	• GW grid	All pixels where GW is deeper than 10 feet are given priority
6	Add all prioritization grids together (Use Cell Statistics with sum function).	• Output from Step 5.1 through 5.7	Grid showing prioritization scores of each pixel, ranging from 14 to 1.
7	Multiply Build grid with the sum of all the prioritization grids (Use Raster Calculator).	• Output from Step 2.2 • Output from Step 6	Final output

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PART 2 OUTPUT: A grid where all pixels that can be built on are ranked by how many programmatic criteria are met (Figure 4).

Results

Selected sites were divided into short-term and long-term possibilities. Results are shown in the map below; running the model yielded the following high-priority, medium-priority, and low-priority sites (Figure 4). Rain garden construction in high-priority sites will happen over the short-term (1-2 years) and over the long-term (3-5 years) for medium- and low-priority sites.

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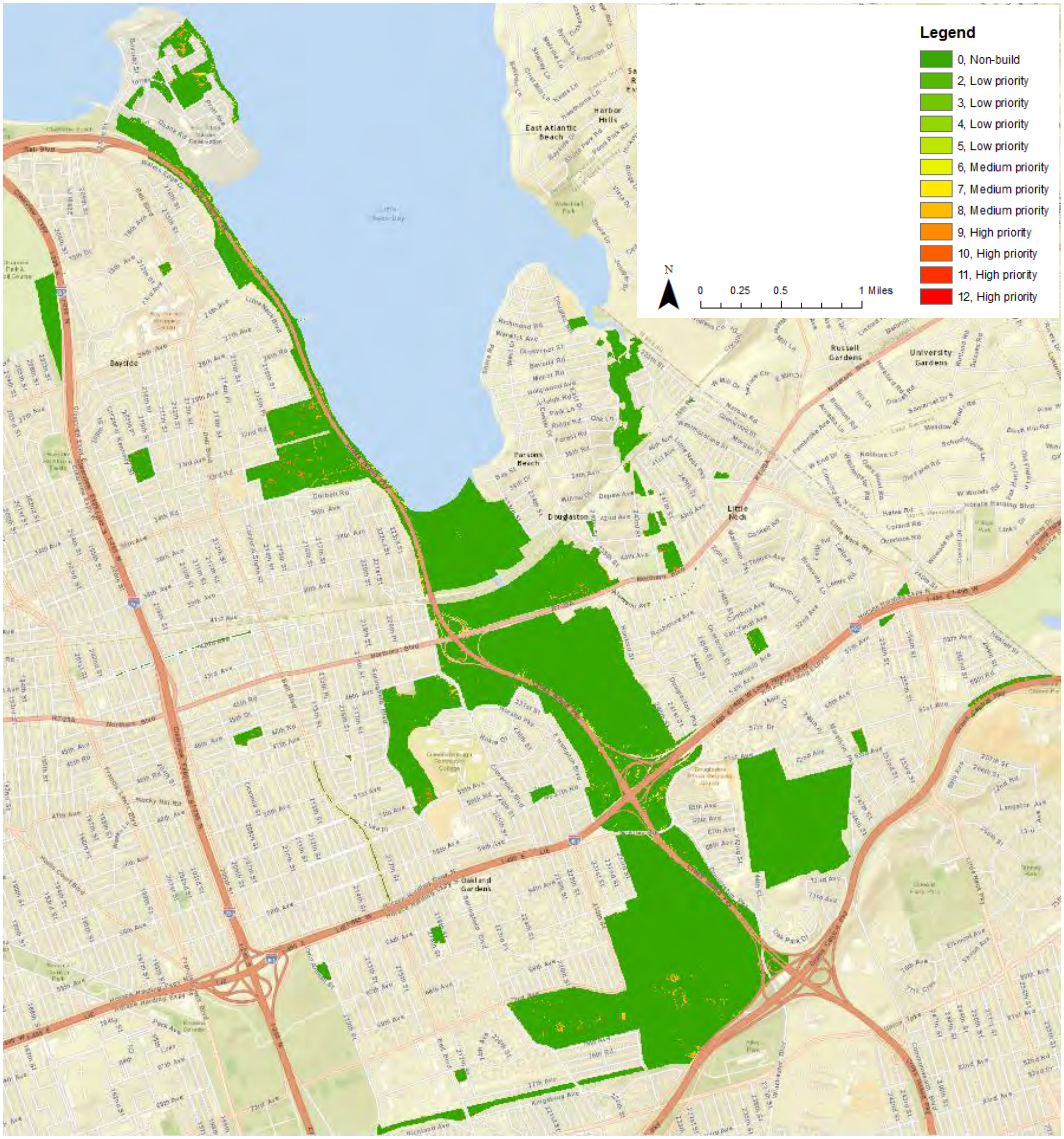

Figure 4. Map showing the final output

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Figure 5. Zoomed-in view of model results showing medium to high-priority sites at John Golden and Crocheron Park

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Figure 6. Zoomed-in view of model results showing medium to high-priority sites at Kennedy Playground.

Figures 5 and 6 show a zoomed-in view of the selected model results and overlaid them on Google Earth imagery. In Kennedy Playground (Figure 6), the red areas – which indicate high priority sites – are along the streets. Placing rain gardens here would capture runoff flowing from these streets making these locations ideal. Similarly, in Figure 5, the red areas are next to the parking lot and tennis courts and streets surrounding the park. Rain gardens in these areas will capture runoff from these impervious surfaces.

Discussion

Model ReproducibilityOutside the Study Area

One of the objectives of this research is to see how a city might automatethe selection of optimal rain garden locations. For the Study Area, this model is entirely automated, except for selecting the current model inputs (See Appendix for more detail about data preparation). Once the user has selected the appropriate inputs and runs the tool, the model will produce a map,identifying high-priority, medium-priority, and low-priority sites.

Another objective is to see how the model could operatebeyond the Study Area, including the rest of New York City. Because biophysical and programmatic variables can change from region to region, the model will require some manual desktop work from the user to change the inputs accordingly. The advantage of creating a model is that additional inputs and steps to analyze them can easily be added and removed, as necessary, to make it specific to the region in question. For example, soils play a significant role in determining infiltration (e.g. clay soils are less permeable than loam soils). Soils were not considered as a biophysical variable in this protocol because of insufficient data.Once this data becomes available, soil should be considered a prioritization variable. With this model, soils can be added as a prioritization variable into Part 2 of the model – lands with loamy soils will have higher priority than lands with clay soils. Existing model variables that do not apply to the region of interest can also be easily taken out. If the user wants to treat MS4 and CSO drainage areas similarly, those inputs and associated functions can be deleted without affecting the rest of the model. Or the user may decide to prioritize MS4 drainage areas over CSOs. This will require manual work to update the prioritization numbering scheme outlined in the protocol.

Building a model allows locating optimal rain garden locations to be automated within the Study Area and achieves Objective 1. As variables to select rain garden locations may change from region to region, some user input will be required to adjust the model accordingly. Despite the need for additional input, the ability to operate the model outside the Study Area achieves Objective 2.

<u>*Limitations*</u>

There were several significant omissions within this research. First, the model does not consider repurposing lands that may serveas ideal potential rain garden locations. For example, a basketball court at the edge of a park may have proved to be the best site for a rain garden and could have been retrofitted. By removing all such “programmed” land, this protocol overlooks the potential that any of these lands can be retrofitted for stormwater management. A finer-scale analysis that creates subcategories of programmed land into surfaces that can and cannot be retrofitted can increase the land that is available for GI.

Second, the model does not consider soils as a site selection variable because the soil profile dataset did not provide enough information to meaningfully categorize the Study Area by infiltration capacity. The model should be updated to include soil as a selection variable once the data becomes available.

Third, the IS layer is incomplete and does not include all IS within the Study Area. The source data is the 2010

Figure 7. LiDAR data overlaid over Google Earth imagery

Light Detection and Ranging (LiDAR) data showing landcover. Figure 5 shows that IS within the LiDAR dataset (in red), when overlaid with a basemap from Google Earth, does not cover the entire extent of the existing IS, particularly roads.

Step 3 of the protocol calculates whether any buildable areas drain runoff from IS. Not having all the existing IS included in the LiDAR dataset means that not all IS flow is accounted for. Because the purpose of this modelis to understand where GI should be placed to treat runoff from impervious area, having a dataset that includes all impervious surfaces is crucial. As Figure 7 shows, there are more impervious surfaces within the Study Area than were used for the runoff analysis. Using a complete dataset would have resulted in identifying more sites that received runoff from IS and, thus, making them eligible for building rain gardens.

Fourth, the model always assumes some amount of water treatment from phragmites. However, the actual amount of water quality improvement is likely dependent on several factors: detention duration, location, time of year, local hydrological conditions, and species-species interactions. Thus, the assumption made in this paper is site-specific to the Study Area. To use the model outside the Study Area, users must decide if the assumption that phragmites provides water quality treatment is applicable to their location. Users will have to decide whether to include phragmites either as a programmatic variable or to leave it out of the model entirely.

Fifth, social variables such as community willingness, public awareness, etc. are not included. These factors are harder to evaluate, but not impossible– for example, if a majority of survey respondents answered positively about community willingness, this could be added to the model. However, this type of social data can be much more complicated and nuanced than biophysical data and may not lend itself to a model-type analysis. The user must determine whether the inclusion of social data in the model will provide useful and meaningful results.

Sixth, the model cannot account for how much infrastructure retrofit or new construction would be needed to redirect impervious surface flow to the identified rain garden locations. This analysis would have to be done for each individual location manually. To identify infrastructure needs, a second-tier analysis of supplemental fieldwork and assessments at model-selected sites would be necessary.

Finally, the model does not indicate which variables were and were not met. For the Part 1 output, the model cannot distinguish between whether a pixel was non-build because of conflicting land uses or because it did not receive IS flow. Similarly for the Part 2 output, the model cannot identify whether a pixel is low priority because it had high slope or because it had phragmites.

This model presents a 'first-tier' analysis in choosing rain garden sites. Although there are limitations this approach and all identified locations should be subject to further analysis through fieldwork, using the model approach significantly decreases manual user input.

Role of Field Assessments

Field assessments should still be an essential part of choosing sites. Visual inspections should be used to confirm model results. For example, one field visit revealed that a flower garden with a rock border had been constructed at the edge of the park. The gentleman that had built the garden was present and spoke about his love of the park, his desire to take care of it, the need for stormwater management in the area, and supported the idea of rain gardens. Another field visit to [specific site] revealed that nearby residents had set up a memorial to a solider. These observations would never be picked up by the model but present valuable and supplemental information in choosing sites. In the first example, there is a contact that can be tapped into for rain garden maintenance. Interviews can be conducted at the second site with neighbors to see if they would be amenable to constructing a rain garden in their place of their existing memorial.

Of course, on-the-ground conditions can change all the time, but data layers do not. Because data layers used for the model represent a snapshot in time, fieldwork is essential to corroborate the accuracy model results.

Beyond Rain Gardens

Currently, model results only show the best locations for rain gardens. Over time, NYCDPR may want to implement other GI strategies within or outside of the Study Area. Riparian buffers, vegetated swales, and tree pits have similar requirements as rain gardens. For example, the New York State Stormwater Management Design Manual recommends that riparian buffers be built on areas with slopes less than 6% and vegetated swales be built on locations with a slope between 0.5 to 4% grade. The methodology presented in this paper uses a slope constraint of 5% grade. Thus, with slight adjustments, the model can be used to identify optimal locations for riparian buffers, vegetated swales, and tree pits.

Other GI strategies such as green roofs and downspout disconnections have different feasibility requirements. The variables for identifying locations will have to be adjusted accordingly. The user must decide if these changes to the current model will still result in suitable locations or if a different model should be created.

Additional Considerations

The current model and the results reflect the programmatic criteria that NYCDPR has for building rain gardens within the Study Area. Criteria are balanced between those that focus solely on providing the maximum amount of stormwater treatment with those that do not. For example, the criterion of‘impervious surfaces threshold’ is only concerned with stormwater management objectives. But, the criterion of ‘slope’ is not – the focus here is on reducing construction work and time. There may be areas that have steeper slopes that can treat larger volumes of stormwater that are being pushed down in priority because of the‘slope’ programmatic criterion. Similarly, lands that are owned by other government agencies such as the Department of Transportation (DOT) are moved down in priority because of the additional work and time required for inter-agency collaboration even though there may be some low-priority DOT lands that can treat larger volumes of stormwater than some other high-priority NYCDPR owned lands.

Where you want to place rain gardens may change depending on the purpose of the protocol. Programmatic criteria may change from region to region. They can change over time as well, including within NYCDPR. The following examples show how the protocol can be adjusted and changed to reflect different purposes:

1. Stormwater management objectives

   Although the current programmatic criteria reflect an optimal and realistic priority ranking of rain garden sites within the Study Area, these are not necessarily the sites that treat the largest volumes of stormwater. The model and protocol created for this research can be adjusted so that the results show all areas where stormwater can be treated, regardless of whether the slope is too steep or the land is owned by DOT, etc. This adjustment would require for Part 2 of the protocol, the prioritization part, to be eliminated. By simply running Part 1 of the protocol, the model results will show all areas where rain gardens can be physically placed that are also draining runoff from impervious surfaces. The results could be ranked by areas that are draining the largest to smallest amount of IS runoff; areas that are draining the largest volume of runoff could be considered 'high priority'.

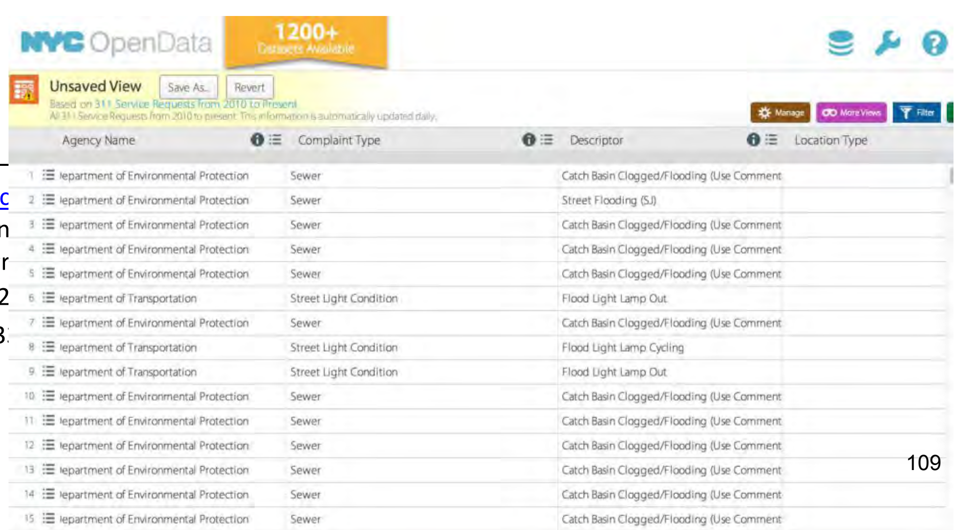
2. Environmental co-benefit objectives

   The protocol can also be used to maximize environmental co-benefits. Programmatic criteria can be based on placing GI in areas with high visibility to increase environmental education, reducing air pollution, and alleviating the urban heat island effect. Any binary variable – e.g. slope is either steeper than 5% grade or it is not – can be used within Part 2 of the protocol. For example, in a response to alleviate the urban heat island effect – areas that have average temperatures higher than a certain degree can be considered prioritized locations for placing GI. Similarly, to increase environmental education, areas in close proximity to schools can be prioritized for placing GI.This methodology will select sites that provide both stormwater management and associated co-benefits.

3. Environmental justice objectives

   The current protocol does not look at any variables that result in environmental justice. Cleveland, Ohio is under a similar Consent Order from the EPA to reduce CSOs. In fulfilling this, Cleveland is placing green infrastructure in low-income neighborhoods.[12] Research shows that street trees[13] and greenery[14] can reduce crime rates. Programmatic variables that are looking at demographics, income, and other socio-economic metrics can be designed. Selected sites through this methodology will provide stormwater management in an equitable manner.

4. Additional NYC data



	Agency Name	Complaint Type	Descriptor	Location Type
1	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
2	lepartment of Environmental Protection	Sewer	Street Flooding (SJ)	
3	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
4	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
5	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
6	lepartment of Transportation	Street Light Condition	Flood Light Lamp Out	
7	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
8	lepartment of Transportation	Street Light Condition	Flood Light Lamp Cycling	
9	lepartment of Transportation	Street Light Condition	Flood Light Lamp Out	
10	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
11	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
12	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
13	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
14	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	
15	lepartment of Environmental Protection	Sewer	Catch Basin Clogged/Flooding (Use Comment	

[12] http://www.epa.gov/scienc
[13] Troy, A., Grove, J.M., & O'n
urban-rural gradient in the gr
[14] Kuo, F.E. & Sullivan, W.C. (2
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Additional NYC data can be incorporated into the model. Calls made to 311, NYC's main source of government information and non-emergency services, are coded and recorded.

This data is available online[15]and can be downloaded for analysis. Two categories for coding calls are 'street flooding' and 'catch basin clogged/flooding' (Figure 8). Addresses and location coordinates are recorded and, therefore, can be mapped. This can be used as a data layer/input into model as a prioritization factor, i.e. locations with known incidences of street flooding can be given higher priority over locations that do not have such incidences.

Communication across agencies must be improved. A field visit to a site at 34th Avenue and Brookside Street revealed that the NYC Department of Transportation (NYCDOT) was putting in a new water main and replacing the sidewalk. Knowing which sites are slated for construction would be helpful because NYCDPR can capitalize on this to try and include GI in the already-occurring construction.

Figure 8. 311 calls, logged and coded

Conclusion

This paper demonstrates that GIS can be used to automate the process of locating optimal sites for rain gardens within the Study Area. This process can also be automated, to an extent, for areas outside the Study Area. Using GIS can significantly reduce the time, effort, and manual input required for siting rain garden locations. However, users must keep in mind that the model is only the first step in analysis. Fieldwork is still essential in validating model results and for gaining additional valuable information that cannot be displayed by the model.

[15]https://nycopendata.socrata.com/data

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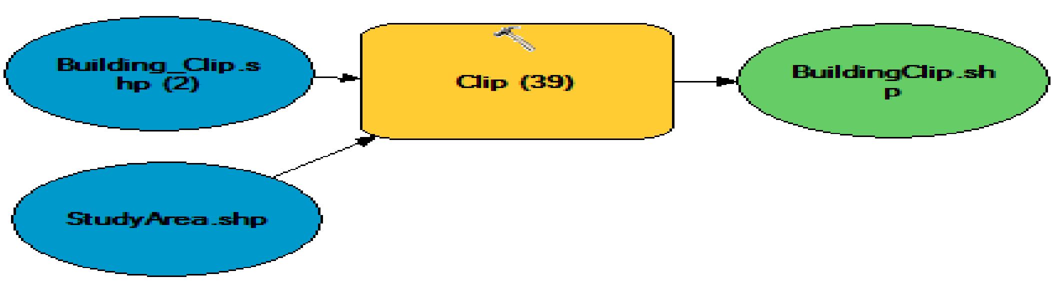
Appendix

All data used in the model was provided by NYCDPR. Running the model will not result in any variations in the map regardless of who is running it. Each input in the model has been parameterized. Setting inputs as parameters means that users will be asked to upload input files before the model will run. A detailed description of how data layers were analyzed and how the model was created is described below. Each input in the model has been parameterized. Setting inputs as parameters means that users will be prompted to upload input files before the model will run.

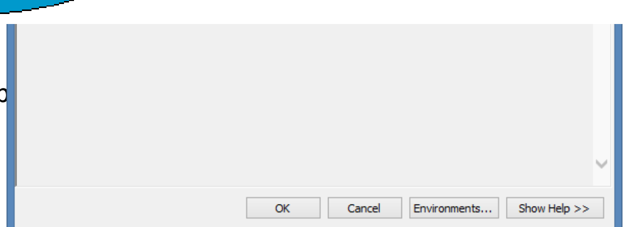
PART 1

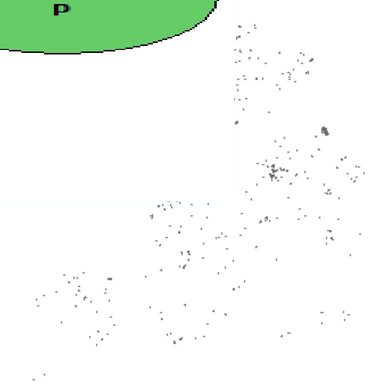
Step 1: Data was provided for the whole of NYC. Data layers were clipped to the region of interest, public lands within Study Area. Because impervious surfaces exist outside of public lands, these were clipped to the extent of the entire Study Area. Figure A1 shows an example where the buildings layer for all for NYC was clipped to include buildings only within public lands in the Study Area (shown in red on image on the right).

a. Use 'Clip' tool. Set file to be clipped as the 'Input feature' and the file that will be used to clip (i.e. extent of interested region) as the 'Clip feature'.



App





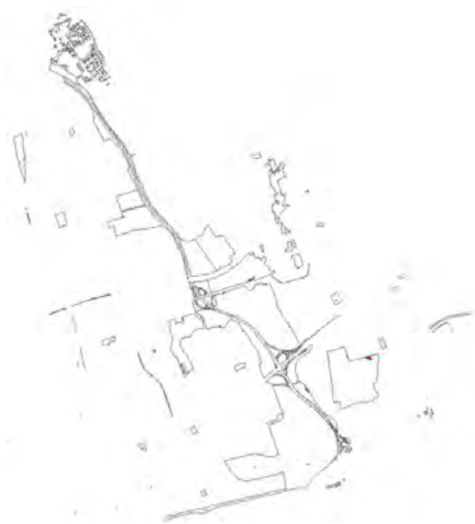


Figure A1. Building Clip

Step 2: Programmed land data was in the three different file types – points, lines, and polygons. For ease of work, data was combined into one file. Point and line files were converted to polygons. The following line features were merged together into one file and then buffered: 1) bicycle paths; and 2) paths. The following point features were merged together and then buffered: 1) access points; 2) AMPS centroids; 3) chess tables; 4) drinking fountains; 5) eateries; 6) fire hydrants; 7) flagpoles; 8) kayak canoe launches; 9) monuments; 10) paddleboat rentals; 11) park tree priorities; 12) spray showers; 13) waste receptacles; and 14) Wi-Fi hotspots. Figure A2 shows an example.

a. Use ‘Merge’ tool to combine files of the same file types.
b. Use ‘Buffer’ tool to draw 5-foot buffers around point and line features.

Appendix 15

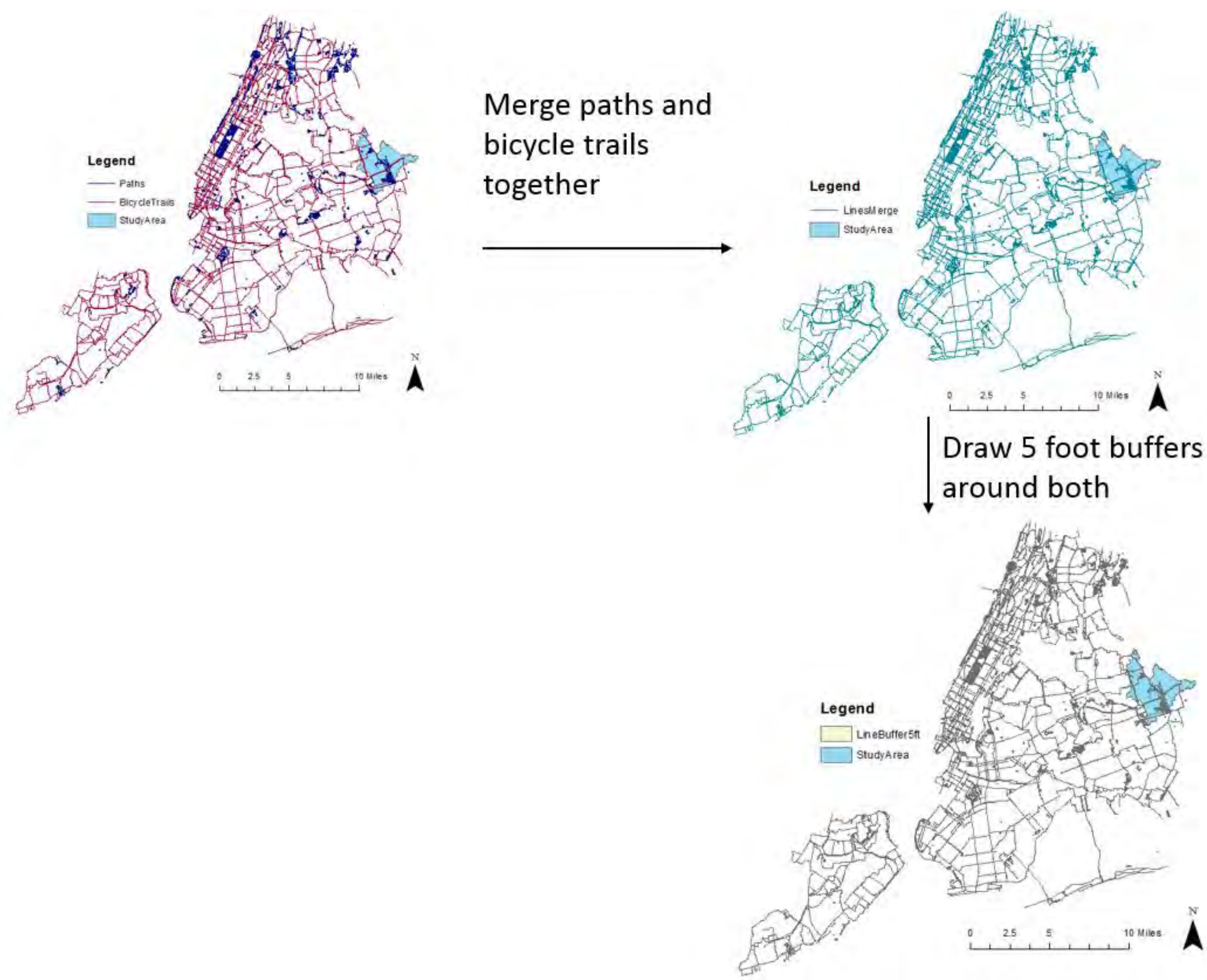


Figure A2. Combining different file types together

Step 3: Convert all files from vector to raster format.

a. Use ‘Polygon to Raster’ tool. Set cell size to 1 foot.

Appendix 15

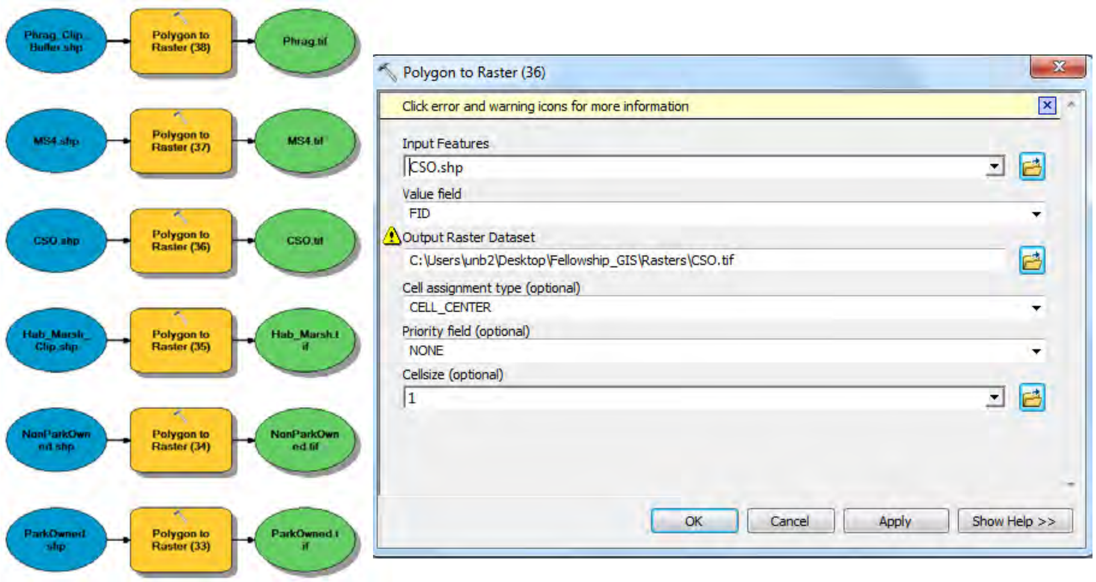


Figure A3. Converting all files from vector raster format

Step 4: Categorize all 'non-build' lands. 'Non-build' pixel are: programmed land; roads; open water; marshland, habitat, and canopy.

a. Use 'Reclassify' tool to give all 'non-build' pixels a value of '0'.

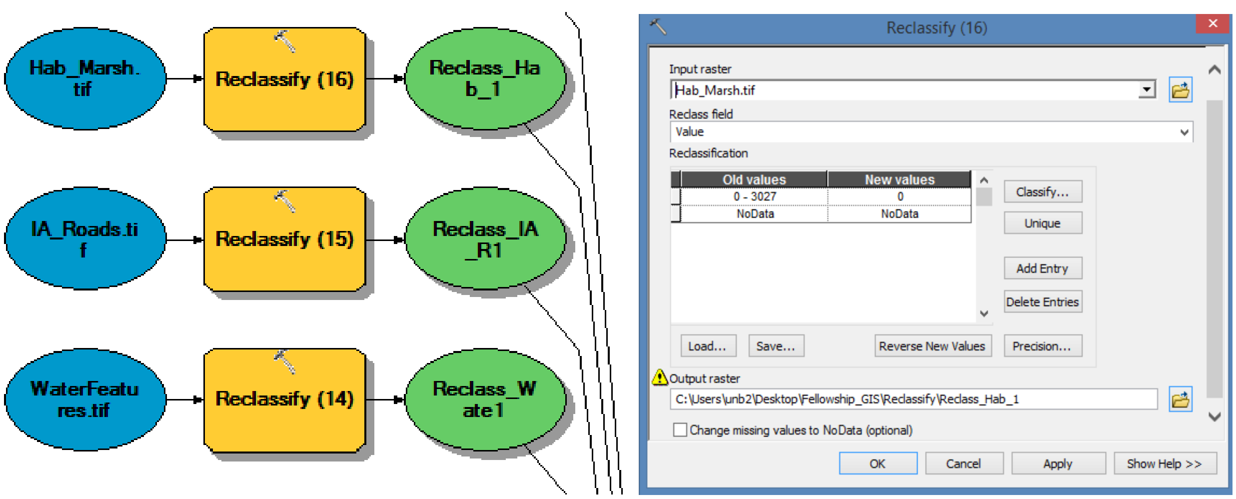


Figure A4. Categorizing all 'non-build' pixels

Step 5: Determine if any flow from impervious surfaces is flowing to the 'build' pixels. Since the goal of the model is stormwater management, only pixels that receive stormwater flow are identified. To isolate stormwater that is only flowing from impervious surfaces, the following steps were taken.

a. Use ‘Flow Direction’ tool using the DEM layer* as the input. This will identify in what direction stormwater that lands on each pixel will flow.
b. Use ‘Reclassify’ tool to give all impervious surfaces a value of ‘1’. The value indicates that one drop of rainfall falls onto every pixel.
c. Use ‘Flow Accumulation’ tool. Use the input from Step 6a for the ‘Input flow direction raster’ input. Use input from Step 6b for the ‘Input weight raster’ – weighting the impervious surface layer will isolate flow from only those surfaces. The will output a layer (IS flow acc) that shows were all flow from impervious surfaces accumulates.
d. Use ‘Raster Calculator’ tool to multiply the ‘Build’ grid with the IS flow acc layer. Pixel values indicate how many other pixels the stormwater has flown over, i.e. pixels that are located upstream. This means pixels located at the tops of hills will have low values and pixels located in valleys will have high values.

