VOLUME 2 – JAMAICA BAY WATERSHED PROTECTION PLAN

CHAPTER 1 - WHAT IS WATERSHED PLANNING? 1
1.1 Watershed Planning and Jamaica Bay 1
1.2 Issues Common to Watershed Planning Processes 1
1.3 The Watershed Planning Approach 2
1.4 References 2
CHAPTER 2 - PLANNING FRAMEWORK 3
2.1 The Planning Process for Jamaica Bay 3
2.2 Organization of the Plan 4
2.3 The Vision for Jamaica Bay 5
2.4 Issues Identification 5
2.4.1 The Key Issues 5
2.4.2 Water Quality 6
2.4.3 Ecology 6
2.4.4 Public Access, Open Space, and Recreation 7
2.4.5 Land Use and Development 7
2.4.6 Public Education and Outreach 7
2.5 Objectives 8
2.6 Management and Implementation Strategies 9
2.6.1 Overview 9
2.6.2 Interrelationship Between Strategies 10
2.6.3 Advisory Committee Recommendations 10
2.6.4 Plan Framework's Relationship to Local Law 71 12
CHAPTER 3 – CATEGORY 1, WATER QUALITY: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES 15
Current Programs 29
CHAPTER 4 – CATEGORY 2, RESTORATION ECOLOGY: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES 40
CHAPTER 5 – CATEGORY 3, PUBLIC USE AND ENJOYMENT: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES 57
CHAPTER 6 – CATEGORY 4, SOUND LAND USE AND DEVELOPMENT: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES 64
CHAPTER 7 – CATEGORY 5, PUBLIC EDUCATION AND OUTREACH: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES 77
CHAPTER 8 – CATEGORY 6, COORDINATION & IMPLEMENTATION 96

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CHAPTER 1 - WHAT IS WATERSHED PLANNING?

1.1 Watershed Planning and Jamaica Bay

Watershed planning recognizes the interconnection between land and water, that much of what we do on a parcel of land makes its way to our waterways, bays, and ocean. It is complex because a watershed plan is not just a series of actions to be taken, but it is also a process. To be successful, it must involve the participation of multitudes of people with different perspectives and priorities. It also requires ridding ourselves of age old habits and creating a vision that motivates people to change.

The *Jamaica Bay Watershed Protection Plan* is intended to create awareness of the issues facing the Bay; to develop comprehensive planning strategies of potential actions that may benefit the Bay and its watershed; and to serve as a template for the future. It is intended to serve as a vision for what strategies could be used, and describes necessary implementation steps for a process to accomplish the vision for a sustainable Jamaica Bay.

Given the complexity of the issues facing Jamaica Bay, this *Jamaica Bay Watershed Protection Plan* does not provide solutions to all of the issues facing the Bay, but rather will make recommendations for certain actions and provide a guide for the next phase of steps to be undertaken to maintain and improve upon the progress in this planning effort. It is expected that there will be differing views with respect to specific strategies described in this document, and that changes in priority or even approach may occur – this is a living document that will need to be modified to adjust to the successes and new information and technologies that will arise with time as well as ongoing dialogue. The highest priority of this *Jamaica Bay Watershed Protection Plan* is that of guiding an ongoing planning process.

1.2 Issues Common to Watershed Planning Processes

The preceding volume of this document provides context for the *Jamaica Bay Watershed Protection Plan*. It summarizes the history of Jamaica Bay to the present day, identifies the key issues and problems, and describes the programs that have occurred or are presently underway to improve water quality, ecological, and human use conditions in the watershed. Taking what is learned from Volume 1, there are several major themes that can be identified:

1. Environmental conditions in the Jamaica Bay watershed are affected by the human population within the basin. As the population increases, the stress on these natural resources increases accordingly.
2. There is a need to further improve water quality, ecology, and human uses.
3. Issues facing the Bay and its watershed are highly interrelated and call for a coordinated approach. Implementation of the *Jamaica Bay Watershed Protection Plan* will require coordination among a myriad of public agencies, residents, businesses, environmental organizations, and stakeholders.

It should be noted that these themes are not unique to Jamaica Bay; other estuaries throughout New York Harbor, and indeed throughout the United States, are grappling with similar problems and there are many success stories.

1.3 The Watershed Planning Approach

This *Jamaica Bay Watershed Protection Plan* adopts a "watershed planning approach" towards management of environmental resources. Because watershed planning has become a buzz-word and can be construed to mean many different things, it is necessary to define it. An excellent definition has been provided by the Maine Department of Environmental Protection, which defines watershed planning as:

"…an approach to protecting water quality and quantity that focuses on a whole watershed. This is a departure from the traditional approach of managing individual wastewater discharges, and is necessary due to the nature of polluted runoff, which in most watersheds is the biggest contributor to water pollution. Polluted runoff is caused by a variety of land use activities, including development, transportation, agriculture and forestry, and may originate anywhere in the watershed. Due to its diffuse nature, polluted runoff has not been effectively managed through regulatory programs alone… Watershed planning and management involve a number of activities, including: targeting priority problems in a watershed; promoting a high level of involvement by interested and affected parties; developing solutions to problems through the use of the expertise and authority of multiple agencies and organizations; and measuring success through monitoring and other data gathering…." (MEDEP 2006).

The watershed planning approach has been implemented in dozens of estuaries around the United States that have become progressively more degraded from urban development. Chesapeake Bay, San Francisco Bay, and Galveston Bay are all examples of this style of comprehensive water quality and ecosystem management planning. In fact, many of these watershed management planning documents were reviewed as the *Jamaica Bay Watershed Protection Plan* was being developed.

The *Jamaica Bay Watershed Protection Plan* adopts the watershed management planning framework that is intended to overcome the hurdles of a potentially disjointed planning process by:

1. Offering a process and a common vision (rooted in ecosystem function and sustainability) to coordinate relevant water quality improvement and ecosystem restoration efforts and allow input from all stakeholders in the watershed.
2. Providing detailed management strategies that specifically address the key issues affecting the Bay.
3. Ensuring that implementation strategies and frameworks are identified so the *Jamaica Bay Watershed Protection Plan* does not "sit on the shelf."
4. Providing a framework to steer future land use planning decisions to ensure the long-term sustainability of environmental health in the watershed.
5. Building flexibility into the management actions and the prioritization process, allowing management strategies to respond to new information and changing conditions.

Let's get started.

1.4 References

Maine Department of Environmental Protection (MEDEP), Bureau of Land and Water Quality. March 2006.
http://www.state.me.us/dep/blwq/watersh.htm

CHAPTER 2 - PLANNING FRAMEWORK

2.1 The Planning Process for Jamaica Bay

The Planning Framework used to create the *Jamaica Bay Watershed Protection Plan* starts with a shared, long-term vision. To accomplish this vision, a number of steps have or will need to be undertaken:

- The issues facing the Bay - including issues that are widely known and discussed as well as those that surfaced during the compilation of *Volume 1: Jamaica Bay Watershed Regional Profile* - are identified and categorized.
- For each set of Jamaica Bay and watershed issues, a comprehensive list of objectives has been formulated.
- Then, potential management strategies, or actions, are identified to address the objective. Ultimately, the development and refinement of these management strategies will be the "roadmap" for attaining the future vision of a healthy, sustainable Jamaica Bay.

The management strategies to address key Jamaica Bay and watershed concerns are recognized as the key elements of this *Jamaica Bay Watershed Protection Plan* in that the strategies are intended to shape the future management of the Bay and its watershed and, accordingly, will be monitored and adapted into the future based on feedback from the Bay's ecological system. However, the management strategies included in this *Draft Jamaica Bay Watershed Protection Plan* are labeled "Potential Management Strategies" because further assessment and evaluation is required to select the recommended management strategies based on environmental, technical and economic feasibility, per Local Law (LL71). The final recommended management strategies will be included in the *Final Jamaica Bay Watershed Protection Plan* to be delivered to the City Council on October 1, 2007.

There were several important considerations in the development of this *Jamaica Bay Watershed Protection Plan* regarding form and format. It is imperative that the document be well organized and readable; that it be understandable and not overwhelmed by technical jargon. At the same time, it is a critical planning document that will inform future choices; therefore, accuracy and detail are key. It is our hope that the *Jamaica Bay Watershed Protection Plan* is approachable by technical specialists and the lay public alike.

As this *Jamaica Bay Watershed Protection Plan* relates in several sections throughout, the City of New York through the New York City Department of Environmental Protection (NYCDEP) and other City agencies, the National Park Service (NPS) and other federal agencies, and New York State though the actions of the New York State Department of Environmental Conservation (NYSDEC) and other state departments, have been making considerable efforts to improve the water quality of Jamaica Bay; are taking steps to protect and restore the Bay's ecological systems; and are studying further options to improve the ecological values of the Bay's watershed. Additionally, non-governmental organizations, community groups, and individuals have dedicated countless hours to improve conditions in the Bay and its watershed, and to encourage others to take up that cause. Their combined energies and resources have had a positive effect over the last two decades after the depredations of the previous 120 years and more. The *Jamaica Bay Watershed Protection Plan* attempts to capture the current projects and initiatives of other governmental and non-

governmental organizations whose actions have positively impacted the future of Jamaica Bay.

"We do not inherit the earth from our ancestors, we borrow it from our children."
- Native American Proverb

An important step in the development of this *Jamaica Bay Watershed Protection Plan* has been the inclusion of stakeholders in the process. Through the activities of the Jamaica Bay Watershed Protection Plan Advisory Committee (the Advisory Committee), and public meetings and workshops held by the NYCDEP, the public has had the opportunity to provide input to the development of the *Jamaica Bay Watershed Protection Plan*, including comments on key issues, potential management strategies, and suggested outcomes. Thus, it conforms to the stated criteria of a stakeholder-driven management process. It is fundamental to the nature of a watershed planning process, and critical to the ultimate implementation of the *Jamaica Bay Watershed Protection Plan*, that this collaborative process be continued and relevant stakeholders brought to the table for the implementation and continued evolution of this document.

2.2 Organization of the Plan

The *Jamaica Bay Watershed Protection Plan* is organized into two Volumes. *Volume 1: Jamaica Bay Watershed Regional Profile* provides the context within which this *Jamaica Bay Watershed Protection Plan* has been developed; that is, the history of Jamaica Bay, the key issues currently affecting the Bay, and current management efforts. This volume, *Volume 2: Jamaica Bay Watershed Protection Plan*, provides the vision, objectives, and potential management strategies for the *Jamaica Bay Watershed Protection Plan*. These volumes are designed to be stand-alone documents, yet work together for a complete understanding of the current conditions of Jamaica Bay and future management of its watershed.

Volume I, *Jamaica Bay Watershed Regional Profile*, has several purposes. It is intended to be a comprehensive reference document for Jamaica Bay. And it also provides the information needed to identify issues of concern that face the Bay, setting the stage for the development of management strategies to address these issues, which are provided in this Volume 2.

Volume 2 is intended to serve as a blueprint for the future management of the Bay and its watershed to achieve a shared vision for Jamaica Bay. Therefore, Volume 2 starts with a vision for the Bay and the issues that need to be overcome to achieve the vision. For each issue, objectives for the Bay were set, and for each objective, potential management strategies, or actions, are identified to address the objective. This *Draft Jamaica Bay Watershed Protection Plan* also documents the steps that will need to be undertaken to evaluate each Management Strategy before a recommendation can be made as to its feasibility and effectiveness (see sections entitled "Strategy Assessment Approach" under each Management Strategy). Where possible in these sections, potential future implementation strategies were also identified. While implementation approaches for each of the recommended Management Strategies will be discussed in the *Final Jamaica Bay Watershed Protection Plan*, the further development of implementation steps for many of the recommended strategies will be an ongoing process after the *Final Jamaica Bay Watershed Protection Plan* is completed in October 2007.

Volume 2 provides the issues, objectives, and potential Management Strategies-related

assessment approach for the *Jamaica Bay Watershed Protection Plan*. There are three primary sub-sections:

- an introduction to watershed planning concepts (Chapter 1)
- the framework for the *Jamaica Bay Watershed Protection Plan* including the vision, issues identification, objectives, and management strategies (Chapter 2)
- Objectives, Potential Management Strategies, and evaluation methods to address five categories:
    - Category 1: Water Quality Improvements (Chapter 3)
    - Category 2: Restoration Ecology (Chapter 4)
    - Category 3: Public Use and Enjoyment (Chapter 5)
    - Category 4: Sound Land Use and Development (Chapter 6)
    - Category 5: Public Education and Outreach (Chapter 7)
    - Category 6: Coordination and Implementation (Chapter 8)

Chapter 8 provides preliminary concepts relating to the activities that will be necessary to move the *Jamaica Bay Watershed Protection Plan* forward. These concepts will be developed further for inclusion in the *Final Jamaica Bay Watershed Protection Plan.*

The *Final Jamaica Bay Watershed Protection Plan*, to be issued in October 2007, will provide the evaluation of the potential management strategies, make recommendations on promising strategies and implementation steps.

2.3 The Vision for Jamaica Bay

The *Jamaica Bay Watershed Protection Plan* begins with a shared long-term vision of what a future Jamaica Bay could be:

The Jamaica Bay watershed is a place where New Yorkers and visitors co-exist with natural areas and clean water that harbor healthy waterfowl, fish, and shellfish populations. It is a place where urban communities embrace environmental stewardship and where wetlands and other natural areas are protected and restored for future generations. The Jamaica Bay estuary is once again a cultural and recreational hub for Brooklyn and Queens, where residents swim, fish, boat, and enjoy nature.

The above vision statement was created early in the planning process, based on discussions between NYCDEP and the Advisory Committee about what a future Jamaica Bay could be to direct and coordinate water quality improvement and ecosystem restoration efforts. The vision was developed to support the planning process and help identify the most appropriate and effective objectives and management strategies.

2.4 Issues Identification

2.4.1 The Key Issues

To achieve the *Vision for Jamaica Bay*, the *Jamaica Bay Watershed Protection Plan* must address five key issues facing the watershed. These issues, as identified in Volume 1, are:

- Water Quality
- Ecology
- Public Access, Open Space, and Recreation
- Land Use and Development
- Public Education and Outreach

A summary of each of these issues is provided below. For a full description of each, see its applicable chapter in Volume 1, *Jamaica Bay Watershed Regional Profile.*

2.4.2 Water Quality

The water quality of Jamaica Bay and its tributaries has degraded over time. Impairments to water quality in the Bay can be attributed to several factors:

- Increasing human populations in Brooklyn, Queens, and Rockaway and the associated increase in human waste products (in terms of sewage and solid wastes).
- Increasing volumes of surface runoff as a result of urban development and the spread of impervious surfaces.
- Landfill operations displacing freshwater wetlands in the upper watershed and tidal wetlands in the estuary, impeding natural wetland filtration processes and altering tidal circulation patterns.
- The continuing westward extension of the Rockaway Spit, which may be contributing to the lack of circulation and mixing of Bay waters in the estuary.
- Dredging operations in the Jamaica Bay estuary, which have increased the bathymetric depth of the Bay and resulted in a decrease in circulation and mixing.

NYCDEP has a number of programs in place to upgrade the wastewater treatment plants that discharge into the watershed and to address combined sewer overflow (CSO) discharges. Current programs and additional measures under consideration to address water quality issues are discussed in Volume 2, Chapter 3, *Water Quality*.

2.4.3 Ecology

Impairment and loss of ecosystem function in the Jamaica Bay watershed has occurred since New York City expanded into Brooklyn and Queens at the turn of the 20th century. The primary drivers of ecosystem disturbance are:

- Direct displacement and fragmentation of habitat by residential, commercial, industrial, and transportation infrastructure.
- Landfilling of ecologically sensitive areas, especially tidal wetlands around the perimeter of the Jamaica Bay estuary and freshwater wetlands and riparian areas in the upper watershed.
- The introduction of invasive exotic flora and fauna into the watershed, which can prey on or out-compete the native species for available resources.
- Degraded water quality (discussed above) in marine and brackish environments that can lead to direct and indirect health problems for aquatic organisms.
- Changing climate patterns, which has a myriad of effects (many of them poorly understood or unforeseen) on ecosystems in the Jamaica Bay watershed.

NYCDEP is implementing a number of Jamaica Bay restoration projects including restoration of three landfills and a large wetland restoration effort in Idlewild Park. A number of public and private entities are also undertaking projects to restore environmental features and ecological functions including the joint restoration project at the Elders Point Salt Marsh Islands by NYCDEP, U.S. Army Corps of Engineers (USACE), NY/NJ Port Authority (Port Authority), NYSDEC, Natural Resource Conservation Service (NRCS), and NY/NJ Harbor Estuary Program (HEP). Current programs and additional measures under consideration to promote ecological restoration and enhancements are discussed in Volume 2, Chapter 4, *Restoration Ecology*.

2.4.4 Public Access, Open Space, and Recreation

Transportation, residential, commercial, and industrial development patterns running along the perimeter of the Jamaica Bay estuary, makes it difficult for neighboring communities to access the Bay. While private boating access can be achieved at one of the many marinas, public boating access is very limited. In addition, public access to fishing, hiking, bird watching, and swimming is only available in portions of the Bay.

There are a number of planning proposals to develop access to and amenities along Jamaica Bay. Current programs and additional measures under consideration to address public access are discussed in Volume 2, Chapter 5, *Public Use and Enjoyment*.

2.4.5 Land Use and Development

Since 1636, when the first Dutch settlers began to populate the areas now known as Brooklyn and Queens, drastic alterations have occurred within the Jamaica Bay watershed. The primary mechanisms of transformation have been directly or indirectly related to human disturbance. Urban development, with the associated residential, commercial, industrial, and transportation infrastructure, has had a direct impact on water quality in the receiving waters of the Jamaica Bay estuary and the health of upland, wetland and estuarine ecosystems, which in time have resulted in impaired human uses of the local environment. The primary impact of urbanizing environments -- the covering of soils with impervious concrete and asphalt surfaces -- decreases ground water infiltration, while increasing the volume and rate of stormwater runoff.

NYCDEP has a number of regulatory programs in place to address on-site stormwater runoff and is working with other agencies to further address minimizing impervious surfaces and providing for greater stormwater control. Current programs and additional measures under consideration to address land use and development are discussed in Volume 2, Chapter 6, *Sound Land Use and Development.*

2.4.6 Public Education and Outreach

The physical barriers to the Bay, combined with extensive urban development, have disconnected the Bay from those who live in its watershed. Several water quality and ecological issues can be attributed to a lack of public awareness about the Bay - its current conditions and related impacts of human activities. There are many opportunities for the public to help improve the Bay's condition such as conserving water, landscaping yards with native or noninvasive species, and participating in beach clean-ups. Many education and outreach programs exist to increase the visibility of Jamaica Bay; one challenge is that the efforts of different entities are uncoordinated and, therefore, may not target or reach the diverse population groups - public officials, property owners, business owners, school children, etc. - throughout the watershed.

As mentioned, a number of agencies, non-governmental organizations and educators have programs to increase public awareness and stewardship through outreach and education activities. Current programs and additional measures under consideration to promote education and outreach are discussed in Volume 2, Chapter 7, *Public Education and Outreach.*

2.5 Objectives

As touched upon in the introductory text for this chapter, for each of the five issue categories, a set of achievable and relevant Objectives has been identified to address the issue. The five categories and their respective Objectives are listed below:

Category 1: Water Quality Improvements

- Objective 1a: Improve stormwater management to reduce the volume of stormwater runoff and filter and remove pollutants.
- Objective 1b: Reduce nitrogen loading to the tributary basins and Jamaica Bay.
- Objective 1c: Increase dissolved oxygen levels in tributary basin areas of chronic hypoxia to improve ecological productivity.
- Objective 1d: Increase dissolved oxygen in Grassy Bay and North Channel areas of chronic hypoxia to improve ecological productivity.
- Objective 1e: Reduce pathogen loading into the tributary basins and the Bay.
- Objective 1f: Reduce floatables in tributary basins, open waters, and along the shoreline.
- Objective 1g: Alleviate the loading of hydrocarbons or other toxic contaminants into the Bay, tributaries, ground water and/or surface water resources, and prevent future leakage in commercial and industrial areas.
- Objective 1h: Provide for the proper remediation of toxic sediments in the Jamaica Bay estuary, and prevent the further degradation of sediments from heavy metals and other contaminants.

Category 2: Restoration Ecology

- Objective 2a: Restore the salt marsh islands in Jamaica Bay.
- Objective 2b: Protect wetlands through research, monitoring, and enforcement.
- Objective 2c: Restore and create additional tidal wetlands along the peripheral and shoreline buffer areas of the Jamaica Bay estuary.
- Objective 2d: Restore submerged aquatic vegetation (SAV), such as eel grass, in protected areas of the Bay.
- Objective 2e: Restore or create additional freshwater channels, ponds, and non-tidal wetlands around the periphery of Jamaica Bay and throughout the watershed.
- Objective 2f: Restore the headwater tributaries of the Bay.
- Objective 2g: Restore and enhance existing indigenous grassland communities.
- Objective 2h: Restore or enhance dune and beach habitats.
- Objective 2i: Support the recovery of federal and state-listed rare, threatened, and endangered (RTE) plant and animal species.
- Objective 2j: Restore or create additional woodland and shrubland habitats.

Category 3: Public Use and Enjoyment

- Objective 3a: Increase public access to Jamaica Bay.
- Objective 3b: Increase public access to a wider range of landscape types in the upper watershed in order to expand the public's understanding of the interconnectivity of the entire Jamaica Bay watershed.

Category 4: Sound Land Use and Development

- Objective 4a: Minimize the extent of impervious surfaces within existing and new development in the watershed.
- Objective 4b: Enhance the use of on-site stormwater management techniques and best management practices in new and existing development.
- Objective 4c: Encourage "green" development in the Jamaica Bay watershed.

Category 5: Public Outreach and Education

- Objective 5a: Increase the visibility of the Bay and the interconnections between human activities in the watershed and impacts on Bay conditions.
- Objective 5b: Improve coordination among existing groups involved in Jamaica Bay-related education activities.
- Objective 5c: Raise awareness of Jamaica Bay-related issues among young people to promote local environmental stewardship during childhood.
- Objective 5d: Raise awareness of Jamaica Bay-related issues through creating an informed citizenry.
- Objective 5e: Reduce polluting or damaging behaviors through community outreach and educational activities related to land use activities.
- Objective 5f: Increase the number of volunteers throughout the watershed by promoting volunteer opportunities in a coordinated manner and providing meaningful volunteering experiences.

2.6 Management and Implementation Strategies

2.6.1 Overview

For each Objective, individual Potential Management Strategies are identified that define a specific set of actions to achieve the Objective. The development and refinement of these management strategies or actions will be the "roadmap" for attaining the future vision of a healthy, sustainable Jamaica Bay.

The management strategies included in this *Draft Jamaica Bay Watershed Protection Plan* are labeled "Potential Management Strategies" because further assessment and evaluation is required to select the recommended management strategies based on environmental, technical and economic feasibility, per LL71. The final recommended management strategies will be included in the *Final Jamaica Bay Watershed Protection Plan* to be completed October 1, 2007.

Chapters 3 through 7 are each dedicated to one of the 5 issues categories. Each chapter presents Objectives, related Current Programs, and Potential Management Strategies. Each management strategy is described and the methods and approach for NYCDEP's evaluation of the strategy is provided. In addition, Chapter 8 discusses preliminary concepts for coordination and implementation to be developed based on the final recommended strategies.

The *Final Jamaica Bay Watershed Protection Plan*, to be issued in October 2007, will provide the results of the evaluation of the Potential Management Strategies, make recommendations to select promising strategies; and implementation steps for recommended strategies.

2.6.2 Interrelationship Between Strategies

Although the management strategies are placed into one of 5 categories in this *Jamaica Bay Watershed Protection Plan*, it is important to recognize that many of the strategies within the categories are interdependent. For example, objectives and strategies related to wetlands, buffers, fish, and wildlife comprise Chapter 4, *Ecological Restoration* due to the direct interconnections between these types of restoration projects and expected impacts. However, the strategies identified in Chapter 4 are also expected to have a direct positive impact on the Bay's water quality, which is addressed in Chapter 3, *Water Quality*. This is common across all categories of issues, objectives, and strategies where the expected benefits of specific strategies transcend more than one issue.

The key issues and the interrelationships between the sources of perturbation, the resulting stressors, ecosystem effects, and human use impacts are further illustrated in the Ecosystem Model (Figure 2.6.1) developed as part of this planning process. This diagram displays the cause and effect of various disturbances that historically or presently occur in the Jamaica Bay watershed, detailing how natural and human-influenced processes have altered the environment. It is hierarchical in organization, meaning that the higher up in the diagram an element is located, the greater range of influence it has over other factors. For instance, the "sources" are ultimately the root causes of alteration, which lead to a series of environmental "stressors." If a "source" of alteration is mitigated, then the "stressor" will ultimately disappear. "Stressors" influence ecosystem elements, triggering an "ecosystem response." Finally, changes to the ecosystem influence the "human uses" of the landscape, which feed directly back to the original driver of perturbation, urbanization and landscape alteration.

2.6.3 Advisory Committee Recommendations

Many Potential Management Strategies provided in Chapters 3 through 7 closely match the preliminary recommendations of the Advisory Committee submitted to the City Council and NYCDEP on June 29, 2006. As a result of an integrated process between NYCDEP, the Advisory Committee, and the stewards of Jamaica Bay, many Potential Management Strategies contained in this *Jamaica Bay Watershed Protection Plan* were developed through communications with the Advisory Committee and the public, or the case may be that their recommendation was consistent with NYCDEP's approach for actions necessary to improve the Bay and its watershed.

As stated in NYCDEP's Interim Report (September 1, 2006), which provided a preliminary determination of how each recommendation would be included in the *Final Jamaica Bay Watershed Protection Plan*, many of the Potential Management Strategies put forth in this *Jamaica Bay Watershed Protection Plan* still require further data collection and analysis before NYCDEP can recommend them for inclusion in the *Jamaica Bay Watershed Protection Plan*.

NYCDEP generally supports all of the Advisory Committee's recommendations that promote Jamaica Bay as a natural and recreational resource for New York City. However, despite a robust capital investment program, the NYCDEP's budget for capital investments is not limitless and there are many competing needs for these funds citywide. These dollars must be carefully programmed for drinking water protection, infrastructure repair and maintenance as

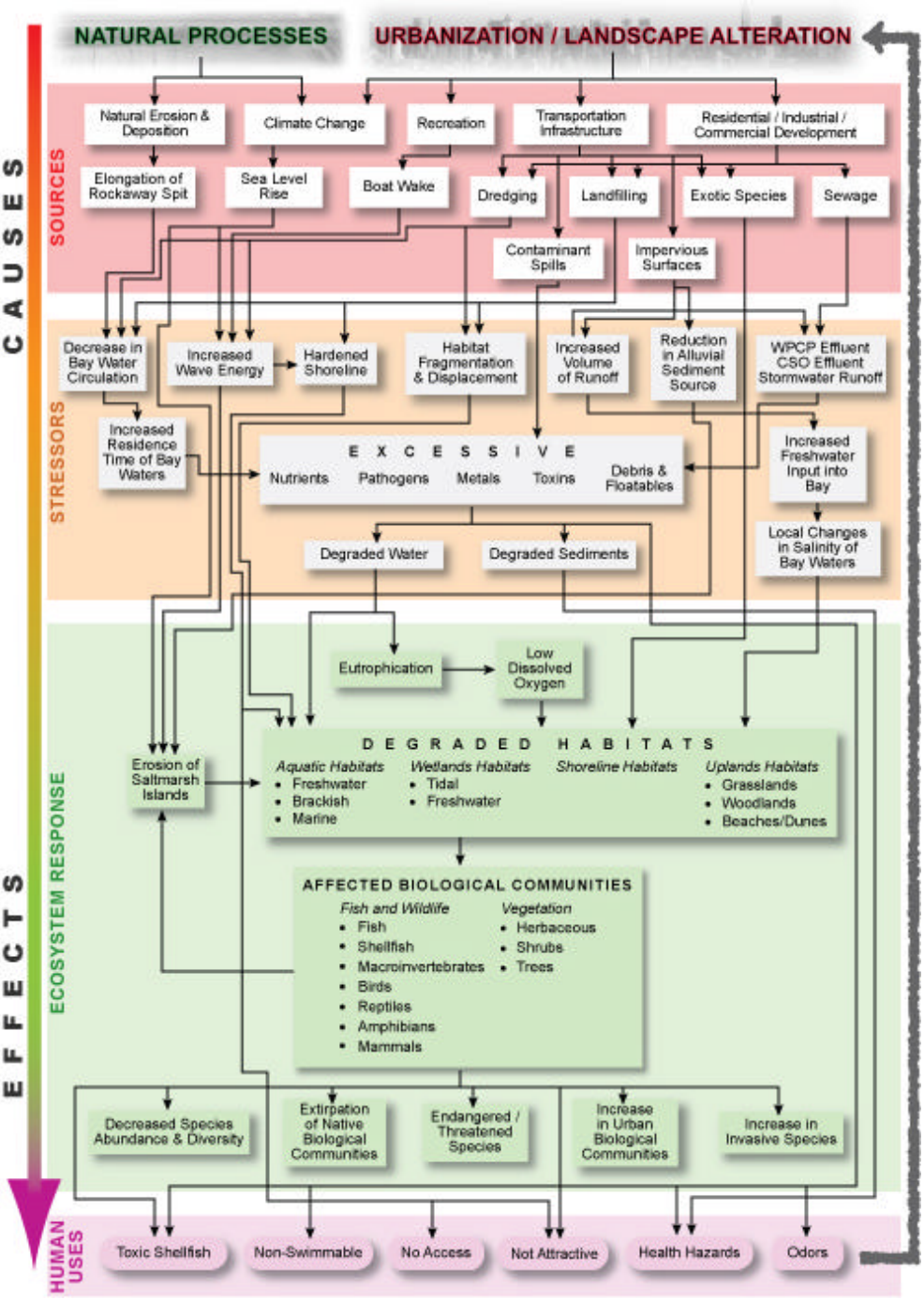

Figure 2.6.1 Jamaica Bay Watershed Ecosystem Model. Source: Biohabitats

This diagram helps to explain interrelationships between ecosystem elements as well as provide a tool for evaluating recommendations intended to alleviate the sources and stressors associated with ecosystem and human use impacts.

well as for water quality protection of all the City's waterways.

Several of the Advisory Committee's recommendations are also outside of NYCDEP's authority or mission. For many of these recommendations, NYCDEP recognizes the direct benefits to the Bay that these strategies offer and will reach out to other agencies with the appropriate authority to discuss specific Advisory Committee recommendations. However, other City, state and federal agencies experience similar levels of financial responsibility to program limited funds throughout the City. Therefore, further consultation with these agencies and their support for projects must be considered in the context of other agency mandates.

2.6.4 Plan Framework's Relationship to Local Law 71

In 2005, the New York City Council took up the challenge of protecting Jamaica Bay and its watershed – on June 30, 2005 it passed by a vote of 50-0 LL 71 of 2005 "To amend the administrative code of the city of New York, in relation to a watershed protection plan for the watershed/sewershed of Jamaica Bay." This is the first substantive legislation at a governmental level for a watershed approach to the protection of Jamaica Bay.

LL 71 required that several points be addressed as part of the process of preparing this *Jamaica Bay Watershed Protection Plan*, or be included in it. First, LL 71 requires in Subdivision (b) that: "The commissioner shall assess the technical, legal, environmental and economical feasibility of including the following measures, at a minimum, in the plan…" The noted measures and their respective locations in this *Jamaica Bay Watershed Protection Plan* are summarized in Table 2.6.1. Note that not all items are addressed in this *Draft Jamaica Bay Watershed Protection Plan* because some are related to implementation which will be addressed in the *Final Jamaica Bay Watershed Protection Plan*.

TABLE 2.6.1 Local Law 71 Elements and the *Jamaica Bay Watershed Protection Plan*

Required Measure	Specific Item	Category in Plan
"(1) best management practices for the minimization and control of soil erosion and stormwater runoff and reduction of both point and non-point source pollution, including, but not limited to, the promotion of development practices such as…"	"on-site detention and infiltration of stormwater runoff"	Water Quality and Land Use (see Chapter 3 and 6)
	"the minimization of impervious surfaces"	Land Use (see Chapter 6)
	"the creation of natural systems to control and minimize stormwater runoff"	Water Quality and Land Use (see Chapter 3 and 6)
"(2) measures to address threats to aquatic habitat, including, but not limited to…"	"stabilizing and restoring salt marshes, wetlands, soils and other natural areas"	Restoration Ecology (see Chapter 4)

Required Measure	Specific Item	Category in Plan
	"strengthening ecological buffers"	Restoration Ecology (see Chapter 4)
	"restoring natural features to Jamaica bay watershed/sewershed shoreline"	Restoration Ecology (see Chapter 4)
	"reestablishing water flows"	Land Use and Restoration Ecology (see Chapters 4 and 6)
"(3) land use acquisition and land use planning practices and opportunities, including, but not limited to"	"incentives, such as expedited permitting and property tax relief, for infill, brownfield redevelopment and other environmentally beneficial development"	Land Use (see Chapter 6)
	"disincentives, such as stricter development guidelines, for development that may adversely impact Jamaica bay"	Land Use (see Chapter 6)
"(4) a protocol for coordination with appropriate federal, state and city governmental entities that have jurisdiction over the Jamaica bay area, with respect to, but not limited to…"	"efforts to restore and maintain the water quality and ecological integrity of Jamaica bay"	To be addressed in Final Plan
	"notification regarding proposed development projects within the Jamaica bay watershed/sewershed that may adversely impact Jamaica bay"	To be addressed in Final Plan
"(5) a protocol for coordination with the office of environmental coordination…"		To be addressed in Final Plan
"(6) a public education program, including, but not limited to programs for schools, developers, commercial facilities, civic groups and other local organizations and entities to	"increase awareness about the ecological significance and degradation of Jamaica bay"	Public Education and Outreach (see Chapter 7)
	"restoration and watershed stewardship activities undertaken by the department and others involving Jamaica bay"	Restoration Ecology and Public Education and Outreach (see Chapters 4 and 7)

Required Measure	Specific Item	Category in Plan
	"methods and practices to reduce pollution in Jamaica bay"	Water Quality, Land Use and Public Education and Outreach (see Chapters 3,6, and 7)
"(7) a program to target enforcement efforts that will help reduce polluting behaviors and operations that may adversely impact Jamaica bay"		To be addressed in Final Plan

CHAPTER 3 – CATEGORY 1, WATER QUALITY: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES

Jamaica Bay is a shallow estuary located on the south shore of western Long Island, New York. It is an important piece of the greater New York/New Jersey estuary system. The Bay is bordered by Brooklyn to the west, Queens to the north, Nassau County to the east, and Rockaway to the south; it is roughly circular in shape and spans 19 square miles of open water, tidal flats, bordering marshes and beaches, and multiple interior marshland islands. Navigable channels averaging 27 feet in depth encircle most of the outer ring of the Bay. Much of the area in the center of the Bay consists of shallow, narrow channels and tidal marsh islands, which are exposed during low tides. Interchange of water with the Atlantic Ocean is through the Rockaway Inlet.

Jamaica Bay is one of the largest and most productive coastal ecosystems in the State of New York, and within the Northeastern United States. It contains the largest tidal wetland complex in New York State, providing habitat for an incredible biodiversity of resident and migratory birds, fish, and other wildlife species, and performing beneficial ecological functions such as nutrient uptake, flood protection, and shoreline erosion control for urban areas in and around the Bay. The nutrient rich Bay waters support high quality spawning and foraging habitat for aquatic species.

As New York City developed into a large metropolis, Jamaica Bay has been increasingly influenced by human activity. Urban development in the watershed, as well as long-term natural processes, have both contributed to degraded water quality conditions in the Bay waters. The primary drivers of this paradigm are the large amounts of human waste generation in the watershed, the disruption of natural drainage by piping runoff through the storm drain network and the combined sewer overflow system, the creation of deep channels and borrow pits from dredging in the Bay, the construction of hardened shoreline structures such as bulkheads and sea walls, and the reduced circulation of Bay waters from the elongation of Rockaway Spit and filling in the estuary.

Due to widespread urbanization, natural hydrologic functions that typically occur within a broadly vegetated watershed such as infiltration, vegetative interception and uptake, and biogeochemical processing have been reduced. These have been replaced by sewerage and drainage infrastructure necessary to provide sanitary conditions and flood protection to the approximately 2 million people living within the Jamaica Bay watershed. The "watershed" has eventually changed into a "sewershed." Four Jamaica Bay Water Pollution Control Plants (WPCPs), owned and operated by NYCDEP, treat the wastewater generated within their respective sewersheds. These include the Coney Island, 26th Ward, Jamaica, and Rockaway WPCPs. With the exception of the 26th Ward WPCP, which provides biological nutrient removal via separate centrate treatment, the WPCPs currently discharge secondarily-treated effluent to the open waters of Jamaica Bay.

The effluent from the WPCPs carries nitrogen and phosphorus that cause eutrophication (an over-enrichment of nutrients) in Jamaica Bay. The high nutrient loads from the WPCPs fuel algal growth that causes aesthetic problems and low dissolved oxygen levels. Low dissolved oxygen levels can limit the propagation of fish and shellfish, and can also lead to odor problems due to the production of hydrogen sulfide (H_2S) gas (rotten egg smell) in the sediment. CSO discharges

occur within some of the tidally restricted tributary basins, and discharges from the storm drain network route untreated waters into the Bay, exacerbating water quality impairments in the tributaries and Bay.

The poor circulation within Jamaica Bay, especially the eastern half, compounds the adverse effects of nutrient loading. The Bay is bisected by the Broad Channel community. The North Channel and Beach Channel are restricted as they pass to the north and south of Broad Channel. Grassy Bay, in the eastern portion of Jamaica Bay, was dredged to provide fill for the JFK International Airport (JFK Airport) and other projects. Deepening this area restricted flow and increased vertical density stratification that contributes to the lowest DO concentrations found in the open waters of the Bay. Other restrictions, such as the extension of the Rockaway Peninsula, the filling of Barren Island, and the JFK Airport runway extension, may also contribute to the poor circulation within Jamaica Bay.

The NYSDEC assigns classifications to all of the waterbodies within its jurisdiction. These classifications are assigned such that: "The discharge of sewage, industrial waste or other wastes shall not cause impairment of the best usages of the receiving water as specified by the water classifications at the location of the discharge and at other locations that may be affected by such discharge" (6 NYCRR Part 701). Two of the classifications developed by NYSDEC that apply to waters within Jamaica Bay are Class SB and Class I. The best usages of Class SB waters are primary and secondary contact recreation and fishing. These waters must also be suitable for fish propagation and survival. Class I waters have a best usage of secondary contact, and must be suitable for fish propagation and survival. Associated with each of these classifications are water quality standards that are assigned such that each waterbody can achieve its best usage. Class SB applies to the open waters of Jamaica Bay, Shellbank Creek, Gerritsen Creek and Mill and East Mill Basins. Class I applies to the remaining tributaries of Jamaica Bay.

Currently, average surface and bottom DO levels in Jamaica Bay are above NYSDEC standards (as an example, 2005 surface and bottom average summer DO levels were 7.70 mg/L and 6.59 mg/L, respectively). However, certain sections of the Bay where circulation is very restricted, including Grassy Bay and the North Channel, have summer DO levels that sometimes fall below NYSDEC standards, and be limiting for the survival of aquatic organisms in these areas.

In 1948, Mayor La Guardia, and Parks Commissioner Robert Moses, in an attempt to protect Jamaica Bay from development, transferred the lands adjacent to Jamaica Bay and the salt marshes to the NYCDPR. In 1974, Jamaica Bay became part of the Gateway National Recreation Area (GNRA), which is under the jurisdiction of the NPS.

The City of New York is committed to its role as an environmental steward of the New York Harbor, and began addressing water quality issues in the 1950's. To date, the Department has spent or committed over $2.1 billion in its Citywide Combined Sewer Overflow (CSO) abatement program. Because of this ongoing program, water quality has improved dramatically over the past 30 years. For additional information on water quality trends, see the *2005 Harbor Water Quality Survey*.

Additionally, implementation of NYCDEP's current 10-year capital plan will maintain that trend, as it continues to address CSO-related water quality issues through its City-Wide CSO Floatables Program, pump station and collection system improvements, and the ongoing analysis and

implementation of CSO abatement solutions. For additional information on specific ongoing NYCDEP projects to improve Jamaica Bay, see *Volume 1, Chapter 3 – Water Quality*.

The Objectives and Potential Management Strategies to improve water quality conditions identified below focus on lowering nutrient loadings to the Bay (including treatment or non-treatment alternatives) and controlling and treating wet weather discharges to tributaries and the Bay. These actions go beyond programmatic efforts already underway. Improving water quality conditions within Jamaica Bay is a long-term goal, and will take a coordinated effort between the residents of the watershed and multi-agency support and funding. There is no "silver bullet" solution available to address these water quality issues. Instead, a holistic, comprehensive suite of management and engineering solutions will need to be evaluated in order to improve water quality and restore an ecologically-vital Jamaica Bay.

It is important to note that while the following potential strategies provide structural or direct engineering solutions to these water quality issues, many of the Objectives and Potential Management Strategies in Categories 2 – 5 could also have a direct influence on water quality conditions in Jamaica Bay, including education and outreach campaigns, habitat restoration, and sound land use initiatives. Thus, the improvement of water quality conditions in Jamaica Bay is a comprehensive goal, spanning almost all of the recommendations in the *Jamaica Bay Watershed Protection Plan*.

Objective 1a: Improve stormwater management to reduce the volume of stormwater runoff and filter and remove pollutants.

Issue

Based on the preliminary analysis of multi-spectral satellite imagery being performed by the Lamont Doherty Earth Observatory, the land area in the Jamaica Bay watershed is approximately 65% impervious surfaces. Rooftops, pavement, sidewalks, driveways, and other hard surfaces direct stormwater directly into the storm drain or combined sewer system. These hard surfaces are so efficient at moving water that the time of concentration for stormwater to arrive at any given point in the watershed is very short, translating into a large volume of runoff occurring in a short amount of time in the combined sewer or storm drain network.

The historical development of the sewer system in New York City shows that the initial primary objectives were to alleviate street flooding, the prevention of sewer "back-ups" and the transport of wastes from the streets. As knowledge was gained on the effects of waste products on water quality and human health, the City built "intercepting sewers" at the outfalls of the "combined" sewers to convey dry weather flow to "new" sewage treatment plants. These intercepting sewers and the new treatment plants were designed to convey and treat up to two times design dry weather flow (DDWF). During wet weather, flow in the combined sewers that exceeded two times DDWF was diverted at regulators, to the receiving waters.

It was not until decades later that the effects of CSO were found to be important and in need of regulatory control. Although the City did recognize the effects of CSO and built the first CSO facility in 1972, the Spring Creek Auxiliary WPCP, the funding available after the 1972 Clean Water Act was focused on building new secondary treatment plants and upgrading existing treatment plants to secondary treatment capability.

In addition, stormwater runoff picks up floatable debris, grease, pet waste, metals, and other contaminants that occur on the streets or sidewalks of the City and eventually deposits these pollutants directly into the tributaries and the greater Bay. By reducing both the volume and the pollutant load of stormwater runoff, more sewage in the combined sewer system can be treated in the WPCPs. Stormwater best management practices (BMPs) can be introduced into the watershed to improve infiltration, retention, and detention of stormwater runoff. In addition, management opportunities to reduce the amount of impervious surface, increase interception of rainfall, and promote the development of pervious media (including landscaped areas) can help to reduce the impact of urban stormwater on water quality in Jamaica Bay.

This *Draft Jamaica Bay Watershed Protection Plan* addresses two different types of stormwater management: "off-site" control, which typically involves capturing runoff from multiple parcels (usually at a neighborhood or community scale) and routing it to a storage facility such as a stormwater pond, underground detention tank, or other structure; and "on-site" source control, a distributed system which attempts to attenuate, infiltrate, and capture runoff at the source (such as a residential lot). Both on-site and off-site stormwater management effectively reduce stormwater volumes and runoff entering the storm drain and combined sewer system, thereby reducing the pollutant load and the volume of water that discharges directly to Jamaica Bay through CSOs or the water pollution control plants (WPCPs) during a rainfall event. This Chapter, *Category 1: Water Quality*, addresses "off-site" stormwater controls, while "on-site" stormwater controls and BMPs at a development or parcel level are discussed in Chapter 6, *Sound Land Use and Development.*

Current Programs

NYCDEP is currently evaluating several investigations as a part of the NYC Long Term Control Plan (LTCP) and the *Jamaica Bay Watershed Protection Plan* efforts to research, assess, and document opportunities to employ stormwater BMPs that could help control the quantity and quality of stormwater runoff entering the City's combined sewer system. There are several ongoing studies of stormwater BMPs by independent researchers and the development of urban BMPs by several non-profit and community organizations in New York City. The New York City Department of Design and Construction (NYCDDC) recently introduced sustainable design standards, including stormwater BMPs, for New York City buildings and infrastructure, as contained in the *High Performance Building Guidelines* and *High Performance Infrastructure Guidelines.*

Potential Management Strategy 1a1:

Promote and evaluate the use of vacant public lands for their potential conversion to "stormwater parks" that facilitate stormwater runoff attenuation and infiltration to capture pollutants and reduce runoff volumes.

There may be opportunities to convert vacant, publicly-owned parcels throughout the watershed to multi-use, off-site stormwater detention facilities and potential passive recreational features. The design of these stormwater facilities can incorporate palustrine woodlands, gardens, vegetated swales, bio-infiltration areas, and other stormwater capture and treatment features designed to attenuate urban stormwater runoff as well as provide some level of urban habitat and / or public use. This concept may include converting paved areas into permeable surfaces, could be effective on a city-block scale, and provide both immediate stormwater runoff benefits as well as

establish "pocket parks" throughout the watershed. The greatest opportunities lie in capturing runoff from adjacent developed lots by disconnecting roof leaders and rerouting the runoff from impervious surfaces into the off-site stormwater facility.

Strategy Assessment Approach

The strategy assessment approach will involve identifying existing public vacant parcels and prioritizing the parcels by greatest potential to allow the implementation of stormwater attenuation BMPs. Prioritization criteria include lot size, topography and drainage, depth to ground water, proximity to existing open space, and critical environmental features. In coordination with the Gaia Institute, NYCDEP will develop, implement, and establish a monitoring program for a stormwater pilot study on those parcels that show the most promise to attenuate stormwater, provide urban habitat, and additional open green space.

Potential Management Strategy 1a2:

Promote and evaluate the use of existing open space (such as parks, plazas, community gardens, etc.) for their potential to accommodate stormwater BMPs.

Additional opportunities to attenuate, store, infiltrate stormwater runoff may be applicable on existing open space lots in the Jamaica Bay watershed. The retrofitting of existing landscaped areas to accommodate stormwater detention, retention, and infiltration capabilities, including bioretention, vegetated swales, rain gardens, etc., while improving the ecology of these same areas, will be evaluated.

Strategy Assessment Approach

The strategy assessment approach will entail developing a map and list of existing open spaces (such as parks, community gardens, etc.) and evaluating the parcels with the greatest potential for accommodating stormwater BMPs. Special attention will be paid to parcels near vacant, publicly owned lands, in order to maximize the potential effectiveness of stormwater capture and treatment in those locations.

Potential Management Strategy 1a3:

Promote and evaluate the use of highway rights-of-way and adjacent lands under New York City Department of Transportation (NYCDOT) jurisdiction (including the future bridges reconstruction project for the Belt Parkway) for their potential to accommodate stormwater BMPs.

Several major and intermediate roadways and transportation corridors intersect the Jamaica Bay watershed through Brooklyn and Queens. The volume of stormwater runoff and pollutant loading from these surfaces could be reduced through the integration of stormwater BMPs. There is a combined opportunity to increase freshwater wetland habitat in these areas. The key is to identify future roadway construction, reconstruction, retrofit, and maintenance projects early in the design process to incorporate stormwater management features.

Strategy Assessment Approach

The strategy assessment approach will entail creating a map of highway transportation routes, prioritizing routes that could potentially support the integration of stormwater BMPs, and reviewing the 10-year capital plan to evaluate the opportunities for roadway stormwater BMPs within the watershed. NYCDEP in consultation with NYCDOT, New York City Department of

Parks and Recreation (NYCDPR) and NPS will develop designs, where feasible, for stormwater BMPs in conjunction with the reconstruction of the Fresh Creek, Paerdegat and Rockaway bridges along the Belt Parkway. A pilot study will then be implemented incorporating the appropriate stormwater management features to attenuate and reduce the direct discharge of stormwater into Jamaica Bay. In addition, the potential for these BMPs to effectively intercept "first flush" will be also evaluated and, if determined to be feasible, incorporated into the design criteria.

Potential Management Strategy 1a4:

Increase the number of street trees in the watershed, to provide additional leaf canopy and rainfall interception, as well as to provide stormwater runoff attenuation, infiltration, and vegetative uptake.

In an urban landscape, trees provide myriad ecological services, including carbon sequestration, oxygen generation, temperature regulation, habitat for birds and insects, and aesthetic benefits. According to the New York City Department of Parks and Recreation (NYCDPR) 2000 Tree Census Survey, there are 62,301 street trees within the Brooklyn portion of the watershed and 89,018 street trees within the Queens portion of the watershed. In addition, beginning in 1996, NYCDPR began transforming select street triangles and traffic islands into Greenstreets. A program designed to increase the amount of vegetation within a community. To date, NYCDPR has converted 1,765 Greenstreets, with many of those within the watershed of Jamaica Bay. They can also be effective at altering the patterns of stormwater runoff, through the processes of rainfall interception on the trunk and branches, and the combined processes of runoff attenuation, infiltration, and vegetative uptake. Generally, the more trees in a landscape, the less severe the runoff associated with storm events. Thus, an increase in the number of trees in the watershed would positively influence runoff processes by decreasing the volume and pollutant load of stormwater runoff entering the storm drain or combined sewer system, as well as provide the numerous other ecological benefits.

Strategy Assessment Approach

The strategy assessment approach will involve utilizing geospatial data provided by NYCDPR to identify, list, and map areas of low to medium street tree canopy cover by neighborhood. Using these data, NYCDEP, in coordination with the Gaia Institute, will implement a pilot study to install larger modified street tree openings that would allow stormwater to infiltrate into the soil, and to install stormwater storage devices that would allow water use by the tree during dry periods. A list of potential street tree funding mechanisms available to NYCDPR to increase the overall tree coverage in the Jamaica Bay watershed will be evaluated.