   Note: The DEM layer provided has a cell size of 1 foot. At this small scale, all bumps and ridges and contours of the surface are captured. Although such fine resolution is usually desired, the DEM layer did not prove useful for flow accumulation analysis. Flow accumulation was calculated using the 1-foot DEM and projected in ArcScene – an ArcGIS extension that allows for 3-D viewing (Figure A5). The valley running through the center of the image is Alley Creek, where all the flow accumulates. As can be seen in Figure A5, this is not the case. This is because as flow hits a bump, it stops. Because every single bump and ridge is captured, flow stops in ways that’s inconsistent with what may be happening on the ground; in reality, a . To understand if this phenomenon was indeed occurring, the DEM was ‘smoothed out’ using ‘Focal Statistics’ tool with the ‘average’ function. This tool looks at a pixel’s user-specified number of neighbors, calculates the average, and reassigns the pixel value to be the average. This averaging process will smooth out the bumps.
   ‘Focal Statistics’ was run on the DEM, with 15 neighbors – each pixel is reassigned the mean value of the 15 neighboring pixels. Figure A6 shows flow accumulation run using this DEM and projected in ArcScene. Flow travels farther towards Alley Creek than it does in Figure A5.

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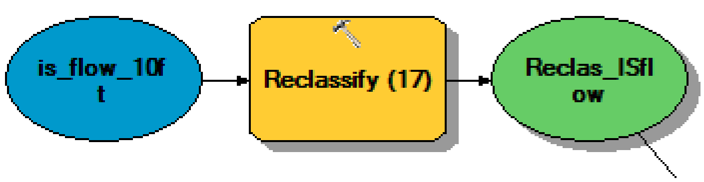
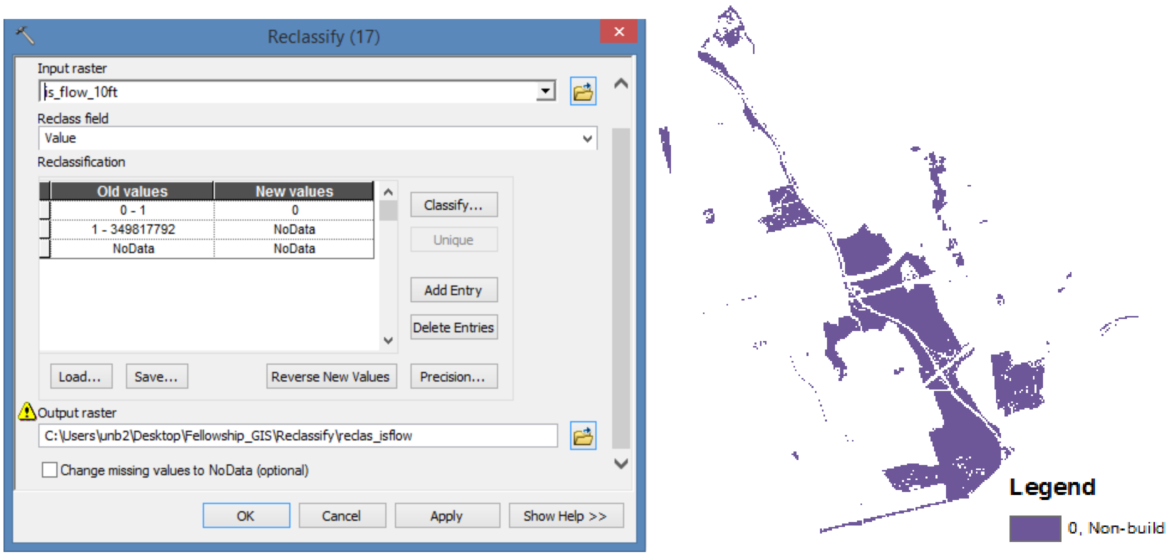
Step 6: Categorize pixels that receive flow from impervious surfaces as 'build' and those that do not receive any flow from impervious surfaces as 'non-build'. Flow accumulation was calculated in Step 6 assuming 1 unit of rainfall on each pixel. So, pixels with a value higher than 1 are pixels that are receiving flow from impervious surfaces – 'build' pixels. Pixels with a value of 0 or 1 are not – 'non-build' pixels. Rain gardens will only be built on public lands. Therefore, only public lands that receive stormwater flow are identified.

a. Use 'Reclassify' tool to give 'non-build' pixels a value of '0'.



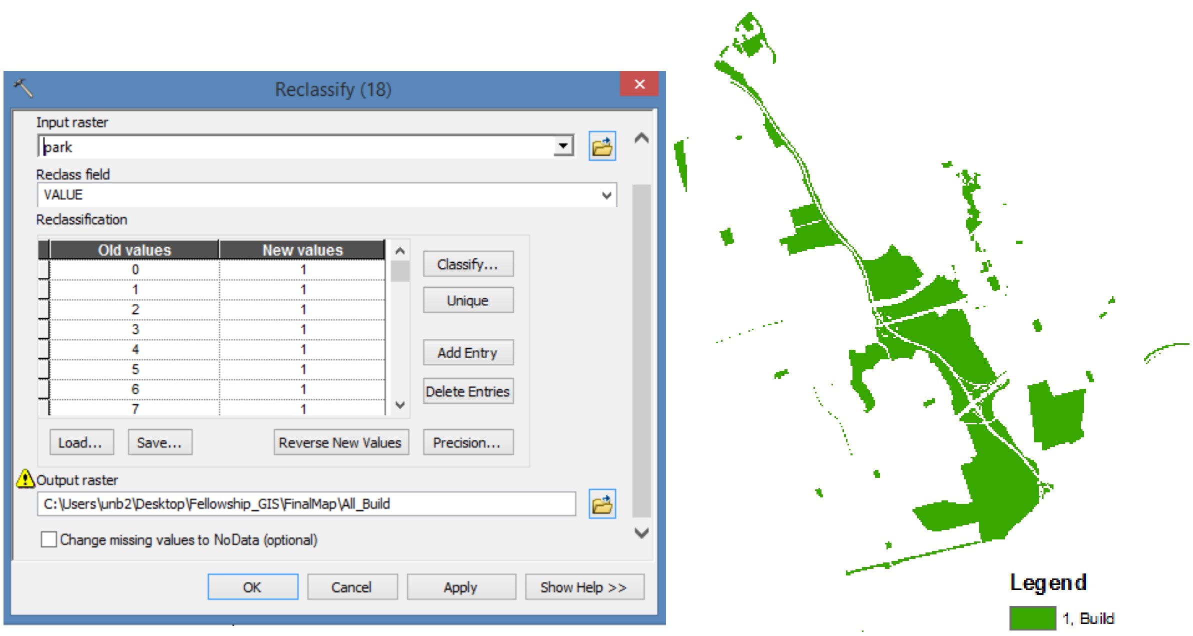


Step 7: Merge outputs from Step 3 and Step 6 together to form one 'Non-build' layer.

a. Use 'Cell Statistics' tool. Note: Because all pixel values are set to '0', choosing either the 'minimum' function or the 'maximum' function will result in the same output.

Step 8: Categorize all 'build' lands. 'Build' lands are all pixel lands within the Study Area.

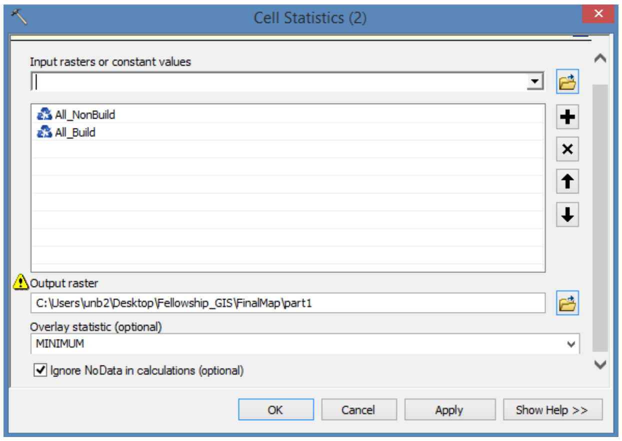
a. Use 'Reclassify' tool to give all 'build' pixels a value of '1'.

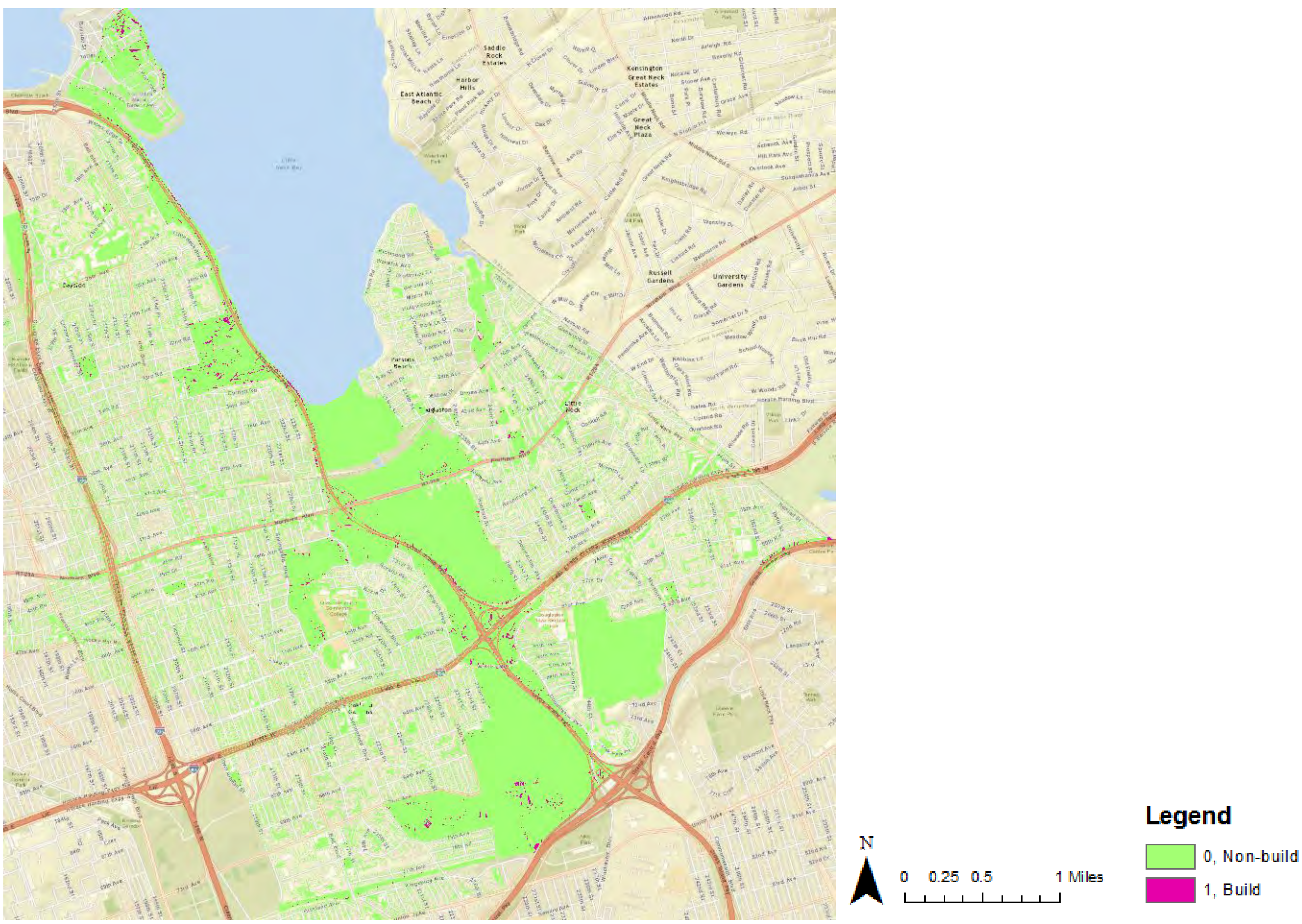


Appendix 15

Step 9: Merge outputs from Step 7 and Step 8 to form the **final output of Part 1**.

a. Use ‘Cell Statistics’ tool with ‘minimum’ function.



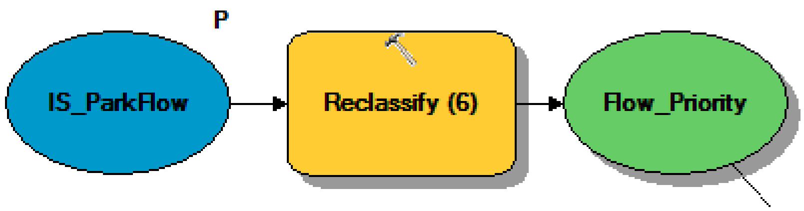


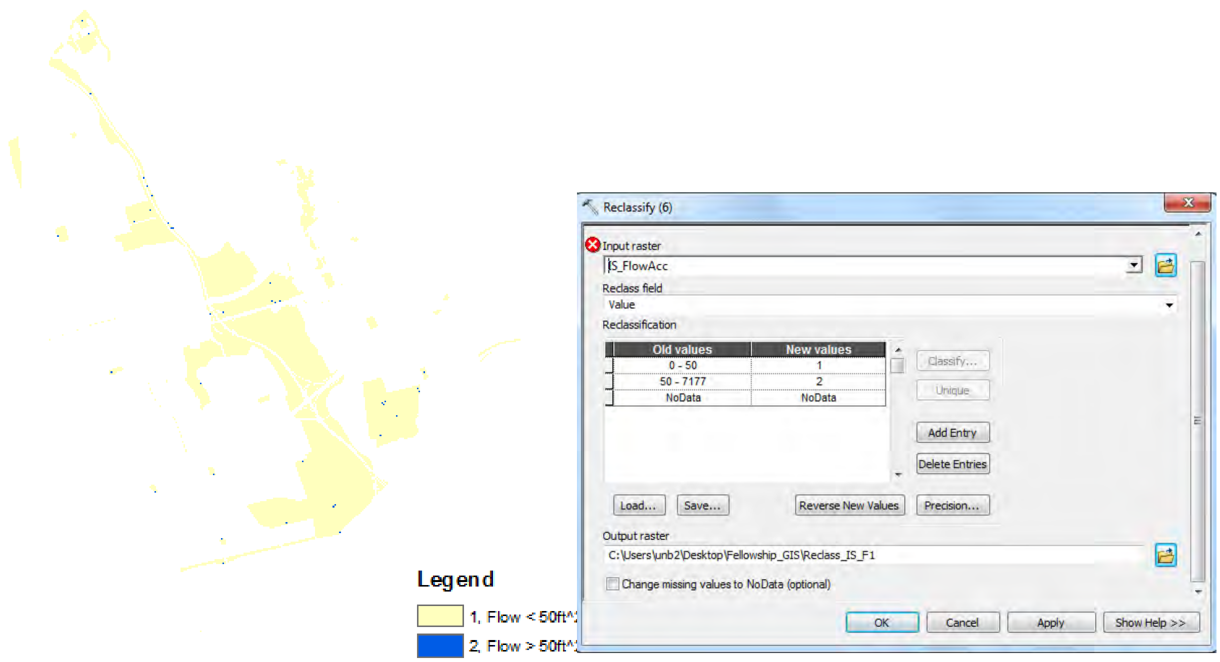
Appendix 15

PART 2

Step 9: Categorize pixels that receive flow from impervious surfaces larger than 50 ft^{2}as higher priority than pixels that do not.

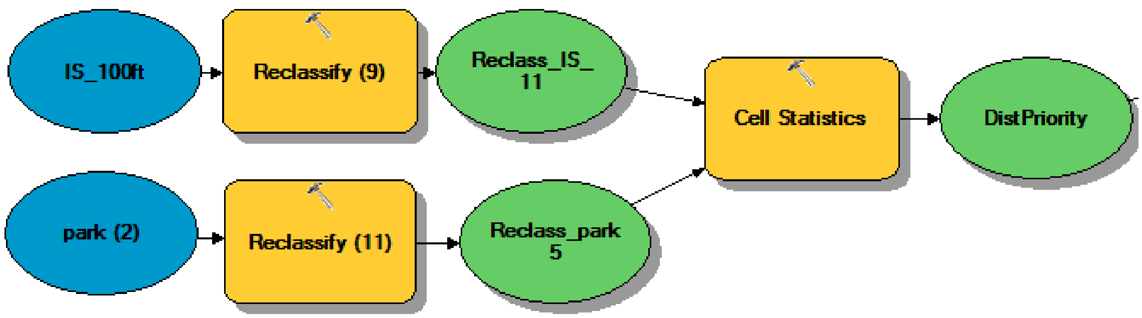
Use 'Reclassify' tool to give pixelsthat receive flow from impervious surfaces larger than 50 ft^{2}a value of '2' and pixels that do not a value of '1'.

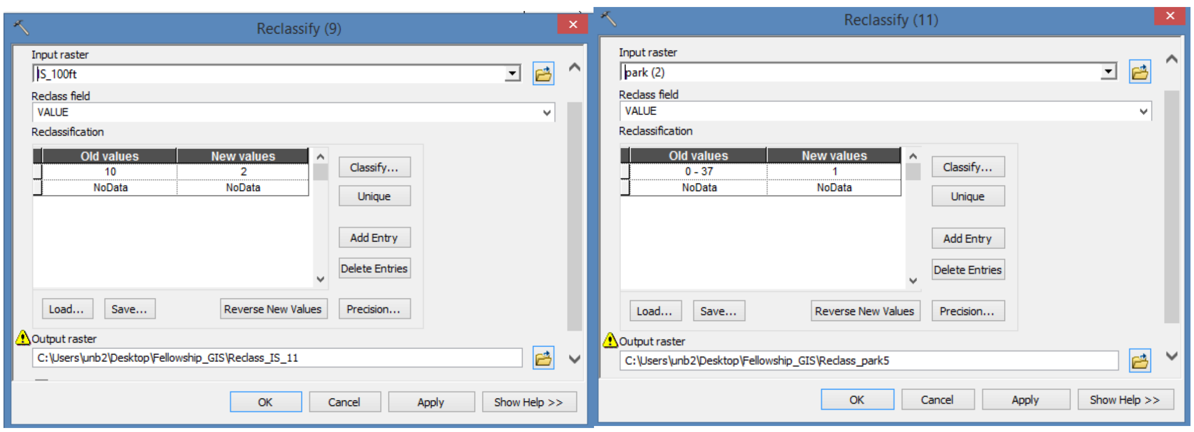




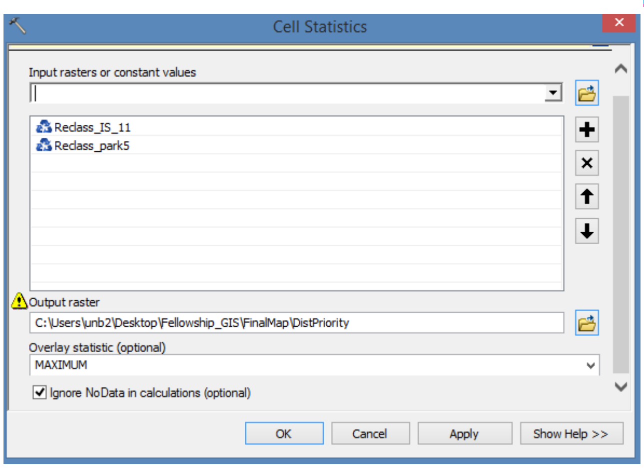
Step 10: Categorize pixels that are within 100 feet from impervious surfaces as higher priority than pixels that are not.

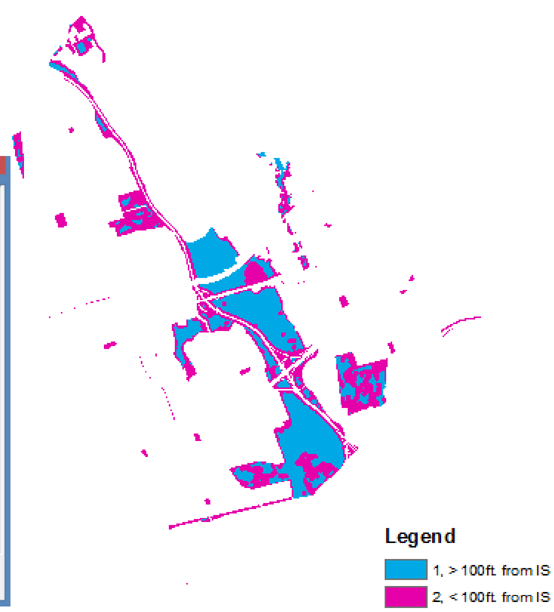
a. Use 'Buffer' toolto draw a 100ft. buffer on the impervious surface layer and convert to raster using 'Polygon to Raster' tool.
b. Use 'Reclassify' tool on output from Step 10a to give pixels that are within 100 feet from impervious surfaces a value of '2'.
c. Use 'Reclassify' tool to give output from Step 8a a value of '1'.





d. Use 'Cell Statistics' with the 'maximum' function to merge output from Step 10b and Step 8 into one prioritization layer.

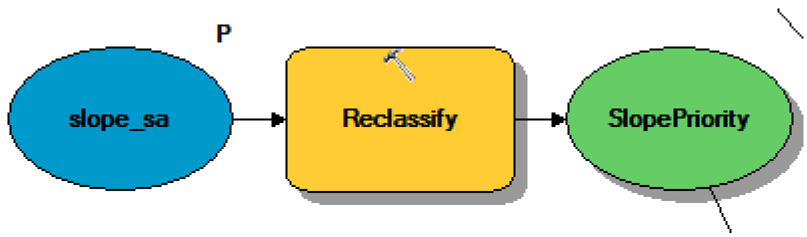


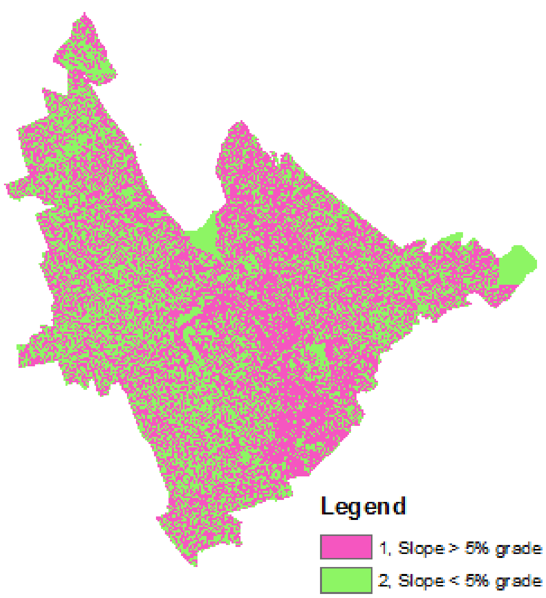


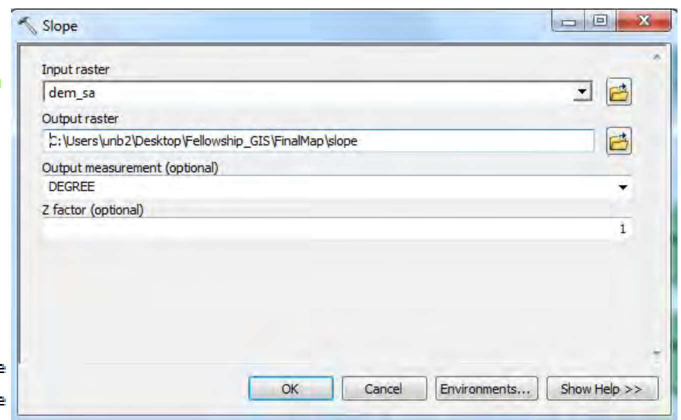
Appendix 15

Step 11: Calculate slope and categorize all pixels that have a slope of less than 5% grade higher priority than pixels with higher slope.

- Using the DEM as the input, use ‘Slope’ tool.
- Use ‘Reclassify’ tool to give pixels that have a slope of less than 5% grade a value of ‘2’ and all other pixels a value of ‘1’.

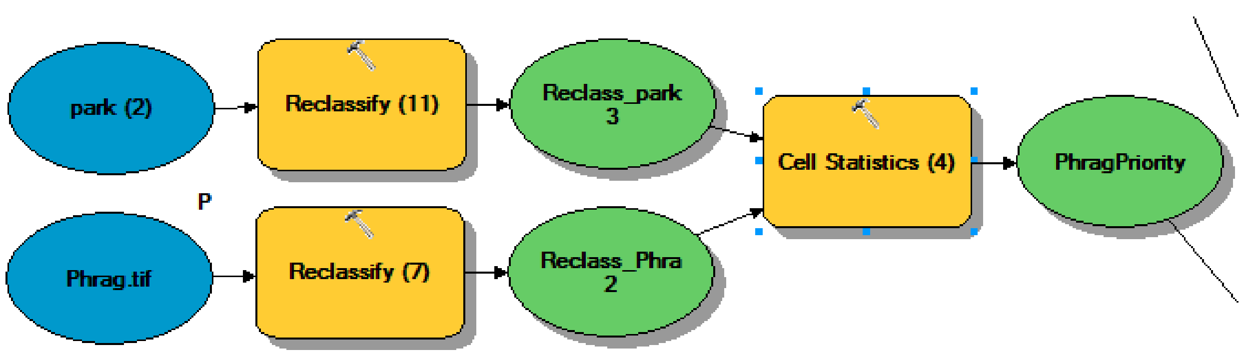




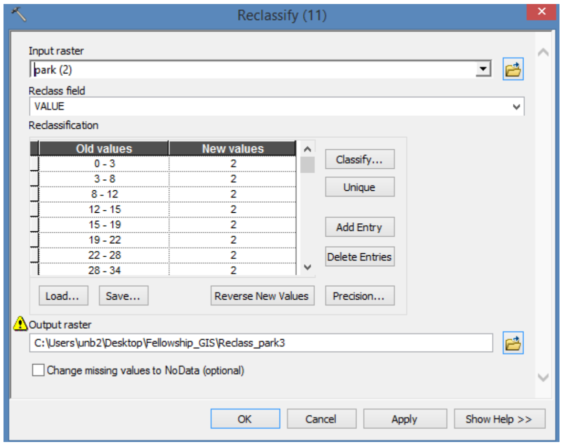


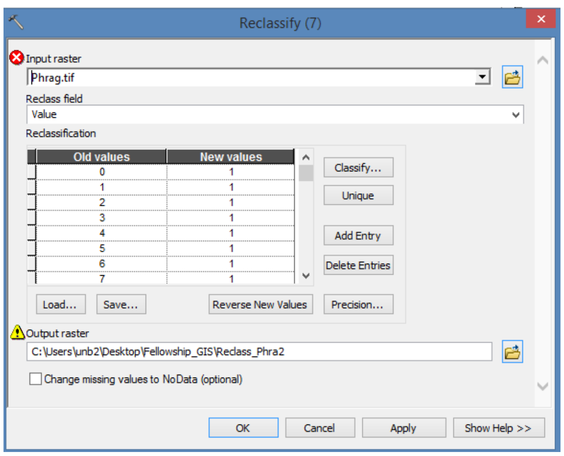
Step 12: Categorize pixels where there are no phragmites as higher priority. Areas within a 5ft. buffer (done using ‘Buffer’ tool) of phragmites pixels were also classified as phragmites.

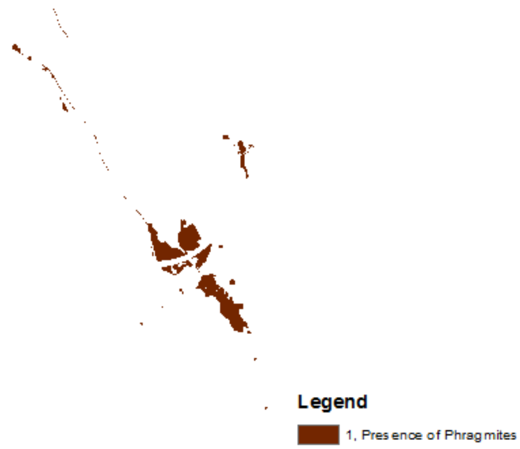
a. Use ‘Reclassify’ tool to give output from Step 8 a value of ‘2’.
b. Use ‘Reclassify’ tool to give the phragmites layer a value of ‘1’.



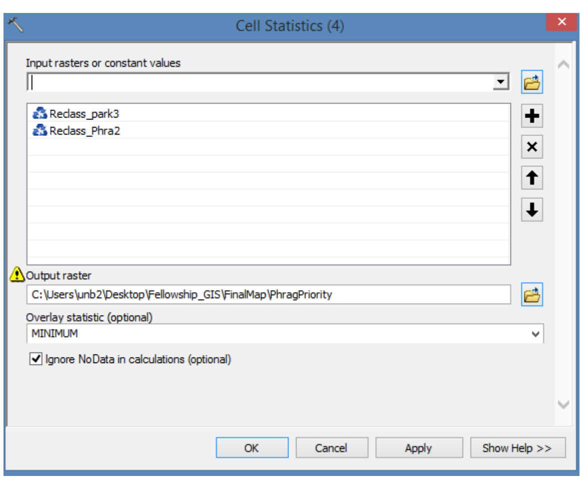
Appendix 15

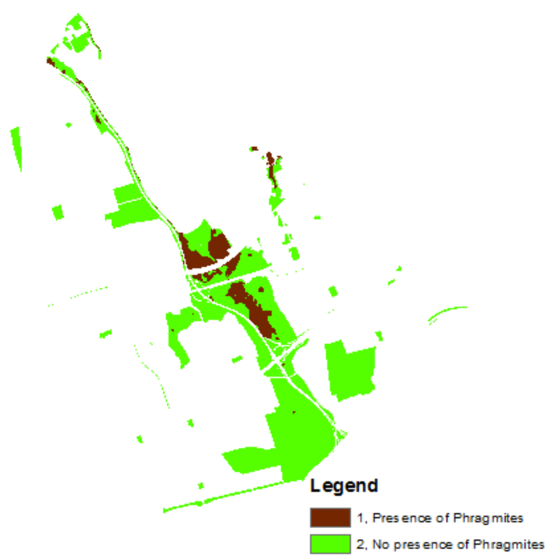






c. Use 'Cell Statistics' with 'minimum' function to merge into one prioritization layer.

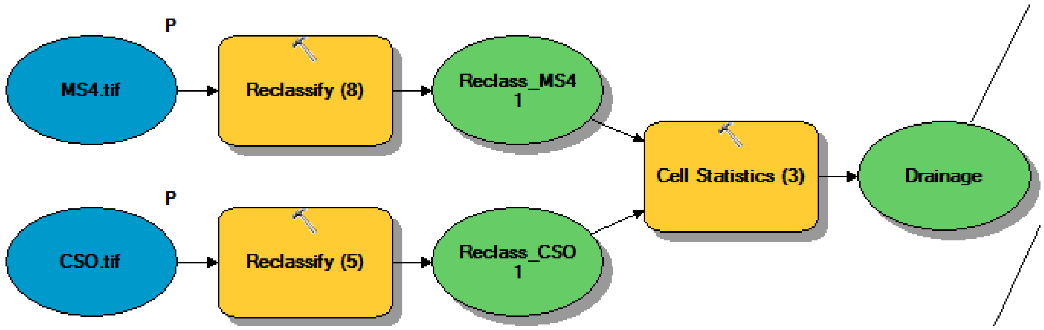


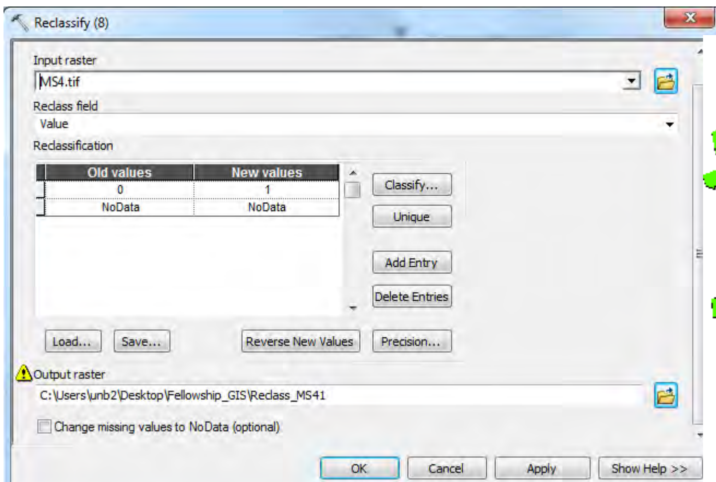


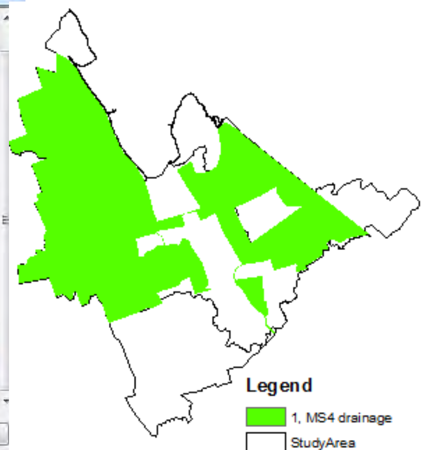
Appendix 15

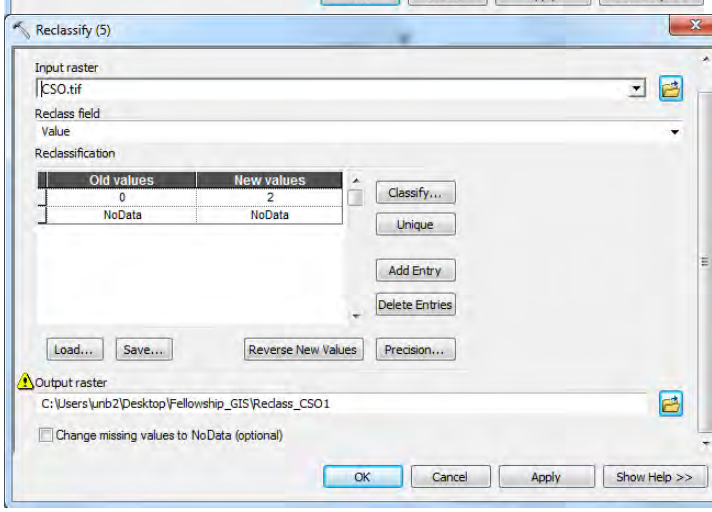
Step 13: Categorize CSO drainage areas as higher priority than MS4 drainage areas.

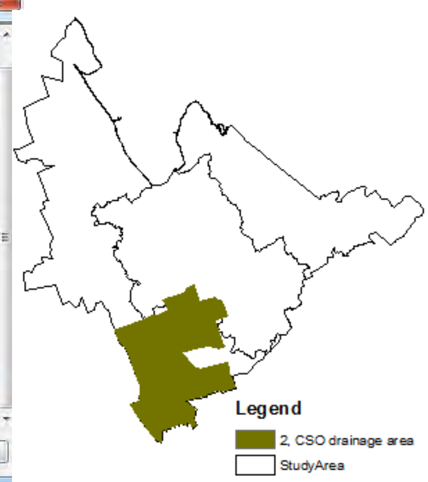
a. Use ‘Reclassify’ tool to give CSO drainage area pixels a value of ‘2’.
b. Use ‘Reclassify’ tool to give MS4 drainage area pixels a value of ‘1’.



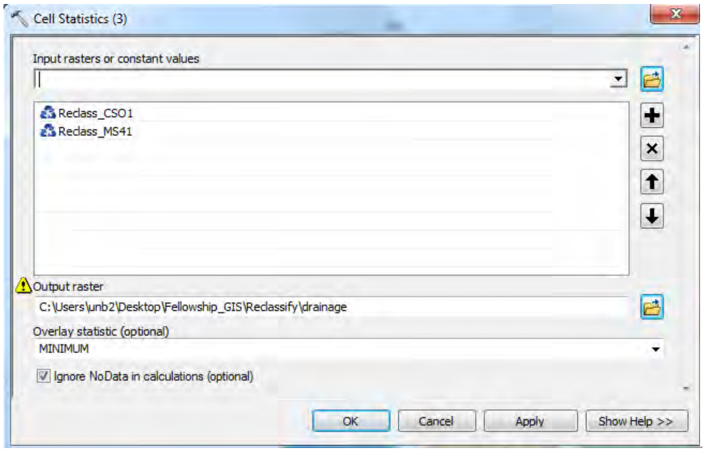


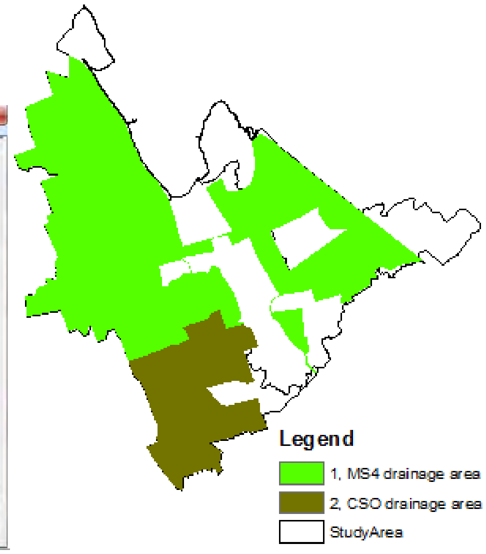






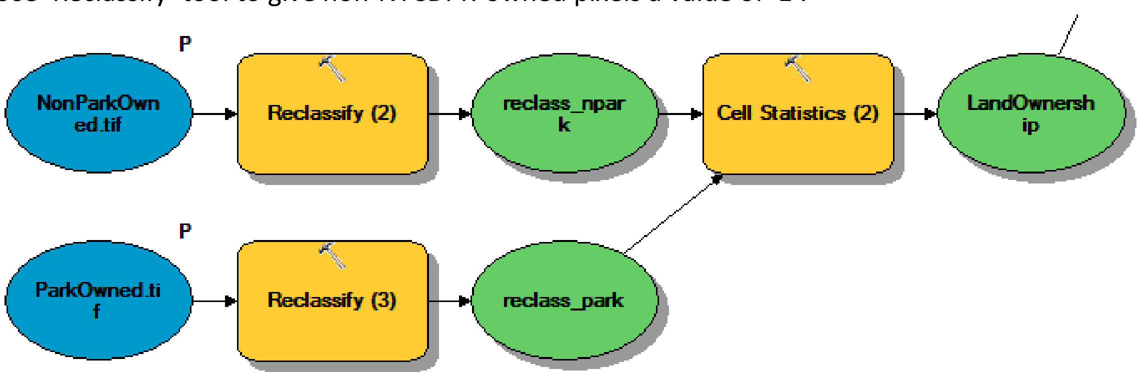
c. Use ‘Cell Statistics’ tool with ‘minimum’ function to merge into one prioritization layer.

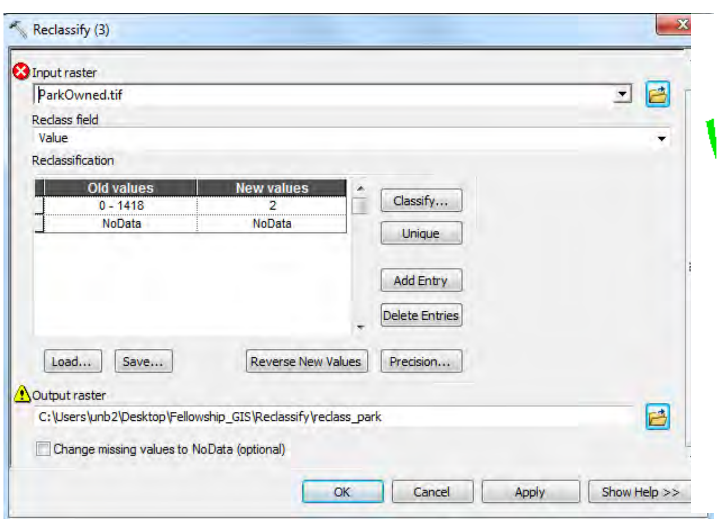


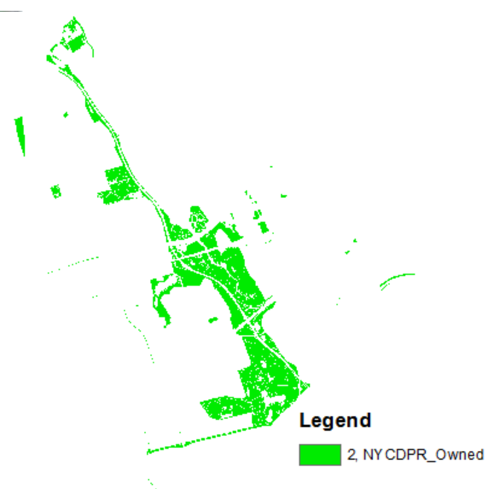


Step 14: Categorize NYCDPR-owned land as higher priority than other lands.

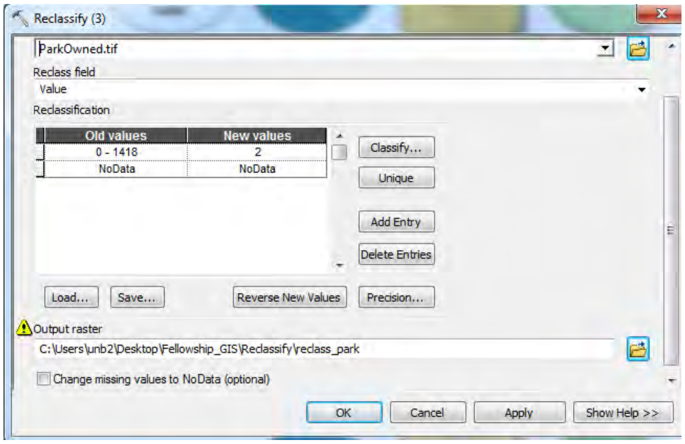
a. Use ‘Reclassify’ tool to give NYCDPR-owned pixelsa value of ‘2’.
b. Use ‘Reclassify’ tool to give non-NYCDPR-owned pixels a value of ‘1’.

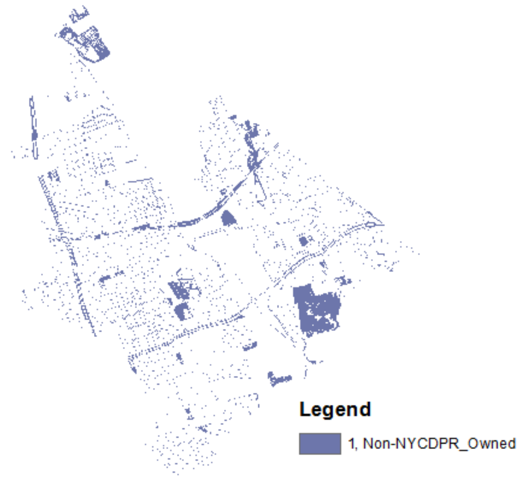




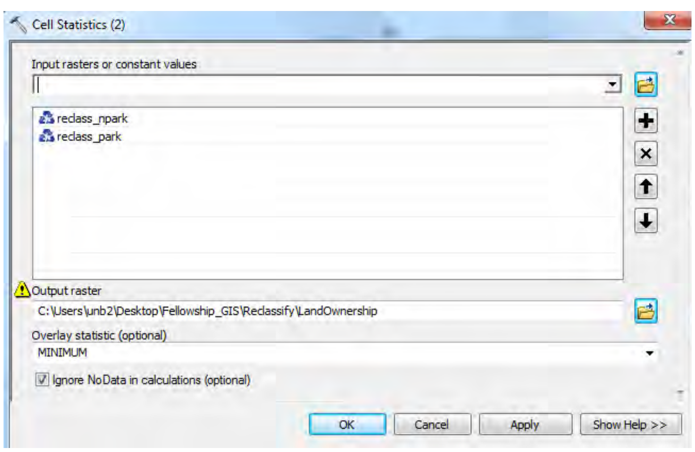


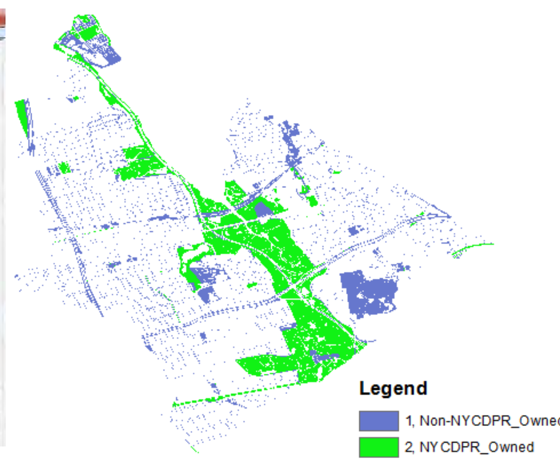
Appendix 15





c. Use 'Cell Statistics' with the 'minimum' function to merge into one layer.

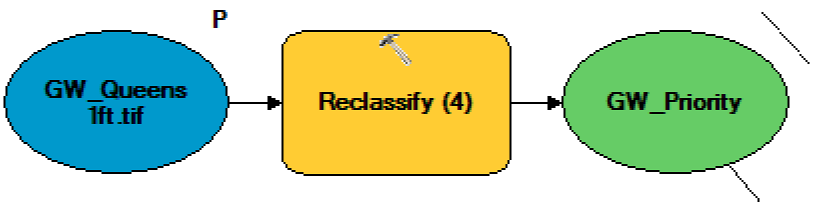


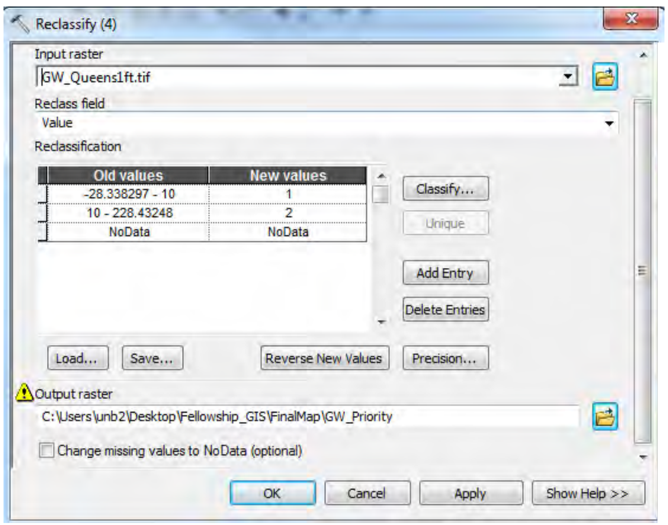


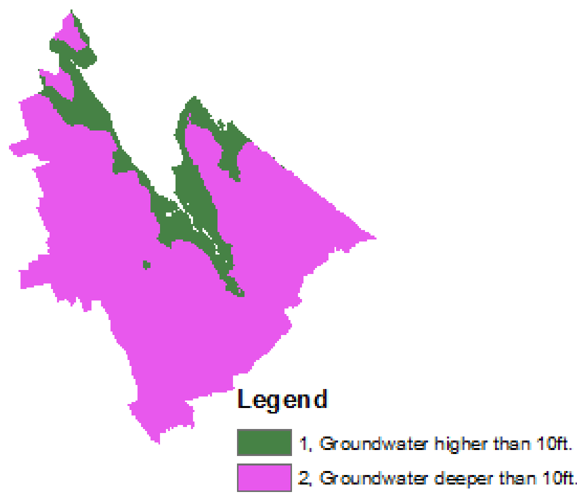
Step 15: Categorize areas where groundwater is deeper than 10 feet as higher priority.

a. Use 'Reclassify' tool to give pixels where groundwater is deeper than 10 feet a value of '2'.
b. Use 'Reclassify' tool to give pixels where groundwater is higher than 10 feet a value of '1'.

Appendix 15

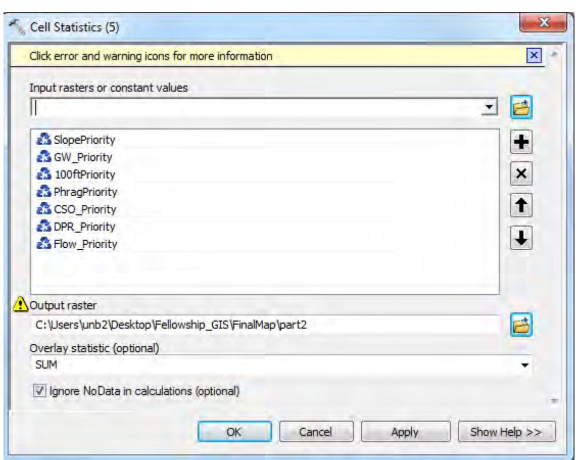




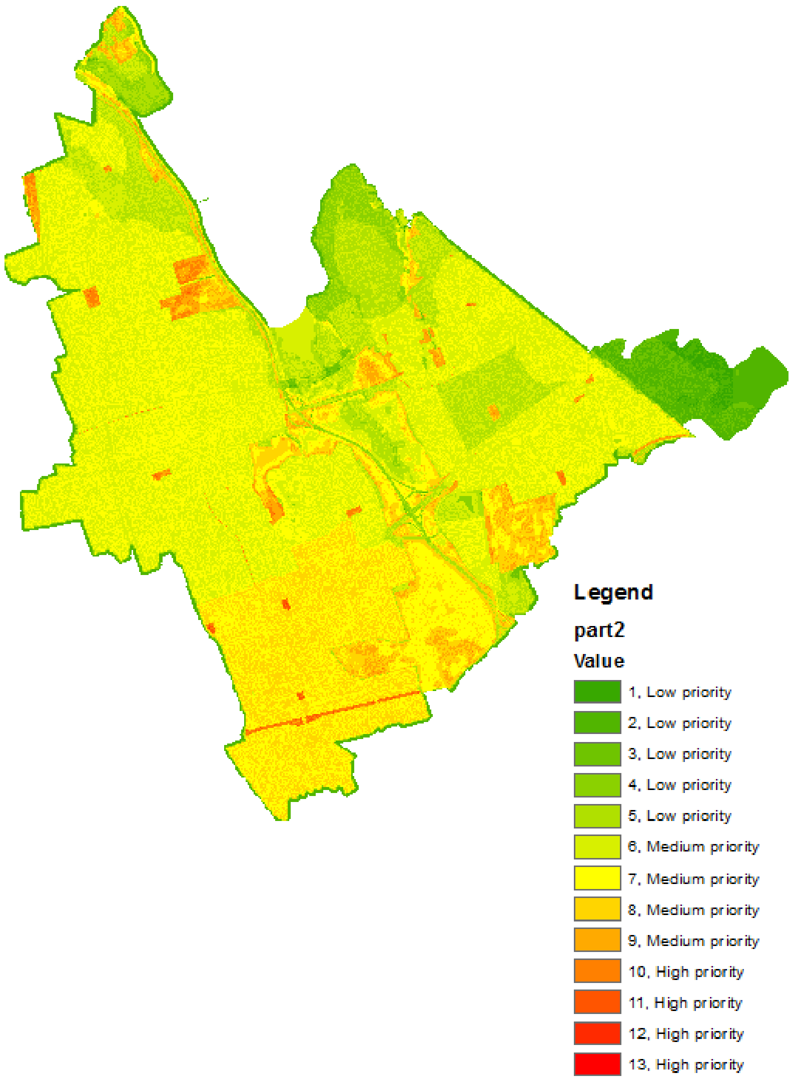


Step 16: Add all prioritization layers together to get final scores for each pixel.

Use ‘Cell Statistics’ tool with the ‘sum’ function to add all layers together.

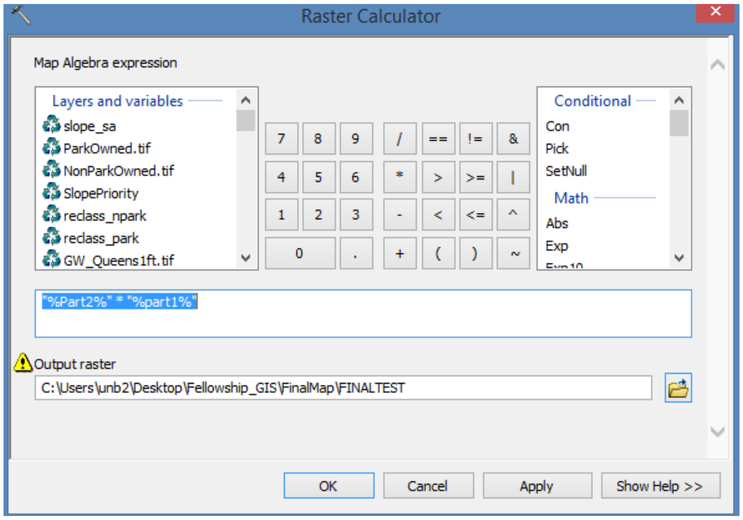


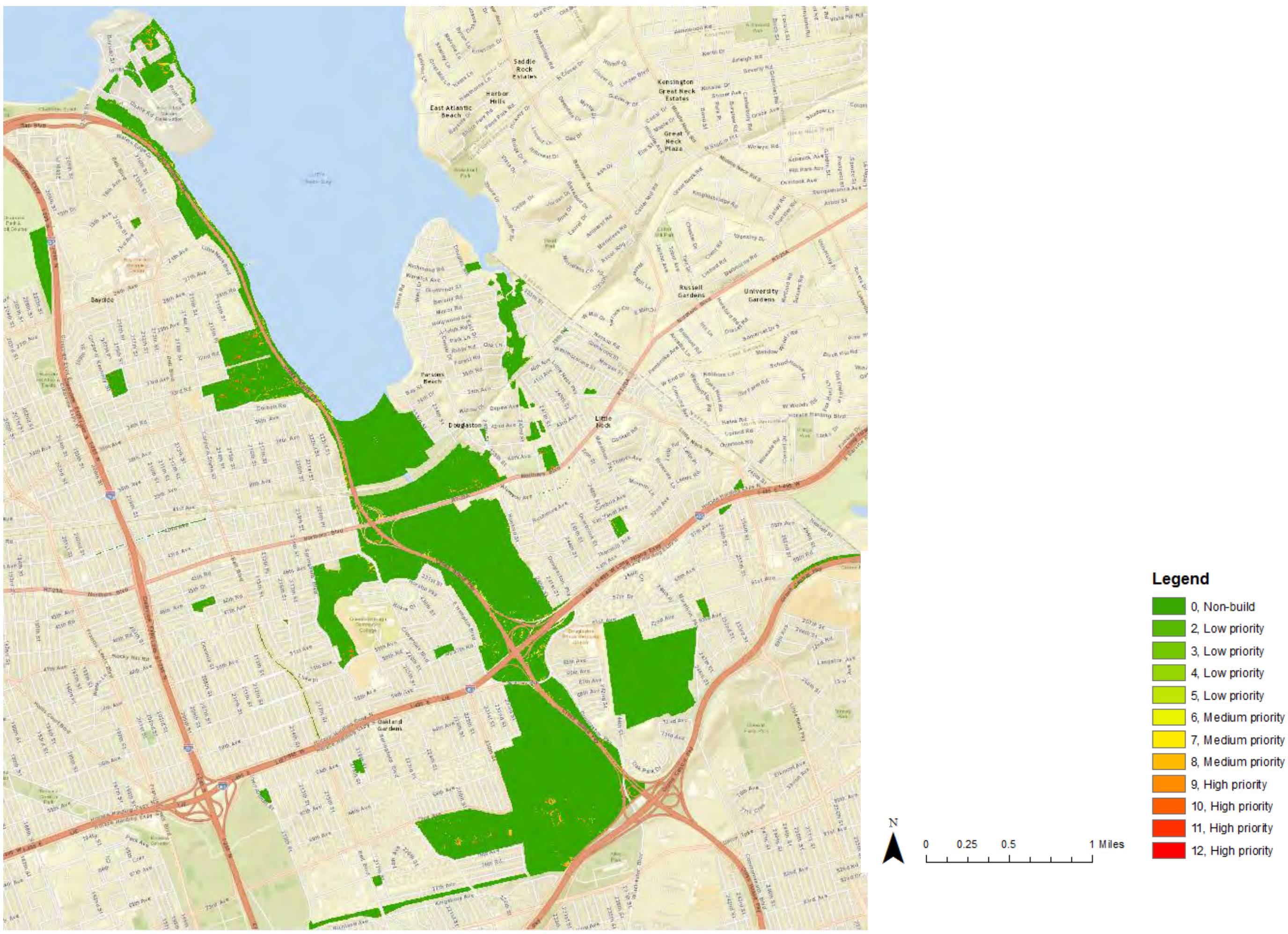
Appendix 15



Step 17:Multiply the final output from Part 1 with the output from Step 16 to form the **final output from Part 2**.

Appendix 15


Raster Calculator
Map Algebra expression
Layers and variables
slope_sa
ParkOwned.tif
NonParkOwned.tif
SlopePriority
reclass_npark
reclass_park
GW_Queens1ft.tif
Conditional
Con
Pick
SetNull
Math
Abs
Exp
"%Part2%" * "%part1%"
Output raster
C:\Users\unb2\Desktop\Fellowship_GIS\FinalMap\FINALTEST
OK
Cancel
Apply
Show Help >>


Legend
0, Non-build
2, Low priority
3, Low priority
4, Low priority
5, Low priority
6, Medium priority
7, Medium priority
8, Medium priority
9, High priority
10, High priority
11, High priority
12, High priority
N
0 0.25 0.5 1 Miles