Potential Management Strategy 1a5:

Identify off-site stormwater BMPs to capture and treat "first flush."

"First flush" can be defined as the delivery of a highly concentrated pollutant loading during the early stages of a storm due to the washing effect of runoff on pollutants that have accumulated on the land. Data from previous NYCDEP studies suggests that there is not a strong "first-flush" effect within the Jamaica Bay watershed. This may be due to the large size of the drainage system. "First flush" can be captured by stormwater BMPs before the stormwater enters the storm drain or combined sewer system. Generally, it is the stormwater runoff draining the streets and sidewalks that contains the highest pollutant load, carrying automobile byproducts, road salt and

sediment, and urban litter and debris. Stormwater BMPs located on the street, such as vegetated swales, bioretention areas, curb cuts, and porous pavement, in addition to BMPs located at the catch basins or storm drain inlets, such as grease separators, hoods, and other pollutant-filtering devices, can be used to great effect to capture and treat "first flush" runoff events, and prevent these pollutants from entering the storm drain or combined sewer system.

Strategy Assessment Approach

The strategy assessment approach will review areas within the watershed that may have the potential for a significant "first flush" effect by measuring the pollutant concentrations of flow entering the storm drain system, and evaluating the effectiveness of stormwater management BMPs in these areas. It is possible that end of pipe "first flush" is due to the resuspension of settled material in the sewer system. NYCDEP will evaluate this strategy in conjunction with the stormwater management pilot efforts planned within the watershed.

Objective 1b: Reduce nitrogen loading to the tributary basins and Jamaica Bay.

Issue

The NYSDEC and NYCDEP entered into a Nitrogen Control Order on Consent (Index # CO2-20020131-7) on April 22, 2002 that updated State Pollutant Discharge Elimination System (SPDES) permits of the four Jamaica Bay WPCPs in order to reduce the total nitrogen load discharged into Jamaica Bay. One of the goals of the Nitrogen Order on Consent was to control the occurrence of eutrophic conditions in Jamaica Bay by reducing the total nitrogen load discharged to the open waters of the Bay, thereby improving attainment of dissolved oxygen water quality standards.

Presently, the SPDES permits of the four Jamaica Bay WPCPs establish two types of limits on permissible aggregate nitrogen discharges. These include: (a) the "Maximum Monthly Average Limit," defined as the average of the individual samples for that month; and (b) the "12-month Rolling Average Limit," defined as the average daily total nitrogen load for the current month, averaged with the eleven previous months average level. The aggregate Maximum Monthly Average Limit for the Jamaica Bay WPCPs under the current SPDES permit is 54,600 pounds per day, and the aggregate 12-month Rolling Average Limit for the Jamaica Bay WPCPs is 45,300 pounds per day.

The Consent Order obligated NYCDEP to undertake and submit to the NYSDEC, for review and approval, a Comprehensive Jamaica Bay Report. The Report is also to include recommendations and an implementation schedule for improving water quality in Jamaica Bay either through treatment or non-treatment.

The Order on Consent Nitrogen was superseded on January 10, 2006 by a Consent Judgment (Index # 04-402174). The Consent Judgment required the development of the Comprehensive Jamaica Bay Report, which was submitted to the NYSDEC on October 31, 2006. The Consent Judgment also requires that that construction of Phase I Plan Improvements to the 26th Ward WPCP be completed by June 30, 2008 and that said improvements to the 26th Ward WPCP result in a Combined Nitrogen Effluent Limit for the Jamaica Bay WPCPs of 45,300 pounds per day.

Water quality sampling and mathematical modeling have shown that Jamaica Bay is a eutrophic system. The eutrophication is due to increased nitrogen loading from the WPCPs and other

sources that discharge to the Bay. Planktonic algae are aquatic plants that require nutrients, light and the appropriate temperature to grow. The macronutrients that are required for algal growth are nitrogen and phosphorus. If either nitrogen or phosphorus concentrations in the water column are low, algal growth becomes nutrient-limited. In most estuarine systems, nitrogen is potentially the limiting nutrient, which means that algae typically deplete nitrogen in the water before they deplete phosphorus. However, within Jamaica Bay, nitrogen and phosphorus are in excess and, before these can be depleted, light required for chlorophyll production becomes the limiting growth factor. A concentration of less than 0.04 mg/L of dissolved inorganic nitrogen (DIN) is thought to begin to limit algal growth.

DIN consists of ammonia (NH_3), nitrite (NO_2) and nitrate (NO_3). Volume 1, Chapter 3 presents the year-round DIN data collected in the water column of Jamaica Bay from 2001 through 2005. The data show that except for rare occasions in the western and southern portions of the Bay, the DIN concentrations are well above the limiting concentration for algal growth. In some locations the median DIN concentration would have to be reduced by more than a factor of ten to approach nutrient limiting conditions.

Current Programs

NYCDEP is actively implementing several nitrogen control pilot studies at the 26th Ward WPCP and others are being planned or studied. A Biological Nutrient Reduction (BNR) pilot study for nitrogen is currently in place and the results are being evaluated. Water treatment plant upgrades, which include separate centrate treatment, have been implemented at the 26th Ward WPCP to reduce the total nitrogen load discharged to the open waters of Jamaica Bay. The Comprehensive Jamaica Bay Water Quality Plan (CJBWQP) evaluated additional alternative scenarios for reducing the nitrogen loading to the Bay.

The CJBWQP has been developed and was submitted to the NYSDEC on October 31, 2006 for review and approval. The CJBWQP includes a nitrogen reduction strategy for Jamaica Bay, and a proposed implementation schedule. The CJBWQP includes an evaluation of treatment and non treatment technologies including WPCP upgrades, recontouring strategies, and WPCP outfall relocation. This CJBWQP is currently under review by NYSDEC.

Potential Management Strategy 1b1:

Evaluate and implement appropriate end-of-pipe nitrogen removal technologies in tributary basins, including algal turf scrubbers, constructed wetlands, and oyster reef restoration.

New eco-technologies provide opportunities for synergies between natural habitat restoration and nutrient uptake. By harnessing the natural nutrient processing capabilities associated with the growth and reproduction of biological systems, nitrogen reduction in Jamaica Bay can be coupled with the propagation of desirable organisms, plant communities, and estuarine ecosystems. Technologies under consideration include extracellular nutrient adsorption by algal mats on filter media, nutrient uptake by wetland plants and soil microbes, denitrification in the saturated wetland soil matrix, and filter feeding bivalves, such as oysters and ribbed mussels stripping the water column of organic and inorganic particulates. A mature oyster can filter approximately 800 gallons per day and the ribbed mussels are good filters of bacteria from the water column. While potential for implementation in Jamaica Bay is most feasible as pilot scale projects, the opportunity to scale them up to larger treatment capacities is uncertain at this time.

Strategy Assessment Approach

The assessment of this strategy will continue to review existing information on the emerging algal turf scrubbers technology to evaluate the most effective treatment. This technology has not been used in a large setting and requires further evaluation. To collect additional information on the potential benefits of bivalves, NYCDEP will develop pilot studies to evaluate potential local water quality changes directly around the oysters and mussels. These studies will be monitored to collect water quality information and record survivability rates. In addition, attractive nuisance controls measures will be designed and implemented at each bivalve pilot study location.

Potential Management Strategy 1b2:

Limit processing of additional centrate from WPCPs outside of Jamaica Bay.

The 26th Ward WPCP typically dewaters its own sludge as well as the sludge generated at the Coney Island, Rockaway, and sometimes Jamaica WPCPs. The Jamaica WPCP typically dewaters its own sludge. On certain occasions, the 26th Ward WPCP accepts and dewaters sludge from WPCPs located outside of Jamaica Bay Watershed, such as the Port Richmond, Owls Head, North River and Newtown Creek WPCPs, but the NYCDEP makes a concerted effort to avoid this situation to the best extent possible.

Increasing nitrified centrate to the process resulted in lower ammonia levels in the effluent, from 7.47 mg NH_3/L at no centrate to 3.57 mg NH_3/L at 100% nitrified centrate during winter months. It should be noted that only 3.4% of the sludge dewatered at 26th Ward WPCP during 2006 was derived from WPCPs outside of Jamaica Bay (Port Richmond, Owls Head, North River and Newtown Creek). Currently, NYCDEP has discontinued the shipment of sludge from WPCPs outside of Jamaica Bay for processing at the 26th Ward WPCP. However, due to operational concerns, routine plant maintenance, or other unforeseen events at the other wastewater treatment facilities, NYCDEP needs to keep this treatment option "open" for potential future use through at least mid 2009 so as not to incur potential violations within other waterbodies. However, as a result of the Nitrogen Consent Judgment, beginning in July 2009 NYCDEP agreed to ship sludge or centrate from the Bowery Bay and Tallman Island WPCPs in the Upper East River to a location other than Jamaica Bay for treatment. Modeling was performed to determine whether reducing centrate treatment at 26th Ward WPCP would impact nitrogen loading in the Bay.

Strategy Assessment Approach

The strategy assessment approach will entail reviewing the frequency at which outside WPCPs currently ship centrate to Jamaica Bay and whether any alternatives exist to continue limiting the shipping of imported centrate to the 26th Ward WPCP. The process of developing alternatives to shipping centrate to the 26th Ward WPCP will be balanced with NYCDEP's current Consent Order requirements as well as any known future requirements and the technological capabilities of other WPCPs.

Potential Management Strategy 1b3:

Evaluate the potential for harvesting excess *Ulva* from the water column (possibly with the use of skimmer boats) to improve aesthetic issues and to evaluate the potential for limited nitrogen removal.

Jamaica Bay experiences abundant blooms of *Ulva*, a type of dense algae that lives primarily in marine environments. It attaches to rocks in the middle to low intertidal zone, but can be free floating in protected estuarine areas like Jamaica Bay. *Ulva* are opportunistic species that respond quickly to nutrients and can form extensive blooms when environmental conditions are right. In addition to aesthetic water quality issues, the decomposition of the algae increases the biological oxygen demand (BOD), lowers the dissolved oxygen of the water column, and creates stress for aquatic organisms. Excess *Ulva* blooms have also been identified as a potential cause of wetland loss when sufficient mats smother wetland plants.

The harvesting of *Ulva* during widespread blooms in Jamaica Bay would result in limited nitrogen removal from the Bay (*Ulva* is 1% to 6% nitrogen by dry weight), but may have other potential benefits: preventing the "smothering" of salt marsh wetlands, and reducing negative aesthetic issues. In addition, there may be the opportunity for using the harvested *Ulva* as a source for biodiesel production.

Strategy Assessment Approach

The strategy assessment approach will entail reviewing the environmental conditions of previous algal blooms and using tidal information to estimate locations where *Ulva* can accumulate. Cost effective methods of harvesting *Ulva* will be determined, and the potential uses of dried *Ulva* evaluated. If warranted, NYCDEP will develop and implement a pilot study.

Potential Management Strategy 1b4:

Review and evaluate on-site sewage treatment decentralization technologies.

There are several compact domestic decentralized wastewater treatment technologies that are employed in rural areas (particularly in Europe) that might have applicability within select areas of the watershed. These technologies are typically reserved for small applications that treat wastewater from 10 to 500 individuals. The units follow the same general principles of wastewater treatment (activated sludge) as the much larger conventional package treatment facilities.

Strategy Assessment Approach

The strategy assessment approach will involve evaluating each technology's practical application based on existing conditions and configurations, available manufacturers, and the identification of applicable locations within the watershed. If determined to be beneficial and feasible, NYCDEP will develop and implement a pilot study to monitor the effectiveness of the selected technology as compared to the published literature.

Objective 1c: Increase dissolved oxygen levels in tributary basin areas of chronic hypoxia to improve ecological productivity.

Issue

Low DO concentrations in the tributaries are the result of a number of contributing factors, including WPCP effluent, CSO events, and stormwater discharges. WPCP effluent contains nitrogen and phosphorous, which fuels algal growth and exerts BOD, leading to a reduction in DO. The basins collect CSO solids at the outlets, which also exert a large oxygen demand on the water column. Stormwater discharge entering the basins during wet weather events can carry nutrients collected in the upper watershed that further increase oxygen demand in the waterbody.

This situation is exacerbated in tributaries that have deep pits along their length where currents are slow and density stratification can set up. In these cases, anoxic conditions can occur. In addition to nutrient control strategies (proposed by the CJBWQP, LTCP program efforts, and strategies throughout many Categories in this document), the removal of sediment mounds, recontouring selected tributary basins to improve tidal flushing, and mechanical aeration can achieve improvements in the DO concentrations of the tributaries.

Current Programs

An analysis of water quality conditions in the tributaries is currently being investigated as part of the City-Wide LTCP. As part of this project, Waterbody/Watershed Facility Plans are being developed for Paerdegat Basin, Fresh Creek, Hendrix Creek, Spring Creek, Bergen Basin and Thurston Basin. These plans will focus on the reduction of CSO discharges to improve DO levels.

Mechanical aeration is currently being used in Shellbank Basin as a pilot study targeting odor reduction. Additional evaluations of aeration in the tributaries of Jamaica Bay will be conducted as part of the LTCP.

Potential Management Strategy 1c1:

Identify the tributary basins that would receive the greatest benefit from the removal of CSO sediment mounds and/or recontouring to enhance drainage and eliminate borrow pits and deep trenches.

CSO discharges include a combination of sanitary and stormwater flow. Sanitary flow contains high concentrations of solids. These solids are eventually ejected from the CSO outfalls into the tributary basins, and over time form large sediment mounds at the head end of the basin. The sediment mounds contain materials that increase BOD and have contaminants associated with sanitary flow and stormwater runoff, resulting in low DO in the water column, potential odor problems, and sediment that is toxic to aquatic life.

Some tributary basins in Jamaica Bay have deep pits along their lengths and at the head (away from Jamaica Bay) end of the basins; however, these become very shallow where the channel connects to Jamaica Bay. For example, Shellbank Basin has a depth of 52 feet at the head end, while the depth where it discharges to Jamaica Bay is only 7 feet. Mill and East Mill Basins, and Norton Basin have similar bathymetric features. This bottom topography results in poor tidal circulation and the development of hypoxic or anoxic waters which can get exported into the near shore areas of Jamaica Bay during large storm events, when tidal surges greatly increase the circulation of waters in and out of these basins.

Strategy Assessment Approach

The strategy assessment approach will evaluate the Jamaica Bay Ecosystem Research and Restoration Team (JBERRT) studies and other projects for relevant data, and the associated benefits of the proposed recontouring of each of the applicable basins. Related descriptions of the 40 water quality modeling results from the JBCWQP and the pilot study of Norton Basin and Little Bay efforts will be reviewed and evaluated. This information will be used to identify appropriate remediation techniques for the tributaries.

Potential Management Strategy 1c2:

Identify hypoxic locations in the tributary basins and determine areas that may benefit from alternative strategies to increase dissolved oxygen levels, such as mechanical aeration.

Mechanical aeration is a technique that injects oxygen directly into water deprived of DO as a result of the presence of oxygen demanding substances in the water column and underlying sediments. Mechanical aeration has not been used in Jamaica Bay, but has been shown to increase DO levels in the water column and reduce odors during times of hypoxia when used continuously.

A pilot aeration project in Shellbank Basin is currently being operated to reduce odors in the tributary. Mechanical aeration is being implemented to break up vertical density stratification, increasing the DO from 0.0 mg/L to approximately 1.0 mg/L.

Strategy Assessment Approach

The strategy assessment approach will involve identifying and mapping known hypoxic locations in each of the tributaries. Water quality data and descriptions of the 40 water quality modeling results from the CJBWQP effort will be reviewed and evaluated. The Shellbank Creek aeration pilot study will be evaluated to determine applicability in other areas. Aeration strategies used in other locations will also be evaluated according to their ability to improve DO and minimize ecological impacts associated with the installation and operation of aeration systems.

Objective 1d: Increase dissolved oxygen in the Grassy Bay and North Channel areas of chronic hypoxia to improve ecological productivity.

Issue

During 2005, the lowest DO levels recorded in Jamaica Bay were located in Grassy Bay, which lies in the northeastern portion of the estuary where tidal circulation is confined. Grassy Bay is also deepest portion of the estuary. DO sampling is performed at intervals below the water surface; impaired DO levels are particularly noticeable in the bottom waters. DO levels in Jamaica Bay generally increase moving westward toward Rockaway Inlet. Based on data collected by the NYCDEP, all parts of the Bay have at least some occurrences of DO concentrations of less than 5.0 mg/L. The greatest number of these occurrences occur in the deepest sections (the borrow pits) of the North Channel and in Grassy Bay. Modeling calculations have shown that reducing nutrient levels would improve DO concentrations in the Bay. However, even complete removal of WPCP nutrient loads would not lead to 100% attainment of DO levels due to the effects of the deep pits and channels. DO levels in the Bay would likely be improved if the deeper areas of the Bay were recontoured to a shallower depth, restrictions in the channels were removed, and better flushing was provided.

Current Programs

The projected benefits of recontouring these areas of Jamaica Bay have been modeled as an alternative scenario under the CJBWQP. Modeling conducted during the late 1980s and late 1990s examined the removal of the JFK Airport runway extension and the resulting implications for water quality. These analyses showed some improvement in water quality in Jamaica Bay at the expense of water quality in the Grassy Hassock Channel area. Despite the minor water quality improvements in Grassy Bay, the relatively slight benefits would not warrant the removal of the JFK Airport runway extension. As these modeling analyses examined the complete removal of

the runway extension, the addition of culverts under the runway would result in even smaller changes to water quality conditions.

Potential Management Strategy 1d1:

Improve flushing and dissolved oxygen levels by recontouring Grassy Bay and North Channel with uncontaminated material in partnership with other agencies.

In 1942, the city of New York started construction of JFK Airport, "borrowing" clean fill material from Grassy Bay for expansion of the City shoreline and construction of the then Idlewild Airport, now JFK Airport. The result is that these excavated areas of Grassy Bay are excessively deep, potentially restricting the amount of tidal flushing and allowing the buildup of pollutants from WPCPs and landside discharge areas, leading to very low DO levels. It is also possible that these areas act as a "sediment sink," perpetuating wetland and submerged aquatic vegetation loss in the estuary. Modeling results have demonstrated that filling these borrow pit areas would greatly increase compliance with DO standards in Jamaica Bay, and would presumably be beneficial for aquatic habitat. There are concerns that contaminated sediments from within Jamaica Bay or other parts of New York/New Jersey harbor would be used to fill Grassy Bay and the North Channel, and that this may perpetuate or worsen the poor ecological conditions in these areas.

Strategy Assessment Approach

The strategy assessment approach will entail evaluating the analysis and recommendations provided within the CJBWQP, which proposed a recontouring strategy of Grassy Bay. The overall ecological health of Jamaica Bay with respect to the seasonally depressed water quality conditions that occur within Grassy Bay will be considered.

Potential Management Strategy 1d2:

Improve dissolved oxygen in Grassy Bay and North Channel by evaluating alternative strategies such as mechanical aeration, fountains, or other engineering solutions.

Mechanical aeration is a technique to increase DO levels as a result of high BOD in the water column and benthic sediments. Mechanical aeration has not been used in Jamaica Bay, but has been shown to increase dissolved oxygen levels in the water column and reduce odors during times of hypoxia when used continuously. Mechanical aeration could potentially be used to increase DO levels in the Grassy Bay and North Channel areas.

Strategy Assessment Approach

The strategy assessment approach will involve the creation of a map identifying hypoxic locations within North Channel and Grassy Bay. Water quality data and related descriptions of the 40 water quality modeling results from the CJBWQP effort will be reviewed and evaluated. In addition, monitoring information from the Shellbank Creek aeration pilot study will be used to inform potential applicability to other areas. Other aeration strategies (such as fountains) will be evaluated according to their ability to improve DO and minimize overall ecological impact.

Potential Management Strategy 1d3:

Investigate potential land breaching locations such as northwest corner of Floyd Bennett Field, Rockaway Spit, and the northeast corner of Rockaway Peninsula to enable increased circulation of Bay waters and the potential for sediments to enter the Bay.

Many areas within Jamaica Bay that were once open water or saltmarsh have been filled to create additional land for development. These new landforms have the potential to restrict flow within the Bay, creating areas with poor circulation and tidal flushing. Some of these possible restrictions include Floyd Bennett Field, and the western end and southeast corner of the Rockaway peninsula. Removing some of these land areas or building culverts beneath them could improve circulation within the Bay, leading to improved water quality conditions. During the period of European settlement and development of the Jamaica Bay environs (the last 300 to 500 years), Rockaway Beach has grown southward across the mouth of Jamaica Bay to its current condition, which creates a more circuitous route for tidal exchange. A modeling analysis conducted during the late 1980s as part of the Jamaica Bay CSO Study showed that a 500 foot wide channel through Rockaway would not be adequate to improve water quality conditions in the Bay. Substantially wider channel cuts would likely be required.

Strategy Assessment Approach

The strategy assessment approach will involve developing a map that identifies potential breaching locations. Modeling results from applicable scenarios within the CJBWQP will be evaluated. Improving circulation within the Bay would require extensive landform removal; modeling of these removals will be performed to illustratively show potential improvements. An evaluation of potential locations for the re-use of excavated fill material for other restoration projects and restoration opportunities will be explored.

Objective 1e: Reduce pathogen loading into the tributary basins and the Bay.

Issue

In 2005, Jamaica Bay summer fecal coliform (FC) levels were well below the 200 cells/100mL (SB) standard for all stations. Mean FC levels in Jamaica Bay as a whole have been at or below the 200 cells/100mL standard for bathing over the past 20 years. The Head of Bay met the monthly median total coliform standard of 2,400 cells/100ml, but had greater than 20% of samples greater than 5,000 cells/100ml at the surface and bottom. The sources of coliform bacteria to Thurston Basin were dry weather discharges from 50 identified homes which have subsequently been abated, raw sewage discharge at the mouth in the Meadowmere/Warnerville communities which is presently being abated by the NYCDEP (New York Times, February 18, 2007), and combined sewer and storm sewer discharges at the head end.

Under wet weather conditions, the Bay can experience localized degradation. At these times, spikes in FC may temporarily exceed the SB standard of 200 cells/100mL for the entire northern portion of the Bay (from Mill Basin to Bergen Basin).

Bergen Basin displayed the most chronic coliform problem, failing to meet state standards for total and fecal coliforms for all surface water stations. However, total and fecal coliform concentrations were below NYSDEC water quality criteria in bottom waters. The concentration disparity between top and bottom is due to stratification, which is typical in confined basins of this nature.

When elevated pathogen concentrations occur they can impair the secondary contact recreational uses of these tributaries. Based on mathematical modeling and the NYCDEP Harbor Water Quality Survey, the Bay is attaining the water quality standard (WQS) for primary contact

recreation for coliforms but there is potential for extreme events that can result in the impairment of primary contact recreation during portions of the year. Solutions focus on the improvement of existing sanitary and combined sewer infrastructure, control of pathogens at the source through public education and illicit discharge investigations, and the remediation of existing "sinks" within the tributary basins. Implementation will result in immediate benefits to local public health, aesthetics, and recreation in and near the tributaries that receive CSO and stormwater discharges.

Current Programs

The resolution of CSO discharges is a high priority for NYCDEP, with ongoing LTCP planning efforts in Fresh Creek, Bergen Basin, and Thurston Basin. In 1972, a facility at Spring Creek was constructed to store 12 to 20 million gallons of CSO discharges. This facility is now undergoing stabilization and modernization to assure that it will continue to operate as designed for many years into the future. NYCDEP plans to undertake cleaning of some sewers upstream of Fresh Creek in connection with 26th Ward WPCP upgrade, increasing wet weather capacity by 50 MGD to handle additional wet weather CSO loadings. Finally, construction of the Paerdegat Basin CSO retention facility, which will capture the first 50 million gallons of CSO from each rainfall event, will be completed in late 2011.

NYCDEP is developing waterbody/watershed Drainage Basin Specific Long Term CSO Control Plans for each CSO impacted tributary and open water area of Jamaica Bay. These plans are investigating additional CSO control needs and opportunities for these areas in accordance with requirements of the USEPA CSO Policy and the requirements of New York City's WPCP SPDES discharge permits, as well as the 2004 CSO Consent Order.

NYCDEP is also continuing to correct improper sewer corrections in the sewershed of the Rockaway WPCP.

As recommended in the Jamaica Tributaries Modified CSO Facility Planning Report (revised February 2004), NYCDEP is moving forward with the design of a high level storm sewer system in the Laurelton section of the Thurston Basin drainage area.

The Southeast Queens Drainage Plan incorporates the following activities. The proposed design work of the is still in the preliminary stages, but several projects, which are summarized below, are being developed that will partially separate the Laurelton combined sewer system: *Laurelton High Level Storm System* – as previously discussed in the Existing Facility Plan (Alternative #1), the NYCDEP is moving forward with design of a high-level storm sewer system in the Laurelton area. The high-level storm sewer system would be a partial separation of the existing combined sewer system. While a majority of the Laurelton sewer flow would be separated into storm and sanitary piping systems because of the proposed Southeast Queens Drainage Plan improvements, storm water flow from roof leaders, sump pumps and other sources would likely remain connected to the sanitary sewer system. As a result, combined flow would continue to discharge into Thurston Basin, but at a much-reduced volume/rate. *Hollis Avenue Storm Sewer Diversion* – stormwater generated in the 5,550-acre separately sewered drainage basin would be diverted around the Laurelton combined sewer area via a new storm sewer interceptor system and discharged into Thurston Basin. The exact route and size of the new diversion storm sewer piping is still being evaluated.

Potential Management Strategy 1e1:

Reduce Jamaica Bay CSO discharges through the incorporation of off-line and in-line storage, drainage basin planning, and high-level storm sewer design.

This strategy is related to the LTCP recommendations to reduce CSO discharges and abate pathogen loading to Jamaica Bay. The LTCP program and NYCDEP are currently in the process of analyzing, modeling, and executing off-line and in-line storage, drainage basin planning, and high-level storm sewer design, as detailed above.

Strategy Assessment Approach

The strategy assessment approach will entail a review of the existing LTCP program in the context of the *Jamaica Bay Watershed Protection Plan* efforts, to evaluate the greatest possible CSO reductions through the LTCP and *Jamaica Bay Watershed Protection Plan* actions.

Potential Management Strategy 1e2:

Correct compromised sanitary sewers and implement a sanitary sewer connection program focusing enforcement and monitoring of interconnections between sanitary and storm sewers within the Jamaica Bay watershed.

Cross-connections of sanitary lines from business offices, restaurants, and residential units to storm drains allow untreated sewage to enter the storm drain system, which has an adverse effect on the water quality of stormwater baseflow draining to Jamaica Bay. Previous efforts including an Infiltration/Inflow Study (1992) and a more recent Thurston & Bergen Basin Storm Sewer Inspections Study (2001) identified many direct connections of sanitary sewers and home lateral connections to storm sewers. NYCDEP has already corrected the known connections where sanitary sewers are connected directly to storm sewers. I/I studies indicate there is a significant amount of wet weather runoff entering the sanitary sewers. Further, the LTCP project has identified areas within the Jamaica WPCP collection system where sanitary sewers overflow to storm sewers under certain wet weather conditions. NYCDEP acknowledges the fact that this sanitary sewer system was never constructed as a separate sewer system and has taken steps to reconstruct these sewers. A monitoring and enforcement program to correct currently compromised sewers and ensure that new connections are dedicated would result in a reduction in the loading of pathogens and other pollutants into the tributary basins through the storm drain system.

Strategy Assessment Approach

The strategy assessment approach will involve obtaining information to identify current procedures for compromised sewer detection. After creating a list of compromised sewer connections, and if deemed necessary, a revised schedule to repair the compromised sewer connections will be created. To better identify and correct compromised sewers and prevent future cross-connections, alternative procedures will be researched, including those utilized by other municipalities.

Potential Management Strategy 1e3:

Provide sewage treatment service to the remaining un-sewered neighborhoods along margins of the Bay.

Currently a small number of areas around Jamaica Bay (along the eastern shoreline) do not have public sewer service and use under-performing septic systems, storage tanks requiring frequent pump-out, or illegal discharges directly into surface waters. The connection of these unsewered areas is currently a high priority item at NYCDEP, with the most recent and final project in the Warnerville and Meadowmere sections of eastern Queens. NYCDEP has completed the design of sanitary sewers, a pump station, and a force main to collect this sanitary sewage and deliver it to the Jamaica WPCP for treatment. Bid documents have been issued for the construction of this remedy. NYCDEP has issued a contract for the construction of these control actions.

Strategy Assessment Approach

The strategy assessment approach will entail the procurement of additional information required to locate and map any remaining un-sewered areas within the watershed. Interim measures to improve control of sanitary sewage releases from these areas will be evaluated.

Potential Management Strategy 1e4:

Increase efforts to promote the proper disposal of pet-waste, including the provision of pet waste disposal bags and enforcement of sanitation ordinances.

Improperly disposed pet waste carried by stormwater has been found to represent a significant source of bacteria in urban watersheds (www.stormwatercenter.net/Pollution_Prevention_Factsheets/AnimalWasteCollection.htm. New York City Department of Sanitation (DSNY) codes adopted the New York State Public Health Law §1310 "Failure to Remove Canine Waste" as its "pooper scooper" ordinance in 1978. Violations may be enforced by fines of up to $100. Public outreach currently consists of sidewalk signs posted throughout the City, NYCDPR sign postings, and information distributed by non-profit organizations such as the Green Thumb community gardens program. Service requests for canine waste removal violations can be made via the DSNY website or by calling the New York City Citizen Service Center at 3-1-1. Proper disposal of pet waste can reduce bacteria loading to receiving waters; the enforcement of existing ordinances and the provision of pet waste disposal bags would help to curb the amount of animal feces that end up in Bay waters.

Strategy Assessment Approach

The strategy assessment approach will involve reviewing and analyzing ticket enforcement data for pet waste and Community Board cleanliness ratings to identify pet waste problem areas. To promote proper pet waste disposal, NYCDEP will coordinate with DSNY to discuss the potential for enhanced street sweeping efforts, and to enforce and reissue public service announcements.

Potential Management Strategy 1e5:

Expand the boat pump-out program in Jamaica Bay.

Personal watercraft in Jamaica Bay sometimes "pump-out" ballast waters or wastewaters directly into the Bay, typically at the marinas in which they are berthed. This water contains high concentrations of pathogens and other pollutants associated with human waste products.

New York State's Clean Vessel Assistance Program was established to protect and improve water quality in New York's navigable waterways. The program provides federally funded grants of up to 75% of eligible project costs with a current maximum of $35,000 per project. The grants are to assist marinas, municipalities, and not-for-profit organizations install pump-out stations to accept

sewage from recreational boaters. Using funds from this program, NYCDEP has installed two pump-out facilities on Jamaica Bay (at Coney Island WPCP and Hudson River Yacht Club) and seven in total city-wide.

A boat pump-out unit at the Rockaway WPCP is currently being designed and NYSDEC permit applications for the installation of pilings for a floating pier are being prepared.

In addition, since 1994, the New York/New Jersey Baykeeper operates a pump-out boat which travels to Jamaica Bay marinas and offers free wastewater disposal to private boat owners, depositing the wastewater in the municipal sewage system for treatment at a sewage treatment facility. Expansion of this type of program would allow treatment of large quantities of pathogens in wastewater that would otherwise end up in the Bay.

Potential legislation that requires pump-out units at any marina or facility selling or dispensing gasoline will be investigated, this is a frequent requirement of other municipalities. In addition, according to existing legislation, before being eligible for a "no discharge zone" designation, a sufficient number (> 4) of pump-out need to be available. Additional sites for pump-outs beyond what is currently planned will be explored to assist in meeting the minimum requirements.

Strategy Assessment Approach

The strategy assessment approach will involve identifying and mapping existing boat pump-out locations. Existing boat pump-out locations will be evaluated for efficiency. New potential boat pump-out unit locations will be identified. The potential for legislation requiring pump-out units at any marina or facility selling or dispensing gasoline, as is required by many other municipalities, will be investigated. Additional legislation that would require a sufficient number of pump-out stations be available to attain a “no discharge zone” designation will also be explored.

Objective 1f: Reduce floatables in tributary basins, open waters, and along the shoreline.

Issue

Floatable materials reduce the aesthetic qualities of the Bay, and can be a hazard to human health, the navigation of watercraft, and to wildlife populations from entanglement or health complications when ingested. The majority of floatables are derived from street litter that is washed into storm drains during wet-weather events and enters the Bay and its tributaries through CSOs and the storm drain network. Other litter blows directly into the Bay from public areas (such as beaches) where collection barrels are sometimes not used; and also from vehicles on surrounding roadways. New York City has aggressively addressed the control of floatables and debris in the open waters of the Bay over the last 20 years. NYCDEP funds an anti-littering campaign to increase public awareness. The Catch Basin Hooding Program has inspected and installed catch basin hoods in the majority of the City’s storm drains to capture debris before it enters the sewer system. These catch basins are now routinely serviced and maintained by the City. NYCDEP operates a successful floatables control program with facilities in Paerdegat Basin, Fresh Creek, Hendrix Creek, Bergen Basin, and Thurston Basin as part of the Interim Floatables Containment Program, which includes booming and skimming. The benefits of these actions have been realized in improved fish and wildlife habitat and aesthetics in the Jamaica Bay estuary. In addition to the efforts described in this Objective, additional educational and outreach

actions that will serve to reduce the source of floatable debris in the upper watershed are provided in Objective 5e.

Current Programs

In December 2004, NYCDEP developed and submitted a Comprehensive CSO Floatables Facility Plan to NYSDEC in accordance with the requirements of the CSO Consent Order. This Plan calls for a number of BMPs and other actions to reduce floatables to all areas of New York Harbor. The City-Wide CSO Floatables Plan consists of the following action elements:

- Monitor city-wide street litter levels and coordinate with the DSNY to maintain litter levels at or below 1993-1994 levels (based on a prescribed protocol for regularly assessing street cleanliness);
- Install baffle hoods on street catch basins to retain floatables (and reconstruct unhoodable basins);
- Capture floatables at wet weather CSO storage/treatment facilities;
- Capture floatables at end-of-pipe netting facilities, including the Interim Floatables Containment Program (IFCP);
- Continue the Illegal Dumping Notification Program (IDNP) in which NYCDEP regularly surveys storm outfalls for illegal discharges and notifies apparent source contributors with enforceable orders to curtail discharge;
- Engage in public outreach programs to increase public awareness of litter and appropriate disposal in public spaces;
- Evaluate emerging floatables-control technologies through pilot testing and demonstration projects.

As part of the Floatables Facility Plan, NYCDEP will also be developing a Floatables Monitoring Plan for New York Harbor. The long-term goals of the Floatables Monitoring Plan will be as follows:

- Collect basic floatables presence/absence data from representative monitoring sites in the Harbor;
- Use the basic data to rate the floatables conditions throughout the Harbor;
- Track the ratings over time to assess long term conditions and trends;
- Correlate rating trends to floatables control programs where applicable to gain a measure of program efficacy;
- Instigate site-specific investigations in those areas where consistently poor ratings occur;
- Prompt inter-pier skimmer vessel or deployment of the vessel "Cormorant" (see below) in applicable service areas if monitored floatable conditions create acute human or navigation hazards.

NYCDEP currently maintains 25 total floatables boom and net sites city-wide, with five such facilities in Jamaica Bay located in Bergen Basin, Fresh Creek, Hendrix Creek, Paerdegat Basin, and Thurston Basin. These facilities are inspected, serviced, and maintained by a contractor under the NYCDEP's IFCP. Inspections are conducted at least weekly and after rain events, with floatables skimmer vessels dispatched to retrieve captured floatables based on the inspections. Maintenance work (such as boom repair and hardware replacement) is also conducted based on the inspections. NYCDEP also maintains an open water skimmer vessel, the "Cormorant," which is available for recovery of large floatable slicks.

Since 1999, NYCDEP has conducted several successive catch basin repair, maintenance, and retrofitting programs. The current program, beginning in 2002, has resulted in the inspection of roughly 99 percent of the City's nearly 140,000 catch basins. Furthermore, over 98 percent of the "hoodable" basins now have hoods, and retrofit/construction requests for all basins needing hoods have been submitted by NYCDEP to the NYCDDC. Current hooding operations have entered an ongoing routine maintenance phase, including inspections and related repair, scheduled, and complaint cleaning.

NYCDEP helps sponsor and participates in volunteer shoreline cleanup efforts. NYCDEP pays for refuse hauling costs and provides general support and promotion for the Annual New York State Beach Cleanup, which is organized by the American Littoral Society and is part of the International Coastal Cleanup of The Ocean Conservancy. NYCDEP also organizes and supervises extensive volunteer field surveys (and cleanup) of trash on New York City's beaches, conducting an average of 200 field surveys at 20 separate locations per year. Several volunteer cleanup and environmental programs sponsored outside of NYCDEP also have a large effect on the reduction of floatables and litter, through the physical removal of material and the hands-on environmental education messages inherent in these programs. In addition, numerous city, state, and federal agencies sponsor non-governmental litter prevention and recovery efforts (such as Business Improvement Districts, "Litter Deputies," and Adopt-A-Highway). The Litter Prevention Working Group (LPWG) represents one avenue for coordination among such efforts.

Potential Management Strategy 1f1:

Continue efforts to repair, maintain, and retrofit catch basin hoods and clean storm drain inlets, sewer lines and catch basins.

Street litter has been identified as a primary source of floatable debris in receiving waters. During rain events, street litter is washed through storm drains into the sewer system and can be discharged through CSO and storm drain outfalls. Catch basin hoods provide a method of debris capture, and in conjunction with proper catch basin cleaning and maintenance, provide a significant measure of floatables control.

Strategy Assessment Approach

The strategy assessment approach will involve mapping existing catch basins with hoods, catch basins without hoods, and all floating booms. Another map will be created to identify all outfalls with booms and/or chronic floatable locations. The maintenance, repair, and inspection schedules of catch basin hoods, sewer lines, and floating booms will be reviewed, current schedules will be evaluated for efficiency and adjusted accordingly based on existing inspection reports. Should additional devices, monitoring programs, or increased maintenance at specific locations be deemed necessary, appropriate measures will be evaluated.

Potential Management Strategy 1f2:

Continue the ongoing floatables booming, skimming, and netting programs, as appropriate, until other floatable control operations become effective.

Floatables booms and nets capture discharged floatables at or downstream of CSO and storm drain outfalls, preventing dispersion to the open waters of Jamaica Bay. Recovery of the captured floatables by skimmer vessels removes the material for proper disposal.

Strategy Assessment Approach

The strategy assessment approach will involve mapping boom locations. The maintenance and inspection schedule of booms will be reviewed to evaluate the need for increased inspections or additional devices. A review of the Community Board cleanliness ratings will identify any problem areas. Meetings with DSNY will be scheduled to discuss current sweeping efforts in problem areas. Meeting with the LPWG will be scheduled to discuss the potential for a new Floatables Monitoring Program in Jamaica Bay.

Potential Management Strategy 1f3:

Provide support for litter removal and reduction programs including beach clean-ups.

Litter deposited along shorelines by upland or waterborne mechanisms can be dispersed in waterbodies through wind or tides. Upland litter has been identified as a primary source of floatable debris via discharge through CSO and storm drain outfalls. In coordination with the American Littoral Society, NYCDEP has started a global positioning system (GPS) mapping effort of debris piles around the perimeter of the Bay. In addition to the aesthetic issues, these piles are partly responsible for the suppression of the natural restoration of these areas. They also serve as a source for much of the debris that is reintroduced into the Bay by spring and storm tides. To expedite this process, NYCDEP has assisted in several beach clean-ups and volunteer plantings in 2006 and will continue these efforts in the future.

Community, environmental advocacy, and volunteer groups and other non-governmental organizations can play a large role in cleaning up and preventing litter and other debris along shorelines and in upland areas. Based on the Scorecard Litter Rating (SLR) system through which the Mayor's Office of Operations tracks city-wide cleanliness, New York is the cleanest it has been in over 30 years. Continued support of non-governmental partners in the city-wide litter prevention and removal effort and cleanliness tracking will help the City maintain cleanliness and reduce the presence of floatables (see also Objective 5f).

Strategy Assessment Approach

The strategy assessment approach entails continuing to map shoreline debris locations and other known litter or debris problem areas in the watershed. This map will provide the necessary planning tool to begin to develop a routine maintenance and inspection schedule for the shoreline based on estimated shoreline debris volumes and necessary cleaning resources. Additional support necessary for local environmental and community groups to continue beach cleanups throughout the year will be evaluated.

Potential Management Strategy 1f4:

Request that NYCDPR and NPS maintain trash receptacles on beaches and parks through the end of October.

A correctable source of floatable debris and litter is from trash receptacles in public parks and nearshore areas that are not maintained during the "off-season": Labor Day to Memorial Day. As the weather remains warm for several weeks either after or before these dates, these public areas continue to be used. Trash can overflow and eventually spill out onto the adjacent ground surfaces, becoming a source of debris that can end up in Bay waters. Extending the maintenance schedule of these trash receptacles would help to reduce the amount of potential floatables during this time period.

Strategy Assessment Approach

The strategy assessment approach will entail discussing issues (*e.g.*, staffing and financial) that currently prevents NYCDPR and NPS from maintaining receptacles prior to Memorial Day and beyond Labor Day. Potential funding mechanisms will be explored to potentially support the staffing and other resources required to maintain trash receptacles on beaches and parks.

Potential Management Strategy 1f5:

Review and strengthen enforcement activities and sanctions against illegal dumping into Jamaica Bay.

Several existing environmental regulations prohibit the illegal dumping of materials into waterways. A review of the current procedures and policies against illegal dumping in the Bay, as well as current enforcement activities, may help to identify opportunities to strengthen the level of effort in identifying and prosecuting polluters. In addition, this may provide an opportunity to enhance the dedicated Jamaica Bay damages account or similar banking mechanism that would make fines available for enactment of *Jamaica Bay Watershed Protection Plan*-led projects.

Strategy Assessment Approach

The strategy assessment approach will involve identifying the roles of each regulator (including NYSDEC, USACE, NPS, U.S. Coast Guard, National Oceanic and Atmospheric Association (NOAA), and potential other agencies) and reviewing their existing environmental regulations and corresponding penalties. Discussions with these entities, evaluations for additional enforcement efforts, increased fines for illegal dumping into the Bay, and related issues can be explored. Multi-agency discussions could also include the possibility of dedicating penalty fines to restoring and protecting Jamaica Bay.

Objective 1g: Alleviate the loading of hydrocarbons or other toxic contaminants into the Bay, tributaries, groundwater and/or surface water resources, and prevent future leakage in commercial and industrial areas.

Issue

A reduction in the amount of toxic contaminants introduced into the water column and sediments will improve wildlife habitat and reduce potential human health risks. The highest toxic contaminant concentrations in the Bay have been found near point sources such as WPCPs and CSOs, as well as near landfills. Strategies to reduce these loads include source identification, developing pollution prevention approaches that include structural and non-structural controls, remediating existing problem areas, and conducting risk assessments that lead to the development of management plans to prevent future contamination.

Current Programs

Ongoing pretreatment and pollution prevention (P2) programs targeted at industry provide outreach, technical and regulatory assistance, and permitting/enforcement mechanisms to help the industrial community address and avoid the discharge of pollutants. NYCDEP has several City-wide regulatory and P2 programs focused on industrial users of the sewer system (some of these programs also target commercial establishments). These include; the Industrial Pretreatment Program (IPP); the Citizens Advisory Committee (CAC) for Pollution Prevention; the Significant Industrial Users (SIU) permit programs for sewer system discharges; the water and sewer system

service connection permit program; the Environmental Economic Development Assistance Unit (EEDAU) regulatory and P2 assistance; and illegal discharge investigation and enforcement.

The IPP has been continuing a phased program to monitor and control discharges of industrial toxicants of concern in separately sewered drainage areas. Data-gathering, control mechanism development, and implementation phases are ongoing. The current focus is on the automotive and transportation industries and the development of P2 outreach and structural BMPs to reduce stormwater runoff impacts in those sectors. In addition, SIU permits have been modified to include a requirement to hold process wastewater and non-contact cooling water to the maximum extent practicable during heavy rain events.

Potential Management Strategy 1g1:

Review NYCDEP's portfolio of industrial pre-treatment permittees within the Jamaica Bay watershed with the goal of enhancing BMPs with respect to their industrial processes.

Proper control of industrial and commercial wastes and materials is essential to prevent the introduction of unacceptable levels of pollutants into storm and combined sewers that discharge to waterbodies. P2 programs targeted at industrial and commercial businesses provide outreach and technical and regulatory assistance to raise awareness and help the business community address and avoid the discharge of pollutants such as heavy metals, pathogens, oil and grease, suspended solids, nutrients, floatable materials, and chemicals. There may be an opportunity to increase the effectiveness of existing P2 programs by identifying additional BMPs that could be utilized by the dischargers to reduce the amount of wastewater pollutants.

Strategy Assessment Approach

The strategy assessment approach will involve mapping industrial and commercial businesses containing automotive and/or transportation facilities. A list of facilities enrolled in the pre-treatment program will be compiled. Opportunities to enhance the effectiveness of current programs will be evaluated, including the expansion in outreach and operation of the Industrial Pretreatment Program.

Potential Management Strategy 1g2:

Perform risk identification of potential sources of contamination, including airports and other industrial operations, as well as known underground storage tanks, oil storage facilities, former landfills, and Superfund sites.

Identification of potential watershed contamination sources and calculating the risk of a contamination event are important steps in pollution prevention and control. Compiling data from local, state, and federal databases of hazardous waste sites, storage tank permits, and active and inactive industrial operations into a geographic information system (GIS) inventory can facilitate ranking and prioritization for planning purposes. NYCDEP has created industrial user (IU) and SIU databases as part of its IPP. In addition, the USEPA and the NYSDEC maintain databases of hazardous waste, Superfund sites, and various permitted waste and industrial facilities.

Strategy Assessment Approach

The strategy assessment approach will involve developing a list of known contaminated sites in the watershed, using existing data from NYSDEC, USEPA, New York City Department of Health (NYCDOH), NYCDEP, and other relevant agencies. This inventory will organized by

contamination type. Historic, current, and proposed remediation efforts of these contaminated sites will be reviewed.

Objective 1h: Provide for the proper remediation of toxic sediments in the Jamaica Bay estuary, and prevent the further degradation of sediments from heavy metals and other contaminants.

Issue

The chronic toxicity of sediments in the Jamaica Bay estuary is an important long-term ecological health issue. As described in Objective 1g, the highest toxic contaminant concentrations have been found near point sources and near landfills. The toxic contaminants adsorb to organic materials (such as sediments with high total organic compounds (TOC) concentrations) and settle out as bottom sediment. In Jamaica Bay, toxic sediments tend to be concentrated in tributaries and the northern and eastern portions of the Bay. New sediment is deposited into the Bay at rates of 0.5 to 2.0 cm/yr. If this new sediment is "clean," then areas of existing toxicity can be naturally remediated by capping and sequestration over long periods of time.

Areas in the Jamaica Bay estuary with high levels of existing toxicity will be identified.

Current Programs

The Contaminant Assessment and Remediation Program (CARP) and the Regional Environmental Monitoring and Assessment Program (REMAP) have collected limited data on sediment contamination and sources of contamination in Jamaica Bay. However, Jamaica Bay is not does not have current programs to thoroughly analyze the data collected in the Bay.

Potential Management Strategy 1h1:

Identify the existing extent and condition of contaminated sediments in Jamaica Bay.

The sediments of Jamaica Bay are known to contain metals, polychlorinated biphenyls (PCBs), pesticides, polynuclear aromatic hydrocarbons (PAHs), and dioxins and furans. Programs such as REMAP and CARP have performed limited sediment sampling in the Bay. REMAP identified 32 percent of Jamaica Bay sediments as toxic to *Ampelsica abdita* (an amphipod), and 20 percent as highly toxic. Additional research and analysis of the REMAP and CARP datasets would need to occur to be able to provide a more complete evaluation of the extent and condition of contaminated sediments in the Bay.

Strategy Assessment Approach

The strategy assessment approach will involve reviewing information from the JBERP Study, the CSO Program, the REMAP and CARP datasets, and other data sources to categorize sediment contamination within Jamaica Bay. Using the sediment data collected from these sources, the locations and composition of sediment mounds in the Bay will be identified and mapped.

Potential Management Strategy 1h2:

Create a plan to mitigate toxic sediment mounds in Jamaica Bay, either through on-site capping or sediment removal.

Once the extent of sediment contamination in the Bay has been more thoroughly evaluated (see Potential Management Strategy 1h1), an assessment of remediation alternatives and monitoring

methods will be explored, and the environmental costs and benefits (such as the re-suspension of contaminants into the water column during toxic sediment removal operations, potentially increasing the risk of bioavailability to aquatic organisms) will be identified.

Strategy Assessment Approach

The strategy assessment approach will involve mapping toxic sediment mound locations within Jamaica Bay and evaluating potential sediment mound remediation efforts. Remediation methods, including on-site capping, toxic sediment removal, and other successful techniques that have been used to perform toxic sediment remediation in similar environments will be assessed.

CHAPTER 4 – CATEGORY 2, RESTORATION ECOLOGY: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES

Jamaica Bay is located adjacent to the confluence of the New York Bight and New York Bay, and is at the turning point of the primarily east-west oriented coastline of New England and Long Island and the north-south oriented coastline of the mid-Atlantic coast. This geographic location acts to concentrate marine and estuarine species migrating between the New York Bight portion of the North Atlantic and the Hudson-Raritan Estuary. Shorebirds, raptors, waterfowl, landbirds, fish, and various migratory insects are concentrated by the coastlines in both directions (USFWS 1997). Anyone who has visited Jamaica Bay can easily attest to this rich biodiversity; they need only to see the wide expanses of salt marsh and beach habitats, migrating birds gracefully coming in for a landing in the shallow waters, or hundreds of migrating Monarch butterflies crossing the fields in search of a bit of nectar for their long journey back to the mountains of Mexico.