Appendix 15

Appendix 16

Green infrastructure protocol - concepts for high priority opportunities

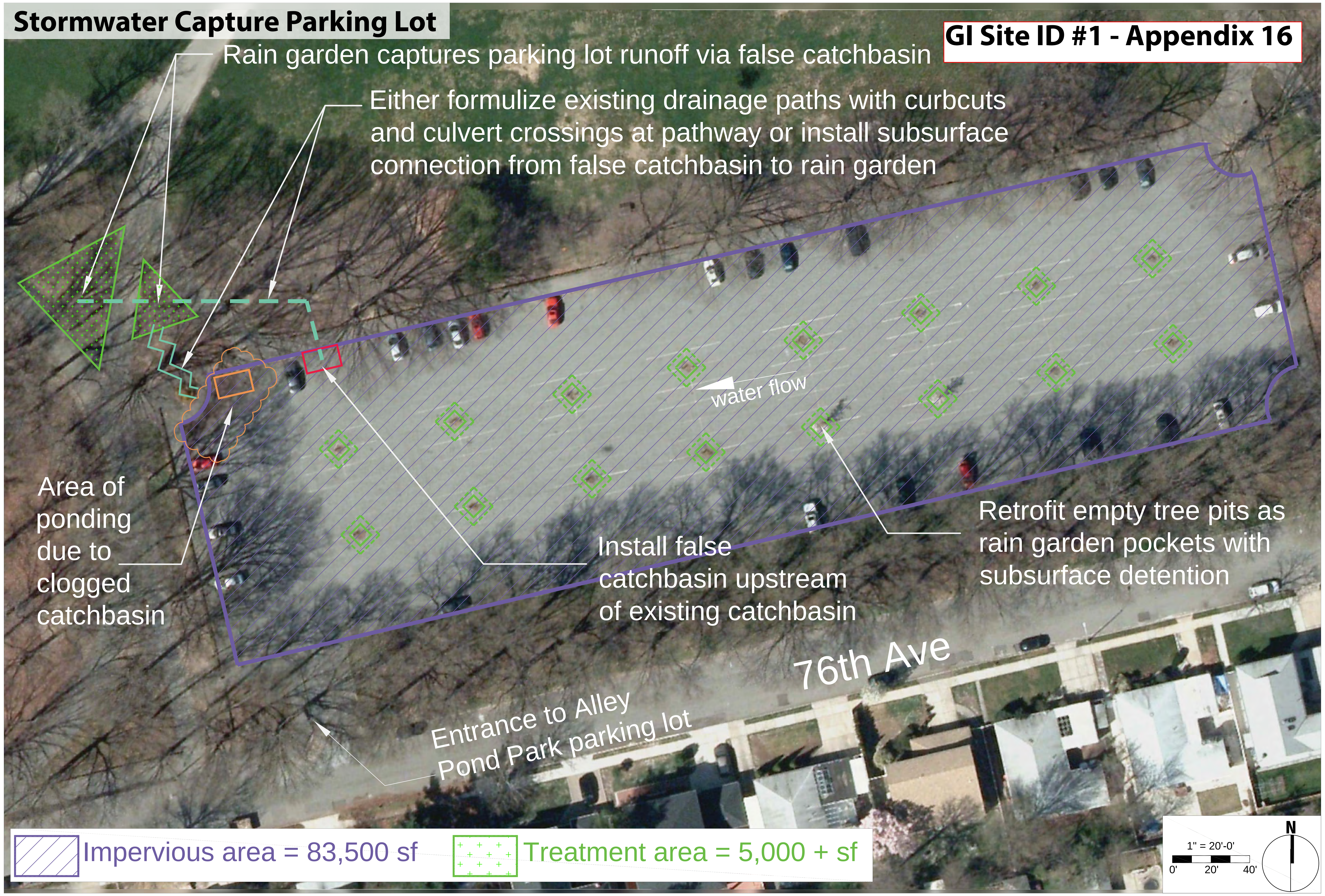
Vast Impervious Surface

Empty Tree Pits

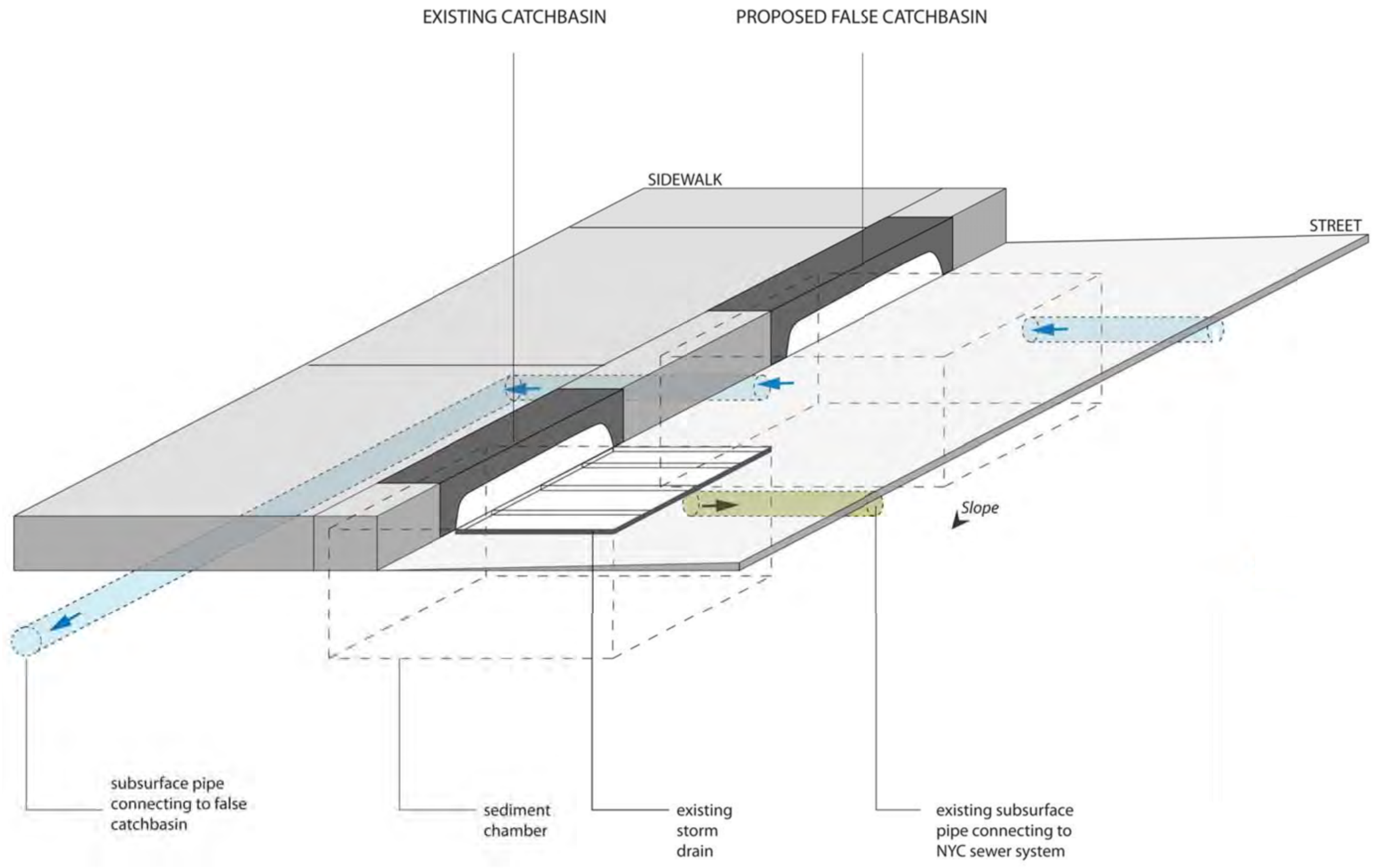
Ponding of Runoff

Stormwater Capture Parking Lot

GI Site ID #1 - Appendix 16

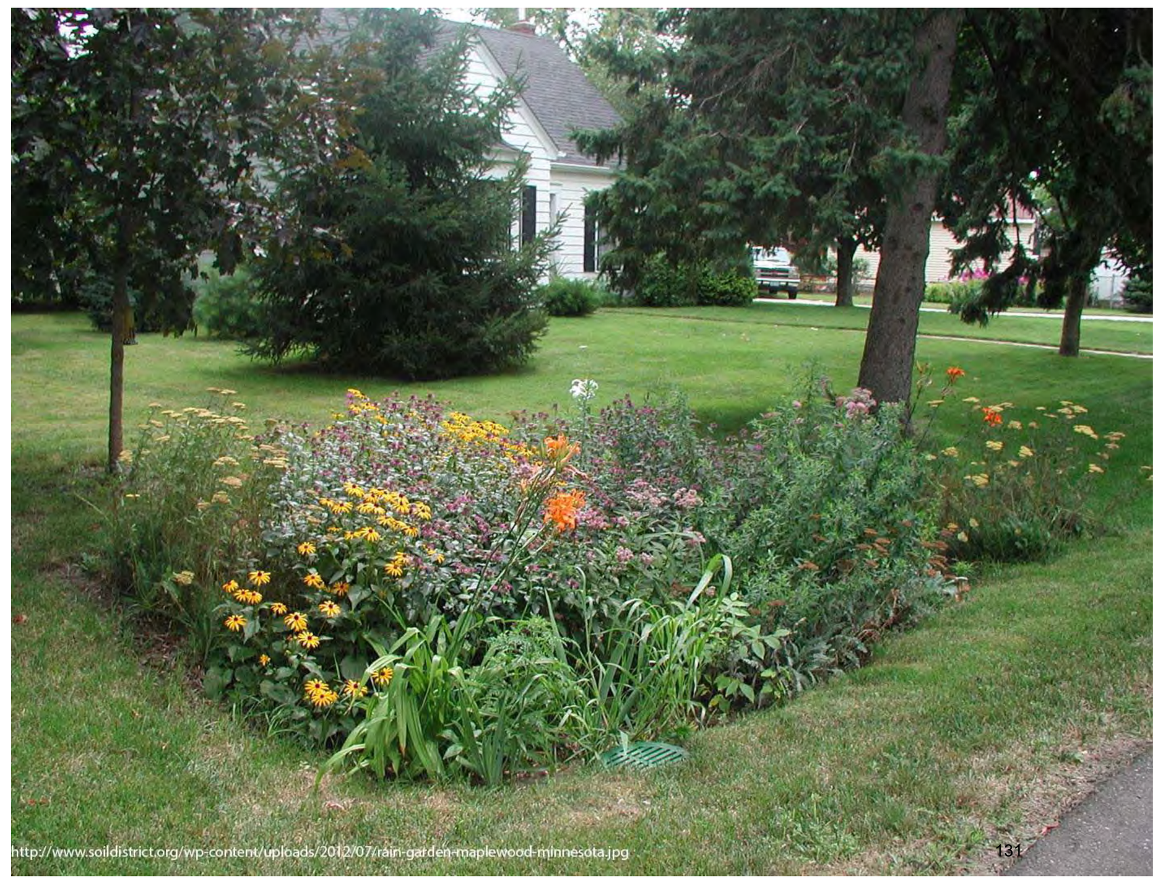


False Catchbasin



Parking Lot Curb Cut

Rain Garden

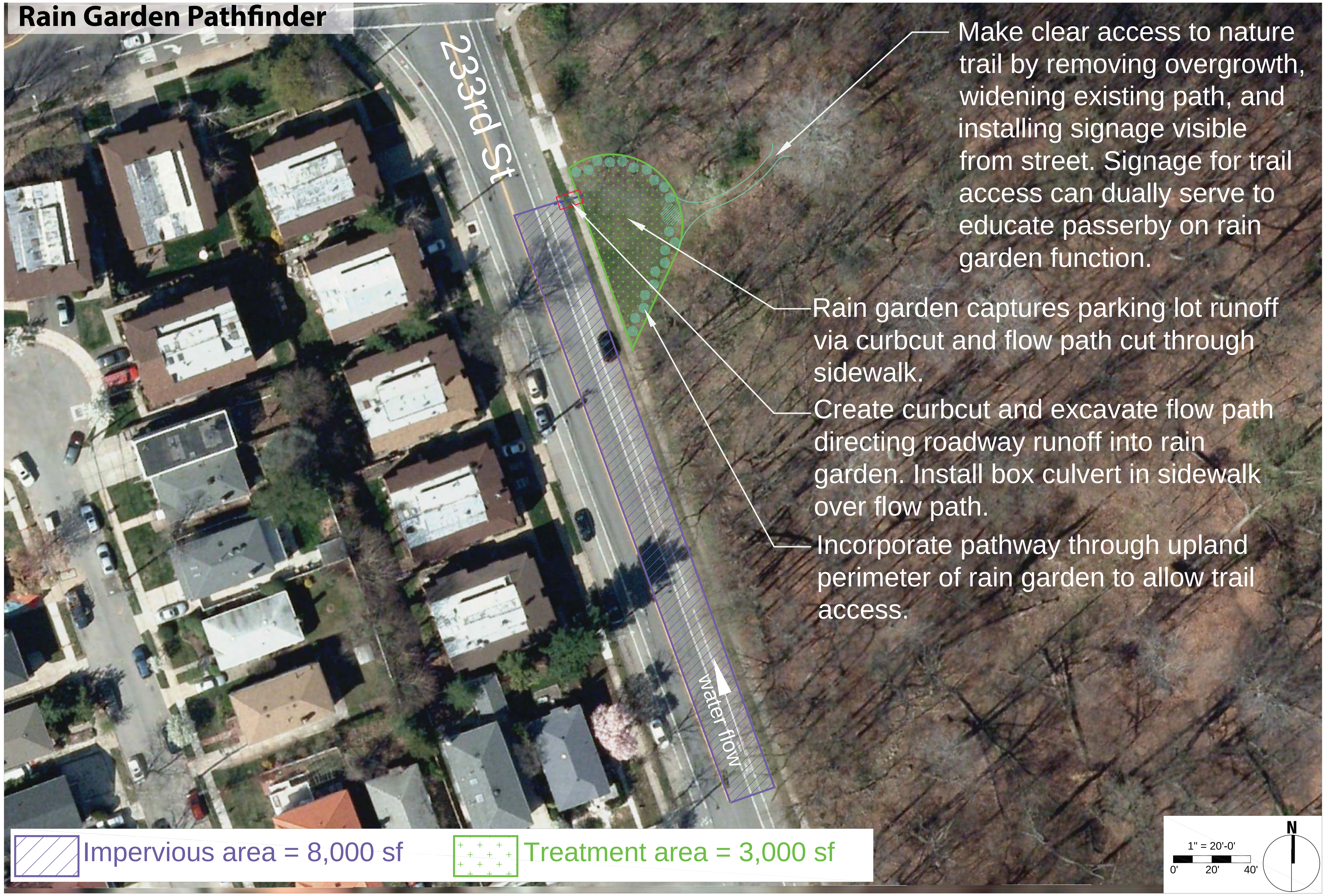


Existing Lawn At Entry of Nature Trail

GI site #2 - Appendix 16

Large Catchment Area

Rain Garden Pathfinder



Sidewalk Box Culvert

Rain Garden Signage

Nature Trail Wayfinding

Existing Planting Bed

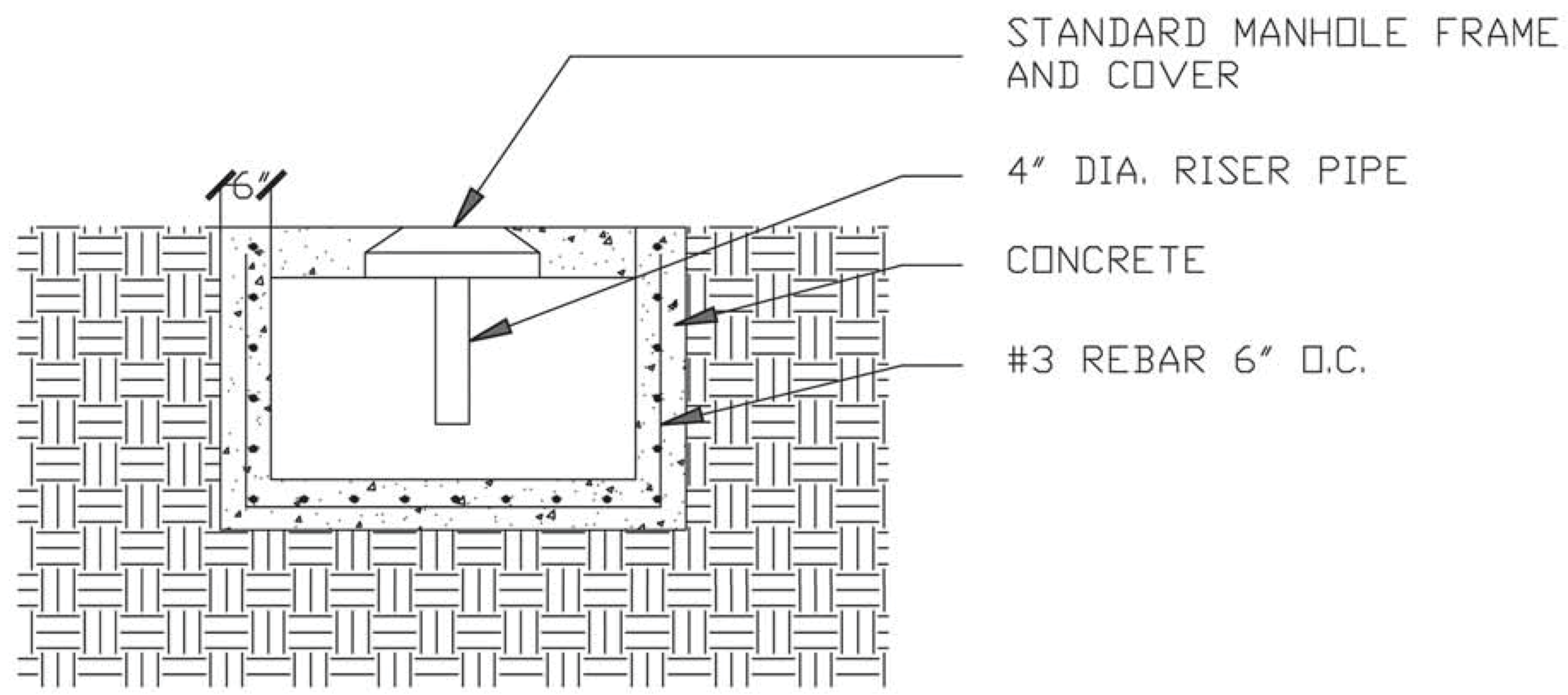
Large Volume of Street Runoff

Neighborhood Showcase Park

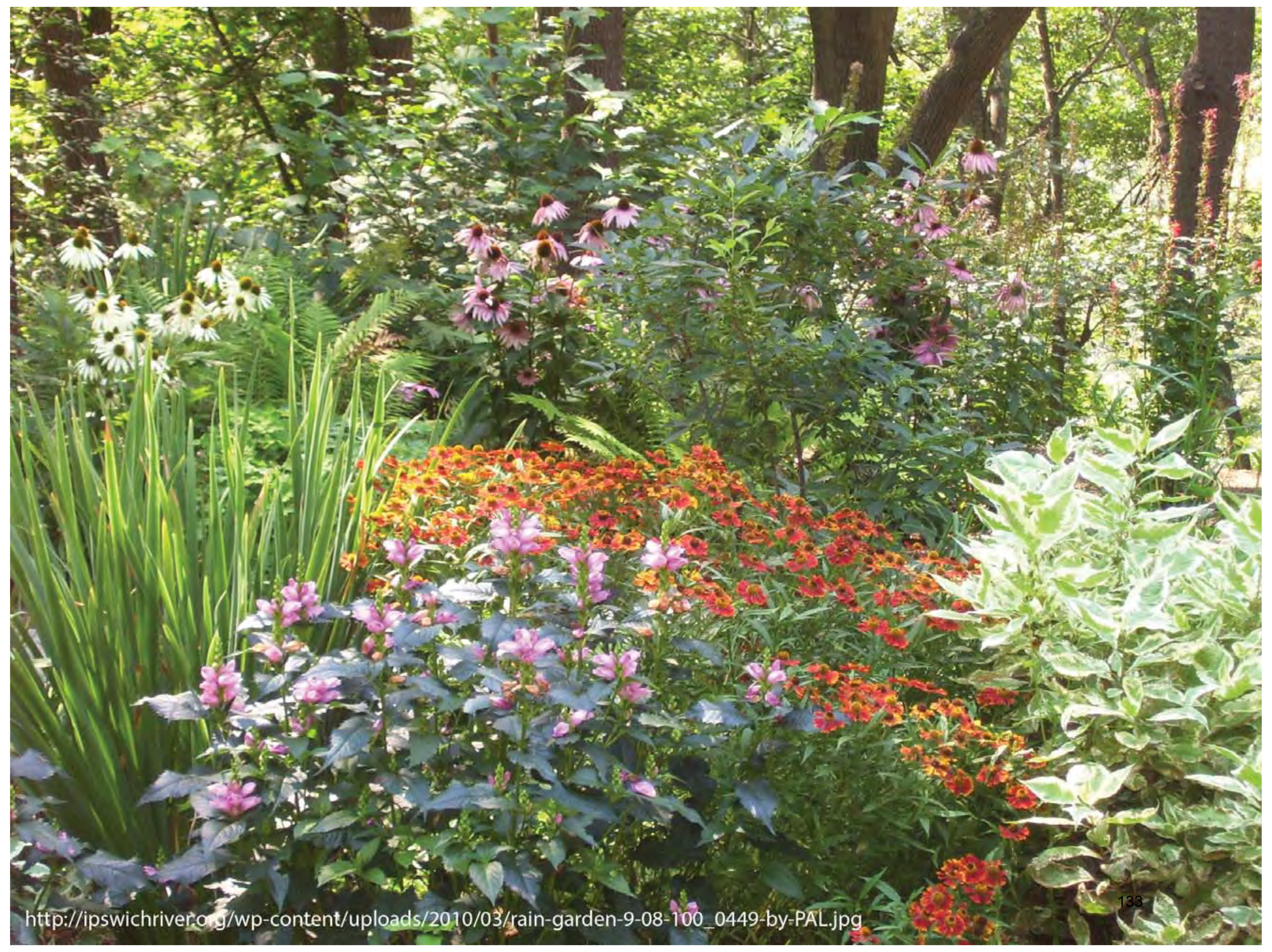
Plant Savvy Rain Garden

GI site ID #21 - Appendix 16

False Catchbasin



Planting Bed Retrofitted With Rain Garden Plant Pallette



Appendix 17

Riparian restoration - concepts for high priority opportunities

Vernal Pool - South of Northern Boulevard

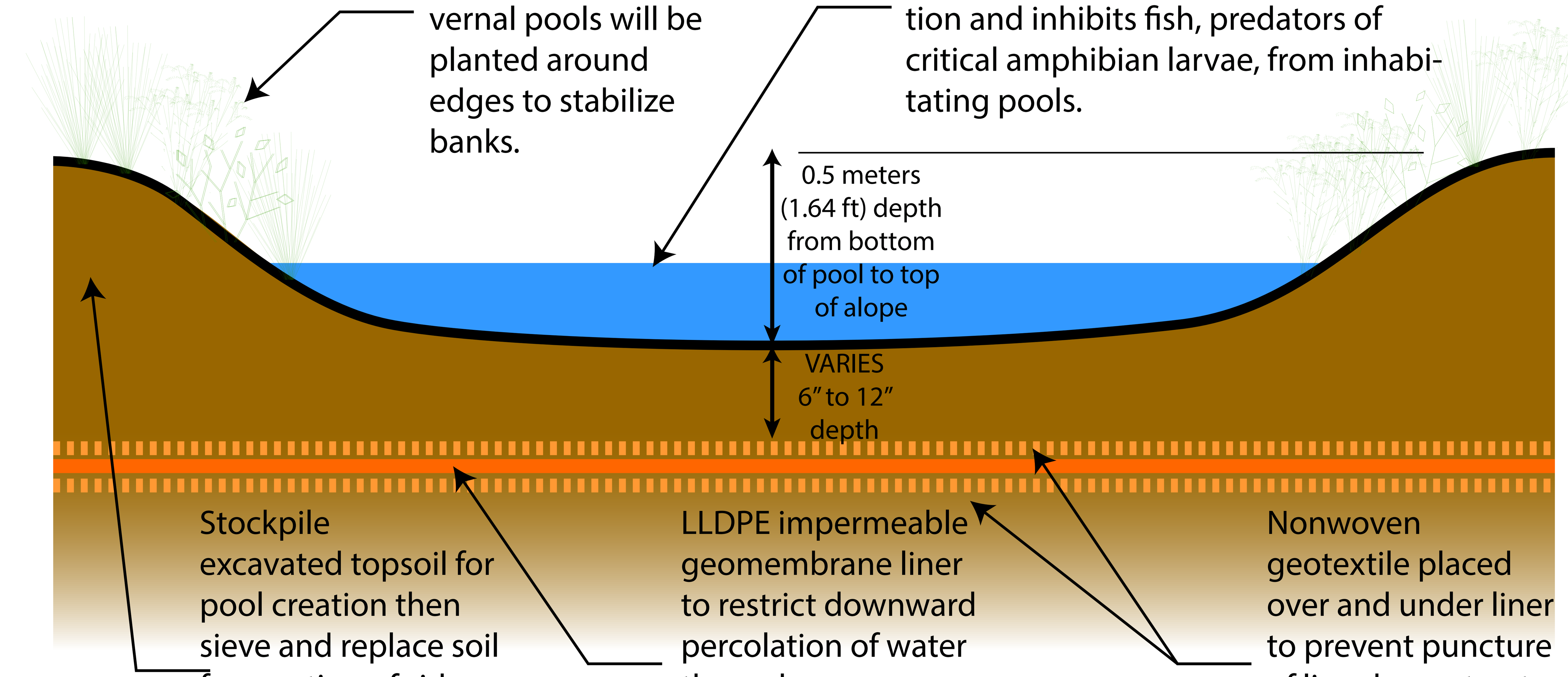
Site ID # 36 - Appendix 17

Proposed Habitat

PLAN

Existing Habitat

Vernal Pool Section



Alley Creek - Ephemeral Reaches
CONCEPT PLAN
Note: Concept is diagrammatic, for planning purposes only. Location of site features not exact.
Site ID # 32 & 39 - Appendix 17
Potential capture of stormwater runoff in areas along the parkway where there is a gap in canopy
Increase energy dissipation controls at the base of outfall pipes
Existing outfall pipe
Estimated minimum catchment of unmanaged stormwater discharging to the ephemeral stream corridor
Ephemeral stream
Proposed 'Pool & Riffle' Area
Distribute stream flow along a series of 3 ft deep pools and cobble and boulder riffles to alleviate erosion of stream banks and in-stream sedimentation.
Douglaston Pkwy
Cross Island Pkwy
Pool & Riffle PROFILE
Riffle
Pool
COMPOST
1 FT LIFT
COBBLE APRON
PONDED WSE
SILICA COBBLE d_{50}=8"
3 FT
SEEPAGE
INFILTRATION
EXFILTRATION
UNDISTURBED SUBSTRATE
SAND/WOOD CHIP MIX
GEOTEXTILE
500 – 6,000 LB SANDSTONE BOULDER GRADE CONTROL
Riffle SECTION
PARABOLIC CROSS SECTION WIDTH 14 FT. FOR TRIBUTARIES
COBBLE d_{50}=9" FOR TRIBUTARIES
Copyright 2009 Underwood & Associates
COMPOST BLOWN IN PLACE
COBBLE
SAND/WOOD CHIP (MIN. 3 FT)
UNDISTURBED SUBSTRATE
Pool SECTION
COARSE WOODY DEBRIS
Copyright 2009 Underwood & Associates
UNDISTURBED SUBSTRATE
COMPOST
SAND/WOOD CHIP MIX (MIN. 3 FT)
Pool and Riffle diagrams are sourced from Underwood & Associates' design details for Milkhouse Run within Rock Creek Park, Washington DC
1" = 100'-0'
0' 100' 200'
N

Appendix 18

Private landowner engagement for stormwater management

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Introduction and Objectives

Urban Ecology seeks to understand the interactions between biophysical and social processes in human-dominated systems[1]. Watershed boundaries serve as a compelling tool through which to study urban ecology as the biophysical properties of a watershed are highly intertwined with human activity and social systems[2].

Private property ownership presents a unique problem to watershed management. The way land is developed and used has a direct impact on the quality of the receiving water body. Yet, to take action to protect a watershed on private property would require the cooperation and coordination of anywhere from hundreds to millions of individuals depending on the size of the watershed in question. In addition, or perhaps as a result, the traditional role of infrastructure engineers and city agencies has been to provide solutions in the form of design, construction, and maintenance of centralized hard infrastructure located on public lands and in the public right of way. Green infrastructure, or the use of distributed, vegetated systems to capture stormwater runoff, has evolved as a competing solution to managing urban runoff.

In 2012, the New York City Department of Environmental Protection (DEP) made green infrastructure a part of the consent order for mitigating combined sewer overflows. In addition to grey infrastructure improvements, a goal was set to manage stormwater from 10 percent of the impervious surfaces in NYC using green infrastructure by 2030.[3] While the DEP expects to fulfill the obligations of the Consent Order largely by installing GI on public property, in most watersheds, this goal cannot be met by capture on public property alone and will involve some capture on private lands. Best practices for engaging with homeowners in urban watersheds have yet to be developed. Green infrastructure offers opportunities to employ new forms of governance and engage new actors that were previously left out of sewer system planning.

This paper will use the Alley Creek watershed in Queens, NY as a case study to 1) define and characterize social-site typologies of private homeowners, 2) design effective methods of outreach and engagement for each of these typologies and 3) offer management recommendations moving forward. By breaking homeowners and their landscapes into distinct typologies, we can begin to address individual homeowners in groups and develop appropriate methods of engagement, incentives, and outreach strategies accordingly.

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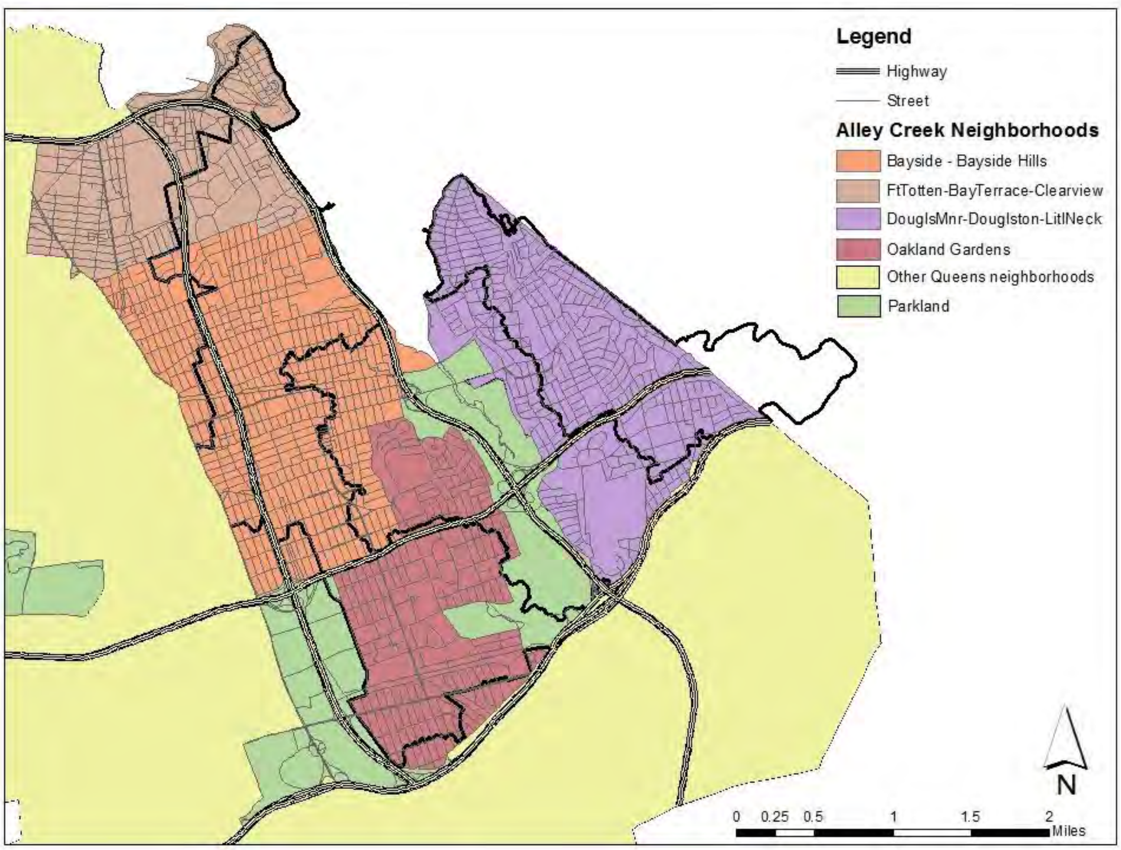
[1] (Alberti et al., 2003)

[2] (Pickett & Cadenasso, 2006)

[3] http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml

Site Description

The Alley Creek watershed is composed of five neighborhoods, namely Bay Terrace, Bayside, Douglaston, Little Neck, and Oakland Gardens. The boundaries of these neighborhoods are only roughly defined as often the neighborhoods are lumped together and referred to as either Bayside or Douglaston. Alley Pond Park surrounds Alley Creek and runs down the middle of this watershed, serving as a boundary between the two neighborhoods. Major thoroughfares crisscross the watershed with the Cross Island Parkway running north-south through the center of Alley Pond Park and Northern Boulevard, Long Island Expressway, and Grand Central Expressway lying east-west across the watershed. These highways break up the neighborhood fabric and often serve as informal neighborhood boundaries.



In addition to this broad neighborhood construct, there are a number of households that have aligned into smaller communities. These communities are defined by a physical boundary, often based upon historical development patterns. Until the early 1900s, the Alley Creek watershed was sparsely developed with mostly farmland and large estates for few wealthy New Yorkers. When these families decided to sell the property, a developer would purchase, divide and develop the land, building hundreds of houses at once. Regardless of the developer, almost all of this early development up until the 1950s was constructed according to the garden city planning ideal, which sought to combine the amenities of urban life with ready access to nature typical of rural areas. The populations that moved into these developments were mostly white, middle to upper class families that were fleeing urban centers with the rise of suburbanization.

New York City was the first municipality to introduce zoning in 1916. Some communities within the Alley Creek watershed were established prior to the institution of zoning regulations. These communities maintain their own set of deed restrictions that regulate the allowable characteristics of buildings, their uses, and a number of other aesthetic preferences such as minimum lot size, setbacks, and more. Further, there are two developments that are designated as privately owned areas, namely Douglas Manor and Bayside Gables. While these communities are rare in NYC, this status allows the community to maintain exclusivity in exchange for being self-sufficient. While residents still pay the same taxes, they additionally assume the costs of community upkeep, including maintaining their own streets, parks, sewer systems, insurance, and often security. All of these additional rules and restrictions have an impact on the private property landscape in Alley Creek.

Currently, of the approximate 4,900 acres within the Alley Creek watershed, 62% of the area is zoned as residential property with an additional 15% zoned as open space and outdoor recreation and the rest a mix of commercial and public land. While overall the watershed remains a middle-upper to upper class demographic that is changing rapidly giving way to a mostly Asian population. In some neighborhoods, for example, the shift to an Asian majority has already occurred. According to the US Census from 2000 to 2010 in the neighborhood of Bayside, the percentage of the population that identified as White decreased from 60% to 46% while the Asian population increased from 33% to 47%[4].

An area of concern for many of the residents is the destruction of existing homes and their replacement with larger “McMansions”. Despite zoning regulations that aim to maintain the historic character of the neighborhoods, homes continue to be constructed that push these zoning boundaries to the maximum in terms of height and overall area. This has created a tension with some of the existing population. While much of this work is being done by developers that want to maximize their profit and therefore build houses that will receive the greatest return, many of the new homeowners are of Asian descent and therefore are being blamed for the changes taking place. As such, much of the narrative around new development, preserving historic features, and new homeowners is being framed as an immigration issue. As will be presented throughout the report, issues of land use, immigration, neighborhood character and environment are all still intertwined and correlated in complex ways.

[4] http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

Methods

Qualitative data was collected over the course of 10 weeks from June through August 2014. The methods used for this research were mostly based on participant observation, interviews, and overall immersion into the community as the researcher lived on-site. Over 50 conversations were had with representatives of the city government, community board, civic and homeowners associations, local libraries, Queens Borough Community College, Queens Botanical Garden, active local citizens and other local cultural and environmental institutions. General observations of land uses were made while spending time walking and traveling within the watershed.

Contact with the community was made from a number of different angles. The first point of contact was with the five local libraries. Through the Queens Libraries website, civic associations and other local cultural organizations were identified. The District Manager at Community Board 11 was contacted directly and provided contact information for more local leaders. I attended an event at the Bayside Historical Society, located on Fort Totten, and met more active citizens. From these points of entry, other introductions were made in a snowball-like fashion. Direct contact was made with other agencies and institutions by obtaining email addresses and phone numbers through the organization's websites. Detailed field notes were kept throughout the research period. Weekly updates were given to US Forest Service social science researcher advisors that helped iteratively refine my research question, inquiry, and strategy for data collection.

In addition to these informal conversations, interviews were conducted with homeowners that had received a rain barrel from the DEP in the past. Addresses of these homeowners were obtained through a publicly available map maintained by the DEP[5]. Nineteen (19) homeowners with rain barrels were identified within the Alley Creek watershed. Of these homeowners, nine (9) responded to the request for an interview. An additional homeowner with a rain barrel was identified and interviewed during other data collection activities. In total, 10 of the 20 homeowners with rain barrels were interviewed, leading to a 50% response rate.

Within the last two years, three public meetings were held within the Alley Creek watershed to address stormwater and watershed management. These meetings were hosted by different parties and offer an opportunity for comparison of outreach methods, engagement strategies, and results. The first meeting was hosted by the NYC Department of Environmental Protection (NYCDEP) on May 13, 2013 as part of the public outreach required by the consent order for Long Term Control Planning for combined sewer overflows. This was the second of two meetings. The second meeting was hosted by the NYC Department of Parks and Recreation on Jan 31, 2014 as a community outreach meeting for the

[5] Note that the DEP map is currently undergoing renovation and hasn't been updated in the last couple of years. But there has only been one recent local distribution of rain barrels since this time and the offer was only to homeowners within a small portion of the western edge of the watershed.

development of their Alley Creek Habitat Restoration and Watershed Management Plan. This was the second meeting of a three meeting series. The third meeting was hosted by myself, a graduate student researcher, on August 1, 2014 at the request of the Friends of Douglaston Library group to talk about water infrastructure in general. Each meeting resulted in differences in attendance and participation of the public. And while no specific aspect of these meetings can be singled out as creating these differences, a comparative analysis of the outreach and messaging strategies employed was conducted. A summary of these meetings can be found in the table below and more detailed analysis in the Appendix.

Date	Title	Host Org	Location	Attendance
May-13	Alley Creek Long Term Control Plan Public Meeting #2	NYC Department of Environmental Protection	APEC	10
Jan-14	Alley Creek Habitat Restoration and Watershed Management Plan Community Outreach Meeting	NYC Department of Parks and Recreation	APEC	23
Aug-14	The Waters of Queens: Dirty or Clean?	Graduate Student	Douglaston-Little Neck Library	>45

Exploratory characterization and definition of social-site typologies

Over the course of the research period, it became evident that there was a multiplicity of perspectives held about private property by homeowners within the watershed. For instance, many current residents grew up in the neighborhood, own their homes and have lived in the same location for decades. These residents value the historical character and want to preserve the neighborhood in "its garden city ideal". Then, there are empty nesters that, now that their kids are grown and left the household, have more time and money to spend on their hobbies such as gardening. They also are looking to downsize soon and move into apartments to decrease their property management needs, opening up space for new homeowners and continuing the ever-changing demographics of the watershed.

In order to capture all of these perspectives and provide a framework for thinking about private homeowners and their potential for stormwater management, it was decided that the development of a social-site typology would be a useful endeavor. Defining a typology would allow for the breaking down of the "public" into groups that contain individuals with shared characteristics. As one employee from DEP remarked, "It will depend on the individuals you talk to." But it could be added that, if you talk to enough individuals, patterns and shared thinking become illuminated.

The goal of the typology is to better understand the variety of perceptions of private land held by the community and how those perceptions influence behavior toward their landscapes. Particularly of interest are the barriers and opportunities for stormwater management. This social-site typology can then be used to determine the most effective outreach and engagement methods to be used with

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private homeowners in the Alley Creek watershed. Together with physical characteristics, appropriate incentives and regulations that can be applied by city government can be assessed to assist in the adoption of stormwater management on private property.

The breakdown of the typology listed below is preliminary. Since the initial summer research was conducted, two focus groups were held with private homeowners. The data collected from these groups will further inform the development of this typology.

Clean Landscapers

Properties maintained by homeowners within this type are driven by a particular aesthetic where nature is controlled and highly manicured to produce a “clean” appearing landscape. The result of this aesthetic generally results in lush lawns, trimmed bushes along foundations, and no “messy” trees. Many of the newly constructed houses fall into this category as developers often remove existing vegetation to start with “clean slate”.

A homeowner in the neighborhood of Little Neck described her neighbor as having a neat yard and has even observed her picking up leaves off the lawn by hand. She described watching other new houses being built where everything on site is demolished and replaced with new landscaping.

The Jones

These property owners are driven to manage their landscapes by doing whatever is familiar, easy and in their best interest. The Jones types want to keep up with their neighbors and fit in but will deviate from the existing norms and alter their landscape to fit their immediate needs. Lawns are often preferred because they are familiar and perceived to be the easiest landscape to maintain. Many people within this typology have low skilled landscapers mow their lawns and sometimes trim bushes along foundations. Many times, landscapers are hired by numerous households in a particular area to perform work on multiple front lawns at one time. Outside of lawn area, remaining open space is often developed or paved in order to meet a personal need or simply to avoid maintenance requirements of vegetated spaces.

A homeowner in Bayside described watching giant trees being cut down to build larger houses, garages and pools. Another saw a neighbor cement a whole backyard although wasn't sure if the goal was for entertaining or parking.

The Greens

Property owners within this type are consciously maintaining their landscapes in a way that aligns with what they believe is good for "the" environment. What is best for the environment is not consistent among this group and can result in a number of different activities, including reduced pesticide and fertilizer use, vegetable gardening, forested landscapes, use of native plants, preserving existing vegetation, and more. These homeowners are not necessarily incorporating green infrastructure but are interested in doing the right by the environment.

A homeowner in Douglaston allowed their backyard to return to a wooded landscape and referred to themselves as "treehuggers". Another homeowner in Bayside commented that his yard is referred to as "the rainforest" by kids in the area as he little by little eliminated the grass and planted more trees. Others, especially rain barrel owners, use their limited space to grow vegetables for themselves and their family. All of these activities show a respect and appreciation for the environment, whether or not the practice is actually the most beneficial in terms of stormwater management.

Early Adopters

Homeowners within this type have taken actions on their property specifically to address stormwater management, from disconnecting downspouts and redirecting towards vegetated surfaces to installing rain barrels and permeable pavement. These homeowners are motivated by a desire to conserve water and/or mitigate the impact of stormwater on their community.

Rain barrel owners are an example of homeowners willing to go out of their way to retrieve and install new technology and maintain over time. These homeowners often participated in other environmentally sound activities such as organic vegetable gardening and pesticide-free landscaping.

Historical Preservers

These residents have generally lived in the area for extended periods of time and feel deep attachment to their neighborhood. They share an affinity for a particular aesthetic of a past era, usually the one during which their housing development was constructed. This preference is reflected in their current property use. As land use is constantly changing in NYC, many of these residents have active civic lives through which they seek to maintain the past aesthetic of choice. This participation has resulted in the designation of historic districts and the downzoning of neighborhoods in the watershed to maintain the current low density housing scheme.

A subset of this typology is older residents that live singly or in couples and no longer have children living in their households. Often retired, these homeowners use their extra time to rediscover hobbies such as gardening and other community related activities. Those residents that have taken up gardening as a hobby value their flower beds and diversity of plant species.

Maintained without direct input

The people living on these properties do not have direct control over how their landscape is managed. This can include properties that are rented out, condominiums, co-ops, or assisted living style housing where a management firm is hired to handle landscaping needs. This type was not deeply explored during this study and can benefit from further research.

In a conversation with one building manager, he lamented not having enough time to do more than the bare minimum to upkeep the landscape and buildings he works on. He has to service multiple buildings a day throughout the city and so travel time reduces the amount of time he can spend at each building. Therefore, he focuses on basic maintenance and operational needs like reducing flooding. He said tenants end up being the ones to provide extra upkeep. He showed us a building foyer where tenants are maintaining vegetable plants in the small area of open space.

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Considerations for outreach to homeowners

How do you get a message about a natural resource issue to people within a given community?

Community Boards

A first point of entry into a community in NYC is through the appropriate Community Board. There are 59 Community Boards in the City and 14 within the Borough of Queens. The Alley Creek watershed overlaps two Community Boards with a majority of the area falling within CB 11 and a smaller northern portion of the watershed within CB 9. Community Boards are tasked with overseeing matters related to zoning, land use, city budget, and other community matters. A Community Board can have up to 50 volunteer Board members that receive two year appointments by the Borough President. A District Manager is hired by the Board members to oversee and operate the daily business functions of the Board. Each Board has by-laws by which it governs itself.

While the Community Boards were created to facilitate connections between city services and the residents of the City, the effectiveness of this structure is dependent on a number of factors. The District Manager is the only hired position and fields calls and complaints from the residents, talks to people about upcoming meetings, and compiles the monthly newsletter. Often this person ends up with more institutional knowledge than any of the Board members with their short term appointments. Yet, the District Manager is not a formal member of the Board. Therefore, information asymmetries exist between the District Manager with the extensive local knowledge and the Board with decision-making power. Addressing these asymmetries will allow the Board to have more information by which to develop meaningful solutions to community issues and to make more informed decisions on issues concerning their neighborhoods.

Also, Community Board members are volunteers that want to do right by their community and while motivated and active, they may not have the level of expertise needed to understand all issues affecting their community. Yet, important city happenings are being presented to the Board first with the intention that the Board will then inform its constituents. If the Board does not fully comprehend the impacts and/or urgency of the material being presented by a city agency, for instance in the case of sewer system upgrades, then the information delivered to residents will reflect that and may not even be passed along.

Finally, the Board feels email communication is too heavily relied on for outreach to the community. With respect to water and sewer issues, a suggestion was made to include more educational information within mailed water bills to reach a broader section of the public.

Stewardship Organizations and Alley Pond Environmental Center (APEC)

In addition to the Community Boards, there are existing networks of civic and environmentally-focused stewardship organizations throughout the City. These networks and existing relationships can be capitalized on for outreach and engagement. Past US Forest Service research has begun to identify these organizations, their "turf", and their connections to one another in major metropolitan areas including New York City[6]. Partnerships with these community organizations can be beneficial for city agencies given the scope and scale of reaching out to millions of individuals. DEP and Parks are often relying on these networks to distribute meeting invitations and other information related to their operations.

When partnering with a community group, you are relying on their connections for distributing your information. Therefore, it is important to understand the organization's particular relationship with its network. Sometimes there are disconnections between how the government views the partner organization, how the organization views itself, and what the community is looking to the organization for. This will impact how messages move through the system. The more these perspectives are aligned, the more effective this option will be in delivering the right message to the target population.

For example, in the Alley Creek watershed, the Alley Pond Environmental Center (APEC) is utilized as a primary contact for outreaching to the "environmentally-aware" community. While the name implies a focus on the local natural resource Alley Pond, the nonprofit organization's primary focus is on providing educational opportunities for students throughout the New York metropolitan region. Children come from all over the boroughs to take part in the outdoor and wildlife programming offered by APEC.

City agencies often use APEC's physical space to host public meetings and their email list-serve to invite members of the public to these meetings. Yet, APEC's weekly newsletters are mostly filled with events and programs available for children and families. Therefore, using these newsletters and list-serve to send information about upcoming local public meeting may be less effective than expected as it includes people that are beyond the boundaries of the Alley Creek watershed and people may not be expecting this type of information from these newsletters. For instance, one rain barrel homeowner mentioned how his kids go to APEC for summer programming and so when I asked him if he had seen the invitation for the recent watershed meeting within one of the emailed newsletters, he replied that he usually just deletes them as he has been too busy lately. His kids are already at APEC so doesn't need to check the newsletter for more information.

Civic Associations

An additional benefit in the Alley Creek watershed is the number of active civic and homeowners associations that can be used to reach private property owners. The map in Figure XX shows the approximate geographic extent of these organizations. The existing homeowners and civic associations were generally formed to preserve this original garden city environment against increasing development pressures and to address other communal issues such as crime and neighborhood beautification.

[6] (Connolly, Svendsen, Fisher, & Campbell, 2013)

Neighbors within these communities are highly connected with one another and seem to share lots of information related to property management and other issues.

New Partnerships

To reach the remaining segment of the population not directly involved within a civic association or APEC, new partnerships may need to be made, for instance, with the local libraries and churches that are involved in civic activities. One volunteer that I met with from a local library is an avid gardener and was a great connector within her neighborhood, sharing plants with her neighbors and supporting local landscapers.

An increasing challenge to outreach in this watershed is the changing cultural diversity and associated language barrier that arises with new immigrants. Acknowledging this shift is important when developing outreach materials to ensure inclusivity and negate any bias towards native English speakers. Some possible methods for reaching this community will be to partner with cultural centers and churches, the local libraries that are offering English as a second language (ESL) courses, and even through the school system as the children of these families often learn English more quickly and are more confident in their language skills. Watershed management can be used as a tool to build the partnership between existing, long term residents and new immigrant families and alleviate the perception that new immigrant families are destroying neighborhood fabric with their large out-of-context houses.

Considerations for messaging to different types of residents

Once you have people's attention, what do you want to tell them? How do you engage in a meaningful way?

As the findings from the previous analysis show, content and messaging affect the entire process of interacting with the public, from outreach to engagement. Distribution of information is one factor of outreach, but with the wrong message, people will not respond to the information you are giving them. The message should be tailored to the audience and highlight an aspect of what is important to them. For example, framing green infrastructure in terms of stormwater management limits its appeal to those homeowners that care generally about "the environment". To reach a broader audience, the message used to engage the public may need to connect on a more personal level. As one local community leader noted, "There's a need to connect people to the reasons why and how. This is an expensive area and there are a lot of two income families so they do not have a lot of spare time." A case study in Chicago came up with similar conclusions, "Until communications around the Milwaukee Avenue

Corridor stopped focusing on "stormwater solutions" and started emphasizing "landscape improvements," local property owners had little interest in participating." [7]

The typologies can be used to gauge the perceived barriers to adopting green infrastructure and messaging can be developed that addresses these concerns. Common barriers include cost, time, knowledge, interest and risk. These barriers can be addressed by providing targeted and appropriate opportunities for each typology. For instance, if lack of knowledge is the barrier, then an appropriate solution would include providing more seminars and educational programs. If lack of resources is the major barrier, then incentive programs would allow these people to adopt GI. More research is needed to determine exactly what these barriers area but a preliminary analysis of barriers and opportunities by typology is provided below.

	Major Barriers				
	Cost	*Time*	*Interest*	*Knowledge*	*Risk*
Clean Landscapers			X	X	
The Jones	X	X	X		
The Greens	X			X	X
Early Adopters				X	X
Historical Preservers		X	X		
Without Control	X	X		X	

<u>Clean Landscapers</u>

Barriers: This type will tend to choose aesthetics over environmental considerations. Generally, these homeowners are already investing resources and time into their landscapes. The largest barriers with this type are interest in and knowledge of GI options.

Opportunities/Messaging: The goal of messaging to this group would be to show how GI can be aesthetically pleasing. Pavement and hard surfaces are often preferred to meet their clean aesthetic and contribute negatively to stormwater management. Promoting permeable pavement options may be an easy sell to homeowners within this type.

<u>The Jones</u>

Barriers: These homeowners are time and resource-constrained and want to do whatever is easiest with respect to their landscapes. Lawns are perceived to be easy and moreover, familiar and so is the most common landscape of this type. Private property will also be altered to fit individual needs, such

[7] http://www.metroplanning.org/news/article/6903

as paving of front yards to make a parking spot for their car. Interest, time, and resources all prevent The Jones from taking on stormwater-related projects on their property.

Opportunity: This type is least likely to respond to GI messaging that is focused on improvements to “the” environment. To promote interest for GI with these homeowners, messaging will need to shift towards how GI will personally benefit them, such as promoting flood reduction, health benefits, or reduction in maintenance costs/time as compared to lawn care. Additionally, GI incentive programs that address the resource and time barriers will be popular with this type.

The Greens

Barriers: This type is mostly limited by lack of knowledge of GI techniques and the associated risk to their property. Also, since these homeowners feel strongly about protecting the environment, they may participate in activities that favor a different, and potentially conflicting, environmental objective. For example, a large vegetable garden may be desired over a rain garden or forested area. These homeowners also may be limited in terms of time and resources.

Opportunity: This type is most likely to respond to the current messaging that focuses on the greater environmental co- benefits of GI. Connecting these homeowners to existing resources and expanding educational and outreach programming would assist in attracting more of these homeowners to adopt GI practices.

Early Adopters

Barriers: These homeowners are the most likely to adopt GI as they have already taken action towards water conservation and stormwater management on their property in some form. But installation of one type of practice does not mean that a homeowner is aware or informed of other actions he/she can take. This barrier of knowledge along with the associated risk of new technology mostly limits GI adoption with this type.

Opportunity: The greatest opportunity available lies within this typology as these homeowners already accept the need for water conservation and stormwater management. The remaining barriers to overcome are most likely practical ones. There exists a need to connect these homeowners with professionals that can assist them in installation of more advanced techniques such as permeable pavement and rain gardens.

Additionally, since the DEP maintains a map with rain barrel owners and other GI adopters, these homeowners can be identified and specifically targeted with resources. From these early adopters, GI techniques can spread to nearby neighbors.

Historical Preservers

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Barriers: In some ways, this type will be the hardest to budge because they are stuck on a particular aesthetic and least likely to want to change. Probably more stable financially due to longevity in the neighborhood and therefore not going to be swayed by financial incentives. Interest and time are the major barriers for this type.

Opportunity: With cost not necessarily being a huge factor, an opportunity lies in a design challenge for professional landscapers and architects to incorporate GI into historical aesthetic. To combat interest barrier, messaging could market the potential for increased property values as more and more homeowners are seeking green buildings.

Maintained without direct input

Barriers: The barrier for this type is unique in that unlike a homeowner, the individual living within these properties has limited control over the landscaping practices. Typically, a management firm handles the landscaping. More research should be performed on the decision-making processes for these property types.

Opportunity: The centralized nature of the management of these large properties provides an opportunity to have a significant impact on stormwater management by convincing a limited number of decision makers. While an individual may not have complete control over the management of the property, he/she may be able to influence these key persons to adopt more environmentally-sound practices including GI. Also, there may be opportunity for an interested person to perform some landscape improvements, such as building and maintaining a rain garden.

Outside of the opportunities for an individual living within these properties, any cost savings or maintenance reductions due to GI installations can be marketed to building owners and management firms. Messaging could also show that renters/people living in these spaces want environmentally friendly landscaping.

Lessons Learned: A comparison of outreach and engagement methods from three public meetings

Public meetings are a common format used by city agencies to inform, gain input, or receive feedback from residents of a particular area on upcoming public works projects and planning initiatives. Within the last two years, three public meetings were held within the Alley Creek watershed to address stormwater and watershed management. These meetings were hosted by different parties (DEP, Parks, and myself) and offer an opportunity for comparison of outreach methods, engagement strategies, and results. The Appendix contains a full analysis of the messaging and engagement methods used for three recent public meetings. Below is a summary of the lessons learned.

- **Outreach Methods**: Email and electronic communication have made it easy to spread a message to many people quickly and efficiently. But overreliance on these methods can lead to poor results in terms of attracting people to attend meetings. Door-to-door canvasing would potentially reach more people but would require too much time and resources. Therefore, a combination of outreach methods needs to be considered in order to effectively attract people to a meeting. The source that someone hears about the meeting from is important. A small investment in making sure local leaders and community connectors understand the topic and importance of a planned meeting can go a long way as they will be more apt to promote your cause personally to others. Identifying these leaders and hand delivering flyers to them offers an opportunity for conversation about the cause and builds rapport and trust.

- **Flyer Content**: While some people may hear about a meeting by word of mouth, a majority of the public is going to view the invitation flyer as a stand-alone message (no people around to explain anything). Therefore, its content is extremely important in sparking interest and enticing people to attend public meetings. Technical jargon and acronyms should be avoided. Also, make clear in the flyer why the public should be interested in your topic. Often flyers include the goals of the meeting from the perspective of the city agency/presenter but these goals may be less important to the community. How does the objective of the meeting overlap with topics that may be of more interest to the public? For stormwater and green infrastructure related events, the typology framework offers suggestions for attracting various segments of the public. Using a variety of topics within the flyer could entice a diverse crowd to attend the meeting.

- **Engagement**: The purpose of a public meeting is generally to inform about activities in the area <u>and</u> receive feedback. Often the flow of a meeting tends to succeed in the direction of informing the participants but struggles in the ability to receive valuable input. This de-valuing of local knowledge can leave participants feeling disempowered and less likely to attend future meetings. To assist in alleviating this disconnect, prior to the meeting, identify the aspects of the plan that can be enhanced by local knowledge and public input. If possible, design interactive methods of gathering feedback as asking questions in a larger group may be uncomfortable for some people.

- **Meeting Content**: If the content of the meeting contains excessive technical jargon and analyses, people will be overwhelmed and lose interest. Therefore, in order to convey the most information to a general audience, prepare the meeting content with low expectations of prior knowledge. When presenting, gauge the collective knowledge of the audience by checking in with prompts and questions along the way. If the audience seems to have the technical background needed, then the decision can be made to skip those explanations.

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Existing regulations and programs impacting private homeowner land management

A number of initiatives are already underway in throughout the City and the Alley Creek watershed to regulate stormwater and promote GI. The Alley Creek watershed is complicated because it contains a combination of combined sewered, separately sewered and septic areas. Initiatives and regulations for GI are often related to and based on these sewer system boundaries and therefore are not distributed and offered equally throughout the watershed. This uneven distribution of programs can confuse residents as they identify collectively by other boundaries such as neighborhoods and civic groups. Below contains a summary of the initiatives underway and an analysis of their impact.

Community Initiatives

- **Stewardship Activities:** Some community organizations are already engaged in stormwater management or similar activities that can be capitalized on. Queens Botanical Garden (QBG) has a LEED platinum building that recycles stormwater through vegetation and reuses it for non-potable uses within the building and a parking lot that uses bioswales to capture runoff. A new LEED silver building is planned for APEC's offices that will include bioswales to capture parking lot runoff. The Douglaston Garden Club has over 100 members that take part in neighborhood beautification events and garden related seminars. These resources, in terms of example infrastructure and human interest, are assets to this community. Many people expressed a desire to have more seminars and events offered that explain why green infrastructure is important and how to get involved. Both QBG and APEC focus most of their activities on educational events for children and a suggestion would be to create more opportunities for adults. The Douglaston-Little Neck library has begun to fill this role and is looking to establish itself as the "green" library for the community, offering workshops on composting, local wildlife, and other related activities.

Regulation

- **2008 Yards Text Amendment:** In response to an increase in homeowners paving over front yards to create additional parking spaces, in 2008, New York City passed a regulation to require a minimum percentage of vegetated space for front yards. The amendment requires at least 20 percent vegetated coverage for a yard less than 20 square feet and at least 50 percent for yards 60 square feet or greater. Prior to the code, there was no requirement for vegetated area.

  Unfortunately, according to the 311 website, a number of complaints are still being reported about neighbors paving over their front yards. In Alley Creek's watershed alone, over 130 complaints of illegal curb cuts and driveways have been filed since 2010. The complaints are sent to the Department of Buildings. People do not feel that enforcement has been significant enough and that the regulation is not hindering the trend of front yard paving. An article in the

Queens Chronicle dated as recently as March 2014 states people are still enraged and feel "the reason that residents continue to pave over their green space is because the law is too lax."[8] Sometimes fines are issued but rarely, if ever, are homeowners forced to remove the new paving. Often this is because it is difficult to prove that the paving was performed after 2008 when the regulation was in place. Also, the Department of Buildings, the city agency in charge of this regulation, does not have the resources to continually follow-up every case. A local contractor states, "While he has seen homeowners having to rip up their cement, a few years later, they're paving again."[9] The cumulative impact of increasing impervious surfaces can have significant effects on the local sewer infrastructure and resulting overflows into waterbodies like Alley Creek.

- **2012 Stormwater Performance Standard**: DEP and DOB have collaborated effectively on the establishment of the latest stormwater performance standard. Effective as of July 2012, the performance standard applies to new development and major alterations where the total new stormwater release rate exceeds 0.25 cfs.[10] As many smaller sites may not exceed this threshold, medium and large lots are most likely to be affected. The rule allows for a number of technologies to be used to from traditional dry well systems to green roofs and rain gardens. While allowed, the innovative vegetated systems are not being installed as frequently as other traditional solutions. Part of the reason for this is that special approval is required by DOB for these systems as they are considered "new technology". The additional processing time is seen as a hindrance to the development timeline and the faster option is chosen.

  In addition, architects, developers, and contractors may not be familiar with these techniques and so are not offering them as an option to homeowners. In an interview with a rain barrel owner, when asked about other techniques for capturing stormwater such as permeable pavement and rain gardens, she replied that she did not know about them. After the techniques were explained, she told about an enormous dry well that she just had installed in her backyard with the dimensions 6 feet deep and 4 feet wide. She had built an addition to the house and the dry well was sized by the architect based on the new stormwater requirement. If she had known about rain gardens, she would have opted for that because she feels the dry well is an eyesore as she can't even plant on it. She felt that it would be important to educate the architects because if they don't know about rain gardens and the like, then the construction

[8] http://www.qchron.com/editions/queenswide/the-problem-with-paving-over-lawns/article_18b48d05-6681-5b28-a8e7-bc6f7570e06f.html

[9] http://www.qchron.com/editions/queenswide/the-problem-with-paving-over-lawns/article_18b48d05-6681-5b28-a8e7-bc6f7570e06f.html

[10] http://www.nyc.gov/html/dep/pdf/green_infrastructure/stormwater_guidelines_overview_2012.pdf

companies won't do it. Another resident in Bayside expressed similar notions as his neighbor just had two large drywells installed in this backyard.

Incentives

- **Rain Barrel Giveaway Program**: This program was started by DEP in 2008 as part of the Jamaica Bay Watershed Protection Plan. Not knowing what to expect that first year, the agency offered a free rain barrels to residents of Queens. With only 250 55-gallon barrels to giveaway, the DEP found that demand far exceeded the supply. In years since, the DEP has become more strategic about its rain barrel giveaway program, focusing on distribution within priority CSO areas. Residents within these designated areas will receive an email if the program is available to them and then they must follow instructions and pre-register to receive a barrel. This process ensures that all who sign up will receive a barrel on distribution day. The DEP then selects a distribution date and location and homeowners must pick up the barrel at that time and install it themselves. Given that only part of the Alley Creek watershed is within a priority CSO area, only residents within these areas have access to the Rain Barrel Giveaway Program. This confuses residents as CSO areas rarely follow neighborhood boundaries and people wonder why their friend was offered this benefit and they were not. The community board receives many requests for rain barrels and has also been inquiring whether the program can be brought back to their area.

- **NYC GI Grant Program:** Like the Rain Barrel Giveaway Program, this program is only offered for properties located within priority CSO areas. While a small percentage of the City's total investment in GI, this private property grant program is large compared to what other cities are doing. Currently, DEP has 29 active projects costing $11.5M total. In addition to only being offered in CSO areas, there are some eligibility requirements that make this grant program difficult to obtaining for the private homeowner in the Alley Creek watershed. The grant requires a $35,000 minimum ask, a 20 year restrictive covenant or require to maintain for at least that long, one owner per project, and the project must be publicly visible if not accessible. Because of these requirements, this GI Grant Program is mostly reaching community based and anchor institutions. Only a small portion of the Alley Creek watershed is eligible for projects and so far no projects have been implemented as a result of this program within the watershed[11].

- **Bioswale Implementation:** DEP's right-of-way contracts make up a majority of the GI Program's efforts and resources according to its 2013 Green Infrastructure Annual Report. These are being implemented in area-wide contracts of 200 to 300 bioswales at a time within priority CSO areas and therefore are not happening within Alley Creek. A story was shared of a local civic

[11] NYC GI Grant Reference Map
http://www.nyc.gov/html/dep/pdf/green_infrastructure/2014_gi_grant_reference_map.pdf

association that was interested in turning one of their planted road medians into a bioswale and DEP said they could not offer assistance as they are focused on priority CSO areas. The civic association even offered to share the costs but was turned down. While the prioritization of bioswale implementation based on those CSO sheds that are most in need is important, residents overall do not completely understand the boundaries and feel confused and discouraged from implementing these types of projects. While this is not directly a private property issue, the impact of being told that "you are not located in a priority watershed" could send mixed messages about the importance of stormwater capture. Given that the MS4 permit is currently being written, separately sewered areas will become a priority in the future and these types of projects could be seen as a missed opportunity. If not DEP's responsibility, what other organization could be assisting civic associations in achieving these goals?

Assessment of possible stormwater management actions

Where could people (city agencies, stewardship organizations, concerned citizens) put their focus to get the most "impervious area disconnected for their buck"?

The current strategies to address stormwater management only reach a small portion of the homeowners in Alley Creek; all of the incentives are focused only on CSO watersheds, the regulations are either poorly enforced or only address new development, and the education opportunities for adults are minimal or underutilized. The majority of homeowners that live within separately sewered areas are being left behind. And while CSO watersheds are the current priority for the DEP, separately sewered areas will come under increasing scrutiny as the MS4 permit is developed. Further, homeowners do not identify with their sewer system type and do not understand why some neighbors are offered benefits and they are left behind.

In this section, a number of strategies were assessed for their ability to have a positive impact on stormwater capture versus the level of investment that would be required. Impact was evaluated based on both the biophysical *and social* improvements to the watershed. Keeping stormwater out of the sewers is the primary means for improving the water quality of a receiving waterbody, in this case Alley Creek. Improved water quality links to increased opportunities for recreational activities such as fishing and swimming. The impact of a given strategy can then be estimated by considering the number of homeowners reached by a particular action and the resulting impervious area that would be disconnected from the sewer system if that homeowner installed GI. Further, the biophysical benefits are maximized if retention options, or techniques that use vegetation or reuse to capture water, are used as opposed to detention techniques that store the water in cisterns, pipes, or other hard infrastructure. Since GI is promoted as providing additional co-benefits, such as improved air quality, reduced urban heat island effects, and increased property values, then it is equally important from a social perspective to strive towards even distribution of GI opportunities and installations across the various populations throughout the watershed. Therefore, actions that engage a population that has been previously been under-serviced would be considered high impact.

The level of investment was estimated as the financial and human resources that would be required to achieve each strategy. Also, consideration for the feasibility of the action and the ease of implementation was accounted for in the estimate of level of investment. For example, a strategy that builds off of an existing project and is support by existing institutional infrastructure is considered to need a lower level of investment.

In addition to the existing programs being implemented by government agencies and stewardship groups outlined in the previous section, a few strategies piloted by other municipalities were considered in this analysis. A brief summary of these programs is listed below:

- *Post-development Stormwater Management Ordinance, Atlanta:* The previous stormwater rule focused on peak flows from large storms which led to the creation of large, dry detention ponds and expensive underground cisterns. The new Runoff Reduction Standard regulates that new construction projects must capture first inch of rainfall using infiltration, evapotranspiration or reuse for irrigation or indoor plumbing. Specific guidance and training is provided for engineers, architects, and other professionals that will be affected by the rule. This ordinance is an improvement upon NYC's current SW Performance Standard because it requires/prioritizes retention over detention and has supporting infrastructure to ensure professionals know and understand the standard.

- *Water Audit Program, Baltimore and RiverSmart Homes, District of Columbia:* This program provides water audit assessment services for free to homeowners in priority watersheds. The audit includes sending a staff person to perform an on-site assessment of a property and results in a set of recommendations the homeowner can take to manage stormwater runoff on their property. These recommendations include downspout disconnection, rain gardens, hardscape removal, and tree planting. Further, this program offers related services and rebates to assist homeowners with the costs of installing these practices. The cost of this program is supported by a stormwater fee implemented in Washington DC in 2010. This "mini-grant" program could provide incentives for homeowners in NYC that do not have a project large enough to apply for the NYC GI Grant Program.