There is a tremendous amount of 'what is right' with Jamaica Bay, and at the same time there is much to be concerned with. The configuration of the Bay and the natural landscapes within the watershed, once a vast, complex network of meandering streams, floodplains, palustrine woodlands and shrublands, dunes, beaches, grasslands, freshwater wetlands, tidal wetlands, and shallow-water estuary, have been altered considerably over the last few centuries. These changes are in response to long-term natural processes within the greater geophysical province (such as erosion/deposition, climate change, sea level fluctuations, and the extension of the Rockaway Spit decreasing the circulation and tidal mixing of Bay waters), as well as human development, especially in the last 150 years (such as land filling; dredging; exotic species introduction; and the construction of residential, commercial, industrial, and transportation infrastructure). Although remnant natural ecosystems are still present in limited areas, their ecological functions have been disturbed, and in some cases permanently altered.

However, the ecological restoration and enhancement of Jamaica Bay is possible. Ecological restoration is defined by the Society for Ecological Restoration as "assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." Often, it is associated with the re-establishment of self-sustaining, reproducing populations of native organisms in the ecosystem. In addition, restored ecosystems demonstrate sufficient resiliency to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem. Finally, in restored ecosystems, potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible. In Jamaica Bay, the ecosystem has been irreversibly altered from its historic conditions. Thus, ecosystem restoration efforts will seek to restore resiliency and sustainability to the current complex of habitats, and opportunistically to increase the range of habitat areas and reduce potential impediments from the surrounding landscape.

The following Objectives and Potential Management Strategies provide a management framework and initial strategies to promote the restoration of selected ecosystems and larger habitat complexes in Jamaica Bay. Fundamentally, watershed-based planning and restoration efforts recognize the inter-connectedness of ecosystems at the watershed scale. This requires a holistic approach towards restoration. The composition, distribution, health and vitality of

individual habitats and plant and animal communities are dictated by the exchange of energy, nutrients, and materials in between ecosystems in the watershed; therefore, any efforts to restore specific ecosystem elements must consider the larger system.

The interrelated nature of water quality conditions, land use practices, human stewardship actions, and the health of natural communities in the watershed is reflected in the *Jamaica Bay Watershed Protection Plan* through all of the recommendations in Chapters 3 – 8; the implementation of Potential Management Strategies recommended in other sections of the *Jamaica Bay Watershed Protection Plan* will improve the long-term ecological health of the Bay. For example, in the open water and shallow water estuarine and shoreline habitats in Jamaica Bay, seasonally depressed water quality is an important physical limitation to ecosystem health. Thus, the restoration of those areas is largely dependent upon the implementation of Potential Management Strategies in Category 1: *Water Quality*. Reciprocally, the restoration of natural areas also plays a minor, but important role in attenuating and immobilizing pollutants and nutrients from developed upland sources, and in the protection of urban infrastructure. For example, wetlands and shoreline buffers can provide for improved water quality through nutrient uptake and the capture of suspended sediments, act as shoreline stabilizers, and provide important flood protection from storm surges. In this Chapter, Potential Management Strategies have been organized according to the enhancement or restoration of distinct habitats, plant and animal communities, or the mitigation of recognized ecosystem stressors. However, it is intended that restoration actions be implemented holistically, and in concert with all of the other efforts recommended in this document, with awareness of the interconnected nature of ecosystems.

Multiple federal, state, and city agencies, as well as local environmental groups and programs, are actively engaged in ecological restoration and enhancement programs within Jamaica Bay. NYCDEP is one of a number of collaborative public and private partners involved with improving the ecology of Jamaica Bay and its watershed, but it does not have direct control over many of the Potential Management Strategies presented within this document. The following recommendations constitute the initial management framework for the *Jamaica Bay Watershed Protection Plan* and will require significant coordination between all stakeholders. The efficient leveraging of multi-agency and private funding sources through program coordination, cost-sharing, and information-sharing will be required to successfully implement and manage any recommended actions in the *Final Jamaica Bay Watershed Protection Plan.*

Objective 2a: Restore the salt marsh islands in Jamaica Bay.

Issue

It has been estimated that at the time of European settlement, the Jamaica Bay estuary originally contained approximately 16,000 acres of wetlands. An estimated 12,000 acres have been lost to dredging and fill placement, mostly within the last century. In recent years, the interior salt marsh islands have been disappearing at an increasing rate. An extensive analysis of the salt marsh islands within Jamaica Bay by the NYSDEC has determined the following:

- from 1924 through 1974, approximately 780 acres were lost to dredging and filling operations and 510 acres were lost to unknown reasons at a loss rate of 10 acres per year;
- from 1974 to 1994 approximately 526 acres were lost to unknown reasons at a loss rate of 26 acres per year; and
- from 1994 to 1999 approximately 220 acres were lost to unknown reasons at a loss rate of 44 acres per year.

Despite an active ongoing research effort, the exact mechanism of salt marsh island disappearance has not yet been identified.

The salt marsh islands are an integral part of the Jamaica Bay environment, providing valuable fish and wildlife habitat, water quality, hydrologic, and ecological benefits, as well as protection from coastal storm events. Expanding and prioritizing the salt marsh island restoration effort is necessary to minimize the annual loss of these important natural areas. However, the prioritization of restoration opportunities is also essential, to address areas that could most benefit from restorative actions.

Current Programs

Although the mechanism of salt marsh disappearance has not yet been identified, pilot studies and restoration projects are moving forward to gather additional information that may provide additional insight into the causes of salt marsh loss, and determine effective long-term solutions. A pilot restoration project was initiated by NPS in 2003 on the 2 acre Big Egg Marsh, using an innovate technique known as "thin-layer" sediment spraying to raise the salt marsh elevation. Based on monitoring results, the project has been deemed successful and the initial restoration area has been substantially enhanced through additional plant recruitment. Elevation monitoring and data collection by the NPS will continue for at least several more years at the site.

A larger salt marsh restoration effort (70 acres) funded by multiple agencies began in spring 2006 at Elders Point (East and West). It will provide additional information on appropriate salt marsh restoration techniques and viability for application to other sites. The restoration of another salt marsh island, Yellow Bar, also funded by a multi-agency partnership, is expected to begin during the summer of 2007. A cost-sharing program (75/25) between NYSDEC and local sponsors is currently being considered, which will include the identification of additional salt marsh islands for potential future restoration.

Potential Management Strategy 2a1:

Promote the beneficial uses of appropriate dredged material to restore or create salt marsh island wetlands. Establish an interagency coordinating committee to oversee and direct these efforts.

A substantial volume of clean fill is required for the restoration of the salt marsh islands. As the amount of fill material required is unlikely to be generated from a sole source, multiple sources of material will be necessary to adequately restore additional salt marsh islands. A coordinated program to direct the use of clean dredged material generated from Rockaway Inlet or other nearby navigation projects toward the restoration, creation or enhancement of intertidal wetlands is important. For example, the Elders Point Marsh restoration effort utilized approximately 300,000 cubic yards of dredged material for beneficial reuse. Currently, the only regular dredging reported in Jamaica Bay occurs every 2-3 years at the Rockaway Inlet producing 200,000 to 250,000 cubic yards of clean, mostly sandy material.

Strategy Assessment Approach

The strategy assessment approach will evaluate the inventory of Jamaica Bay restoration and acquisition projects and gather important information and lessons learned from restoration projects such as Big Egg, Yellow Bar and Elder's Point as well as other proposed wetland

restoration projects in the Bay.

If determined that sufficient quantities of suitable dredged material can be secured to supply the needs of future salt marsh island restoration projects, implementation strategies will be explored. One potential implementation strategy is to develop a coordinating committee to focus on the material needs of future salt marsh island restoration projects and to secure the volumes of clean dredged material that may be available from Rockaway Inlet or other nearby navigation projects. The committee would also be used to explore potential alternative funding mechanisms for future restoration projects.

Potential Management Strategy 2a2:

Prioritize the restoration of additional salt marsh islands such as Black Wall, Ruler's Bar, Duck Point, etc.

Opportunities to expand the salt marsh island restoration efforts to include other salt marsh island locations need to be explored and evaluated. This would involve the incorporation of the lessons learned and post-design construction modifications of other salt marsh wetland islands that have been severely impacted by marsh loss, such as such as Black Wall, Rulers Bar, and Duck Point. Because of the accelerated rate of salt marsh disappearance, restoration actions must continue to minimize these losses while recognizing that the reasons for wetland loss are evolving and that strategies and the prioritization of restoration projects must be able to adapt and implement new information as it becomes available.

Strategy Assessment Approach

The strategy assessment approach involves defining the limits of potential restoration locations based on the historic (*e.g.*, circa 1974) extent of salt marsh island footprints, identifying potential logistical issues and estimating the materials and costs required to restore and maintain each location. The evaluation and prioritization of salt marsh restoration areas should be accomplished through an evaluation of past efforts and how these are applicable in balancing immediate opportunity with the desire to provide the greatest restoration efficiency and sustainable benefit. Historic aerial photo analysis and information gathered in consultation with NPS, USACE, and NYSDEC will provide reasonable estimates as to the actual restoration extent. Once these opportunities for salt marsh island restoration have been characterized, it will be necessary to identify potential funding mechanisms and cost sharing partners.

Potential Management Strategy 2a3:

Using information from Elders Point and existing literature, examine various technologies of "non-hardened" wave attenuators (such as coir logs) to protect windward and ice flow sides of marsh islands from wind and water erosion forces.

Recently restored marsh islands have limited vegetative cover, including a minimal amount of root mat that make them vulnerable to the erosive forces of wave and wind energies. These areas are also vulnerable to erosive forces from ice flows during the winter months. The use of geotextile fabrics or other biodegradable materials may be effectively used to armor the vulnerable windward fringe of these marshes, allowing protection while the *Spartina alterniflora* becomes fully established. These treatments may help to reduce the rate of loss of existing marsh islands and increase the protective benefits to previous restoration efforts. Similar techniques

have been used in the restoration of Elders Point Marsh and in other locations. Incorporating the monitoring results of the Elders Point restoration project will provide important information to future efforts and restoration designs. Pilot projects would be required to monitor the effectiveness of this strategy prior to any large scale implementation.

Strategy Assessment Approach

The strategy assessment approach will require a review of the methods utilized for the Elders Point restoration, and the evaluation of their relative success based on monitoring results. An analysis of existing research in alternative wave attenuating /shoreline protection technologies used in other locations will also provide useful techniques that may be appropriate for use in Jamaica Bay. Those techniques that show the most promise will be further vetted by NYCDEP in developing a pilot project to test the recommended alternatives on an existing marsh island to assess their ability to attenuate salt marsh island loss and/or increase the capture of sufficient sediment for the natural colonization of *Spartina alterniflora.* To maximize the effectiveness of this pilot, the specific location chosen for the study will be coordinated with the NPS, USACE, NYSDEC and local environmental groups prior to start of the project. The identification of potential funding mechanisms and cost-sharing partners beyond the pilot study will be required to implement a broader protection program throughout Jamaica Bay.

If determined to be beneficial and feasible from the results of the pilot study, implementation strategies to broaden the scope of this approach will be explored.

Objective 2b: Protect wetlands through research, monitoring, and enforcement.

Issue

The current loss of salt marsh islands coupled with past bathymetric changes within the Bay, topographic alterations of the upland buffers, and the displacement of the perimeter wetland habitats has left Jamaica Bay with a delicate remnant of a once historically rich tidal wetland ecosystem complex. Future efforts to restore and protect these remaining wetland areas must be grounded in sound scientific principles and research that continue to evaluate the sources of impairment, as well as active monitoring of ongoing wetland restoration and enhancement efforts to improve the habitat restoration and enhancement approach. The continued, active enforcement of environmental regulations that protect wetland areas from direct and indirect harm is essential to this effort.

Current Programs

Numerous academic institutions and resource management agencies are actively engaged in determining the mechanisms and sources of salt marsh island disappearance within Jamaica Bay. The disappearance of intertidal marshes is not unique to Jamaica Bay; western and eastern portions of Long Island Sound and South Oyster Bay have also been experiencing unexplained wetland losses. In March 2004 the NPS convened a “Blue Ribbon Panel” of scientists and researchers that investigated potential reasons for salt marsh loss. The NPS Jamaica Bay Science Board continues to provide oversight and guides additional research efforts in this area. Based on these efforts, several areas of research were encouraged by the panel to be continued (and funded), including the further evaluation of relative sea level rise with respect to sediment accretion rates and marsh elevations using sediment elevation tables (SET), and the development of a comprehensive sediment budget for the Bay. The State University of New York at Stony

Brook has used short-lived radioisotopes to determine patterns of sediment deposition in marshes and subtidal sediments, and used computer models and physical oceanographic data to understand sediment transport in Jamaica Bay. They will also be monitoring the geological and chemical aspects of the restoration at Elders Point Marsh.

Monitoring efforts have been ongoing for the salt marsh restoration project at Big Egg Marsh, and monitoring will be initiated at the Elders Point Marsh upon completion of the restoration phase of the project. This monitoring information will be used to ensure that future restoration efforts in the Bay have the latest information to provide long-term effective environmental benefits to Jamaica Bay.

Federal, state, and to a lesser extent local agencies, have legal authority over the uses and activities that can occur in wetland areas. In addition, the NPS employs U.S. Park Police and park rangers who patrol the perimeter federal lands and perform boat patrols of the Jamaica Bay wetland areas, providing direct enforcement of existing NPS regulations.

Potential Management Strategy 2b1:

Develop funding mechanisms to promote continuing research on the causes and rate of salt marsh disappearance, implement field programs to continue wetlands monitoring, and continue enforcement efforts.

Additional, consistent sources of funding are required to maintain current monitoring efforts and the expansion of new research efforts on the potential causes of salt marsh loss in Jamaica Bay. The translation and dissemination of this information from the researchers to the field resource practitioners is dependent upon effective coordination between academic entities and applicable resource management agencies, and the development of funding sources. Likewise, the success of wetlands monitoring programs and the utility of that information for future restoration efforts is dependent upon synchronicity between multiple entities and funding opportunities.

Several federal, state, and local agencies have legal authority over the uses and activities that can occur in wetlands and adjacent upland areas. There may be opportunities to increase enforcement efforts to discourage further displacement and degradation of protected areas. Fines collected as a result of environmental penalties will be evaluated to determine the feasibility of redirecting additional funds into the Jamaica Bay Damages Account or other mechanism that would assist in the research and restoration of wetlands within Jamaica Bay.

Strategy Assessment Approach

The strategy assessment approach requires the continued review and identification of existing agency research and monitoring programs, as well as applicable academic programs that include wetlands monitoring. This will be summarized into an inventory of the scope, cost, and schedule for all existing research and monitoring programs. Data gaps will be identified to understand where future efforts should be focused. In consultation with NYSDEC, NPS, and USACE, the assessment approach will explore the potential for developing an outreach mechanism toward relevant colleges and universities, to evaluate their potential for incorporating ecosystem monitoring programs into their curriculum to assist in the expansion of existing efforts and to fill data gaps. Additionally, research funding mechanisms and grant opportunities for continued monitoring will be evaluated to facilitate successful agency/academic collaboration.

Objective 2c: Restore and create additional tidal wetlands along the peripheral and shoreline buffer areas of the Jamaica Bay estuary

Issue

In recent history, the natural evolution of tidal wetlands as they age and expand is to slowly migrate inland, into adjacent upland areas. Often, this migration of wetlands areas occurs in response to fluctuations in climate or sea level. However, development and infrastructure along the perimeter of the Bay has substantially restricted this process. Over the last 100 years, the tidal wetlands along the periphery of Jamaica Bay have been filled and converted to non-tidal uplands as New York City expanded to accommodate a growing population. In the past century, it is estimated that up to 75% of the pre-industrial tidal wetland complexes in the Bay have been lost. The remaining peripheral wetlands continue to sustain a wide diversity of plant and animal life, and provide essential physical and biological ecosystem functions. These areas buffer the open water and shallow water areas of the Bay from the more highly altered upland landscapes, providing wildlife habitat, and performing ecosystem services essential to many natural communities. In addition to these ecological benefits, the remaining tidal wetlands on the periphery of the estuary provide another important function: protecting urban infrastructure from storm surges.

Current Programs

Over the years, numerous reports have been developed with recommendations for the acquisition and restoration of wetland and upland buffer areas around the periphery of Jamaica Bay. They include: *Buffer the Bay* (Trust for Public Land & NYC Audubon, 1987), *Buffer the Bay Revisited* (Trust for Public Land & NYC Audubon, 1993), *JABERRT* (Frame *et al*., 2002), *Harbor Estuary Program Priority Acquisition and Restoration Sites* (NY/NJ HEP, revised 2006), *Jamaica Bay Study Area Report* (USACE, 2004), and the *New York State Open Space Conservation Plan* (NYSDEC, 2006) recommendations. A number of these recommendations have been implemented, including restoration projects at locations such as Four Sparrows Marsh, Idlewild Park, Spring Creek, Fresh Creek, and Big Egg Marsh and the acquisition of many of the *Buffer the Bay* recommended sites, including Vernam-Barbados Peninsula, Paerdegat Basin and Fresh Creek Basin.

At this time, the project status of the varied ecosystem restorations being considered under the Jamaica Bay Ecosystem Restoration Project, a cost-sharing agreement between the NYCDEP and USACE, is unclear. Congressional authorization for funding these restoration projects is required before they can proceed. If implemented, these restoration proposals would restore and/or create a suite of varied ecosystems in Jamaica Bay, including peripheral tidal wetlands complexes.

Potential Management Strategy 2c1:

Reduce the extent of invasive vegetation to create wetlands and/or upland buffers and develop a GIS layer displaying the extent of invasive vegetation within the watershed.

Due to past disturbances, including the degradation or removal of indigenous soils and replacement with anthropogenic soils, a number of exotic and invasive plant species have colonized wetlands and upland areas within Jamaica Bay. The dominant invasive plant species along the periphery of the Bay is the common reed (*Phragmites australis*), which now occupies large areas of wetland and upland buffer areas. *Phragmites* monocultures provide limited wildlife benefit and out-compete most native species, resulting in reduced biodiversity and the loss and

degradation of wildlife habitat function and value. The 2002 JABERRT Report includes a vegetation analysis at 12 study sites within the Jamaica Bay estuary, from the waters edge to several hundred meters inland. A draft vegetation analysis has also been prepared by the NPS that shows the limits and acreages of various plant community types along the perimeter of the Bay. In addition, NPS is developing a draft invasive species management plan that identifies target species and recommends control practices. Some restoration techniques such as those suggested in Strategy 2c3 provide for the eradication of invasive vegetation along shoreline areas (especially *Phragmites*) through the reintroduction of tidal influence where it has been restricted, providing for the twin goals of wetlands restoration and invasive species control.

Strategy Assessment Approach

The strategy assessment approach will collect information from previous studies, such as JABERRT and the NPS draft vegetation analysis to create a GIS database identifying all known invasive vegetation locations by species and approximate area. This will provide the proper planning tools to begin to address this issue in a coordinated manner. A related effort is the mapping of existing debris piles along the shoreline of the Bay for their removal. In coordination with the American Littoral Society, NYCDEP has started a GPS mapping effort of debris piles around the perimeter of the Bay. In addition to the aesthetic issues, these piles are partly responsible for the suppression of the natural restoration of areas. They also serve as a source for much of the debris that is reintroduced into the Bay by spring and storm tides. To expedite this process, NYCDEP has assisted in several beach cleanup events and plantings in 2006, and will continue these efforts in the future. The control of invasive vegetation is part of the larger strategy of restoring the various interdependent ecosystem components in Jamaica Bay.

Potential Management Strategy 2c2:

Review existing recommendations for the acquisition and restoration of tidal wetlands and upland buffer areas around the Bay's periphery and evaluate the potential for additional acquisition and restoration opportunities.

Several surveys of Jamaica Bay's open natural areas have previously identified sites where large wetlands and adjacent upland buffers may be restored and/or acquired. A review of these surveys has revealed that many of the recommendations from these reports were implemented, but there were some sites that were eventually developed into residential, commercial, industrial, or institutional land uses. As such, the present opportunities now may be limited to the smaller parcels and others that potentially hold opportunities for restoration, habitat improvements and/or stormwater management.

A survey and evaluation of the remaining sites will be undertaken to determine their potential for ecological conservation or restoration opportunities. Additional vacant or under-utilized sites that were not originally considered because of their size, or were already afforded protective status but are ecologically degraded will be evaluated for their restoration potential. These locations include but are not limited to; shoreline areas that currently have marginal habitat value due to historic land practices, have hardened shorelines, or contain extensive exotic plant species. There may be opportunities to regrade shoreline areas to allow greater tidal influence into more landward areas, converting degraded urban fill derived uplands to salt marsh and salt meadow habitat. This restoration technique allows the recreation of wetlands along the periphery of the Bay, and also naturally controls invasive *Phragmites* populations and other invasive plant species.

Strategy Assessment Approach

The strategy assessment approach will review the inventory of previous acquisition and restoration and sites within Jamaica Bay to evaluate the potential for additional site acquisition and restoration projects. Additional amendments to the dataset will be made based on information collected from groups such as the Wetland Task Force and others. A comprehensive mapping analysis that inventories previous recommended sites, assesses their current status, and identifies new opportunities will be used to determine current restoration and acquisition priorities. The restoration of tidal wetlands and buffers is part of the larger strategy of restoring the various interdependent ecosystem components in Jamaica Bay.

Potential Management Strategy 2c3:

Identify and restore areas of peripheral shallow water and mudflats.

To help protect vegetated wetlands and increase their ecological value, shallow water mudflats absorb wind and wave energy, support a large biomass of macroinvertebrates, and are highly productive areas. Mudflats provide habitat and forage for migratory waterbirds and waterfowl. Wading birds such as herons and egrets, and shorebirds such as terns and gulls frequently use these sites for feeding. During high tides, they provide shelter for juvenile fish. Historically, navigation charts displayed vast areas of mudflats throughout Jamaica Bay. However, dredging operations and other alterations have converted many of these areas into deep water channels. In addition, some mudflat habitats currently experience sediment pollutants and contain debris.

Strategy Assessment Approach

The strategy assessment approach will review mudflat areas that have developed as a result of the current marsh island loss. To the greatest extent possible, the pre-wetland loss mudflat delineation will be evaluated using GIS and information from NPS and NYSDEC. These data can then be cross-referenced with the inventory of existing restoration proposals and used to identify potential shallow water/mudflat restoration projects. As previously mentioned, the restoration of the shallow water/mudflat areas must be part of a larger strategy for restoring the various interdependent ecosystem communities within Jamaica Bay.

Objective 2d: Restore submerged aquatic vegetation (SAV) such as eel grass (*Zostera mariana*) in protected areas of the Bay.

Issue

SAV beds are highly valued habitats for a variety of fish and shellfish species. SAV beds also have water quality functions; they are capable of locally altering ambient water quality, increasing oxygen and pH during the daylight hours and maintaining clear water around the beds with low total suspended sediment and chlorophyll a. SAV, especially eel grass (*Zostera mariana*), were historically present over large areas in Jamaica Bay, but today coverage is limited due to a legacy of disease, dredging, and reduced light penetration from nutrient induced turbidity in Bay waters. The optimal growing requirements of eel grass lie within a very narrow range of environmental factors. Calm, non-turbid, and low nutrient waters are essential to the success of this species. Today, these requirements are not often found within Jamaica Bay, but there may be limited areas where the minimum threshold might be met and eel grass habitat restoration could be attempted. Eel grass restoration in Jamaica Bay will be challenging, requiring local water quality conditions to provide for adequate light penetration, and proper establishment in specific

bathymetric and substrate conditions. Although there has been little research conducted in this area of wetland restoration in Jamaica Bay, ongoing eel grass restoration pilot projects in the Chesapeake Bay may inform local eel grass restoration efforts.

Current Programs

Currently, there are no ongoing research or restoration projects attempting SAV reintroduction in Jamaica Bay. SAV restoration projects conducted in the Raritan Bay and Long Island Sound estuaries have had mixed results.

Potential Management Strategy 2d1:

Design and implement a monitoring plan to track water quality at candidate restoration sites to determine if SAV restoration is feasible and monitor levels of success.

The selection of candidate SAV restoration sites can occur through the identification of limiting factors for SAV survival in the Bay, and then targeting areas that may contain appropriate habitat conditions. High levels of turbidity will likely be the limiting factor for SAV restoration. As such, a review of existing water quality data at potential reintroduction sites will be necessary to establish a prioritization of which sites may be most appropriate. Any pilot project attempting to establish eel grass populations will also need to consider oyster bed pilot restoration projects. These two ecosystems are historically linked as the oysters help to filter the water and further improve water clarity around the SAV beds. It is important to note that broad-scale SAV restoration is a long term goal, contingent on water quality improvements and estuarine ecosystem restoration that will create the requisite ecological conditions for SAV establishment.

Strategy Assessment Approach

The strategy assessment approach involves the review of existing literature and GIS datasets to map historical SAV bed locations within Jamaica Bay. NYCDEP will develop a *Zostera mariana* pilot project for Jamaica Bay. In coordination with appropriate agencies and environmental groups, the SAV restoration site will be identified by integrating existing water quality and bathymetry data into the GIS dataset. Analysis of SAV restoration efforts undertaken in other locations and comparison to environmental conditions within the Jamaica Bay estuary will be used to determine appropriate restoration and monitoring protocols for the pilot project. The restoration of SAV beds is part of the larger strategy of restoring the various interdependent ecosystem components in Jamaica Bay.

If determined from the pilot study that additional areas of eel grass can be restored, implementation strategies for a broader application will be explored.

Objective 2e: Restore or create additional freshwater channels, ponds, and non-tidal wetlands around the periphery of Jamaica Bay and throughout the watershed.

Issue

In its pre-development condition, the Jamaica Bay watershed supported a large network of freshwater streams and wetlands that drained the upper watershed and routed water to the estuary. During the development of Brooklyn and Queens, those wetlands and stream channels were filled, drained, and piped, to make way for development and reduce the hazard of flooding in the urban areas. Of the once expansive complex of freshwater wetlands known to exist throughout New York City prior to late 1700s, only some 2,000 acres remain today, with only a small

percentage of those present in the Jamaica Bay watershed. Today, NYSDEC freshwater wetland maps include nine mapped freshwater wetlands within the Jamaica Bay watershed. While these small isolated freshwater wetlands are important, in most cases they are hydrologically and ecologically disconnected from the wider landscape. Freshwater channels, ponds, and wetlands provide habitats for myriad plant and animal species, and valuable ecological functions that include sediment transport and sequestration, processing of nutrients, and floodwater storage.

Current Programs

NYCDEP's "Bluebelt" stormwater management program that includes the enhancement and restoration of freshwater stream channels and wetlands on Staten Island is a regional model for freshwater habitat restoration. While the Jamaica Bay watershed is a different landscape from that of Staten Island, generally more urban in nature, certain stormwater elements may be applicable. The *Jamaica Bay Study Area Report* (USACE, 2004) identified one site for the creation or restoration of freshwater riparian wetlands, and *Buffer the Bay Revisited* (Trust for Public Land & NYC Audubon, 1993) report identified several sites where these habitat types could be restored. Creation of freshwater ponds was also recommended in the *Jamaica Bay Comprehensive Watershed Management Plan*, NYCDEP, 1994).

In the early 1950s, two large freshwater habitats were created on Rulers Bar Hassock. The 54-acre freshwater West Pond has been kept primarily as open water and the 120 acre slightly brackish East Pond is hydrologically controlled to expose mudflats for shorebird habitat and foraging. These two wetlands represent the largest freshwater to brackish systems within the watershed.

Potential Management Strategy 2e1:

Identify and compile all known freshwater habitat restoration plans. Where applicable, implement federal, state, and local agency projects along the periphery of Jamaica Bay and within the watershed.

An inventory of Jamaica Bay restoration projects currently being compiled by NYCDEP contains the current status and location of known freshwater habitat restoration plans in the Jamaica Bay watershed. The greatest opportunity for the restoration and recreation freshwater habitats is likely coupled with the propagation of off-site stormwater BMPs in parks, roadway areas, and other locations throughout the watershed (see Objective 1a). Many of the off-site stormwater BMPs being evaluated for implementation include bioretention and infiltration structures that support freshwater wetland habitat creation.

Strategy Assessment Approach

The strategy assessment approach will utilize the inventory of Jamaica Bay restoration projects currently being compiled by NYCDEP, as well as NYSDEC datasets, to identify the location and status of freshwater wetlands. Potential opportunities for the development of new freshwater wetlands areas associated with roadway redevelopment and other City projects will be identified; especially in conjunction with stormwater planning efforts (see Objective 1a). In collaboration with NYCDOT, NYCDPR and NPS, the design of stormwater BMPs that include freshwater wetlands habitat will be evaluated for the Belt Parkway Bridges reconstruction project. In addition, a review of existing vacant public parcels within the watershed will be undertaken to develop several pilot projects that utilize wetland detention basins to capture and attenuate urban stormwater runoff. This will provide water quality benefits as well as additional habitat areas for

an ecosystem that is under-represented within the Jamaica Bay watershed. The restoration of freshwater wetlands areas is part of the larger strategy of restoring the various interdependent ecosystem components in Jamaica Bay.

Objective 2f: Restore the headwater tributaries of the Bay.

Issue

The historical configuration of tributary basins in the Jamaica Bay watershed has been significantly altered and the numerous smaller freshwater surface streams of the watershed have been removed from the landscape. This complex network of ecosystems continues to control important ecological functions, including the regulation of freshwater input into the Bay, attenuating nutrients, and receiving sediment during precipitation events. The delivery of appropriate coarse-grained mineral sediments from upland areas required for the accretion of salt marshes in the Bay is controlled through these tributary basins.

The shallow water, mudflat, and wetlands complexes that comprise the tributary basins of Jamaica Bay serve as critical habitat for shorebirds, wading birds, waterbirds, fish, and shellfish species. However, changes in water quality (altered quantities and timing of freshwater input, nutrient-rich effluent from the WPCPs, CSO inputs, and impediments to circulation resulting in locally-increased nutrient concentrations), hardening of shorelines, dredging and filling, sediment pollutants, invasive vegetation, and other anthropogenic disturbances have impacted habitat integrity and reduced their function. Restoration of the headwater basins can be accomplished in concert with wetland and buffer restoration along the periphery of the estuary (Objective 2c).

Current Programs

Restoration efforts have been identified by the NY/NJ HEP (Priority Acquisitions and Restoration Sites), NYCDEP, NYCDPR, NYSDEC, NPS, USACE and others for Spring Creek, Fresh Creek, and Paerdegat Basin and other projects listed in the inventory of Jamaica Bay restoration projects currently being compiled by NYCDEP. In addition, several headwater basins in Jamaica Bay have been identified as NY/NJ HEP restoration or acquisition sites, including Conch Basin, Mott Basin, Bergen Basin, Hendrix Creek, Mill Basin, and Shellbank Basin.

Potential Management Strategy 2f1:

Identify degraded habitats in Thurston Basin for groups of wildlife species and improve these habitats by using appropriate headwater basin planning and restoration.

The headwaters of Jamaica Bay begin in Thurston Basin, the southeast section of the watershed, in an area known as Idlewild Park. The restoration of several ecosystem types (tidal and freshwater wetlands, coastal woodlands and grasslands) within Idlewild Park have already been initiated by NYCDEP and NYCDPR. NYCDEP and NYCDPR have been actively assisting a local environmental organization (Eastern Queens Alliance) in its desire to develop a Master Plan for Idlewild Park, by participating in community volunteer planting efforts and by designing and directing restoration efforts that enhance the ecological diversity and value of this area. The Eastern Queens Alliance has been actively engaged in securing funding and increasing awareness of the importance of Thurston Basin and Idlewild Park as an ecological and community resource for local schoolchildren and for local residents to learn about the environment. To date, the efforts of the Eastern Queens Alliance have been successful, and widely applauded by government agencies and members of the environmental community.

Strategy Assessment Approach

The strategy assessment approach will review existing information from USACE, NYSDEC, NYCDPR, and NYCDEP research, restoration, and management efforts. NYCDEP will assist in the review of grant applications and programs to increase restoration efforts within the park. GIS datasets will be used to map existing functional natural areas, including those recently restored, and to identify degraded habitats that are suitable for additional restoration. Coordination with the Eastern Queens Alliance and other appropriate agencies, and consistency with the Eastern Queens Alliance Master Plan for Idlewild Park will occur throughout this process. The restoration of headwater basin areas is part of the larger strategy of restoring the various interdependent ecosystem components.

Objective 2g: Restore and enhance existing indigenous grassland communities.

Issue

At the time of European settlement, there were large expanses of native prairie grasslands in the upper Jamaica Bay watershed and along the Bay's perimeter. Today, only small patches of native grassland habitats exist along the periphery of the Bay, mostly in Floyd Bennett Field and adjacent to the tributary basins. Grasslands are key habitats for numerous species of insects and birds that occur in Jamaica Bay, including upland sandpipers, grasshopper sparrows, meadowlarks, short-eared owls, northern harriers and the American kestrel. When situated next to woodland or shrubland communities, grasslands provide ecological "fringe" habitat areas that are utilized by rodents and larger mammals. Restored or enhanced native grassland landscapes are natural filters, generating less surface runoff and less nutrient loading to the Bay.

Current Programs

As part of the closure and remediation of the Pennsylvania and Fountain Avenue Landfills, coastal grasslands are being restored, providing some of the largest expanses of contiguous grassland habitat in the watershed. Approximately half of the total area occupied by the two landfill sites (about 200 acres) is reserved solely for coastal grassland habitat. In addition, the NYCDPR and New York City Housing Preservation and Development (NYCHPD) are restoring approximately 55 acres of grasslands on White Island, within Gerritsen Creek.

A previously restored Floyd Bennett Field grasslands site covers 140 acres. The site is located in the Gateway National Recreation Area and is managed by the NPS. It is the site of the former Grassland Research and Management Project (GRAMP), and is protected and actively managed for grassland breeding bird habitat by NPS and the NYC Audubon Society.

Potential Management Strategy 2g1:

Develop, implement, and monitor native grassland restoration or enhancement plans for selected areas in the Jamaica Bay watershed.

Opportunities for additional large-scale restoration of grassland habitat may be very limited within exist the upper Jamaica Bay watershed. However, some upland areas around the periphery of the Bay may afford opportunities to convert degraded areas to more productive and diverse grassland habitats.

Strategy Assessment Approach

The strategy assessment approach will review existing native grassland areas and develop a map to identify potential grassland restoration sites along the perimeter of the Bay and in the upper portions of the watershed. The restoration of grassland habitat areas is part of the larger strategy of restoring the various interdependent ecosystem components in Jamaica Bay.

Objective 2h: Restore or enhance dune and beach habitats.

Issue

Beaches and dunes are natural buffers against the forces of wave and wind erosion, and are dynamic landscape features that quickly change as a result of wind erosion and deposition. Large contiguous portions of the Jamaica Bay shoreline are covered in expanses of sandy beaches and dunes, especially on the northwestern and southwestern sides of the Rockaway Inlet (Breezy Point and Dead Horse Bay), where wave and tidal forces are strongest. These areas support several rare plant species including seabeach amaranth, seabeach knotweed, and Schweinitz's flatsedge. Beaches and dunes serve as vital foraging and breeding habitat for selected birds and aquatic organisms, many of which are listed rare, threatened, or endangered species, including piping plover, least terns, diamondback terrapin turtles, and horseshoe crabs. Beach and dune ecosystems, and the plant and animal species they support, are delicate and easily damaged by disturbance. The hardening of shorelines for urban infrastructure along the periphery of the Bay has impacted historic beach and dune habitats, and potentially limits restoration opportunities in these areas. Invasive plant species such as *Phragmites australis* have displaced much of the indigenous vegetation in large areas of sandy upland habitat along the shoreline.

Current Programs

Breezy Point is the most ecologically important beach and dune habitat area within Jamaica Bay, and is actively managed and monitored by NPS and the U.S. Fish and Wildlife Service (USFWS) to protect piping plover and colonial shorebird habitat. Plum Beach along the northwest shoreline of the Bay and portions of Far Rockaway also contain high quality beach and dune habitat complexes.

Potential Management Strategy 2h1:

Prepare a GIS map of existing and potential dune and beach habitats that could benefit from restoration, prioritize restoration sites, and develop habitat restoration or enhancement plans. Implement active monitoring of restored dune and beach habitats in along the Jamaica Bay shoreline.

These habitats are home to many rare, threatened, and endangered species that utilize the Bay during the summer season and during spring and fall migratory runs. These areas also provide important protection from storm surges and help to stabilize the shoreline with highly specific vegetation well adapted for dynamic environmental conditions. The enhancement and restoration of additional beach habitats will increase biodiversity and improve existing wildlife habitats. Restoration and enhancement opportunities will be assessed by reviewing previous studies and performing a GIS analysis of potential new beach and dune habitat areas.

Strategy Assessment Approach

The strategy assessment approach involves the compilation and review of current datasets, the mapping of existing dune and beach habitats, and assessment of potential dune and beach habitat

restoration areas. Sites that could benefit from the restoration or enhancement of dune and beach grasses will be identified and recommendations for the reintroduction of these vegetation communities will be developed if warranted based on the findings of the assessment.

Objective 2i: Support the recovery of federal and state-listed rare, threatened, and endangered (RTE) plant and animal species.

Issue

A number of species that occur in the Jamaica Bay watershed are listed by the federal or state government as rare, threatened, and endangered. The commonality between these RTE species is that habitat conditions necessary for their survival have been severely degraded, leading to a decline in species health and population. The success of RTE species requires effective management or restoration of the specific habitat conditions necessary for each species. As ecosystem restoration occurs throughout the watershed according to the efforts recommended in other Management Strategies, special attention should be made to identify RTE species in those areas, and to integrate the specific ecological requirements of those species into habitat restoration or enhancement plans. Some of these species will need to be "phased" into the landscape as the necessary habitat conditions for the long-term survivability of the species have not yet been established.

Current Programs

Federal, state and local agencies maintain databases of RTE plant and animal species. These databases are regularly updated as the status of a particular species changes. Those RTE species are granted special protections by federal or state regulations, including the requirement that any project that may impact the health of those species must be evaluated. In addition, once a species has been designated as RTE, it receives varying degrees of active habitat protection and management.

Potential Management Strategy 2i1:

Identify habitats of listed species and suggest projects that would support the recovery of animals and plants that are listed as RTE.

Using the existing federal and state species that are listed as endangered, threatened, rare or vulnerable by the federal or state government, an inventory of RTE plant and animal species known to have occurred within Jamaica Bay and its watershed will be developed. In addition, the habitats necessary for the survival and propagation of those species will be evaluated, identified, mapped, and assessed for their ability to provide the requisite ecological conditions. The integration of this information into ongoing and proposed restoration and enhancement plans will support the recovery of those RTE species, and may aid in the prioritization of future habitat restoration efforts.

Strategy Assessment Approach

The strategy assessment approach involves coordination with NPS and the USFWS to identify the habitats of listed RTE species. Cross-referencing this information with the inventory of Jamaica Bay restoration projects currently under development by NYCDEP will allow the evaluation of habitat areas that could potentially utilized for further enhancement or restoration with RTE species. This process could potentially be enhanced by utilizing existing grant opportunities that support RTE habitat recovery.

Objective 2j: Restore or create additional woodland and shrubland habitats.

Issue

The upper watershed of Jamaica Bay was once largely dominated by large, contiguous expanses of woodlands and shrublands. Much of this habitat has been lost to development; however, there are isolated fragments of these ecosystems still present around the Bay and in the upper watershed. Larger patches of woodland and shrubland habitats still exist in parks and along the fringe of the estuary. These areas support a diversity of plants and animals, and aid in the filtering and processing of nutrients and sediments that drain from the upper watershed. The restoration, protection, and creation of additional woodland and shrubland habitats would provide benefits for plant and animal species, and could be integrated with concepts associated with urban stormwater runoff management. Active monitoring is essential to the management of restored woodland and shrubland areas to maximize the ecological benefits of future restoration projects. Port Authority operations with respect to air travel and competing needs for other habitats must be factored into any prospective woodland and shrubland habitat restoration opportunities.

Current Programs

As part of the closure and remediation of the Pennsylvania and Fountain Avenue Landfills, coastal woodlands and shrublands are being restored, providing some of the largest expanses of contiguous woodland shrubland habitat in the watershed. Approximately half of the 400 acres of the two landfills sites are reserved for coastal woodland and shrubland habitat.

Potential Management Strategy 2j1:

Prepare a GIS map of existing and /or potential locations that could benefit from woodland and shrubland restoration, prioritize restoration sites, and develop woodland and shrubland restoration or enhancement plans. Implement active monitoring of restored woodland and shrubland habitats in the Jamaica Bay watershed.

An inventory and assessment of woodlands and shrublands in the watershed must be performed to understand the current extent and condition of these habitats. Woodland and shrubland restoration around the perimeter of the Bay should be coordinated as part of the larger Jamaica Bay acquisition and restoration efforts described in previous Objectives, but it is essential that woodland habitat be included as part of the restored upland buffer habitat mosaic. Active monitoring and management of these areas is necessary to determine the success of restored areas, and prevent infestation by invasive species.

Strategy Assessment Approach

The strategy assessment approach involves the review of existing studies and reports, the mapping of existing woodland and shrubland habitats in a GIS datasets, and the identification of potential new woodland and shrub habitat restoration sites. An assessment of various native plant species unique to these areas will be developed and strategies for their re-introduction will be evaluated.

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CHAPTER 5 – CATEGORY 3, PUBLIC USE AND ENJOYMENT: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES

Jamaica Bay is the largest natural area in New York City, and presents some of the best opportunities for wildlife viewing, recreation, and outdoor education within the City limits, a natural respite within an extensively urban environment. The area is a valuable resource for New York City residents, including 12,000 acres of bayside and island landscapes within the public, long-term protection of the NPS GNRA. The Bay is internationally renowned for its avian and fisheries habitats, and is a haven for fisherman, birders and naturalists of all manner and levels of sophistication. To many visitors, the intact beauty and wildness of the landscape is surprising, considering the juxtaposition to such a highly urbanized environment. One of the primary goals of the *Jamaica Bay Watershed Protection Plan*, and central to its stated vision, is the provision of public access, recreation, and enjoyment opportunities within Jamaica Bay's diverse natural, cultural, and scenic resources. This must occur in ways that are environmentally sustainable, and do not harm sensitive habitat areas.

Currently, public access to the Bay is limited, largely as a result of barriers that have been constructed along or adjacent to the shoreline of the Bay. The pressures of urban expansion and population growth in Brooklyn and Queens, including the Rockaways, have led to residential, commercial, industrial, and transportation infrastructure running along the along the perimeter of the Jamaica Bay estuary. The Belt Parkway is one such obstacle that acts as a 20 mile divide between the Bay and its adjacent landscapes, particularly for residents on the north side who cannot easily cross the Parkway to access the Bay. Large properties located directly on the Bay that are privately owned or not designated for public uses also act as a barrier to public access. For example, JFK Airport in southeastern Queens prohibits public access due to strict security concerns associated with the airport. Finally, much of the Bay's shoreline has been hardened or bulkheaded for development, limiting direct public access to the waters of the Bay.

Limited access to Jamaica Bay and its shoreline does not allow the Bay's potential as a recreational resource to be fulfilled. Private boating access can be achieved at one of the many marinas located around the perimeter of the Bay (including Dead Horse Bay, Sheepshead Bay, Shellbank Creek, Mill Basin, East Mill Basin, Paerdegat Basin, Shellbank Basin, Motts Basin, Little Bay, Broad Channel, and several others along Rockaway). Public boating access is very limited and, currently, only a few public boat launches exist within the Bay. In addition, public access to recreational activities such as fishing, hiking, biking, picnicking, bird watching, photography, etc. is currently restricted to areas designated as New York City or State Parks (see Volume 1, Chapter 5) or areas within the GNRA (parts of Floyd Bennett Field, Breezy Point, Canarsie Pier, Dead Horse Bay, Fort Tilden, and Jacob Riis Park).

The implementation of potential management strategies included in other categories of this *Jamaica Bay Watershed Protection Plan*, particularly Category 1: *Water Quality* (see Volume 2, Chapter 3) and Category 2: *Restoration Ecology* (see Volume 2, Chapter 4), would have ancillary benefits for the public use and enjoyment of landscapes in the Jamaica Bay watershed by improving water quality and ecosystem health in these areas. The impacts of development on the Bay's water quality conditions and ecosystem health has affected the value and utility of environmental resources for human populations in Jamaica Bay watershed. Shell fisheries were

closed to the public in 1921 as the result of elevated pathogen concentrations in the shellfish harvested from the Bay and have never reopened. Fishing is limited by the closure of the shell fisheries and the consumption of fish and shellfish continues to be restricted due also to the presence of toxic metals in certain finfish populations. Swimming is limited by elevated levels of pathogens in the tributary basins, as well as lack of water clarity due to extensive eutrophication throughout the estuary. Neighboring residents and businesses often report bad odors at the head of tributary basins that receive sediments and waters from CSOs as well as the presence of floatable debris and litter along the shorelines, in wetlands, and along the upland buffers.

There are opportunities to enhance the public use and enjoyment of these natural resources, within a coordinated plan that promotes ecological regeneration, and in ways that facilitate greater understandings of ecological processes, inspire environmental stewardship, and provide enjoyment to residents and visitors alike. Currently, most public access and recreational facilities in the watershed are concentrated around the western half of the estuary, with few connections to the upper and southeastern portions of the watershed. This could be attributed to the fact that most of the natural areas in the upper watershed have been converted to cityscape. Dense urban development has resulted in the fragmentation of the landscape and its ecological functions. The upland and waterside landscapes of the Jamaica Bay watershed are severed. By re-forming connections between the upper watershed and the estuary, both ecologically and recreationally, essential links can be re-established. Consequently, enhancing public access to natural landscapes in the upper portions of the watershed is also important.

A fully restored collection of landscapes is of limited consequence if its does not enhance the daily lives of the citizens sharing the environment. The *Jamaica Bay Watershed Protection Plan* recognizes that one of the best ways to secure public investiture is to viscerally engage them in the aesthetic experience of landscapes. Through their personal participation in them, citizens are not only more receptive to educational lessons but also - and much more importantly - find their own reasons to care about the landscape, advocate for the preservation of the Bay, and become connected to the watershed.

Objective 3a: Increase public access to Jamaica Bay.

Issue

It is estimated that the GNRA Jamaica Bay Unit hosts between 3 and 4 million visitors per year (by comparison, New York City's Central Park typically hosts about 25 million visitors annually). Visitors typically engage in hiking, biking, bird watching, picnicking, sightseeing, photography, and fishing. Boating on the Bay is also popular, although at times the use of personal watercraft on the Bay has been restricted due to health and environmental impact concerns. There are over 50 private marinas situated around the Bay providing boat slips and launch ramps. However, there are only a few free, public access locations - Beach Channel, NYCDPR's Paerdegat Basin Park, and GNRA's Floyd Bennett Field - to launch non-motorized boats directly in the Bay. Public access to the Bay occurs at several programmed areas in the GNRA including Jacob Riis Park, Carnasie Pier, Fort Tilden Beach, Plum Beach and Jamaica Bay Wildlife Refuge, and informal footpaths along the perimeter. The access provided by the above sites is easily reachable by residents in the western and southern neighborhoods of the watershed such as Mill Basin, Mill Island, Marine Park, Bergen Beach, Canarsie, Sheepshead Bay, Neponsit, Belle Harbor, Seaside, Breezy Point, and the Rockaways. There are other areas along the shoreline, comprising approximately half of the Bay, where public access is restricted

due to property ownership, the presence of hazards, and lack of amenities including parking and trails. Southeastern Queens, in particular, has been identified as an area with limited public access. Despite the popularity of GNRA, public access to the shoreline areas and open waters of the Bay could be greatly enhanced.

Current Programs

A *New York City Comprehensive Waterfront Plan* (1993) and the *New Waterfront Revitalization Program* (1992) developed by the NYCDCP provide specific goals to increase the amount of public access to New York City's waterfront areas. The existing *New York City Bicycle and Greenway Plan* (1993) developed by NYCDCP and NYCDOT is responsible for the 350-mile greenway system currently being constructed throughout New York City. This plan articulates a lengthy, spatially extensive greenway through bayside lands (on the northern and western edge of the Bay) with plans for future segments to create a continuous loop around the Bay from Plumb Beach, northwest to Spring Creek Park, south through Cross Bay to Rockaway Park (this portion is an on-street trail), west to Jacob Riis Park, and returning north through Floyd Bennett Field.

GNRA has been studying various alternatives that would enhance access on NPS properties, although the majority of considerations focus on vehicular access. When the Pennsylvania Avenue and Fountain Avenue landfill restoration projects are completed, NYCDEP will cede these areas totaling approximately 400 acres to NPS for maintenance as passive recreational areas. NYCDEP is also in the process of designing the Ecology Park, a 6-acre park that will showcase many of the ecosystems present within New York City and will enable a close-up view of these communities along Paerdegat Basin.

The Waterfront Park Coalition, an alliance of over 35 diverse non-profit organizations, proposed a number of projects that would revitalize and improve access to NYC's waterfront in *New York Waterfront Blueprint* (2002). The proposed projects included for the Jamaica Bay waterfront are currently in various stages of development with funding commitments from a variety of governmental agencies including NPS, NYSDEC, DSNY, and NYCDOT and NYCDPR. Several community groups have taken steps to address the lack of public access to the Bay in southeastern Queens. The Southern Queens Parks Association (SQPA) completed a study on the lack of legal access in southeastern Queens; the study was used to request state funding to implement its findings. The Eastern Queens Alliance has designed a boat launch for the edge of Idlewild Park with NYCDPR and secured grant funding for its construction following NYSDEC approval.

Potential Management Strategy 3a1:

Provide access and connections to the waterfront for neighborhoods most in need, based on consideration of current lack of access, population density, and physical barriers.

Many residents who live in close proximity to the Bay do not use it as a resource because of the barriers to access and physical disconnection from the Bay. The Belt Parkway, JFK Airport, and other infrastructure girdles the Bay, disconnecting the shoreline area from the adjacent neighborhoods particularly in southeastern Queens. The lack of natural area connections from the estuary to the upper watershed, typically provided by tributaries and riparian corridors in other watersheds but lacking in the Jamaica Bay watershed because the tributaries are piped, leads to a lack of awareness that there is an amazing natural landscape in close proximity. Providing physical access points to more areas along the shoreline of the Bay and creating recreational and

aesthetic connections between the estuary and the upper watershed would enable more residents to use and enjoy this resource.