- *Stormwater Facility Credit Program, Seattle:* In this program, a property owner can install an approved SW facility and receive a credit (cost reduction) on their drainage bill. The project is then inspected once a year for compliance. To implement this type of program in NYC, it would require a restructuring of the SW charge. Currently, stormwater and wastewater costs are lumped in a single fee calculated as 159% of the charges of water supplied to that property.[12]

A 2x2 matrix was then developed with Investment on the horizontal axis and Impact on the vertical axis. Those strategies that were estimated to be High Impact-Low Investment were considered the low hanging fruit. These strategies should either be initiated or expanded to meet the stormwater capture needs of this watershed. The strategies that were either High-High or Low-Low Impact and Investment were evaluated for their benefits and potential application to this watershed. The strategies that are High Investment- Low Impact are not going to provide much opportunity for this watershed but were examined to determine if changes could be made to make these options more viable.

Impact	High	Train Local Leaders Revise SW Performance Standard Engage Immigrant Populations	Enforcement of Yards Text Amendment Water Audit Program w/rebates Rain Barrel Giveaway Program
	Low	Educational Programming for Adults	NYC GI Grant Program
		Low	High
		Investment	

Low Hanging Fruit (High Impact- Low Investment)

- **Train Local Leaders:** The Alley Creek watershed hosts a fairly large, active citizenry. These leaders of civic and homeowners associations, the community board, and other local institutions have some level of decision-making power at their disposal and so it is important that they are well informed about the problem of stormwater runoff pollution and the potential solutions available to them. These leaders maintain community ties built on a foundation of trust and mutual interest in neighborhood affairs and therefore can reach and influence a significant portion of the homeowners. The investment to provide this service would be relatively low with one to two trainings offered per year.

- **Engage Immigrant Populations:** Engaging this sector of the population in stormwater management efforts is a high priority and crucial for the future of this watershed. Demographic trends over the last decade show a steady shift of the population in Alley Creek from mostly white to mostly Asian. Given the anti-immigrant sentiment that is connected to the development of new large homes and removal of existing vegetation, watershed management can be seen as a community building initiative where misunderstandings can be addressed and

[12] http://www.nyc.gov/html/nycwaterboard/pdf/rates/fy2013_rates.pdf

trust built. A study of immigrant behaviors in New York City found fears of immigrant populations being less likely to engage in pro-environmental behaviors is unfounded. Of greater significance is their lack of involvement in environmentally oriented political behaviors.[13] Therefore, investment should include a conscious shift of effort when conducting public meetings, volunteer opportunities, and outreach to overcome the language barrier and provide translation. Outreach strategies should include some non-traditional channels such as churches and schools where immigrant populations are most connected.

- **Revise the 2012 Stormwater Performance Standard:** The new stormwater performance standard is already being implemented in this watershed and is leading to the reduction of runoff to the sewer system from new and major redevelopment projects. Of the projects mentioned by community members, dry wells are the solution being suggested to them by architects and contractors. These residents do not like the dry wells and are open to new solutions. An opportunity exists to use these stormwater projects to engage with homeowners about new techniques that may be more desirable aesthetically, such as rain gardens, and offer the additional benefits associated with vegetation. Educating architects, contractors, and homeowners about their options while removing the barrier associated with additional processing time for review of these techniques could contribute to increased implementation of vegetated GI throughout the watershed. Also, the Storm Water Infrastructure Matters Coalition (S.W.I.M.) has begun to maintain a list of designers and contractors that are experienced with GI and homeowners undergoing this process should be connected with this list.

Mid-level (High-High or Low-Low)

- **Enforce Yard Text Amendment:** The enforcement of this regulation should be a priority for this watershed and throughout the City. The cumulative impact of paved front yards could produce significant increases in stormwater runoff. In addition to this stormwater impact, the paving of the front yards discourages other homeowners and makes them feel that the existing regulations are meaningless. The investment it would take in financial and human resources to effectively address this issue is assumed to be the current barrier. A conversation with staff at DOB would be helpful for identifying other barriers and possible solutions. Because this issue has impact on stormwater runoff, collaborating with DEP may help meet the need. It would also be helpful to research the underlying reasons why front yards are being paved in the first place. Is there a lack of adequate parking space? Do people own more cars due to lack of viable public transportation options? Do people choose to pave for ease of maintenance over vegetated options? Knowing the answers to these questions would assist in developing appropriate

[13] (Pfeffer & Stycos, 2002)

mitigation measures. And what about back and side yards? Should regulations be in place to conserve these pervious spaces as well?

- **Water Audit Program:** While the impact of this strategy could be high, it would require a high level of both human and financial resources to perform the audit and provide rebates, respectively. The District of Columbia and other cities have overcome this financial barrier by revising their wastewater charge to account for stormwater specifically. While NYC has and continues to consider SW fees, this option would be costly without that income stream. But with a significant number of properties that could benefit from a simple downspout connection and a scaled-down version of this Water Audit program could be considered. Also, rebates without an audit may not be far off in the future as the DEP is in the process of considering the feasibility a "mini-grant" program. Would be important to consider outreach methods if a program like this were implemented.

- **Rain Barrel Program:** A crowd pleaser that has low stormwater capture potential (as one DEP employee stated, the stormwater captured in a 55 gallon rain barrel is like "a sneeze in the ocean"). But when considering other impacts, including widespread engagement and diversity of homeowners impacted, this high demand program offers additional benefits that increase its overall impact. The rain barrel process can be used as an outreach tool and for public relations. Water rates have increased significantly in recent years and offering a rain barrel makes homeowners feel like they are getting something in return. And since homeowners self-select to obtain a rain barrel, of the rain barrel owners interviewed for this research, all of them were highly environmentally aware citizens. These early adopters could be interested in piloting other green infrastructure solutions and the rain barrel giveaway program is a great way to identify them. Also, to increase the stormwater impact of the program, can consider a joint rain barrel/downspout disconnect program.

- **Educational Programming for Adults:** More general than the leader training and engagement of immigrant populations, offering additional programming for adults on watershed, sewer system, and green infrastructure topics could grow the contingent of active community members attending infrastructure planning meetings and taking initiative to manage stormwater on their own property. Many resources including installation manuals, maps, presentations, and fact sheets, have been developed by organizations within this watershed and throughout NYC. This initiative would seek to connect these existing resources with homeowners in the watershed. For instance, GrowNYC has a great brochure on implementing stormwater management projects. This could be undertaken by the multiple community organizations, city agencies, and civic associations already conducting stewardship activities in the area.

Appendix 18

The actual stormwater captured by this initiative would vary based on the intensity of the initiative and was conservatively estimated as low impact. But by making visible "invisible" infrastructure, a foundation is laid for future GI adoption as promoting education and awareness can empower citizens to take action. As demonstrated in the meeting held at the library, once people understand the basic functions of stormwater infrastructure, they can also begin to develop solutions.

Not Without Changes (Low Impact -High Investment)

- **NYC Grant Program:** Only a small portion of the watershed is eligible and given the restrictions of the grant, only a small number of properties are eligible within that. Queens Borough Community College could serve as a potential site but the technical expertise and administrative resources may not be present within the institution currently. The College is currently behind on a grant received in 2012 to retrofit a parking lot with bioswales due to staff changes and the need for more financial resources. This grant program could potentially assist QBCC in meeting its remaining financial needs. NYC DEP is also actively considering a mini-grant program that would allow homeowners to apply for grants to complete smaller GI projects. Outreach for this program would be an important component in order to ensure equal opportunities to all homeowners.

Conclusions and final recommendations

Urban watersheds are characterized by high levels of development in the form of roads, houses, businesses, and parking lots that support and impact quality of life. These features create large percentages of impervious surfaces that impede the infiltration of stormwater during rain events and alter the natural hydrology of the watershed which contributes pollution to receiving waterbodies. Mitigating the impact of this development is crucial to improving the health of local rivers and creeks so that they can support wildlife and recreational opportunities for residents and visitors.

Since the early 1900's, wastewater and stormwater flows were dealt with in a centralized fashion with the construction of hard infrastructure such as sewers, catch basins, and treatment plants, that collect and treat the water. This "invisible" infrastructure is often undervalued by people as it is out of sight and therefore not consciously thought about. Over the last decade or so, a paradigm shift towards treating stormwater as a resource as opposed to a waste product has shifted solutions to include smaller, decentralized projects that capture and use stormwater at the source. This shift had led to the integration of traditional hard infrastructure and newer green infrastructure in watershed planning efforts including the Long Term Control Planning efforts in New York City.

Watershed plans are made based on baseline conditions, while in reality, the landscape of an urban watershed is dynamic and constantly evolving with the destruction of old buildings, development of new buildings, creation and loss of parkland, restoration of ecosystems, and the upgrade and maintenance of supporting infrastructure. These land use actions are shaped by a number of forces and decisions made at a variety of scales including neighborhood, city, state, and regional levels. In addition, there is a flux of people moving across the watershed boundary changing demographic and economic characteristics. These trends are also considered when conducting watershed planning and developing management strategies.

Decentralized green infrastructure presents new opportunities to engage actors that previously did not concern themselves with stormwater infrastructure. In the Alley Creek watershed, 62 percent of the land area is zoned as residential which indicates that homeowners have a particularly strong influence over the landscape of the watershed. Therefore, understanding how homeowners perceive their private property, what factors drive their maintenance practices, and what prevents implementation of stormwater management measures can assist decision-makers in developing appropriate programs, incentives, and regulations to achieve better land use practices on residential property. While a multitude of perspectives exist, the development of a social-site typology in this study generalizes residents into 6 categories with shared motivations for landscape maintenance practices, barriers to implementing stormwater management practices, and opportunities for messaging and engagement.

In addition, these individuals may participate in local organizations, civic associations, and stewardship groups to address issues that are aligned with their values, interests, and priorities. This "social" landscape can be seen as a web of relationships between residents, organizations, and city agencies and is important for understanding how to best outreach to individuals. This social network can be used along with the biophysical characteristics and social-site typologies to develop appropriate strategies for watershed planning and management efforts. The following is a summary of recommendations for watershed management in Alley Creek.

- **Protect existing pervious area on private property** According to NYC DEP Alley Creek GI Plan data, the CSO portion of the Alley Creek watershed is estimated to be about 65 percent impervious. The DEP does not list Alley Creek as a "priority CSO area" and actions should be taken to preventing this watershed from becoming one. Private pervious area is already serving as a type of "green infrastructure". At a minimum, maintaining this current imperviousness and preventing it from increasing needs to be a priority. Enforcing the Yard Text Amendment is an example of an action that supports this goal by requiring minimum pervious coverage in the front yards of homes. Then, the focus can shift on making these pervious spaces more "productive" in terms of stormwater management.

- **Capitalize on existing social networks and engage new populations** Decentralized solutions to stormwater management open opportunities to engage new non-conventional actors in solutions. The existing social networks in the Alley Creek watershed have organized around local development issues in the past (e.g. zoning downgrades, complaints about paving of front yards). These networks can be capitalized on by training local leaders on issues related to stormwater management. Studies showed that educational efforts addressing groups were more successful than those that focused on individuals alone.[14] A message of stewardship coming from a trusted neighbor is more likely to be received positively and have a larger impact than an impersonal educational campaign. Efforts should be made to engage populations not currently captured within these networks, namely the steadily increasing immigrant populations.

- **Beyond incentives** Cost is not the only barrier to GI adoption and therefore, incentives alone will not equate to widespread GI adoption. According to the typology, The Jones and The Greens will be most susceptible to cost-reducing incentives. A conversation with an employee working for the District Department of the Environment in Washington, D.C. stated that high income residences were not participating in their GI incentive program because they do not need the cost-savings and have different aesthetic preferences. Since these elites often set the desired landscape preferences, targeted efforts towards local leaders are again important.

- **Pilot more GI projects** Aesthetics and related social status/acceptance of new landscape practices are barriers to creativity in development of alternative residential environments.[15] Yet, this role of social capital can also be important and utilized for adopting new practices, like GI, as homeowners are more likely adopt a new practice if an adjacent property has already installed it.[16] The theory of diffusion of innovation seeks to explain how, why and at what rate new technologies are spread through cultures. Following a bell curve from left to right, innovators and early adopters start a trend by taking the risk and trying a new technology. Once these early adopters show that the technology is worthwhile, a group termed the "early majority" will begin to utilize the new technology and so on throughout the population. In the Alley Creek watershed, rain barrel owners can be seen as Early Adopters. These homeowners are most likely to be interested in other GI techniques. Through targeted engagement of these homeowners, GI installations can be spread throughout the watershed. Then, following the theory, homeowners adjacent to these projects will be more likely to adopt GI in the future as the risk and aesthetic barriers will have decreased.

- **Increase trust and communication between the "public" and the "city"** Often these entitites, the public and the city, get generalized into stereotypical actors. In order for innovative and collaborative solutions to arise, miscommunications need to be addressed and awareness built of the complexity on either side. The typologies attempt diversify the "public" while an

[14] (Blaine, Clayton, Robbins, & Grewal, 2012)

[15] (Blaine et al., 2012)

[16] (Green, Shuster, Rhea, Garmestani, & Thurston, 2012)

educational effort to breakdown the role of the various city agencies could provide more transparency of the decision-making around environmental issues.

Future research opportunities

This research project was exploratory and as such many of the findings presented are preliminary and offer opportunities for further research.

- **Testing of these typologies** This social-site typology is preliminary and it would be interesting to know how well it applies to other urban watersheds. Also, more targeted research could be conducted to link beliefs and values with landscape practices and to further narrow down what barriers to GI implementation exist.

- **Controlled studies examining the impact of different outreach methods and/or messaging** An example of this kind of research is underway, led by the DEP, related to grease disposal. More studies like this one related to outreach and messaging of GI would be helpful. The DEP and other city agencies could look to the Urban Field Station for assistance in designing these social science studies.

    - "As part of that pilot program, residents of one building in a Manhattan housing complex served as a control group and received DEP's standard educational materials, while residents of another building in the development participated in additional meetings, workshops, and events focused on grease. The sewer service lines from both buildings were inspected and cleaned prior to the program, and crews will re-inspect the lines at the pilot's conclusion to measure the relative improvement as a result of the intensive curriculum."[17]

- **Comparative research with another watershed** Conduct exploratory research in another watershed with different physical and social characteristics, particularly one with different demographics, density, types of private homeowners. Would be valuable to assess similarities and differences to strengthen applicability of the recommendations offered here to other urban watersheds.

- **Linking typologies to a spatially available source** Comparing and contrasting this qualitative study with existing data such as market segmentation data. Interested in connecting typologies to a spatially available data source that can then be used to predict the potential for stormwater capture by resident type.

- **Community mapping project** This watershed is complex in terms of its physical watershed characteristics and sewer system. Would be helpful to know more about "micro-environments"

[17] http://www.nyc.gov/html/dep/html/press_releases/14-037pr.shtml#.VC6hLxZ0b5A

that exist throughout and how those relate to green infrastructure solutions. Can learn a lot from just talking to people about their personal experiences. For instance, high groundwater table around Oakland Lake was mentioned by people. This presents a barrier to using infiltration techniques for stormwater management on these sites. Initiate community mapping project to understand more about the physical landscape- where are areas of high groundwater, clay/low imperviousness, flooding, etc. This may help identify more physical barriers in this watershed that would be expensive to determine with engineering analyses alone. Can supplement information with engineering analyses as needed.

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Appendix

Within the last two years, three public meetings were held within the Alley Creek watershed to address stormwater and watershed management. These meetings were hosted by different parties and offer an opportunity for comparison of outreach methods, engagement strategies, and results. The first meeting was hosted by the NYC Department of Environmental Protection (NYCDEP) on May 13, 2013 as part of the public outreach required by the consent order for Long Term Control Planning for combined sewer overflows. This was the second of two meetings. The second meeting was hosted by the NYC Department of Parks and Recreation on Jan 31, 2014 as a community outreach meeting for the development of their Alley Creek Habitat Restoration and Watershed Management Plan. This was the second meeting of a three meeting series. The third meeting was hosted by myself, a graduate student researcher, on August 1, 2014 at the request of the Friends of Douglaston Library group to talk about water infrastructure in general. Each meeting resulted in differences in attendance and participation of the public. And while no specific aspect of these meetings can be singled out as creating these differences, a comparative analysis of the outreach and messaging strategies employed offer some insight and lessons learned. A summary of these meetings can be found in the table below.

Date	Title	Host Org	Location	Attendance
May-13	Alley Creek Long Term Control Plan Public Meeting #2	NYC Department of Environmental Protection	APEC	10
Jan-14	Alley Creek Habitat Restoration and Watershed Management Plan Community Outreach Meeting	NYC Department of Parks and Recreation	APEC	23
Aug-14	The Waters of Queens: Dirty or Clean?	Graduate Student	Douglaston-Little Neck Library	>45

Outreach Methods

Outreach is extremely important in attracting members of the public to attend a meeting. First, the appropriate distribution methods need to be identified to get the invitation flyer in front of the target population. The Queens Community Boards (CB 11 and CB 9) and Alley Pond Environmental Center (APEC) are the first points of contact used by city agencies in this watershed. Meetings related to the watershed are generally held at APEC so they are involved early in the planning process. Then to promote the meeting, APEC includes meeting information as an event in their weekly emailed newsletter and may hang a flyer in their offices.

For CB11, the district manager generally receives all incoming community information and then compiles an emailed newsletter that will include the public meeting information. In addition, the DEP often presents an update to CB11 on the Long Term Control Planning process prior to hosting a public meeting. During an informal meeting with the Environmental Committee of CB 11, stormwater management and sewer system issues were discussed. At many points, members of the committee stopped the conversation to ask “What is an outfall and WPCP? What is a CSO?” It was then clear that this committee, full of local leaders, did not possess the level of knowledge necessary to understand the LTCP presentations that they had been given and possibly other related stormwater related messages. Rather than admit their lack of understanding, the issue just goes under the radar and is not passed on to their constituents.

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After a fruitful discussion, CB11 Environmental Committee members felt passionately that there needs to be more information out there about what to do (and not to do) related to stormwater management including topics such as catch basins and their connection to Alley Creek and use of 311 for reporting problems. Current methods of distributing information from the CB are heavily reliant on electronic means with emailed newsletters from Community Boards, civic associations, and local politicians. They felt that people are so overwhelmed with information that they either skim or do not read at all. Also, the elderly and others without access to internet are left out with these methods. One local leader mentioned that many of his group's members are elderly and so while it is more time-consuming and expensive to mail out hard copy newsletters, he does because that is what they want. A suggestion was made by the CB to include educational information within the mailed water bills to reach a broader section of the public.

All of the meetings were advertised in a local newspaper, either the Queens Courier or Queens Ledger. Parks also used email to send their flyer directly to their watershed advisory committee, other stewardship contacts that they had collected over the years, and directly to volunteers that were associated with the zipcodes of the Alley Creek watershed (using an internally maintained Parks volunteer database). In addition, Parks posted the flyer on various social media sources including the facebook pages of local stewardship groups.

The flyer for the general water infrastructure meeting that I held was also included in the Queens Library events newsletter (printed and electronic), by email to the list-serve of the Douglaston Civic Association, and posters within the Douglaston-Little Neck library. The organizer of the library meeting was also instrumental in performing outreach as she was extremely excited about the talk and spread information by word of mouth. Ensuring that the leaders of community organizations understand the importance and purpose of the meeting can create advocates and serve as promoters of the meeting. Otherwise, the flyer becomes even more instrumental as it is the only interface between the organizers and the public.

The flyer itself needs to concisely convey the purpose of the meeting while sparking the interest of potential meeting attendees. While the distribution methods were similar, the language used within the outreach flyers varied greatly. People need to relate to something in the title (or on the flyer) in order to motivate themselves to attend the meeting. A comparison of the titles alone (see table) shows the spectrum of technical jargon used and potential relatability. The title for the DEP meeting, which attracted the least number of attendees, would require someone to know what a "Long Term Control Plan" is. While explained more in the rest of the flyer, an individual may never read that far if not intrigued by the title. The title of the Parks meeting uses less technical language but still assumes some prior knowledge. These two titles are likely to only attract those that are extremely concerned with the environment.

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In conversations with an employee of the DEP, a comment was made that a talk about parks is more exciting than a sewer talk and more members of the community are actively involved in parks not sewers. If this is the case, then how do you make a sewer talk more relatable to people? This was the challenge I faced when designing the presentation on water infrastructure in Queens for the library meeting.

When designing the outreach materials for the library meeting, I knew the title was important and needed to be catchy. I sent multiple title options to the meeting organizer at the Library and allowed her to select one. My personal favorite, "Gutter Talk: There's Poop in the Water!" was not chosen but rather the more subdued "The Waters of Queens: Dirty or Clean?" was preferred. In hindsight, I believe this title choice was excellent. The first half of the title connects directly to people as we all rely and depend on water as a resource. The second half is intriguing and a question that people probably can't answer but would like to know. Sparking curiosity and making the topic matter of water infrastructure relevant to the public is an appropriate purpose of the title if the goal is to attract a range of public participants to the meetings. This meeting attracted the largest number of attendees with over 45 people present and some others turned away because the room was at capacity.

Time, location and its potential impact

Scheduling of the meeting can affect attendance and should be considered as much as possible when hosting a meeting focused on public engagement and participation. Time of year matters as winter weather is unpredictable and can making traveling difficult, people often travel in the summer for vacation, and other potential holiday related conflicts. All of the meetings were held in the late

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afternoon and evening with the focus on making sure people that are working can attend. The DEP and Parks meetings were held at APEC while the other presentation was given at a local library. Meetings were held at all different times of the year and without specific data it is difficult to state what impact this may have had.

Actual content of the meeting

Finally, once people are convinced to attend your meeting, the material presented and methods of engagement are extremely important for conveying knowledge, soliciting feedback, and encouraging questions and comments. In reviewing presentation slides, summaries of meeting minutes, and through my own experience, I found each meeting used different presentation styles to varying degrees of success. I would define a successful community meeting as one where the attendees feel they've learned something and were heard throughout the process and that the host received valuable feedback to assist their planning process.

With this framework in mind, the Parks Department had a successful meeting as the methods used were interactive (vision statement exercise and identifying specific concerns for the watershed) and solicited a number of specific suggestions from the attendees. On the other hand, DEP presentation slides were heavy with technical wording, maps, graphs, and acronyms that prevented people from following the topic. The questions asked by the meeting participants indicate their desire to have technical jargon explained. Also, it seemed that the limited scope of the LTCP to CSO areas frustrated some participants that are interested in the watershed as a whole. The DEP responded well to these comments, highlighting the upcoming MS4 permit that will be addressing other stormwater runoff issues. As for the general water infrastructure presentation, the below comment was sent to me from the library organizer:

> "What also impressed me was the q & a session. We drew a diverse crowd of folks of all ages and level of knowledge of the topic. Among the other attendees were an NYC DEP engineer; Thelma Fellows of the Sierra Club; Susan Seinfeld, District Manager, Community Board 11; and even a little boy and his teen brother. They all asked such interesting questions and made such great comments. We could have easily gone on for another hour; that's how high the level of interest was in your talk!"

There were also follow-up requests asking if I would give the presentation at other locations or on another topic. I believe the interactive nature of the presentation facilitated the sharing of local knowledge and provided a safe space for questioning. There was an exchange of ideas and knowledge both ways: I was able to learn about the communities history, landmarks, and practices from participants as they gained more general and technical knowledge about infrastructure from me.

Summary

While the distribution efforts by all meeting organizers were similar, resulting attendance and participation at each meeting differed. The meeting flyer and its content are extremely important in

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sparking interest and enticing people to attend public meetings. The content of the meeting should not overwhelm people with technical analyses but inform people enough to receive feedback and concerns. If you saturate people with technical jargon, they will be too embarrassed to admit they don't know what you are talking about and lose interest.

In follow-up conversations with DEP, I did find that the agency is expanding the content of their public meetings to include more interactive methods such as a community mapping exercise to identify ways the public uses of local waterbodies. These types of methods do more than inform but allow the public to include their input.

But it was also suggested that what DEP does may be too technical for the community to understand and so their input only goes so far. If this is true, then how do we get the public up to speed on these issues? If DEP doesn't have the time to explain all the concepts during their meeting, what organizations can be filling this role? I see this more as an opportunity for educational programming than a barrier. The level of attendance and interest at the meeting I held this summer proves to me that this community has interest in understanding and providing stewardship to their local environment.

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Environmental stewardship in New York City parks and natural areas

Environmental Stewardship in New York City Parks and Natural Areas: assessing barriers, creating opportunities, and proposing a new way forward

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Fall 2014

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Introduction

Citizen-based environmental stewardship programs are increasingly used as key approaches by government agencies to improve ecosystem function and landscape health in degraded or vulnerable systems. Stewardship programs are also touted to increase community resilience, to improve civic engagement, and to strengthen partnerships between government agency and the local community (Romolini et al. 2012; Fisher et al. 2012). Ideally, such programs work to connect individuals to the natural world by providing meaningful opportunities for engagement and learning. Yet, difficulties arise in how this sense of interconnection is brought into action and what activities constitute meaningful and legitimate engagement in natural areas. Current approaches have tendencies to over-simplify complex socio-cultural desires that drive patterns of park and natural area use.

In this report I hope to address a fundamental need of New York City's Department of Parks and Recreation (NYC Parks) to establish a clear, adaptable framework for the implementation of citizen-based environmental stewardship programs. I also want to propose a new way forward by encouraging managers and practitioners to use the process of social engagement as a goal in and of its self. Reorienting the current process of citizen engagement to allow communities to define, plan, and implement public programs in their own terms and on their own grounds will have a greater social and ecological impact across the city. Additionally, a bottom-up approach, facilitated by NYC Parks, will establish clear channels of communication between institutions and will legitimize distinct modes of engagement. In turn, this process will help build long lasting relationships between community institutions and NYC Parks.

Methodology

This report draws from my experience working on the 2014 New York City Social Assessment of parks and natural areas. It also draws on interviews and informal discussions with various environmental NGOs, officials of NYC Parks, and homeowner associations, each who have a mutual and vested interest in defining how natural areas are used and managed. Through this process, and in participating in the 2014 Social Assessment, I learned a great deal about people's social lives, values, needs, and priorities. The Urban Resources Initiative, at Yale University, and the USDA Forest Service provided the funding and support for this research. While the New York City Urban Field Station provided guidance and supervision.

2014 Social Assessment of NYC Parks and Natural Areas

NYC Parks manages approximately 30,000 acres of land across the city. One third of this land is designated as natural areas and is managed for a multitude of uses, other than active recreation. Other management values include biodiversity, ecosystem services, water control, and wildlife habitat (US ForestService & NYC Urban Field Station 2014). In the summer of 2013, a team of social scientists and ecologists from the US Forest Service collaborated with NYC Parks and the

Natural Areas Conservancy to conduct a social assessment of public green space in the Jamaica Bay region of Queens (Campbell et al. 2014). The goal of this project was to better understand the human use of the space. This project served as the foundation for and the pilot of the 2014 Social Assessment.

Parks and natural areas included in the 2014 Social Assessment were picked based on several factors. First, study areas are defined as followed (see appendix for study area map produced by USFS Urban Field Station of each study area):

> All public Park properties that are managed by the NYC Department of Parks & Recreation and that contain a "Natural Area." These Natural Areas are designated as Forever Wild Natural Areas and Forever Wild Natural Areas Preserves within the NYC Parks property data layers (US Forest Service & NYC Urban Field Station 2014).

Parks in all boroughs were then further categorized and prioritized based on individual size and the total percentage of natural area present. The resulting list of natural areas included in the 2014 assessment excluded heavily studied parks, such as Central Park in Manhattan and Prospect Park in Brooklyn (US Forest Service & NYC Urban Field Station 2014). From the resulting list, each study site was further delineated into zones by considering key characteristics that fragment the area into smaller units based, such as land-cover features, infrastructure, habitat-type, and park management designations.

Working in pairs, we followed structured observational protocols to sweep park interiors and edges. Each site was visited three times throughout the summer field season: once during a weekday (between 8 am-4 pm), once on a weekday evening (after 4pm), and once of a weekend (between 8am and 8pm). The process of returning to a site helped account for temporal variation in park visitation. On the first site visit, full protocols were executed in all parts of the park. This included: interior observations, edge observations, and rapid interviews. Subsequent visits (weekday evening and weekend day) entailed a more rapid assessment including only human observations and interviews within the park interior only.

Within the interior of each park, we counted and categorized human activities by considering scales of sociability and levels of engagement. Direct human observation included quantitative tallies of all people observed within the park site, including what each person was doing, where in the park they were observed (the particular zone), and the their approximate age. Rapid interviews were conducted based on a random sample of every third adult encountered within the study site (note: no interviews were conducted on park edges or with minors) and all interview refusals were recorded. In addition to direct human observation, we observed and documented all signs of human use in each zone. This included informal sitting areas, memorials, substantial dumping sites, informal trails, art, murals, signage and stickers, and any unofficial structures or forts. The park edge was defined as the interface between the park and the rest of the neighborhood and we made note of the character of each park edge and all informal entry points, or desire lines, into the park. Sometimes this edge was clearly defined by a guardrail or sidewalk. At other times, the boundary between the park and the community was less than clear. Lastly, detailed field notes were taken on a daily basis. Our field notes worked to capture the overall feeling of the study area, in addition to detailing notable features, patterns, and surprises. Daily field notes included observations such as if there was significant street tree damage, the presence of litter, or an abundance of shopping carts in one area and not another. We noted what languages we overheard throughout the day and if people only used one playground area as opposed to another.

Assessing the Stewardship Potential in Alley Pond Park

Ally Pond Park in northeastern Queens was identified as a geographic area of focus for several reasons. First, the Natural Resources Group, a division within the NYC Parks, is in the process of writing a new *Alley Creek Watershed Management and Habitat Restoration Plan* (NYC Department of Parks and Recreation 2014). This process gave me insight into how city agency engages the community and allowed me to better understand the dialogue between community actors and city agency. Second, the Alley Creek watershed represents one of the most intact watersheds in New York City (NYC Department of Parks and Recreation 2014). Third, one summer field season did not allow me to survey all groups involved in environmental stewardship across the city. However, this focus allowed me to gain a deeper understanding of the inherent social and cultural complexities faced by both city agencies and community organizations.

I talked to local park management, those working in park facilities, naturalists, photographers, professors at local community colleges, fishermen, shellfish collectors, foragers, runners, dog park presidents, and first-time park users. Additionally, I spoke with NYC Park officials working at the Citywide level and to program administrators in the Department of Education. I met with people working across institutions, at various scales of management, in and around the Alley Creek Watershed. I undertook these conversations to gain a deeper understanding of the institutional perspectives and the political context of stewardship programming and citizen engagement.

Formal interview questions varied somewhat, depending on the interviewee. Generally, however I was interested in learning the history of the organization, how a person personally defined environmental stewardship, their perception of environmental degradation in the urban context, and how their organization works to mediate this degradation. I was interested to learn specific methods of engagement within the community, motivations, and the technical expertise found within the institution.

Part 1: A Citywide Context

Defining Environmental Stewardship in Urban Space

Environmental stewardship, first proposed by Aldo Leopold, has theoretical roots as a personal, human ethic. Environmental stewardship is "dealing with man's relation to land and to the animals and plants that grow upon it" (Leopold 1989). It is widely described as the commitment one holds to the land, where land has broad, natural, place-based connotations. It is entrenched with an intrinsic respect for nature and an ongoing commitment to active 'earth keeping' (Carr 2002). Stewardship means and manifests differently in each person. The interactions between people and natural areas persist and are bound with personal and cultural identities, social class, and personal views about nature. Environmental stewardship in New York City manifests in a multitude of contexts and activities having broad ecological and social impacts. Forms of environmental stewardship emerge on different scales: from the highly organized and formal programming of the Natural Area Volunteers (NAV) to the individual and largely subversive practices of urban foragers.