Strategy Assessment Approach

The strategy assessment approach involves mapping existing recreational amenities and public access points to Jamaica Bay. The assessment of this strategy will account for the current programs discussed above to ensure information about proposed or planned access points is integrated. Since many of the areas with limited access are known (primarily southeastern Queens), the existing barriers for providing access in these areas will be identified. Any new potential access points, connections, and infrastructure requirements will be assessed and discussed with stakeholders and other agencies.

If determined to be beneficial and feasible to extend access and connections to the waterfront, implementation strategies and potential funding opportunities will be discussed and developed with the appropriate agencies and community groups.

Potential Management Strategy 3a2:

Improve publicly accessible waterfront by adding public amenities, facilities and programs, including but not limited to walkways, boat launches, biking paths, fishing access points, etc. Increase the public awareness of these amenities, facilities and programs.

In conjunction with Management Strategy 3a1 above, which calls for securing more access to the Bay, it is also necessary to provide additional public amenities and improvement of current facilities that allow recreation and enjoyment by the public, while also protecting natural areas from disturbance. Additional walkways, biking paths, and trails would allow formal access into areas that are deemed to be appropriate for recreational uses, and programs that provide for education and interpretive experiences could maximize public use and understanding of natural landscapes. Monitoring and maintenance of these areas is also essential to make sure they are safe, clean, and being used appropriately. Finally, the publicizing of these additional amenities will ensure that residents are aware of the existence and location of recreational facilities in Jamaica Bay.

Strategy Assessment Approach

Building on the findings from the Management Strategy 3a1 assessment, the strategy assessment approach involves identifying areas for new amenities based on current and planned access points, and identifying potential programs particularly for locations where access remains limited. New or improved amenities could involve pathways, trails, interpretive exhibits, boat launches, sitting areas, etc. A brochure showing the current and potential future amenities and programs along the Bay could be developed through a multiple agency partnership and distributed to the public.

If determined to be beneficial and feasible to develop new public amenities along the waterfront, implementation strategies and potential funding opportunities will be discussed and developed with the appropriate governmental and non-governmental entities.

Objective 3b: Increase public access to a wider range of landscape types in the upper watershed in order to expand the public's understanding of the interconnectivity of the entire Jamaica Bay watershed

Issue

In the upper portion of the watershed, there are a series of public landscapes with various uses such as community gardens and City parks. They are dispersed throughout the watershed and are a great asset to the neighborhoods and boroughs of the area. Yet, there is limited availability of public landscapes that would be considered "natural," that is, those that are less formalized and are replete with the ecological functions of landscapes not filled with the evidence of human modification. The result is a bifurcated perception of the watershed as 1) the "Bayside 'Natural' Landscape" and 2) the urban landscape that comprises all the rest of the watershed. The goals of water quality improvement and ecological restoration are advanced by the public's understanding of the interrelationship between the upper watershed and waters of Jamaica Bay. Consequently, this Objective proposes measures to increase the diversity of natural landscapes throughout the watershed, help repair ecological fragmentation within the watershed, and expand citizens' understandings of the importance of the watershed concept for Jamaica Bay's restoration.

Current Programs

In addition to proposed greenway along the Bay, the current NYCDOT and NYCDCP *New York City Bicycle and Greenway Plan* includes some smaller, isolated greenway segments throughout the upper watershed. The Plan also articulates a series of on-street bike trails that connect discrete public landscapes with one another, connect discrete public landscapes and greenways, and connect greenways with one another. While funding continues to be identified and allocated toward greenway development, NYCDOT, NYCDPR, and NYCDCP are currently undertaking project planning and development to identify gaps in the current New York City greenway network, and ensure the integration of the thriving perimeter greenways into the City's urban street network, including arterials, retail corridors, transit-oriented development corridors. Such improvements may include signage and markings for delineating greenway use, sidewalk installation, path paving, greenway extensions, intermodal bike facilities, traditional and innovative pedestrian and bicycle facilities, streetscape improvements, and weekly street openings throughout the city. Among possible areas for construction of better access facilities and missing segments or connectors of the greenway are the Rockaway Gateway Greenway serving southern Brooklyn and southern Queens (including Flatlands, Gerritsen Beach, Marine Park, Arverne, Broad Channel, Seaside, and Howard Beach). Many of these communities have lower income populations and are currently underserved in public transit.

Potential Management Strategy 3b1:

Build upon the existing *New York City Bicycle and Greenways Plan* to establish landscape connectivity within the watershed

A greenway is an off-street or designated path within a park(s). This management strategy seeks to leverage existing greenways, bikeways, and plans in ways that enhance public access to restored and regenerated natural landscapes and habitats that contribute to the health of Jamaica Bay and a sustainable watershed. In essence, the strategy proposes the use of greenways as connective tissue linking fragmented landscapes within the watershed and connecting upland with bayside landscapes.

Strategy Assessment Approach

The strategy assessment approach involves a review of NYCDOT and NYCDCP's *New York City Bicycle and Greenways Plan*, the "Greenway Connectors and Access" project, and the mapping

of existing and planned greenways, open space, and public amenities in the upper Jamaica Bay watershed. Based upon the above information, potential new greenway corridors, cross-connections, and infrastructure requirements could be developed or the gap between proposed and funded projects identified. New amenities for existing and proposed greenways could also be considered. A brochure with this information could be developed in partnership with other agencies for the community.

If determined to be beneficial and feasible to develop new greenway connections between the upper and lower watershed upon consideration of the current programs and existing barriers, implementation strategies will be discussed and developed with the appropriate agencies as well as existing funding needs to implement currently proposed projects. Diverse funding opportunities will be explored for new, if any, and currently proposed projects.

Potential Management Strategy 3b2:

Brand the Jamaica Bay Watershed as a recognizable concept along with a process for disseminating related messages.

Raising public awareness of sometimes intangible concepts like water quality, the effects of citizens' and businesses' behaviors within a watershed, and even conveying the idea of a watershed is an extremely difficult task. The abstract nature of these concepts and relationships to complex biophysical processes is challenging for scientists, let alone citizens or laypeople - however concerned they might be. One of the most effective ways to improve public awareness and structure public understanding is to "brand" the Jamaica Bay Watershed as an "imageable" concept and create a tangible construct for citizens and public officials. The success of branding efforts surrounding locales as varied as Curitiba, Brazil, the "Ecological City," and the Chesapeake Bay Foundation's "Save the Bay" campaign demonstrate how effective making a watershed "imageable" can be. These regions have had simple, palatable messages, compelling graphics, media materials, and a supportive public education campaign that have fostered long term public environmental sustainability efforts, involving a spectrum of stakeholders from business owners to residents and government officials to school children. Jamaica Bay could greatly benefit from a similar branding campaign. Branding nomenclature, slogan(s), and graphics could identify landscapes and projects, denote initiatives, and adorn various marketing materials associated with Jamaica Bay watershed events.

Strategy Assessment Approach

The strategy assessment approach begins with a review of environmentally focused branding programs from other regions and the determination of applicability to the Jamaica Bay watershed. Next, the development of a community website, slogan, logo prototype, and other promotional materials to "brand" and publicize information about the Jamaica Bay watershed will be evaluated. Finally, NYCDEP will coordinate with multiple agencies including NYCDOT and NYCDPR to discuss roadway signs, signage requirements and sign installation. Signs could include the Jamaica Bay watershed brand as well as additional interpretive information to convey the interconnections between different parts of the watershed. These signs would be located along roadways that intersect the watershed boundary, within parks, schools, and other natural landscapes throughout the watershed.

If determined to be beneficial and feasible to develop a branding program, implementation strategies and funding opportunities will be explored. Implementation strategies will be focused

on the design of a brand for Jamaica Bay, identifying appropriate locations for sign installation through interagency discussions and funding to cover design, installation and maintenance costs for signs, and identifying funding opportunities for the development of other mediums for disseminating Jamaica Bay-related messages.

CHAPTER 6 – CATEGORY 4, SOUND LAND USE AND DEVELOPMENT: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES

The vision of the *Jamaica Bay Watershed Protection Plan* describes the future watershed as an urban environment that harbors healthy estuarine and land-based habitats in which "*New Yorkers and visitors co-exist with natural areas and clean water*." The attainment of this vision is dependent upon the human uses and management of land within the watershed, which has a direct impact on the water quality of the Bay and the natural resources in and around the Bay. Sound, environmentally-sensitive land use initiatives, ranging from the modification of an individual's landscaping practices to comprehensive planning and management measures, will enable human populations in the Jamaica Bay watershed to live in a more environmentally sustainable manner, and can offset the added stressors of future population growth on the ecological integrity of the Bay.

The transport of pollutants from developed land to water starts with an increase in volume and rate of stormwater runoff from the watershed's impervious areas, which enters the combined sewer system and triggers CSO overflow events. Land use and development decisions made with minimal consideration of the direct and indirect impacts on natural resources have been an influential factor in the degradation of the Jamaica Bay ecosystem. Over time, we have become increasingly aware of our profound influence on natural systems. As this awareness has increased, New York City has responded by implementing policies and programs to mitigate negative land uses and development activities.

The passage of LL 71 requires NYCDEP to create a *Jamaica Bay Watershed Protection Plan* to address the long-term ecological sustainability of the Jamaica Bay watershed. Specifically, the law requires NYCDEP to assess the feasibility of a variety of land use and development practices including, but not limited to, stormwater best management practices, the minimization of impervious surfaces and creation of natural systems to control and minimize stormwater runoff; incentives for environmentally beneficial development, and disincentives, such as stricter development guidelines, for development that may adversely impact Jamaica Bay. This watershed planning process and the required information to develop the *Final Jamaica Bay Watershed Protection Plan* is being linked to other current NYCDEP efforts to improve water quality with the CJBWQP, reduce CSOs city-wide through the LTCP development process, and reduce water supply consumption and wastewater flows through a series of water conservation initiatives.

Other recent "green initiatives" include passage of Local Law 86 which requires all new public construction to be designed and constructed to comply with green building standards to achieve a Leadership in Energy and Environmental Design (LEED) silver or higher rating infrastructure and, in many cases, to use energy and water more efficiently than current codes mandate; LEED is a program of the U.S. Green Building Council. Sustainability concepts have been incorporated into the policies and projects of different city agencies through the formation of specific offices such as the Office of Sustainable Design (OSD), a branch of NYCDDC, which has established green-building principles for New York City. Two documents released by OSD, the *High Performance Building Guidelines*, and *High Performance Infrastructure Guidelines*, introduce sustainable design guidance for New York City buildings.

Finally, the Mayor's Office of Long Term Planning and Sustainability, formed in June 2006 by Local Law 86, is charged with preparing a plan to meet the challenges faced by the City and its one million new residents over the next three decades. *PLANYC 2030* includes ten goals as drivers in the development of citywide sustainability initiatives; one of these goals is to open 90% of the City's waterbodies for recreation. In order to achieve this goal, the Mayor's Office is specifically considering strategies for implementing a comprehensive stormwater BMP approach using information generated as part NYCDEP's watershed protection planning process for Jamaica Bay and long-term control planning for CSOs city-wide. NYCDEP has been working with the Mayor's Office to develop BMP pilot projects, incentives and an interagency task force for BMP implementation.

Many of the potential management strategies in this chapter focus on BMPs to enhance the use of stormwater management techniques for new and existing development. The strategies included explore a variety of alternatives to encourage or require a greater degree of stormwater capture on the individual lots that comprise the watershed. This *Draft Jamaica Bay Watershed Protection Plan* addresses two different types of stormwater management: "off-site" control, which typically involves capturing runoff from multiple parcels (usually at a neighborhood or community scale) and routing it to a storage facility such as a stormwater pond, underground detention tank, or other structure; and "on-site" source control, a distributed system which attempts to attenuate, infiltrate, and capture runoff at the source (such as a residential lot). Both on-site and off-site stormwater management effectively reduce stormwater volumes and runoff entering the storm drain and combined sewer system, thereby reducing the pollutant load and the volume of water that discharges directly to Jamaica Bay through CSOs or the WPCPs during a rainfall event. This Chapter, *Sound Land Use and Development*, addresses "on-site" stormwater controls at a development parcel, while "off-site" stormwater controls and BMPs are discussed in Chapter 3, *Water Quality* under this category's first objective.

The Objectives and Potential Management Strategies listed in *Category 4: Sound Land Use and Development* identify measures and programs that would change the way people develop and use watershed land with the goal of restoring and preserving Jamaica Bay's unique ecological resources. To be successful, these strategies will require widespread participation from watershed residents and businesses. They will require people to change old habits. They will require coordination between multiple New York City regulatory agencies, as well as the engagement of those who directly effect land use and whose actions are inextricable from environmental effects—the citizens who live within the watershed.

Land governance programs and initiatives are often undertaken within singular agencies and within discrete budgets, diminishing the opportunity for coordinating efforts and leveraging funding. To provide more effective results, there needs to be greater coordination of programs. When the relationships between human actions and ecosystem effects are addressed in a holistic and coordinated way will we begin to reverse the current trend of environmental degradation.

Objective 4a: Minimize the extent of impervious surfaces within existing and new development in the watershed.

Issue

The amount of impervious cover within a watershed has a direct impact on hydrologic processes, which in turn affects the function of many upland, riparian, and aquatic ecosystems. Impervious surfaces prevent the infiltration of water into the ground and aquifers, thereby increasing the amount and rate of stormwater runoff generated by land in the watershed.

An Impervious Cover Model developed by the *Center for Watershed Protection* shows a direct correlation between impervious area and aquatic habitat condition (CWP, 1999). Impervious cover influences urban streams by increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its pre-development rate, with proportional reductions in ground water recharge (Schueler, 1994). Streams within watersheds that have impervious cover exceeding 25% show clear signs of degradation, including erosion, biodiversity decline, excessive sedimentation, fish and insect species eradication, eutrophication, and poor water quality.

Despite its predominantly low density residential character, the Jamaica Bay watershed's impervious cover approaches 65%. The high percentage of imperviousness in the watershed directly contributes to larger volumes and higher rates of stormwater runoff entering the sewer system and, as a result, increases the quantity and magnitude of CSO events which contribute to degraded water quality and impaired ecosystem health in the tributary basins and greater Jamaica Bay estuary.

Current Programs

Although New York City has a number of green design guidelines, there are no regulations that specifically control impervious surfaces associated with development of a parcel.

Potential Management Strategy 4a1:

Adopt a requirement in the zoning code to maintain a percentage of lots as pervious surface for new residential, commercial, and manufacturing development. Consider implementation of a maximum impervious surface requirement for new development, and/or an amendment of open space requirements that requires a percentage of open space to remain pervious.

The New York City Zoning Resolution currently provides density, bulk, and setback requirements for development within each zoning district which contain maximum building and other structures per lot. Although not all of the area of a parcel is accounted for by structures, driveways, and other impervious surfaces, there is no impervious surfaces requirement that restricts paving the entire lot, including front and back yards.

Analysis of land use reveals that lots within all commercial and manufacturing zoning districts and most residential zoning districts are most commonly developed up to 100% impervious area. Revising the Zoning Code to require that new development retain an amount of each lot as pervious surface would begin to change the surfaces of New York City, thereby reducing the environmental impacts of stormwater runoff. For zoning districts that include an open space requirement, a certain amount of "open space" on lots could be required to remain pervious. Such a requirement would have aesthetic benefits in addition to reductions in stormwater runoff.

Strategy Assessment Approach

The strategy assessment approach entails a review of NYC's zoning districts and related requirements such as maximum lot coverage, floor area ratio (FAR), open space ratio, driveways and parking areas to calculate the percentage of remaining lot area that could potentially remain pervious for each zoning district. Based on impervious surfaces data being developed for this project, an assessment will be made of typical impervious cover for existing developments in the watershed to gain a better understanding of current practices. Using growth estimates for new development in the watershed, the benefits of an impervious surface requirement for reducing stormwater runoff volumes will be modeled. An assessment will be made to determine if such a requirement would be feasible, given site constraints in a densely populated urban area. In assessing this potential management strategy, NYCDEP will closely coordinate with the NYCDCP, NYCDOB, and other city agencies, and a recommendation will be made in the *Final Jamaica Bay Watershed Protection Plan.*

If determined to be beneficial and feasible to maintain a specific percentage of lots as pervious, implementation strategies will be explored. Policies or code changes for new development could include a maximum impervious surface requirement for new development, an amendment of open space requirements that requires a percentage of open space to remain pervious, a restriction on paving over residential lawns, and/or requirement for alternative parking structures. Utilizing mechanisms available through contextual zoning amendments or overlay districts in environmentally sensitive areas will also be explored with NYCDCP.

Potential Management Strategy 4a2:

Restrict the creation of new impervious surfaces within existing development.

Restricting the creation of additional impervious surfaces on already developed residential, commercial, and industrial lots would preserve areas that are currently providing some measure of stormwater runoff infiltration or attenuation. A recent trend has been observed in some of the City's low density residential neighborhoods whereby property owners are paving over the remaining green space on their properties either to avoid landscaping and maintenance of green space, to provide extra parking on the property, or for aesthetic purposes. As discussed above, this is allowable under the NYC Zoning Resolution.

Strategy Assessment Approach

See approach for 4a1 above.

Potential Management Strategy 4a3:

Reduce the imperviousness of commercial and residential driveways and on-site parking areas through techniques such as the use of permeable and porous pavement for certain driveways, sidewalks, walkways and overflow parking lots; reducing parking ratios, promoting shared driveways, and encouraging other practices.

Driveways, sidewalks, walkways, and overflow parking lots occupy large amounts of land area in the Jamaica Bay watershed. On a typical low-density residential lot, these structures often comprise 20-30% of the land surface. In higher density residential and commercial lots, they can take up a significantly higher amount of land area. Retrofitting or promoting the use of new pervious pavement and pervious concrete technologies can serve to reduce the amount of stormwater runoff generated by these areas through infiltration and attenuation. Other land use

planning practices such as reducing the required width of parking spaces, promoting the shared use of driveways, and encouraging the use of car-stacking technologies already common in parts of Manhattan can minimize the amount of stormwater runoff associated with these surfaces.

Strategy Assessment Approach

The strategy assessment approach involves reviewing building codes specifications and identifying those related to paving materials, and evaluating alternative specifications for permeable and porous pavement materials based on existing literature and scientific knowledge. In addition, the Zoning Resolution will be reviewed to identify specific requirements for parking. In assessing this potential management strategy, NYCDEP will coordinate with the New York City Department of Buildings (NYCDOB), NYCDCP, and other city agencies.

If determined to be beneficial and feasible, implementation strategies will be explored. Policies or code changes could include changes in specifications for paving materials for driveways and parking lots or changes in parking area requirements.

NYCDEP has been working with NYCDCP on the proposed City Parking Lot Design Standards to build in stormwater capture and infiltration techniques where parking lot landscaping is to be required. These stormwater management techniques would help to defer and detain the large amounts of stormwater runoff generated by the impervious coverage on the City's parking lots. The results of this effort will be presented in the *Final Jamaica Bay Watershed Protection Plan*.

Objective 4b: Enhance the use of on-site stormwater management techniques and best management practices in new and existing development.

Issue

Treating stormwater on-site involves the integration of detention measures or BMPs onto a discrete parcel. Typical detention measures include detention tanks to detain certain storm intensities. BMPs include a wide range of low impact development techniques, which can vary with land use as shown in Table 4.1 Many of these techniques infiltrate stormwater into the soils rather than the sewer system.

Table 4.1 *Examples of stormwater BMPs.*

Residential – Low Density	
Building Practices - Exterior	**Landscape Practices**
Rain Barrels/Cisterns	Bioinfiltration Practices
Rain Planters	Porous Paving
Drywells	Dry Wells
	Parking Detention
	Trees
Residential – Medium to High Density	
Building Practices - Exterior	**Landscape Practices**
Rain Barrels/Cisterns	Bioinfiltration Practices
Green Roofs	Porous Paving
Rooftop Detention	Parking Detention
Rain Planters	Dry Wells
	Trees
Commercial/Industrial	
Building Practices - Exterior	**Landscape Practices**

Green Roofs	Bioinfiltration practices
Rooftop detention	Porous Paving
Rain Planters	Sand/Peat Filters
	Parking Lots Trees
	Subsurface Detention

The property owner is responsible for the construction and maintenance of stormwater management measures and controls. In dense urban environments, on-site control is appealing because land availability for off-site BMPs can be scarce, and control of stormwater runoff at the parcel level can lead to reduced public costs for larger, more expensive stormwater management facilities.

Through the sewer permitting process, NYCDEP requires on-site detention storage under certain conditions (see Current Programs below). However, the use of low impact development techniques (BMPs) is not typically encouraged. One issue is that many BMPs require substantial maintenance to ensure their effectiveness over time. However, BMPs can provide considerable stormwater management over a wide range of rainfall conditions and may be more cost effective in some situations.

Current Programs

The City's combined sewer system was designed with drainage criteria corresponding to specific rainstorm events such as 3-year or 5-year storms. The NYCDEP presents drainage criteria to capture a 5-year storm event.

Stormwater control for new developments is regulated by NYCDEP. A developer is required to have his engineer or architect submit a site connection application and hydraulic computations that identify the amount of stormwater runoff generated by the developed site, as well as the allowable established drainage plan criteria in accordance with which the sewer was built. The difference between the developed site-generated storm water and the allowable storm water discharge to the existing sewer has to be detained by a detention system within the development and approved by the NYCDEP. The detention system will release a controlled storm discharge to the fronting storm or combined sewer that equals the allowable flow corresponding to that sewer.

This current system does not capture the City's average or more typical rainfall events which also trigger CSOs. It also does not typically provide for technologies that infiltrate stormwater into the ground. The strategies below explore different alternatives for encouraging and requiring a greater degree of stormwater capture and infiltration on individual lots and other cost-effective strategies to reduce CSOs.

Currently, both NYCDEP and the Mayor's Office of Long-term Planning and Sustainability are evaluating the use of on-site stormwater BMPs to achieve greater on-site runoff detention throughout New York City. Several recent proposals for major new developments have included the use of greater stormwater detention measures and BMPs. Also, as mentioned earlier in this chapter, NYCDDC recently introduced sustainable design guidance for stormwater BMPs in New York City buildings and infrastructure. The recent passage of Local Law 86 directs NYCDDC projects to achieve a LEED rating of silver or higher, which requires a certain amount of stormwater capture and reuse in those structures. In addition, the adoption of the *New York State*

Stormwater Management Design Manual marked a significant step in facilitating the design and implementation of stormwater BMPs.

Potential Management Strategy 4b1:

Encourage/require low impact development and best management practices for new and existing private development (residential and non-residential).

On-site stormwater BMPs at the parcel or lot level can provide significant stormwater runoff volume and pollutant load reduction benefits for a given parcel. BMPs control runoff at the source, intercepting, infiltrating, and storing runoff before it enters the combined or separate sewer system. Examples of residential-scale BMPs include green roofs, downspout disconnection, rain barrels, rain gardens, cisterns, and stormwater planters. Stormwater BMPs can also be sited on commercial, manufacturing, and industrial developments. Because of the specific zoning and infrastructure requirements, as well as the more "utilitarian" nature of non-residential developments, there are distinctive sets of BMPs which are appropriate for controlling stormwater runoff on each land use type as shown in Table 4.1 above.

Strategy Assessment Approach

The following describes the approach to estimate the stormwater runoff and CSO reductions associated with various stormwater BMPs applied to residential, commercial and manufacturing development. Six land use prototypes (*i.e.*, low, medium and high density residential, commercial, industrial, and institutional) will be identified and potential BMP conceptual site plans will be developed for each that could be applied to existing or newly developed properties. Land use prototypes will be based on NYCDCP's Zoning Handbook, including specific zoning regulations for the prevalent zoning district represented by each prototype (*e.g.*, lot area, FAR, open space ratio, etc.). Two sets of BMP site plans "low cost" and "high cost" applications will be developed for each prototype to estimate a range of volume reductions and cost estimates.

Penetration rates for the BMP scenarios will be developed to estimate how extensively they can be applied to both new and existing development. Penetration rates will be determined based on building permit data, and a reasonable estimate of BMP implementation for existing development. A total volume of runoff capture will be calculated for each application scenario, and the accumulated storage volumes will be modeled to calculate the decrease in CSO volumes and overflow events for each WPCP drainage area.

If determined to be beneficial and feasible to implement stormwater BMPs for new and/or existing development, implementation strategies will be explored. The development of economic incentives such as water and wastewater rate discounts, public/private cost-sharing, and direct subsidies can encourage the implementation of selected BMPs. Regulatory requirements for on-site stormwater BMP implementation and maintenance could be tied to the sewer site connection application and the building permitting process for the development of new structures, and the retrofit or improvement of existing structures.

The findings for potential management strategies described above will be supplemented with data from specific pilot projects as this information is developed. NYCDEP, along with the Mayor's Office of Long-Term Planning and Sustainability, is in the process of developing multiple pilot projects to test, monitor and demonstrate the effectiveness of a variety of BMPs for different land uses. Specifically, NYCDEP is in the process of securing funding to design, construct and

monitor green roofs on both residential and commercial developments in the Jamaica Bay watershed. The roofs will be selected based on size, as well as structural integrity, among other criteria. While the construction schedule at the time of writing this report is uncertain, monitoring will be conducted over a three year period.

Potential Management Strategy 4b2:

Identify currently occupied City-owned properties in the Jamaica Bay watershed that can be retrofitted to incorporate on-site BMPs.