New York City's division of Forestry, Horticulture, and Natural Resources released a Stewardship Assessment report in July of 2014 (Monaco & Greenfeld 2014). This report broadly outlines the department's strategy to increase civic engagement and stewardship potential across the city's natural areas. The report states that stewardship "can be understood as a series of programs that relate back to, complement and support the large management goals for the division". To reach stated goals the department will, "engage New Yorkers with street trees, green infrastructure installations, forests and wetlands" (Monaco & Greenfeld 2014). Here, it is important to acknowledge that this strategy does not recognize stewardship as a personal, individual ethic.

The vast majority of stewardship programming seeks only to secure voluntary work forces for restoration projects. As stated, "the key to success is capturing volunteers and groups along the engagement spectrum… while simultaneously improving our natural resources" (Monaco & Greenfeld 2014). The scope of current environmental stewardship programming supported and implemented by NYC Parks remains too narrow to engage large parts of the community. Current modes of engagement and the overall focus of such programming create barriers for active and meaningful civic participation. Some of these barriers include the scheduling of the event during the week, lack of interest in the activity offered, and high level of physical fitness needed by an individual to participate. Additionally, there is a perception among some New York City citizens that the stewardship activities offered by the Natural Area Volunteers (NAV), a NYC Parks stewardship program, are "maintenance work" and "chores".

The Stewardship Assessment (2014) also touches on a concept titled the 'Volunteer Engagement Spectrum.' This concept recognizes the various human interests present in the use of natural areas, however makes several assumptions about individual awareness, engagement, and empowerment. First, it assumes a causal relationship between awareness and engagement. That if someone knows about a stewardship opportunity they will automatically participate. Second, the spectrum assumes that being engaged in park restoration activities leads to individual empowerment, assuming those not currently involved, or participating, are disempowered. On the other hand, one may be aware, yet unable to participate in the opportunities provided because of scheduling conflicts or physical health. Or one may be empowered, but choosing not to participate because they do not like the opportunities provided.

The urgency to develop citywide environmental stewardship programs needs to be met with a diversification of the type of opportunities offered and a broadened conceptualization of what environmental stewardship is. Environmental stewardship needs to be reimagined and brought back to its original values, as first imagined by Aldo Leopold.

Academics and policymakers continue to examine environmentalism, the importance of environmental stewardship, and the expanding use of volunteer workforces to accomplish restoration across the United States, with several of these studies focused on New York City (Fisher et al. 2010). Notably, the Stewardship Mapping and Assessment Project, STEW-MAP, a project designed and implemented by the US Forest Service, brings to light the vast network of existing partnerships between environmental organizations, as well as the social and spatial interactions of this network. Additionally, this research gives great insight into the connection between various ideologies, management types, the capacities of organizations, and the social outcomes derived from participation in this network (USFS 2013). Other reports, such as Fisher et al.'s (2010), *Who volunteers to steward the urban forest in New York City?* And Tidball and Krasney's (2007), *From risk to resilience: what role for community greening and civic ecology in cities?* (Tidball & Krasny 2007) provide great insight into the topics at hand. City agency and other environmental organizations can directly utilize this research to enhance their own organizational capacity and to fill gaps in their current knowledge.

The Value of Parks and Natural Areas in the Community

Despite some barriers to implementing public stewardship programs, natural areas and city parks are highly used and highly valued spaces. Parks and natural areas in New York City are vital to its functioning as a city. The importance of parks and open spaces in the urban context is best stated by William Burch, a professor of emeritus of natural resource management at Yale University,

> Public parks and open spaces are critical catalysts for improving health and being, strengthening social cohesion, fostering democratic principles and providing benefits to urban biophysical systems (Grove & Burch 1997).

Individuals use parks to run and walk, to find solitude, to connect with friends, to fish, to build forts, to pray, and to dig up worms with their children. One man told me, as he threw his Frisbee on to a parkway on-ramp, "I've got no where else to play." Another woman, while standing in the middle of a tulip tree forest aptly states, "this area is a god send for my mental and physical self. It is untamed and natural."

Parks as Destinations: Fort Washington

Parks are destinations and serve as community gathering points. For example, one senior home near Fort Washington Park uses a small triangular lawn located between the Henry Hudson Parkway and the on-ramp to play bingo each night during the summer. The scene is dazzling. On the grassy slopes, beneath a dense canopy of trees, 10 card tables are unfolded. Each table had 4-hinged chairs surrounding it and each is covered with a different sized white cloth. Small plastic solar lanterns are placed in the center of each table emitting a dim halo of light. I look around. Street lamps are noticeably absent from where they usually stand on the sidewalks. A popcorn machine is popping on one side, atop a cooler two pitchers of lemonade stand sweating, an old cassette player plays an upbeat Caribbean- Latin mix. As dusk envelopes, I approach the man standing nearest the brass cage. He must be the man in charge. I ask his name and what he is doing in the park, learning most of the players milling about are immigrants from the Dominican Republic. They live together in the building over there. He points across the street. He emphasizes, twice, that the group does not play for money, nor do they gamble. They come each night to enjoy each other's company, to gossip, and to enjoy the outdoors while the weathers' still nice. Encounters such as this highlight the fact that community engagement and participation is contextual and relative. This highly engaged bingo-playing group does not care, nor are probably aware, if an invasive species is growing along the parkway ramp. However, they are active participants in their own communities, they are engaged in each-others lives, and highly value this particular piece of the park.

In a different example, the modes of engagement and stewardship are rooted in the cultural and social identity of immigrant families from fishing communities in Central America. Dotted along the Hudson River's edge are a series of fishing huts. My last count in the beginning of September 2014, found seven in total. Each is made slightly differently, however each uses the same basic construction design and material. Weathered, flat wooden planks make up the floor while long poles are woven and tied strategically together on 3 sides for an open, breezy floor plan. A matrix of tarps are stretched across the top providing shade. The side facing the river is left open, so one can presumably sit and dangle their feet over the rivers edge. What is striking about these huts, and what provoked me to return several times throughout the summer, is the great care users took in the upkeep of the area. These are not homeless encampments, but serve as places for groups of men to gather after a days work, have a beer and fish along the river. I asked one fisherman, whom I had seen several times before, where they put all their trash, thinking he would nod to the river. He replied, "Aw! We make sure to throw everything out in the bin at the top of the hill. Sometimes, our youth will leave a mess. But, we are the fathers, we pick up after them too." This fisherman does not conceptualize his activities as a form of stewardship.

On the Fear of Natural Areas

There is the general perception that natural areas are unsafe, that one will be attacked, or will get lost if they go too far inside the wooded areas (Brownlow 2006; Chiesura 2004). One interviewee states, in reference to whether she goes into the natural areas of the Bronx park, "Tonight, we just passing through. We try to stay safe, it's safer out here". The perception that natural areas are unsafe results in the vast majority of individuals only using the recreational areas: the basketball and handball courts, the playgrounds, and playing fields. Parks and natural areas continue to be associated with criminal activity and are explicitly implicated as being unsafe agents across the city. For the most part, parks continue to be used as corridors, as a way to get from one place to another.

However, this fear presents unique opportunities for organizations and institutions to develop targeted campaigns to increase access and to reconnect people with the natural environment. In another interview, a park worker in Fort Washington Park brings forth the idea that flowers and gardens give the perception that the area is cared for by the community and is thus safer. He does not go to the park in his neighborhood, one train stop away explaining "Our parks need color too. Like in my neighborhood there is no color. That's why I come here, that's why I bring my little girl here. Its nicer, there's flowers." The perception that parks are not cared for perpetuates feelings of fear. Increasing opportunities for neighborhood groups to plant flowers, paint fences, and to come together to care for their own parks can achieve multiple social and ecological goals. This can be achieved through the creation and expansion of park programs that fund small grants for communities and individuals. Programs, such as *It's My Park Day* and *I Love My Block,* support ideas instigated within the community, allowing the community to define their own goals and implement their own programs, with support from city agency.

On Urban Foraging

People collect oysters and mussels, subsistence fishermen fish off the city's docks and along the bay, firewood collectors continue to gather under the forest canopy. Foraging is an important activity providing many non-economic values including the development and transmission of ecological knowledge, recreational opportunities, mental and physical wellbeing, spiritual fulfillment, reinforcement of cultural identities, and it plays a role in the strengthening of social ties (Mclain et al. 2012; McLain et al. 2014). Gatherers come from diverse backgrounds and are thus likely to differ in their motivations, the kinds of products sought out, depth of ecological knowledge, and the techniques used for gathering plants. City residents continue to interact with diverse urban landscapes finding edible, medicinal, and craft related species in formally and informally managed spaces. Yet, low visibility makes understanding urban gathering and identifying ways for management efforts to support sustainable practices difficult (McLain et al. 2014; Dove 2013).

Strategic encouragement of urban gathering could be an important strategy for developing and maintaining ecologically sustainable systems. For example, encouraging the gathering of mugwort at certain times of year and reaching out to the community who harvest and use this plant has the potential to aid land managers in stopping its active propagation. Stopping its active propagation may help to conserve the time, energy, and monetary funds used for its control and eradication. Developing enforceable policies will require gaining the trust and involvement of a broad spectrum of people and needs to account for the specific species, products, and specific sociological contexts.

Part II: Assessing the Stewardship Potential: Alley Pond Park and Watershed

Characterizing Environmental Stewardship Groups in the Watershed

Stewardship groups form for different purposes at different social and geographical scales. Such groups give communities a sense of pride, while providing a means for social interaction, community cohesion, and a sense of belonging. Groups are formed under self-interest, altruism, and to concentrate the power of group action (Carr 2002). A mixture of social, political and biophysical considerations also define the activities and goals of stewardship groups. Organizations use different strategies to pursue institutional values and goals. Each group of participants is uniquely engaged in the community and the surrounding environment, for example a local running club's activities and goals are vastly different from activities organized by the local angler's club. Understanding how various groups operate, the various perspectives present, values, and strategies used to accomplish stated goals is an important first step to finding new entry points in the community. New entry points will help establish long-term, productive partnerships and friendships.

For ecological and social management goals to be achieved the facilitation of greater levels of engagement and civic participation needs to occur. In and around, Alley Pond Park there are dozens of formal and informal organizations operating at various scales within the community. Core partnering institutions include groups such as the Alley Pond Environmental Center (APEC), Udalls Cove Preservation Committee, and the Douglas Manor Environmental Association (DMEA). These three groups are highly visible, active, and vocal. Each group works to promote individual goals and works within their capacity to achieve stated outcomes. They are repeatedly cited in NYC Parks reports as being key stewards of the local environment.

It is important to recognize the many other groups also engaged in community activities in the watershed. Groups including the Alley Pond Striders, Alley Pond Pet Lovers Association, and the Alley Pond Hikers and Trail Crew Association, each represent institutions working in less visible spheres of the community. Partnering with less visible groups will provide managers with a greater diversity of perspectives and a deeper understanding of community dynamics. In addition, non-profit institutions such as libraries, religious centers, and senior centers can also provide unique partnership opportunities that will help foster wide spread engagement.

Yet, levels of disconnect exist between local stewardship groups and NYC Parks. Neither group fully trusts in the actions of the other. For example, in several conversations with NYC Parks personnel I heard a particular stewardship organization be referred to as a 'black hole'. In another example, while out kayaking with members of a local environmental organization, including the group's president, I asked about modes of collaboration with NYC Parks. In response, one group member stated, "the fact is they (parks) inform. They do not ask for input. I am not upset by this, it just is." This comment was in regards to a new green infrastructure project recently installed. All agreed the project was needed to improve water quality, but seemed disappointed in the lack of opportunity for involvement. This could have been a great opportunity for NYC Parks to garner support not only for the project, but also for their agency.

The following table provides greater detail of the specific characteristics of some groups operating in and around Alley Pond Park. The table describes group type, the area in which the group operates, key or current activities, and ideas for future activities. It is important to note that these ideas are my ideas; the groups themselves did not necessarily suggest these future activities, yet they are ideas that represent new entre points for NYC Parks to engage the community.

Table One: Active Stewardship Groups and Potential Partners for the NYC Parks Department

Group	Group Type	Area of operation	Key Activities	Ideas for future activities	Contact
Bayside Marina	Local business. Yacht club, Kayak storage, Snack bar, Bait shop, rod rental.	Little Neck Bay	Boat rental, kayak storage, fishing dock. 'Snapper Derby'.	Increase programming for estuary education- key group kayakers, rod rentals for students	info@baysidemarinany.com
Bayside Anglers INC.	Non-profit, fishing club	Little neck bay, Little Bay Park	Community outreach, beach cleanups (Annual Family Fishing Festival, BAG Annual Snapper Derby, DEC Children's fishing clinics, national estuaries day festivities. General club meetings are held at 7 pm, first Tuesday at MS 158 (Marie Currie Middle School)	Utilize knowledge and membership base for more beach clean ups, estuary restoration, oyster propagation,	President: Ida Friedland Phone: (973) 714-5471 Email: president@baysideanglers.com
Douglaston Yacht Squadron	Private club	Little Neck Bay	Junior Sailing Club, 30-40 registered kayakers, private open water swimming dock, hosts yearly open water swim competition in bay called 'splash and dash'	Bio- bliz and citizen science program w/ youth group	General Manager: John Veneziano, dclub@nyc.rr.com
APEC Hiking Club and Trail Crew	Charity Organization, Civic association	Alley Pond Park	Trail maintenance, adult education, park clean ups, outdoor recreation, membership to hiking club supports APEC	Partner to increase trail maintenance and trail restoration in high priority areas	tom0153@hotmail.com
Queens County Bird Club	Non-profit, charity organization	Bayside, Alley Pond Park	Field trips, walks, lectures, and presentations for the purpose of finding and identifying birds.	Bio blitz and citizen science in Alley Pond	President: Arie Gilbert ArieGilbert

			Promote conservation of open space and parkland for intrinsic value of avian inhabitants. *Data Collection (citizen science)*		@optonline.net
Bayside Historical Society	Non-profit, civic association	Fort Totten, Bayside	Interactive school programs teaching to common core standards. Organizes summer community programs: Bayside day, Croquet Day, Jazz Brunch, other workshops.	May be good way to disseminate information. Programming could include education series of the environmental history of bayside, or develop an exhibit that focuses on the history of NYC parks in NE Queens	-
Alley Pond Pet Lovers Association	Civic association	Alley Pond Park	Organizes yearly park clean up.	Use membership base to promote BMP and trail stewardship	-
Alley Pond Striders	Running Club, civic association, community group	Alley Pond Park	Weekly, Saturday and Sunday morning group runs. Annual 5 km race in park. Plans annual park clean up days. Holiday parties. The Alley Pond 5 Mile Race is the largest local race in New York City. Group also has very active newsletter.	Use membership base to promote BMP (Over 250 community members, updated website, and Facebook page	Managing Director: Ken Kaiser apstriders @aol.com www.apstriders.org
Queens Coalition for Parks and Green Spaces		Queens County			Fred Kress 718-341-1395
Urban Park Rangers	NYC Parks Dept.	Alley Pond Park, NE queens parks.	Outdoor science education.	Support citizen science, expand programming to include kayak tours and oyster farming,	Sg. Marc MarcSanchez
Queensborough Community College	Public institution	Oakland Lake	Nature Blog.	Partner with parks to develop curriculum, citizen science.	Dr. Eugene Harris, professor of biology
Douglas Manor Environmental Association (DMEA)/ Douglas Manor Association	Homeowners association, registered non-profit	Douglas Manor	*Manor Matters* community newsletter.	Kayak + bio-bliz, citizen science, million trees, green infrastructure	Jamie Sutherland, office@dmanyc.org 718-225-3111
Udall's Cove	Non- profit	Little Neck	Restoration, invasive	-	President:

Preservation Committee	Bay	management, trail maintenance, beach clean ups, storm water management.	Walter Mugden, udallscove @aol.com

Habitat Restoration, Community Participation, and Stewardship in the Alley Creek Watershed

Characterization of Habitat Restoration

Habitat restoration projects in Alley Creek Watershed date back several decades (NYC Department of Parks and Recreation 2014). A multitude of different ecological projects have been completed: invasive species removal, reforestation, forest management, erosion control, kettle pond restoration, and green infrastructure, each funded under various mechanisms at different points in time. The habitat management and restoration needs of the area were again assessed this year and a new report was written (NYC Department of Parks and Recreation 2014). Yet, habitat management needs, goals, and recommendations remain thematically similar to historical issues. Similar problems continue to exist today that existed 20 years ago.

Restoration projects in the area have brought many degrees of success. Additionally, restoration projects have gone far to bring deserved attention and resources back into urban parks, such as Alley Pond Park. For example, water quality in Little Neck Bay is far better today than it was in the 1970s. Yet, the implementation of projects within parks continue to be completed within the constraints of the agency's capital procedures and do not necessarily align with changing community uses, values, or perceptions of park areas.

Characterization of Community Participation

A disconnect persists between those working to achieve management goals and the goals and needs of community actors. The recent closure of Oakland Lake illustrates current disconnect between the community, everyday parks users and NYC Parks. This particular capital improvement project, aiming to restore the 46-acre Oakland Lake Park, was first announced in 2011. At this time, the project went through the mandated public review sessions and a public commenting process. However, when the lake was finally fenced off this past summer for the next year (2014-2015), many in the community remained skeptical about the need for the project. Eugene Harris, a professor at neighboring Queens Community College states, "its crazy that they're caging in the entire lake. I can't see why they couldn't do it in portions so that the public can at least enjoy part of it" (Personal communications: 2014). The following dialogue, was written in the Times Ledger comments section in regards to an article published in October titled *Oakland Lake Shuttered* (Soto 2014). This dialogue highlights community rhetoric and the increasing disconnect between individual community members and actions of the parks department.

> Yes, let's shut the park without any notice because as per usual gov't has total contempt for the citizenry! Let's continue this failed project. This is a highly wild area not needing a walkway. Those who don't want to get their shoes dirty should go somewhere else. More shoddy construction, more kickbacks to those involved. Kickbacks , pure and simple !
>
> ... on the other hand, the delays and delays with the work down at Fort Totten have now proved laughable. Some high ranking officials in the parks department, and the politicians, should review the status of the work and move a mountain or two.

Only a handful of people I interviewed about Oakland Lake's closure spoke positively about the project. Yet, there is no doubt this project will have an overall positive ecological impact in the area. However, the importance of this impact was not effectively communicated to individuals living in the community, nor was the project communicated in a language that was understood by the community. The current policy process implemented by NYC Parks inherently limits access, understanding, and on-going communication with the greater community. Complex language and top-down approaches continue to dominate community meetings, while mandated public comment periods and outreach meetings draw few people. In addition, the goals and objectives of individuals and various institutions do not always align with the larger goals NYC Parks. Recognizing this disconnect provides great opportunity to realign engagement strategies in order to promote collaboration, communication, and ultimately healthy, sustainable neighborhoods.

Recommendations: The Way Forward

Opportunities and Barriers to Stewardship in the Alley Creek Watershed

Engaging neighbors and community members can be the most challenging part of any project implementation. Yet, communities that are given a platform to work together, to achieve shared values and ideas can realize great success. Changing administrative procedures, so that stewardship opportunities are defined and implemented within the community will help to further engage individuals and to secure lines of communication. Thus, no issue, plan, or solution is developed outside of this community network. Most importantly, this process will help to strengthen trust between the community and parks management. Working together can involve sharing human resources, curriculum, or helping each other understand the perceptions and the needs of the community. Ongoing workshops and learning opportunities can provide capacity development for land managers and maintenance staff building the knowledge base of parks workers.

New ways of engaging with community groups and individual actors should focus on the collaborative process, rather than a stated goal, objective, or outcome. Listed below are some new ways to think about community engagement and opportunities to promote environmental sustainability. Beyond these opportunities, many challenges exist in facilitating and encouraging community participation and civic engagement. However, recognizing that challenges and barriers exist is the first step to create the forward momentum needed to overcome such obstacles.

Top Opportunities

- **Hold community events:** community events are a great way to meet neighbors and have fun. They will promote ongoing dialogue and will help establish long-term relationships. Monthly community coffee events will allow residents to ask questions about up coming projects. Meeting on a regular basis, promotes face- to- face communication and allows for curious residents to ask questions and to express concerns in an informal, non-biased setting. Monthly events will also begin the process of building long-term relationships with residents. Other informal events, such as outdoor movie nights, potluck dinners, walking groups, encourage neighborhood community and collaboration. If these events are hosted, in collaboration with the Parks Department, it will build community trust in NYC Parks. In addition, events and programs should take advantage of new installations and green-space. This will build community involvement and support for the project and for all future projects. Other examples of community events can include native plant workshops, urban wildlife programs, and children's gardening classes appeal to a large part of the community.

  Of the 97 events held in Alley Pond Park in the 2014 calendar year about a quarter (20 in total) focused on nature and nature activities. Of these 20 events, just two were dedicated to getting people out onto the water (both canoeing events on Oakland lake). A list of all the events held in Alley Pond Park can be found in the appendix.

- **Use social media:** creating a Facebook page or blog for community events is a great way to start conversations and to connect with community members. A Facebook page, specifically for Alley Pond Park, can help with the dissemination of educational materials and to let community members know about volunteer opportunities.

  One of the most common responses from people across the city was that they don't know about volunteer opportunities happening in their community. Facebook will only appeal to a fragment of the population, yet it will target a younger generations of park users. In addition, the use of this platform has the potential to make communication easy, accessible, and can serve as a neutral platform to update the public on projects, upcoming meetings, and serve as a place for citizens to ask questions.

- **Be inclusive:** tailor communication and events to as many people in the community as possible. Make sure text is large enough to read by seniors, that signage is posted in different languages, and make sure to offer activities for young children, so parents feel welcome to attend gatherings. Ensure access to meetings for people with disabilities.

- **Be resourceful:** recognize the wealth of resources available within the community. During the course of a projects implementation involve student groups and environmental clubs to, for example help build new boardwalks or paths. Reach out to the local Boy and Girl Scout troops for collaboration on restoration projects. Connect with senior homes and assisted living groups in the area to plant new plantings and to help maintain garden areas. Choosing the right people for specific tasks based on their skills, background, and interests will increase community ownership of any project.

- **Hold competitions:** design idea competitions by asking community members to submit proposals that showcase what they think needs to be done in their community and what they want to see done. For example, collaborations can be made between government agency and the local community college students to design creative ideas to reuse vacant lots in and around natural areas, or rain gardens on campus. Competitions can include other topics such as ecology, arts, culture, health and wellbeing, and infrastructure.

  Instituting small grant competitions for community and school groups will promote stewardship throughout the wider community and will promote knowledge sharing of best management practices. Local business districts, school science clubs, libraries, and gardening clubs can also be included. Build program with the expectation that there will be a diversity of project submissions. This recognizes that the needs, strengths, character, and history of each neighborhood. Also, it may be important to recognize more than one winner because the goal to learn and share practices promoting stewardship and environmental conservation.

- **Elementary and high School environmental club challenges:** using the structure provided by the public school system, NYC Parks can instigate an environmental club competition. By giving each classroom a 'toolbox' of best management practices to chose from, NYC Parks in turn supports science education, hands-on experiential learning, and possibly natural areas restoration. A program such as this can also incorporate teacher trainings and a partnership with Urban Park Rangers.

- **Expand modes engagement:** engage with local libraries, sailing clubs, senior homes, and local businesses (cafes, bookstores) by hosting monthly speaker series on various topics, in each of these locations. This will help foster on-going dialogue and learning, where the social process is main objective as opposed to structural goals.

- **Education, training, and leadership programs for NYC Parks employees:** education, training and leadership training will increase awareness of management goals, help to share knowledge, and will build stronger social relationships within the agency. Training programs can be paired with other training of trainers programs or department competitions. Ideas for trainings can include rain-garden construction, bio-swales, native plantings, disconnecting downspouts and the installation of rain barrels.

- **Training of trainer's event series:** a Training of trainers (TOT) program will bolster local capacity, skill, and provide the community extended learning opportunities. For example, if one goal of the Parks Department is to reduce urban run-off, the development of a TOT could be an effective means to increase awareness and engagement on the issue through the community. For example, if there is a need to improve storm water management on private property to reduce runoff, utilize the APEC membership base to create a weekend workshops on natural planting and rain gardens. A demonstration garden could be made by participants at APEC and used as an education tool in the future.

- **Disconnect downspouts, install rain barrel program, bio-swales, and rain-gardens:** educate and empower citizens in methods and benefits of being environmental sustainable. Opportunities include having volunteers of all ages decorate rain barrels and plant greenery around the barrels to handle rainwater overflow. This will increase community excitement for the program. Have neighbors decorate the rain barrels to add character. To raise community excitement, host a competition for the most beautiful rain barrel on the block. Another great starting point for a program of this nature could be to link with local high school environmental clubs or the biology department at Queensborough Community College.

Top Barriers

- **Lack of opportunity**: there is a general lack of opportunity for community members to engage with Parks management in neutral, casual settings (note: not all individuals consider APEC neutral territory). In addition, people lack knowledge about how to participate in volunteer activities and stewardship events. For example, on several occasions I heard people mention that they would have liked to volunteer with the Million Trees plantings that occurred earlier in the year, yet large volunteer groups were brought in from Manhattan for this project, thus NYC Parks did not engage people from the community to help. Also, scheduling conflicts exist limiting participation for some groups. For example, scheduling events in the middle of the day or only on weekends may not be the most inclusive approach.

- **Policy process:** the overall policy process used by NYC Parks is top-down and oriented to meet the agency's agenda, not that of the community. This may be because of the lack of time, resources and capital limitations, available to actively build and maintain community partnerships. Yet, reprioritizing goals and methods of implementation may help to

- **Definitions of stewardship:** individuals, groups, and other government agencies each have a different definition and conceptualization of what environmental stewardship is. Thus, goals between individuals and land managers do not align.

Reimagining Community Partnerships

There are a number of opportunities to build new, innovative partnerships, to instigate creative forms of engagement in the wider community, and to refocus existing collaborations. Described below are a few starting points and new ways to think about engaging with new and existing partners in and around the Alley Creek Watershed.

- **Queensborough Community College (QCC):** QCC represents a community institution with a ready work force of biology students ready to learn how to apply classroom knowledge in the natural world. A close partnership with the professors and students can provide the long-term technical assistance needed by the Parks Department. QCC is focused on building the technical skills of its students for direct application in the workforce. A partnership with parks can train students in hands-on environmental monitoring techniques, data collection, green landscaping, and outdoor educational programming. Alley Pond Park can serve as their 'living classroom'. For example, a class on environmental restoration could use an area of the park (identified as a priority by parks) to remove invasive plants, such as mugwort, and reestablish natural plant communities. The Parks Department can offer an internship program for participating students to train with the urban park rangers, researchers at the urban field station, or teachers at APEC during summer months. A certification program can also be integrated into this program for students in green landscaping, infrastructure, or outdoor education.

- **Alley Pond Environmental Center (APEC):** represents another community institution that is comprised of active, environmentally informed citizens working to bolster environmental knowledge in the community. Yet, programming at APEC does not always align with parks restoration and management needs. While, APEC may not constitute neutral ground for all and supporting more programs here may marginalize other groups in the community, it does provide a membership base that is informed and motivated. NYC Parks can provide APEC with the technical expertise and guidance to develop new programs that work towards meeting the environmental issues prioritized by park management.

  For example, if meadow management and native plantings for biodiversity are identified as top priorities, provide APEC the expertise and resources to pilot new programs and workshops on this topic. Work together to create a long-term vision and goal for the program. This vision should be inclusive of the entire community and, ideally, include youth groups, seniors, and business owners. Build curriculum on native pollinators, vegetable and honey production, insects, birds and other creatures that create a healthy and bio-diverse urban habitat. Ideally, such projects in the community should to be visible and accessible to the general public. Lastly, produce signage to for

- **Bayside Marina:** many community members do not engage with the Little Neck Bay environment, nor do they have the opportunity to engage in activities on the water. Just two events in the past year focused on the water (both were canoeing on Oakland Lake, see appendix for dates). Increasing the number and type of water related events sponsored by the parks department would help connect people to the Bay. This could include guided canoeing or kayaking through the restored marshes, increased the support for fishing rod rentals, or even youth sailing classes. Strengthening the partnership with Bayside Marina could help to facilitate these events.

Ecological goals take a large-scale commitment of resources, agency organization, and communication across various levels of social institution. Involving the community in urban watershed management programs fills gaps between what public institutions can achieve and what the community needs. Yet, without clear messaging and an on-going commitment to connect such approaches to the needs and values of diverse urban communities, such initiatives will ultimately fail. Thus, for ecological and social goals to be met, government agency and city leaders must work to engage community residents in the process of establishing their own goals and in creating their own programs. Citywide programs will help neighborhoods take action to improve ecological health and social resiliency.

Conclusion

Current approaches to promote environmental stewardship simplify complex socio-cultural desires that drive patterns of park and natural area use. The concept of stewardship needs to be reimagined through all public agencies and built on the strength of the individuals within the community, as first proposed by Aldo Leopold. It should be based on an ecological framework that sees natural areas as shared community resources, placing human action directly in the center. It is clear that natural areas provide important environmental, social, and ecological services integral to the urban infrastructure of New York City. However, current approaches to community engagement include very little actual engagement. Policies and programs need to do more than just create public, private and community partnerships and meaningful engagement must be achieved. The adaptive challenges faced by city agencies require change in numerous places across organizational boundaries and efforts need to focus on engaging people: individuals, organizations, and city agency staff by making the engagement of various user groups the goal in and of its self. These challenges require knowledge, innovation, and cooperation.

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Appendix

2014 Social Assessment Sites

* Map produced by USFS at the Urban Field Station.

2014 Events in Ally Pond Park

Total number of events= 97
Total number having to do with environmental stewardship= 20

1. **Sunday, January 12, 2014. Nature Exploration Hike (moderate). 11:00 a.m. Category:** Nature, Tours

2. **Saturday, February 1, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

3. **Saturday, February 8, 2014 Fitness Bootcamp, 1:00 p.m.–2:00 p.m. Category:** Fitness

4. **Saturday, February 15, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

5. **Sunday, February 16, 2014. Birding: Owls. 1:00 p.m. Category:** Birding, Nature

6. **Saturday, February 22, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

7. **Saturday, March 1, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

8. **Saturday, March 8, 2014.Wilderness Survival. 11:00 a.m. Category:** Nature
9. **Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

10. **Saturday, March 15, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

11. **Saturday, March 22, 2014. Fitness Bootcamp.1:00 p.m.–2:00 p.m. Category:** Fitness

12. **Saturday, March 29, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Accessible, Fitness

13. **Saturday, April 5, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

14. **Saturday, April 12, 2014. Birding: Spring Migrants. 10:00 a.m. Category:** Birding, Nature
15. **Fitness Bootcamp.1:00 p.m.–2:00 p.m. Category:** Fitness

16. **Monday, April 14, 2014. Birding for Kids. 1:00 p.m. Category:** Birding, Nature, Kids, Kids' Week

17. **Saturday, April 19, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

18. **Saturday, April 26, 2014.Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

19. **Saturday, May 3, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m.Category:** Fitness

    Sunday, May 4, 2014.
20. **Pets & Pals/ Walk 4 Paws Party. 12:00 p.m.–3:00 p.m. Category:** Arts & Crafts, Games, Kids, Dogs
21. **Hike to Alley Giant (Moderate). 1:00 p.m. Category:** Nature, Tours

    Saturday, May 10, 2014.
22. **MillionTreesNYC Planting Event at Alley Pond Park. 9:00 a.m.–1:00 p.m. Category:** Education, Nature, Volunteer
23. **It's My Park Day at Alley Pond Park. 11:00 a.m.–1:00 p.m. Category:** Dogs, Volunteer, It's My Park Day
24. **Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

25. **Saturday, May 17, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

26. **Thursday, May 22, 2014. Alley Pond Park Garlic Mustard Pull. 9:00 a.m.–1:00 p.m. Category:** Nature, Volunteer

27. **Saturday, May 24, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

28. **Sunday, May 25, 2014. Basic Canoeing. 1:00 p.m. Category:** Nature, Kayaking and Canoeing, Waterfront

29. **Saturday, May 31, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

30. **Sunday, June 1, 2014. Camping Skills Workshop. 11:00 a.m. Category:** Education, Nature

31. **Saturday, June 7, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

32. **Saturday, June 14, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

Saturday, June 21, 2014.

33. **Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness.
34. **Family Camping. 6:00 p.m. Category:** Nature, Kids

35. **Saturday, June 28, 2014. Fitness Bootcamp. 1:00 p.m.–2:00 p.m. Category:** Fitness

36. **Sunday, July 6, 2014. Ranger's Choice: Hike and Paddle Excursion Adventure. 10:00 a.m. Category:** Nature, Kayaking and Canoeing

37. **Friday, July 11, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

38. **Friday, July 18, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m.. Category:** Fitness, Outdoor Fitness

39. **Friday, July 25, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

40. **Saturday, July 26, 2014. Family Camping in Alley Pond Park. 6:00 p.m. Category:** Nature

41. **Thursday, July 31, 2014. A Morning of Music with Darlene Graham 10:30 a.m.–11:30 a.m.. Category:** Kids

42. **Friday, August 1, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

43. **Wednesday, August 6, 2014. Mommy, Music and Me, Inc.: Music Together. 10:30 a.m.–11:30 a.m. Category:** Kids

44. **Friday, August 8, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

45. **Sunday, August 10, 2014. Alley Pond Park Adventure Course: Free Public Sundays. 9:30 a.m.–12:00 p.m.**

Friday, August 15, 2014.

46. **Puppets in the Park. 10:30 a.m.–11:30 a.m. Category:** Kids, Theater, Free Summer Theater**.**
    Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category: Fitness, Outdoor Fitness

47. **Sunday, August 17, 2014. Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–**

12:00 p.m.

48. **Friday, August 22, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

49. **Sunday, August 24, 2014 Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m. Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

50. **Friday, August 29, 2014 Fitness Bootcamp 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

Saturday, August 30, 2014

51. **Alley Pond Park Adventure Course: Staycation10:00 a.m.–12:00 p.m.**
52. **Alley Pond Park Adventure Course: Staycation 1:30 p.m.–3:30 p.m.**

Sunday, August 31, 2014

53. **Alley Pond Park Adventure Course: Staycation 10:00 a.m.–12:00 p.m.**
54. **Alley Pond Park Adventure Course: Staycation 1:30 p.m.–3:30 p.m.**

Monday, September 1, 2014.

55. **Alley Pond Park Adventure Course: Staycation 10:00 a.m.–12:00 p.m.**
56. **Alley Pond Park Adventure Course: Staycation 1:30 p.m.–3:30 p.m.**

Tuesday, September 2, 2014

57. **Alley Pond Park Adventure Course: Staycation. 10:00 a.m.–12:00 p.m.**
58. **Alley Pond Park Adventure Course: Staycation 1:30 p.m.–3:30 p.m.**

Wednesday, September 3, 2014

59. **Alley Pond Park Adventure Course: Staycation. 10:00 a.m.–12:00 p.m.**
60. **Alley Pond Park Adventure Course: Staycation. 1:30 p.m.–3:30 p.m.**

61. **Friday, September 5, 2014 Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

62. **Saturday, September 6, 2014. Back to School Festival. 12:00 p.m.–3:00 p.m. Category:** Arts & Crafts, Kids

Sunday, September 7, 2014

63. **Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m.**
64. **Alley Pond Park Adventure Course: Free Public Sundays. 1:00 p.m.–3:30 p.m.**

65. **Sunday, September 7, 2014. Nocturnal Wildlife. 7:00 p.m. Category:** Education, Nature

Friday, September 12, 2014.

66. **Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness.
67. **Family Camping in Alley Pond Park. 6:00 p.m. Category:** Nature

Sunday, September 14, 2014.

68. **Alley Pond Park Adventure Course: Free Public Sundays. 9:30 a.m.–12:00 p.m.**
69. **Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

70. **Friday, September 19, 2014 Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

Sunday, September 21, 2014.

71. **Alley Pond Park Adventure Course: Free Public Sundays. 9:30 a.m.–12:00 p.m.**

72. **[Alley Pond Park Adventure Course: Free Public Sundays](#) 1:00 p.m.–3:30 p.m.**

73. **Friday, September 26, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m.Category:** Fitness, Outdoor Fitness

74. **Sunday, September 28, 2014. Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m.**

75. **Sunday, September 28, 2014. Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

76. **Friday, October 3, 2014 Fitness Bootcamp 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

Sunday, October 5, 2014.

77. **Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m.**
78. **Alley Pond Park Adventure Course: Free Public Sundays. 1:00 p.m.–3:30 p.m.**

79. **Friday, October 10, 2014 Fitness Bootcamp 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

Sunday, October 12, 2014.

80. **Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m.**
81. **Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

82. **Friday, October 17, 2014 Fitness Bootcamp 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

Sunday, October 19, 2014

83. **Alley Pond Park Adventure Course: Free Public Sundays 9:30 a.m.–12:00 p.m.**
84. **Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

85. **Friday, October 24, 2014Fitness Bootcamp5:00 p.m.–6:00 p.m.Category:** Fitness, Outdoor Fitness

86. **Saturday, October 25, 2014 MillionTreesNYC Stewardship Day at Alley Pond Park (Oakland Ravine). 9:00 a.m.–1:00 p.m. Category:** Education, Nature, Volunteer

Sunday, October 26, 2014.

87. **Alley Pond Park Adventure Course: Free Public Sundays9:30 a.m.–12:00 p.m.**
88. **Alley Pond Park Adventure Course: Free Public Sundays 1:00 p.m.–3:30 p.m.**

89. **Friday, October 31, 2014 Fitness Bootcamp 5:00 p.m.–6:00 p.m.Category:** Fitness, Outdoor Fitness

90. **Sunday, November 2, 2014 Alley Pond Park Adventure Course: Free Public Sundays9:30 a.m.–12:00 p.m. Alley Pond Park Adventure Course: Free Public Sundays. 1:00 p.m.–3:30 p.m.**

91. **Friday, November 7, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m.Category:** Fitness, Outdoor Fitness

92. **Saturday, November 8, 2014. Nocturnal Wildlife. 6:00 p.m. Category:** Nature, Kids

93. **Friday, November 14, 2014Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

94. **Friday, November 21, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor

Fitness

95. **Friday, November 28, 2014. Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category:** Fitness, Outdoor Fitness

96. **Saturday, November 29, 2014. Nature Exploration Hike (moderate). 10:00 a.m. Category:** Nature

Friday, December 5, 2014 CANCELLED: Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category: Fitness, Outdoor Fitness

Friday, December 12, 2014. CANCELLED: Fitness Bootcamp. 5:00 p.m.–6:00 p.m. Category: Fitness, Outdoor Fitness

97. **Saturday, December 20, 2014. Emergency Preparedness: Extreme Winter Weather. 1:00 p.m. Category:** Nature

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Appendix 20

Tracking

Appendix 20 **TRACKING FORM**

This document is a re-formated version of the site specific recommendation tables (tables 22 & 23) and the implementation tables (tables 24-34) in the Alley Creek watershed and habitat restoration plan. This document is intended as an ongoing tracking form to track the status and progress of each of the recommendations in the watershed plan. The description of each field in the tracking forms are detailed below. Each project should have a status nomintaed each year.

Field	**Definition**
Site ID	these refer to maps in the Alley Creek watershed plan and the site specific
Location	A brief description of the project location. Only for Habitat and GI site specific recommendations. This field is not included in the "general implementation"
strategy (1-10)	these refer to the 10 strategies in the watershed plan. These do not change and
Recommendation	the details of the recommendation which is expanded in the watershed plan.
Priority	short term (ST), long term (LT) or NA. These categories were listed in the watershed plan implementation tables and do not change.
Status:	
Recommendation	Un initiated recommendation in the watershed plan
Initiated	Proposed project which is at a fundrasing status or seeking resources and
In progress	Projects that have resources allocated which are in the planning, design, permitting or construction phases. A brief description with details of progress
Completed	projects that are completed
Lead agency	Recommended lead agency which is stated in the watershed plan.
Active agencies	Any partner agencies or stewardship groups should be listed here. These should only be included from projects which have been "initiated". i.e.
Notes	Descriptive notes explaining any additional details regarding changes in

Site specific ID	strategy (1 - 10)	Recommendation	Priority (Short term/ Long term/ NA)	Status 2015	lead agency	Active Partners
na	1.2	Complete ecological assessment of upland forests.	Short term		NAC	
na	1.2 & 1.3	Close redundant trails, replant with native vegetation and update official trail maps.	Short term		Parks	
21	1.3	Update Parks salting practices to protect salt intolerant plantings.	Short term		Parks	
36	1.2 -1.2	Plan next phase of forest restoration ("phase 3") between existing Million Trees restoration sites (phase 1 & phase 2) east of Alley Creek.	Short term		Parks	
na	1.1	Review results of and quality control 2014 management concerns mapping (Appendix 8) and begin to address concerns through above actions.	Short term		Parks	
36	1.3	Design and construct vernal pool and integrate in planning for phase 3 of upland restoration east of Alley Creek.	Short term		Parks	
na	1.3	Complete ecological assessment of freshwater wetlands.	Short term		NAC	
35	1.3	Meet with Golf Course concessions to discuss buffer management around ponds.	Short term		Parks	
na	1.4	Complete ecological assessment of salt marshes.	Short term		NAC	
na	1.4	Initiate salt marsh restoration N of Northern Blvd: collect site info; develop design & cost estimates; coordinate with DEP mitigation.	Short term		NAC	
na	1.4	Coordinate marine debris removal N of RR with Natural Area Volunteers.	Short term		NAC	
na	1.4	Progress concept design of salt marsh water-ward marsh restoration and discuss regulatory implications with DEC.	Short term		NAC	
na	1.1	Acquire land at priority sites along Northern Boulevard and Gabbler's Creek and assess and address condition.	Long term		Parks	
na	1.2	Find funding sources or collaborations for mowing meadows.	Long term		Parks	
na	9.1 & 9.2	Conduct ongoing maintenance and tracking of forest restoration sites.	Long term		Parks	
na	1.2.	Address all mapped management concerns (Appendix 8) and update restoration mapping as needed.	Long term		Parks	
na	1.2	Work with DOT to determine if meadows are suitable for ROW at interchanges.	Long term		Parks	
na	1.2	Complete restoration of “phase 3”.	Long term		Parks	
na	1.2, 4.4, 8.6	Identify new sites in need of restoration as identified through the ecological assessment. Identify key research questions and needs. Expand targeted research partnerships.	Long term		Parks	
na	1.2	Utilize information as appropriate from the most recent NYC street tree census.	Long term		Parks	
na	1.3	Conduct feasibility assessment of day-lighting Oakland Lake overflow.	Long term		Parks	
na	1.3	Monitor for fish in creeks and lakes.	Long term		Parks	
na	1.3	Investigate feasibility of and design and construct alternative stormwater management system in degraded riparian corridors (Oakland Ravine, Douglaston Pkwy and Gabbler's Ck).	Long term		Parks	
na	1.3	Design and construct stream and riparian restoration projects in stable, least degraded reaches.	Long term		Parks	
na	1.4	Construct salt marsh restoration N of Northern Blvd: remove fill (asphalt, concrete, rubble etc.) Coordinate with DEP mitigation and raise additional funds as needed.	Long term		Parks	
na	1.4	Raise funds for construction of Alley Outer water-ward restoration.	Long term		Parks	
1-3,11-21	2.3	Develop concept designs for "Parks priority sites"; Seek funding for construction. (2.3) (ID 1-3,11-21)	Short term		Parks	
3	1.3 &2.5	Advocate for Oakland Ravine restoration for stormwater capture and pursue funds.	Short term		DEP	
na	2	Design and construct a new facility to disinfect during the recreational season.	Short term		DEP	
na	2	Continue to implement the Green Infrastructure (GI) Program.	Short term		DEP	
na	2	Develop protocol for prioritizing GI projects based on all co-benefits and environmental benefits.	Short term		DEP	
1-3,11-21	2	Construct 3 priority sites.	Long term		Parks	

Site specific ID	strategy (1 - 10)	Recommendation	Priority (Short term/ Long term/ NA)	Status 2015	lead agency	Active Partners
1-3,11-21	2	Seek funding for and design all 15 priority sites.	Long term		Parks	
3	2	Design and construct Oakwood Ravine BMPs.	Long term		DEP	
na	2	Monitor water quality to assess result of water quality improvements and using results review if site specific water quality targets need to be adjusted.	Long term		DEP	
na	2	Roll out GI across all drainage types in the watershed.	Long term		DEP	
na	2	Assess potential for community engagement in private landowner disconnect	Long term		Parks	
na	3	Through the LTCP process, identify and remove all dry weather illicit discharges.	Long term		DEP	
na	4	Quantify the effect of unmanaged septic tanks on water quality and integrate results in a refined management plan.	Long term		DEP	
na	4	Develop plan for septic tank management, including standards and enforcement mechanisms.	Long term		DEC	
na	4	Continue monitoring for signals of illicit discharge connections.	Long term		DEP	
na	5	Through the LTCP process, identify and remove all dry weather illicit discharges.	Short term		DEP	
na	5	Review and update stormwater control codes for new developments.	Long term		DEP	
na	5	Update regulations and codes as outlined in PlaNYC.	Long term		DEP	
na	5	Expand building codes to MS4 and include water quality requirements.	Long term		DEP	
na	5	Develop nitrogen and phosphorus voluntary targets through MS4 permit process.	Long term		DEP	
na	5	Review and update codes to allow street retrofit for GI.	Long term		DEP	
na	5	Create codes governing septic tank management.	Long term		DEP	
na	5	Review building codes related to downspouts and develop recommendations.	Long term		DEP	
na	6	Working with Yale summer research fellows, identify key issues that require or would benefit from educational programs.	Short term		Parks	
na	6	Seek funding for two forest restoration staff, part of whose responsibilities will be to strengthen relationships with QBCC, APEC, and local schools.	Short term		Parks	
na	6	Working with Yale summer research fellows, carry out park use stewardship survey and develop recommendations for expanding stewardship activities to target management needs.	Short term		USFS	
na	6	Develop and provide educational materials and educational programs for key issues identified.	Long term		Parks	
na	6	Through new hire, implement active recruitment campaign to increase stewardship and increase connection between stewardship groups.	Long term		Parks	
na	6	Identify and execute one coastal and one upland restoration activity with community/volunteer coordination.	Long term		Parks	
na	6	Create oyster garden and integrate stewardship in monitoring for viability.	Long term		Parks	
57	6	Develop a horseshoe crab monitoring program.	Long term		Parks	
na	7	Identify education needs and training strategies for best standard operating procedures for city maintenance and operations in MS4 catchments.	Short term		Parks	
na	7	Train park managers in up to date invasive species identification.	Long term		Parks	
na	7	Provide more expansive stormwater management and GI design and management training for City employees.	Long term		Parks	
na	7	Pilot projects and expand technical capacity to integrate stormwater management appropriately within natural areas.	Long term		Parks	
na	8	Develop white paper outlining an adaptive management framework to integrate stewardship coordination with NRG's ongoing restoration efforts both in planning and tracking in order to assess goals.	Short term		Parks	
na	8	Identify knowledge gaps for watershed management through the field station research agenda planning.	Short term		Parks	
na	8	Continue tracking research and request data from research through Parks permit program at the UFS.	Short term		Parks	

Site specific ID	strategy (1 - 10)	Recommendation	Priority (Short term/ Long term/ NA)	Status 2015	lead agency	Active Partners
na	8	Continue monitoring at established sites.	Short term		Parks	
na	8	Continue and expand collaboration with Yale and other universities through visiting scholars programs at the UFS.	Short term		USFS	
na	8	Develop restoration guidelines based on evaluation of salt marsh restoration assessment.	Long term		Parks	
na	8	Use adaptive management framework to make decisions in coordination with stewardship groups and integrate stewardship and ecological surveys.	Long term		Parks	
na	9	Inspect forest restoration sites annually.	Short term		Parks	
na	9	Track forest planting and management actions.	Short term		Parks	
54	9	Continue mortality study at Million Trees planting site.	Short term		Parks	
na	9	Monitor water quality in Alley Creek and Little Neck Bay.	Short term			
na	9	Monitor salt marsh restoration success.	Short term		DEP	
na	9	Track management actions and conditions at restoration sites.	Long term		Parks	
na	9	Develop framework to collate monitoring of all local restoration sites from all stakeholders.	Long term		Parks	
na	9	Construct vernal pool and monitor performance.	Long term		Parks	
na	10	Hold periodic progress meetings with the Watershed Advisory Committee (WAC) and interested community members.	Short term		Parks	
na	10	Develop a communication plan.	Long term		Parks	
na	10	Hire watershed coordinator.	Long term		Parks	
na	10	Track water quality and watershed programmatic updates under MS4 and LTCP reporting to DEC	Long term		DEP	
na	10	Report restoration updates and programmatic efforts to HEP and LISS	Long term		Parks	
na	10	Track restoration updates and programmatic efforts under PlaNYC updates (i.e. Wetland Strategy, Stormwater Plan, Green Infrastructure Plan).	Long term		Parks	
na	10	Present progress reports, monitoring results, and implementation strategies.	Long term		Parks	

Site ID	Location	strategy	Recommendation	Priority	Status 2015	Lead agency	Active Partners	Status 2016	Status 2017	Notes
1	Tulip Forest North	1.1; 1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
2	Alley Creek Adjacent Uplands	1.1; 1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
3	Oakland Ravine	1.1; 1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
4	Virginia Point	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
5	Southern Forest	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
6	Golf Course Forest	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
7	Douglaston South	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
8	Adventure Course	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
9	Tulip Forest South	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
10	Old Oak Pond	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
11	Crocheron Park	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
12	Osprey Landing	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
13	Parkland along Little Neck Bay	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
14	Alley Creek Adjacent Forest Restoration	1.1;1.2.2	Remove and control invasive plant and plant native species	LT		NRG/Parks				
15	Fairway parking lot	1.1	Control new invasive species.	LT		NRG/Parks				
16	Gabblers Creek	1.1	Control new invasive species.	LT		NRG/Parks				
17	DEP meadow restoration	1.2.8	Implement meadow management plan and mowing and maintenance regime.	LT		NRG/Parks				
18	DOT cloverleafs	1.2.8	Implement meadow management plan and mowing and maintenance regime.	LT		NRG/Parks				
19	Oakland Lake Ballfields / Horatio Park	1.2.8	Implement meadow management plan and mowing and maintenance regime.	LT		NRG/Parks				
20	Alley Creek East Forest Restoration Sites	1.2.8	Implement meadow management plan and mowing and maintenance regime.	LT		NRG/Parks				
21	Pines near Southern Forest Adventure Course	1.1	Educate the borough on salting practices near roads.	ST		NRG/Parks				
22	Aurora Pond	1.1	Re-vegetation to control erosion with mosses or herbaceous ground cover.	LT		NRG/Parks				
23	Kettle Ponds	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
24	Oakland Lake	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
25	APEC Windmill Pond	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
26	Vernal Pool Creation at 234th St.	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	ST		NRG/Parks				
27	Alley Creek Perennial Reach	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
28	Spring Creeks, Alley Creek "East Arm"	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
29	Old Oak Pond	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
30	Aurora Pond	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
31	Alley Pond - Interchange BMP	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
32	Douglaston Parkway Ephemeral Reach	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
33	APEC Freshwater Wetlands	1.3.10	Remove invasive plants, restore functioning hydrology if possible or close canopy gaps.	LT		NRG/Parks				
34	Old Oak Pond Trail	1.1; 6.1	Remove trash, manage erosion or formalize a trail based on desire lines.	LT		NRG/Parks				
35	Golf Course Ponds	1.1; 1.3.8	Coordinate with grounds keepers to negotiate a minimum buffer for wildlife protection.	ST		NRG/Parks				
36	Vernal Pool in forest restoration sites at Alley Creek East	1.3.6; 1.3.7; 7.3	Protect existing vernal pool and create a vernal pool complex.	ST		NRG/Parks				

Site ID	Location	strategy	Recommendation	Priority	Status 2015	Lead agency	Active Partners	Status 2016	Status 2017	Notes
37	Gabblers Creek South	1.3.1; 1.3.2; 1.3.3; 2.1; 2.5; 5.8; 2.4; 1.1; 1.2.2	Identify opportunities for stormwater source controland dissipate energy at outfalls to reduce erosion. Build natural-like channels, integrating invasive plant control, and access improvements.	LT		NRG/Parks				
38	Oakland Ravine	1.3.1; 1.3.2; 1.3.3; 2.1; 2.5; 5.8; 2.4; 1.1; 1.2.2	Identify opportunities for stormwater source controland dissipate energy at outfalls to reduce erosion. Build natural-like channels, integrating invasive plant control, and access improvements.	LT		NRG/Parks				
39	Douglaston Parkway Ephemeral Reach	1.3.1; 1.3.2; 1.3.3; 2.1; 2.5; 5.8; 2.4; 1.1; 1.2.2	Identify opportunities for stormwater source controland dissipate energy at outfalls to reduce erosion. Build natural-like channels, integrating invasive plant control, and access improvements.	LT		NRG/Parks				
40	Oakland Lake Overflow at APEC	1.3.2	Daylight stream and restore habitat. (1.3.2)	LT		NRG/Parks				
41	Gabblers Creek North	1.3.2; 1.3.4	Invasive plant control and reforestation along ephemeral stream riparian corridor. Continue coordination between Parks and stewardship groups.	LT		NRG/Parks				
42	Alley Creek salt marsh north of LIRR	1.4.3	Remove marine debris through contractors or volunteer stewardship events and replant if needed to prevent Phragmites from colonizing. (1.4.3)	ST		NRG/Parks				
43	Alley Creek salt marsh btwn LIRR & N Blvd	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	ST		NRG/Parks				
44	Alley Creek salt marsh next to driving range	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	ST		NRG/Parks				
45	Alley Creek tidal reach	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	LT		NRG/Parks				
46	ConEd Mitigation site	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	LT		NRG/Parks				
47	LaGuardia Mitigation	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	LT		NRG/Parks				
48	Udalls Cove tidal wetlands	1.3.11; 1.4.2	Lower elevation by removing historic fill, to establish salt marsh elevation and associated hydrology. Trial planting *Spartina cynosuroides* , in lower salinity habitats. (1.3.11, 1.4.2)	LT		NRG/Parks				
49	Alley Creek salt marsh north of LIRR	1.4.4	Examine feasibility of piloting waterward salt marsh restoration with living shoreline to restore marsh area reduce shoreline erosion. (1.4.4)	LT		NRG/Parks				
50	Udalls Cove salt marsh edges	1.4.4	Examine feasibility of piloting waterward salt marsh restoration with living shoreline to restore marsh area reduce shoreline erosion. (1.4.4)	LT		NRG/Parks				
51	Alley Creek salt marsh north of LIRR	1.4.4	Pools could be elevated, through replenishment or uplift with clean sand, to the adjacent elevations and replanted with native salt marsh grasses. (1.4.4)	LT		NRG/Parks				
52	Alley Creek salt marsh north of LIRR	6.6	Investigate options through partnerships and volunteers for monitoring, expanding and protecting habitat. (6.6)	LT		NRG/Parks				
53	Alley Creek salt marsh next to driving range	1.4.2	Remove concrete and asphalt, replace or cap with clean sand, replant Spartina alterniflora to restore low salt marsh. Restore coastal forest where fill removal is not feasible. (1.4.2)	LT		NRG/Parks				
54	Alley Creek salt marsh next to driving range	1.4.2	Manage invasive speciesand replant with coastal forest species (1.4.2)	LT		NRG/Parks				
55	LaGuardia Mitigation	1.4.2	Manage invasive speciesand replant with coastal forest species (1.4.2)	LT		NRG/Parks				
56	LaGuardia Mitigation	1.4.3	Formalize a trail to prevent wandering. Install signage and fencing if need be. (1.4.3)	LT		NRG/Parks				
57	Alley Creek salt marsh north of LIRR	1.4.3	Formalize a trail to prevent wandering. Install signage and fencing if need be. (1.4.3)	LT		NRG/Parks				
58	Memorial Field - Douglaston Manor	1.4.4; 4.2	Consult and partner with DMEA to restore and expand fringing salt marsh along the Douglaston Manor Peninsula on private property. (1.4.4, 4.2)	LT		NRG/Parks				

Site specific ID	Location	strategy (1 - 10)	Recommendation	Priority
1	233rd St	2.4.	GI.1.Construct GI, or stormwater BMPs, on parkland that do not require pipe retrofits under road (no road retrofit design). (2.4.)	ST
2	Parks' Car Park - Check IA protocol	2.4.	GI.1.Construct GI, or stormwater BMPs, on parkland that do not require pipe retrofits under road (no road retrofit design). (2.4.)	ST
3	Cunningham Park 210th St / 69th Ave	2.4.	GI.1.Construct GI, or stormwater BMPs, on parkland that do not require pipe retrofits under road (no road retrofit design). (2.4.)	ST
4	Canopy gap - 210th St / 75th Ave	2.3.1; 4.2	GI.2.Construct GI needing no road retrofit design on DOT right of way.(2.3.1, 4.2)	LT
5	Tall Oak Playground	2.2; 2.3; 4.2	GI.3.Construct GI needing no road retrofit design on school playgrounds.(2.2, 2.3, 4.2)	LT
6	Seven Gables Playground	2.2; 2.3; 4.2	GI.3.Construct GI needing no road retrofit design on school playgrounds.(2.2, 2.3, 4.2)	LT
7	Alley Pond Park	2.2; 2.3; 4.2	GI.3.Construct GI needing no road retrofit design on school playgrounds.(2.2, 2.3, 4.2)	LT
3	Cunningham Park - 210th St / 69th Ave	2.2; 2.3;	GI.4.Construct GI on parkland that may require pipe retrofits under roads (road retrofit design).(2.2, 2.3,)	LT
8	Brooklyn - Queens Greenway	2.2; 2.3;	GI.4.Construct GI on parkland that may require pipe retrofits under roads (road retrofit design).(2.2, 2.3,)	LT
9	Grand Central Pkwy / 218th St	2.2; 2.3;	GI.4.Construct GI on parkland that may require pipe retrofits under roads (road retrofit design).(2.2, 2.3,)	LT
10	Telephone Playground	2.3.1; 4.2	GI.5.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (2.3.1, 4.2)	LT
11	Douglaston 68th St	2.3.2	design). 2.3.2	LT
12	Douglaston 244th St	2.3.2	design). 2.3.2	LT
13	Douglaston 66th St	2.3.2	design). 2.3.2	LT
14	Northern Boulevard East - ROW	2.3.2	design). 2.3.2	LT
15	Northern Boulevard / Old Oak Pond	2.3.2	design). 2.3.2	LT
16	Kennedy Playground	2.3.2	design). 2.3.2	LT
17	Horatio Pkwy / 49th Rd Basketball Court	2.3.2	design). 2.3.2	LT
18	Douglaston Pkwy - Fairway	2.3.2	design). 2.3.2	LT
19	Nassau Blvd / Little Neck Pkwy Greenstreet	2.3.2	design). 2.3.2	LT
20	APP State Route / Grand Central Pkwy	2.3.2	design). 2.3.2	LT
21	57th Ave & 230th St	2.3.2	design). 2.3.2	LT
22	Cross Island Pkwy to Alley Pond - S	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
23	Cross Island Pkwy to Alley Pond - N	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
24	Cross Island Pkwy ROW - N	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
25	LIE / Cross Island Pkwy interchange - S	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
26	Northern Blvd / Cross Island Pkwy interchange	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
27	Horace Harding Freeway / LIE ROW	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
28	Grand Central Pwky ROW	2.3.2; 4.2	GI.7. Construct BMPs (no road retrofit design) on DOT property.2.3.2, 4.2	LT
29	Louis Pasteur Park	2.3.2; 4.2	GI.8. Construct BMP (no road retrofit design) on DOE property.2.3.2, 4.2	LT
30	Marie Curie Park	2.3.2; 4.2	GI.8. Construct BMP (no road retrofit design) on DOE property.2.3.2, 4.2	LT
31	Bay Terrace Playground	2.3.2; 4.2	GI.8. Construct BMP (no road retrofit design) on DOE property.2.3.2, 4.2	LT
32	Challenge Playground	2.3.2; 4.2	GI.8. Construct BMP (no road retrofit design) on DOE property.2.3.2, 4.2	LT
33	42nd Ave & Bell Blvd Greenstreet	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
34	Bell Blvd & 56th St Greenstreet	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
35	Douglaston Pkwy draining to APP	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
36	E Hampton Blvd	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
37	Horatio Pkwy / 49th Rd	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
38	Oakland Ravine	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
39	Northern Boulevard / Driving Range - W	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT

40	Old Oak Pond	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
Site specific ID	**Location**	**strategy (1 - 10)**	**Recommendation**	**Priority**
41	Crocheron Park - S	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
42	Crocheron Park - N	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
43	Gabblers Creek - 247th St / Willow St	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
44	Alameda Ave - Greenstreet	5.8 2.3.2; 4.2	GI.9.Take runoff from streets into Parks by retrofitting catch-basins, grading, and pipe under roads as needed (BMP road retrofit design) (5.8) 2.3.2, 4.2	LT
45	Douglaston Golf Course	2.3.2; 5.8	(2.3.2, 5.8)	LT
46	Open space Springfield Blvd / 73rd Ave	2.3.2; 5.8	(2.3.2, 5.8)	LT
47	APP - between CIP& Fairway - TI 024 pipe surcharge	2.3.2; 5.8	(2.3.2, 5.8)	LT
48	Horace Harding Freeway - Trail in Tulip Forest	2.3.2; 4.2	GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)	LT
49	LIE Off Ramp	2.3.2; 4.2	GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)	LT
50	LIE - Southern Forest	2.3.2; 4.2	GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)	LT
51	APP S - New Douglaston Pump Station	2.3.2; 4.2	GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)	LT
52	Clearview Expressway / Clearview Golf Course	2.3.2; 4.2	GI.10.Construct BMPs (road retrofit designs) on DOT property. (2.3.2, 4.2)	LT
53	LaGuardia Mitigation / 233rd St	2.3.2.	GI.11.Construct BMPs (no road retrofit design) on Parkland. (2.3.2.)	LT
54	Fort Totten Park	2.3.2.	GI.11.Construct BMPs (no road retrofit design) on Parkland. (2.3.2.)	LT
55	CIP draining to Ephemeral - S	2.3.2;4.2	GI.12.Construct BMPs (no road retrofit design) on DOT property. (2.3.2,4.2)	LT
56	CIP draining to Ephemeral - N	2.3.2;4.2	GI.12.Construct BMPs (no road retrofit design) on DOT property. (2.3.2,4.2)	LT
57	CIP to APEC	2.3.2;4.2	GI.12.Construct BMPs (no road retrofit design) on DOT property. (2.3.2,4.2)	LT
58	CIP to Alley Tidal	2.3.2;4.2	GI.12.Construct BMPs (no road retrofit design) on DOT property. (2.3.2,4.2)	LT
59	LaGuardia Mitigation - SW outfall vineland	2.3.2	(2.3.2)	LT
60	Waters edge Rd	2.3.2	(2.3.2)	LT
61	Virginia Point - Udalls Cove	2.3.2	(2.3.2)	LT