New York City-owned properties in the Jamaica Bay watershed present an opportunity for the implementation of appropriate on-site stormwater BMPs particularly when incorporated into new publicly-funded construction and retrofit projects. As part of the *Jamaica Bay Watershed Protection Plan* development process, a preliminary set of on-site BMPs that would be appropriate for various land use types in the watershed have been identified. Implementing the appropriate BMPs on public properties would provide a real life evaluation of the performance of these BMPs and costs for implementation. Such an approach by the City of "leading by example" would expand practice in the construction of BMPs within New York City, help to standardize BMP construction costs, and encourage private developers to pursue these options. Through an on-going monitoring program and campaign to highlight accurate costs and benefits of BMPs on public properties, on-site BMP implementation could be scaled up to include more City-owned properties and extend to private developments.

Strategy Assessment Approach

The strategy assessment approach involves the evaluation of currently occupied City-owned properties to determine sites that have the greatest potential for implementing on-site stormwater BMPs. Through a series of meetings with other City agencies, a review of 10-year capital plans from the appropriate agencies will be conducted to identify future reconstruction projects that could incorporate BMP design. Suitable BMPs for future projects and related construction costs will be discussed through interagency communications and coordination. Finally, different agency policies and procedures for project design and construction will also be considered to determine how best to include BMPs during the early stages of project development.

If determined to be beneficial and feasible, implementation strategies will be explored. In particular, funding mechanisms and agency support will be investigated for future construction and retrofit projects through ongoing discussions between NYCDEP and other City agencies. The Mayor's Office of Long-Term Planning and Sustainability will be convening an interagency BMP Task Force in its efforts to develop *PLANYC* 2030, which would help to facilitate these and related discussions. Interagency communications and coordination into the future would be particularly helpful to share lessons learned about BMP implementation and provide case studies of information for both public and private developers.

As mentioned above for Management Strategy 4b1, the findings and implementation strategies above will be supplemented with data from specific pilot projects as this information is developed. NYCDEP is in the process of securing funding to design, construct and monitor a BMP pilot project for implementation on a city property given the opportunities presented by high-density residential development to capture substantial volumes of stormwater runoff. While the construction schedule at the time of writing this report is uncertain, monitoring will be conducted over a three year period.

Potential Management Strategy 4b3:

Revise sewer codes, drainage plans or building codes to facilitate the use of BMPs and protect environmental features.

Currently, City codes and stormwater management regulations do not require or promote the use of stormwater BMPs during new development or reconstruction. NYCDDC has produced its low impact development guidelines, but these are not mandatory and are targeted toward public construction projects. Implementation of stormwater BMPs that are determined to be effective could be enabled through their direct integration into City codes and stormwater planning policies. The building permit process could account for environmental features and encourage better site design (incorporating low-impact development principles) for large developments or developments in designated environmentally-sensitive areas in the watershed to capitalize on existing natural infrastructure and preserve ecologically-desirable attributes such as high infiltration capacity, excellent habitat conditions, or fertile soils. On-site detention requirements could also be revised to address different stormwater conditions.

Strategy Assessment Approach

The strategy assessment approach will entail the review of sewer codes, drainage plans, and the building code to identify the framework in which on-site development is required to address its stormwater discharges and connect to the sewer system. The approach will involve working through a prototype development proposal to define current procedures, interrelationships between different codes, and limitations in the existing approach to site planning, CSO volumes reduction, water quality improvements and implementation of BMPs. Regulations from other municipalities will be reviewed to identify example modifications and strategies for encouraging and requiring BMPs.

If determined to be beneficial and feasible, implementation of this strategy will be pursued through collaboration with relevant City agencies and coordination between bureaus within NYCDEP. Policies or code changes for new development or major alterations could include encouraging BMPs or additional requirements for stormwater control and protection of hydrological features such as wetlands.

Objective 4c: Encourage "green" development in the Jamaica Bay watershed.

Issue

New York City is progressing toward environmentally-sustainable urban development throughout the five boroughs. Environmental sustainability is a top priority for Mayor Bloomberg, and there is already significant momentum towards “greening” the City. Encouraging “green” and low impact development and redevelopment to occur through the Jamaica Bay watershed will help to ensure the long term ecological health of natural communities, and provide human health benefits as well. “Green” development strives to maximize energy efficiency and be minimally disturbing to natural ecological processes. Widespread adoption of green building principles could involve regulatory mandates coupled with economic incentives for developers, homeowners, businesses, and public entities to implement these technologies, which are often more expensive in the short term, but generally allow cost savings in the long-term. Therefore, additional incentives may be critical to facilitate widespread implementation by private developers and citizens. The Potential Management Strategies within this Objective address programs to support “green” building, low

impact development techniques, water quality improvement, and resource conservation strategies within the Jamaica Bay watershed.

Current Programs

As discussed above, the City has over recent years, developed a number of initiatives to promote green and sustainable development. These include the establishment of the Mayor's Office of Long Term Planning and Sustainability to meet the needs of the City's growing population into the future and to create a sustainable city by 2030; the formation of the OSD, a branch of NYCDDC, which recently introduced sustainable design guidance; the passage of Local Law 86 directing NYCDDC projects to achieve a LEED rating of silver or higher; and the establishment by NYCDEP of the Comprehensive Water Reuse Program (CWRP) which offers a water rate reduction for residential, commercial, or mixed use buildings with water reuse systems. In addition, New York State's Green Building Tax Credit, which allows building owners and developers to deduct expenses associated with the design and construction of green buildings, encourages green construction throughout the state.

It should be noted that the focus of many "green" programs currently in operation is to promote energy conservation. There is a need to expand some of these programs to include stormwater control.

Potential Management Strategy 4c1:

Promote incentive programs for new developments and buildings that implement design options which employ open space, green building techniques, and low impact development measures during design and construction.

Incentive programs can be used effectively to encourage participation in green building and low impact development efforts. By developing a program that has a range of participation levels with varying incentives and compensatory mechanisms, a greater range of participants can be attracted. New York City already has engaged in several incentive-based initiatives, including a toilet rebate program, where residents can file an application for a rebate if they have a new water-conserving toilet installed by a licensed plumbing company, and NYCDEP offers free water-efficiency surveys to home owners. Examples of other incentives-based programs could include:

- Providing subsidies for rainwater catchment barrels or cisterns.
- Providing plants for residential rain gardens, bioswales, and bioretention installations.
- Streamlining development processes such as expediting or fast-tracking building permit applications for developments that include green buildings and low impact development, or developers utilizing the NYCDDC high performance guidelines.
- Providing a discounted water and wastewater rate for buildings that utilize green roofs or other on-site stormwater retention measures.
- Ensuring that property-owners are not taxed for the "highest and best use" of their property.

In New York City, rates for expenditures related to both wastewater and stormwater are incorporated into one wastewater rate. Some municipalities separate out stormwater rates and base these rates on average impervious surface coverage, for various land uses and/or lot size. There are both advantages and disadvantages to this rate structure that will be explored as part of this Potential Management Strategy.

Strategy Assessment Approach

The strategy assessment approach will involve identifying stormwater related certifications and incentives available in the City such as LEED certifications, Green Building Tax Credits, Bronx Redevelopment Corp loans for green roofs, and other lead or sustainability elements. The CWRP will be reviewed to identify potential improvements to reach more developers. Other municipalities' programs that offer incentives for stormwater controls will also be identified. Coordination with the Mayor's new Office of Long-term Planning and Sustainability will occur, with the intent of developing these and additional incentives programs.

If determined to be beneficial and feasible, implementation strategies will be explored. Funding mechanisms and agency collaboration will be pursued. Strategies to disseminate information to developers about incentive programs will also be identified.

Potential Management Strategy 4c2:

Promote the economic value of open space, wetlands, "green" development, and low impact development within the watershed.

Environmental regulations, typically used by governments to protect environmental resources, are often seen as being "unprofitable" to businesses and property owners. For environmental protection and sustainability to become truly integrated into the City, it is necessary to demonstrate that these can also be economically viable. In fact, environmental protection most often makes economic sense when all the public costs are considered. Further, it is well-documented that amenities such as open space can significantly add to property values. Existing information on the private benefits of land preservation and sustainable development can be used to educate developers and other City agencies that environmental sustainability is not only desirable, but also makes economic sense.

Strategy Assessment Approach

The strategy assessment approach will involve reviewing studies and data on the public and private economic value of open space, "green" development, and low impact development for New York City. Based on the results of the literature research, the direct and indirect economic benefits of open space, "green" development, and low impact development for New York City will be identified. This information will be publicized to public and private development entities in New York City, with the goal of encouraging land use and development practices to be more environmentally sustainable.

If determined to be beneficial and feasible, implementation strategies will be explored. Funding mechanisms and collaboration with various governmental and non-governmental entities will be pursued to widely disseminate the appropriate information and findings from above.

Potential Management Strategy 4c3:

Examine the list of brownfields within the Jamaica Bay watershed and evaluate on a case by-case basis how to improve their ecological functioning.

New York City has existing legislation that requires the remediation of brownfields within the City. This includes New York City Council Int. 567, requiring the City to develop a plan to comprehensively address the remediation and reuse of brownfield properties, and Resolution 795 (2005), calling upon the Governor and State Legislature to execute the Memorandum of

Understanding required for the implementation of the 2003 State Brownfield Cleanup Program and distribution of funding through the Brownfield Opportunity Area (BOA) program. However, none of this legislation requires specific ecological restoration programs to occur on remediated sites. Despite this, recent NYCDEP actions to close Pennsylvania and Fountain Avenue landfills have integrated significant ecological restoration efforts, including the planting of endemic grasses and shrubs. The Mayor's Office of Environmental Coordination (OEC) coordinates the City's brownfields efforts and develops brownfields policy. There may be opportunities to enhance ecological restoration and toxics remediation efforts on brownfields in the Jamaica Bay watershed, utilizing tools such as the "Brownfields to Greenfields" program proposed by the NY/NJ Baykeeper.

Strategy Assessment Approach

This strategy includes an evaluation of the location and extent of brownfields within the watershed, their status, condition, and potential risk to ecological integrity, with the goal of recognizing opportunities for ecological restoration and improved toxics remediation. The strategy assessment approach will compile a list of brownfield sites in the watershed and provide an assessment of their condition, with a focus on City-owned brownfields. This information will be compared to New York State funding processes and requirements to determine potential existing opportunities to redevelop specific brownfield sites for multiple environmental objectives.

If determined to be beneficial and feasible, implementation strategies will be explored. Funding mechanisms and collaboration with various governmental and non-governmental entities will be pursued.

Potential Management Strategy 4c4:

Develop strategies to encourage the preservation of critical open spaces in the Jamaica Bay watershed through new development proposals.

The protection of remaining open spaces in the Jamaica Bay watershed is very important. These areas provide ecological functions that are rare in the City, including natural habitat areas for plants and wildlife, off-site or on-site stormwater infiltration or storage basins, and recreational areas for City residents. In combined sewer areas where the preservation of pervious areas is necessary to achieve the reduction of CSO events, open space protection is especially critical. There are several land management strategies which can be employed during new development to encourage the protection of these open spaces. Offset programs allow developers to pay into a fund that is then used to pay for specific environmental programs as long as a reasonable nexus between the development's impact and the objectives of the environmental program can be made. Conservation easements protect open spaces on private lands by offering tax incentives to the landowner in return for permanent protection. Land trusts directly acquire open spaces for permanent protection or help to negotiate conservation easements. Transfer of development rights (TDR) programs protect open space by allowing landowners in conservation zones to be compensated by selling their development rights for a particular parcel of land to the municipality or as an offset to developers in another district.

Strategy Assessment Approach

The strategy assessment approach involves identifying innovative mechanisms to protect environmentally sensitive areas and open spaces to capture stormwater runoff. A review of

mitigation funds, land trust operations, and similar programs being used by other municipalities will be conducted.

If determined to be beneficial and feasible, implementation strategies will be explored. Funding mechanisms and collaboration with various governmental and non-governmental entities will be pursued.

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CHAPTER 7 – CATEGORY 5, PUBLIC EDUCATION AND OUTREACH: OBJECTIVES, CURRENT PROGRAMS, AND POTENTIAL MANAGEMENT STRATEGIES

Some residents in the watershed drive fuel–efficient cars, engage in recycling initiatives, practice water conservation or other activities that reduce the amount of impact they have on their local environment. Others use and dispose of their resources in ways that are acceptable, but not as environmentally-friendly as they could be. At the same time, illegal actions such as dumping, littering, and vandalism, especially in the few remaining open spaces in the watershed, continue to occur and impair the water quality and ecological integrity of Jamaica Bay. The sum of these actions - individual water use, energy use, and waste disposal practices - is the "ecological footprint" of human uses in the watershed. Long-term ecological sustainability is directly linked to the actions and attitudes of the people that live, work, and play in the watershed. The concept of environmental stewardship is that residents understand, value, and care for their environmental resources, and thus are motivated to make decisions that improve the health of the watershed and the Jamaica Bay estuary.

People cannot care for what they do not know. Therefore, it is important to provide residents with opportunities to learn about the Bay - to explore it, study it, and play in it. These opportunities can help to promote a sense of value and environmental stewardship in individuals, both young and old. Diverse learning experiences encourage residents to gain knowledge of how their everyday actions affect water quality, human health, and the ecological processes of the landscape in which they live, develop a sense of caring for that environment, prioritize environmental health, and voluntarily modify their behaviors and practices toward more ecologically sustainable options.

While an individual's efforts may appear small, collective stewardship has the power to significantly reduce degradation of the Bay. In fact, education and outreach may be the most important factors in the attainment of an environmentally-healthy Jamaica Bay because significant change will be challenging without broad constituent support to alter status quo behaviors and to enact the political will in prioritizing ecological health. Many education and outreach programs currently exist to increase the visibility of Jamaica Bay and of stewardship goals; one challenge is that the efforts of different entities are uncoordinated and, therefore, may not target or reach the diverse population groups - public officials, property owners, business owners, school children, and other stakeholders - throughout the watershed.

In order to bring about effective and lasting change for the water quality and ecological conditions in Jamaica Bay, it is essential that the consolidated efforts of environmental education be comprehensive in their approaches. They will be most effective if they address learning of all types of citizens - watershed residents, visitors, and civic officials - and include people of all ages, from kindergarteners to seniors. The Jamaica Bay Watershed Education Coordinating Committee, initiated by NYCDEP as part of the watershed protection planning process, provides one such forum for educators to collaborate and cooperate in its effort to provide comprehensive K-12 education curricula to schoolchildren within the Jamaica Bay watershed. The Committee meets regularly and involves the participation of many organizations currently providing youth education within New York City including NPS, NYSDEC, NYCDPR, NY/NJ HEP, New York

City Soil and Water Conservation District (NYCSWCD), Eastern Queens Alliance, Friends of Gateway and many more.

An effective public outreach program includes instructive techniques of teaching as well as opportunities for the active engagement of the public in the natural environments that the *Jamaica Bay Watershed Protection Plan* endeavors to protect and restore, that is, direct, physical interaction with the natural world. To ensure widespread application and complete information throughout the watershed, outreach efforts also need a coordinated approach in which the programs and activities of different providers are integrated. Category 5: *Public Education and Outreach* recognizes the need for *coordinated* and *comprehensive* education and outreach efforts to increase public awareness, community involvement and local stewardship throughout the Jamaica Bay watershed.

Objective 5a: Increase the visibility of the Bay and the interconnections between human activities in the watershed and impacts on Bay conditions.

Issue

Many residents in the Jamaica Bay watershed may not be aware of how their individual behaviors and lifestyle choices have a direct impact on the Bay. This may be perpetuated by the extreme urban environment that surrounds most residents in the Jamaica Bay watershed and the lack of physical connections to the natural landscapes within the watershed. By increasing personal connections to Jamaica Bay, and providing education on the linkage between human activities and ecological health, environmental stewardship opportunities in the watershed will be strengthened.

Current Programs

Despite the issues above, there are many existing programs designed to raise awareness about the interconnections between human activities and the conditions of the Bay. The following programs, although not an exhaustive list, currently provide opportunities for residents to engage in and educate themselves about Jamaica Bay:

- *Jamaica Bay Task Force (JBTF):* holds quarterly meetings, which serve as a forum for stakeholders to share information about ongoing activities and programs.
- *Jamaica Bay Research and Management Information Network (JBRMIN):* a website which includes an online bibliography; a catalog of stakeholders and universities involved in Jamaica Bay research, programming and advocacy; information on the Jamaica Bay Task Force and the Jamaica Bay Watershed Protection Plan Advisory Committee; a news page; and an events calendar. (http://nbii-nin.ciesin.columbia.edu/jamaicabay/)
- *Jamaica Bay Ecowatchers*: the first environmental group to discover the loss of marshes in Jamaica Bay, Ecowatchers coordinates research about marsh loss and holds conferences to promote ecosystem restoration in the Bay.
- *American Littoral Society, Jamaica Bay Guardian:* provides educational programs about Bay resources for schools and civic groups and bi-weekly programs on general ecology issues with the NPS; maintains an extensive resource slide library, which is available to other organizations; and coordinates International Beach Clean-up Day along Jamaica Bay.
- *Eastern Queens Alliance:* gives presentations to local groups and individuals to increase awareness of Idlewild Park's resources and encourage community involvement.

- *Gateway National Recreation Area, Jamaica Bay Institute:* houses the Jamaica Bay Resources Library - a collection of over 3,000 books, reports, theses, maps, and other materials relating to the natural and cultural resources of the Jamaica Bay Watershed.
- *Gateway National Recreation Area, Jamaica Bay Unit:* operates the Jamaica Bay Wildlife Refuge which provides a variety of public programs and services; offers day programs to provide students (ranging from 4th-8th grade) with a variety of lessons about marine explorations and environments at GNRA, and overnight camping programs at Ecology Village for grades 4-12; and serves as a cooperating agency for Operation Explore, a year-long school program for 4-6th graders which includes one day at GNRA training sites followed by a visit to Stonykill Farm and a two-night trip at to the Taconic Outdoor Education Center.
- *New York/New Jersey Harbor Estuary Program (NY/NJ HEP):* maintains on online stewardship network; and hosted Estuary Live, on September 29, 2006, which is an interactive program that involved many different environmental education partners and high school students from the watershed in an hour-long live nationwide web broadcast from Big Egg Marsh.
- *Friends of Gateway:* operates the Gateway Greenhouse Education Center which provides learning opportunities at Jamaica Bay by getting children to the Bay and offering a set of lesson and activities.
- *Metropolitan Waterfront Alliance:* produces an electronic newsletter, "Waterwire," which includes articles on Jamaica Bay. (http://www.waterwire.net/)
- *New York City Soil and Water Conservation District (NYCSWCD):* hosts an annual Jamaica Bay Roundtable, in cooperation with The New School University, to discuss critical issues facing the Bay.
- *New York City Audubon Society:* sponsors trips to the Jamaica Bay Wildlife Refuge.
- *New York City Department of Parks and Recreation (NYCDPR):* operates the Salt Marsh Nature Center in Marine Park which provides an in-park community center for public education, recreational activities and environmental studies.
- *New York City Department of Environmental Protection (NYCDEP):* serves as a cooperating agency for Operation Explore; sponsors the International Beach Clean-up Day; provides support for the NYCSWCD to help the organization achieve its mission; participates in NY/NJ HEP educational activities including Estuary Live; offers the annual Art and Poetry Contest which encourages fifth and sixth grade students to creatively express their understanding of New York City's water supply, wastewater treatment system, and the importance of water conservation; and organizes and supports the Jamaica Bay Watershed Education Coordinating Committee that was formed as part of the *Jamaica Bay Watershed Protection Plan* development process.

Potential Management Strategy 5a1:

Establish a program of events including a "Bay Day" or "Eco-festival" that increases awareness and enjoyment of Jamaica Bay through celebration and learning.

The Jamaica Bay watershed is endowed with a rich ecological, cultural, and recreational heritage, and can truly be called one of the "gems" of New York City. Public celebrations of these assets will provide environmental education about the watershed to the general public in ways that other programs may not. It will also support a number of *Jamaica Bay Watershed Protection Plan* values: supporting Jamaica Bay watershed restoration and improvement efforts; fostering public outreach; providing opportunities for public education; promoting public use and enjoyment of

Jamaica Bay in a safe and ecologically sustainable manner; and building community cohesion related to the ecological sustainability of Jamaica Bay.

Strategy Assessment Approach

The strategy assessment approach involves identifying outreach and recreational groups to discuss opportunities to leverage and coordinate current activities that are designed to increase awareness and enjoyment of Jamaica Bay, and the potential for organizing a Jamaica Bay event or festival. The assessment of this strategy also includes an effort to identify ways to promote specific actions, such as to spotlight a specific Bay location or activity.

If determined to be beneficial and feasible to establish a Bay-related event, partnerships and appropriate roles will be identified for the implementation of the strategy and different funding opportunities will be explored.

Potential Management Strategy 5a2:

Create a targeted campaign for public officials and public agency representatives that include briefings, workshops and boat tours about Bay-related issues and opportunities.

Coordination and communication between elected officials, public agency representatives, researchers and stewards of the Bay would enhance ecosystem restoration efforts underway in the watershed by bringing attention to the issues facing the Bay. This strategy is designed to gain consensus and commitment to reverse negative impacts on the Bay. Continual education and awareness of the ecological linkages between human uses and water quality and ecosystem health is especially critical for the decision-makers as the *Jamaica Bay Watershed Protection Plan* is implemented.

Strategy Assessment Approach

The strategy assessment approach involves the review of successful educational campaigns in New York City and beyond. However, the further development and implementation of this strategy is largely dependent on the results of the *Jamaica Bay Watershed Protection Plan* development process; this strategy entails utilizing the *Final Jamaica Bay Watershed Protection Plan* to formalize issues, current efforts and necessary future actions with public officials and local, state and federal agencies.

If determined to be feasible and beneficial, a variety of implementation strategies will be explored including the development of a "tool kit" that covers the most critical information about the Bay and its watershed. The information included in the kit could serve as the foundation for a "traveling show" that could be easily tailored based on the target audience while also easily replicated by different presenters in order to reach as many people as possible. A combination of briefings, workshops, and boat tours of the Bay would be organized to foster this transfer of knowledge and provide current information on the status of ongoing projects.

Objective 5b: Improve coordination among existing groups involved in Jamaica Bay-related education activities.

Issue

Many dedicated governmental entities, citizens groups, and concerned Jamaica Bay residents engage in efforts to educate officials, ordinary residents and school children on the environmental

issues related to Jamaica Bay. Yet, many challenges exist for these entities including a lack of resources such as staff or facilities to fully execute their initiatives and adequately educate or provide information to the public. Through the establishment of a framework for enhancing coordination and collaboration between these entities, existing programs can be further leveraged, and future opportunities seized.

Current Programs

As listed at the beginning of this section, several non-governmental organizations, including the Friends of Gateway, JBTF and Jamaica Bay Ecowatchers, engage in education and outreach programs, and provide opportunities for watershed residents to get involved in stewardship actions. Specific public educational activities are coordinated with other organizations, including the American Littoral Society which partners with NYCDEP and Jamaica Bay Guardian which partners with the National Parks Service. GNRA's Jamaica Bay Institute houses the Jamaica Bay Resources Library - a collection of over 3,000 books, reports, theses, maps, and other materials relating to the natural and cultural resources of the Jamaica Bay Watershed and developed by various entities. NYCDEP initiated and continues to organize the Jamaica Bay Watershed Education Coordinating Committee which meets regularly and involves the participation of many organizations currently providing youth education within New York City including NPS, NYSDEC, NYCDPR, NY/NJ HEP, NYCSWCD, Eastern Queens Alliance, other groups.

Potential Management Strategy 5b1:

Develop a process for disseminating Jamaica Bay related information to the watershed community.

Currently, the JBRMIN website maintained by Columbia University's Center for International Earth Science Information Network (CIESIN) includes an online bibliography; a catalog of stakeholders and universities involved in Jamaica Bay research, programming and advocacy; information on the JBTF and the *Jamaica Bay Watershed Protection Plan* Advisory Committee; a news page; and an events calendar. Documents and links are provided throughout as a means of serving as an online repository for information on Jamaica Bay. GNRA's Jamaica Bay Institute operates the Jamaica Bay Resources Library, a central repository for data and information about the watershed, containing over 3,000 books, reports, thesis, maps, and other materials relating to the natural and cultural resources of the Jamaica Bay Watershed.

Despite this wealth of information, there is no centralized medium used by all stakeholders (including agency staff, researchers, community groups, public interest groups, residents, businesses, and other citizens) for disseminating research data, current news and information, educational resources and current events to the watershed community. A common "gateway" would provide a medium for public outreach, serve to increase coordination between all stakeholders, and support the interest and contribution of professional scientists, K-12 teachers, higher education institutions, and students of all levels. In addition, the establishment of a centralized Jamaica Bay watershed community portal would help to facilitate an adaptive management approach towards resources management, and aid in the identification of research needs and prioritization of studies.

Strategy Assessment Approach

The strategy assessment approach involves communications between current education and outreach groups with a stated interest in disseminating Jamaica Bay related information (such as

JBTF, JBRMIN, Jamaica Bay Institute (JBI), and Education Coordinating Committee) to discuss a potential centralized mechanism for organizing data, disseminating messages and encouraging community groups to interact and network. The assessment of this strategy also involves discussions of a process for continually updating the medium for disseminating Jamaica Bay-related information and the potential development of other tools such as a management database that would track and monitor watershed management efforts into the future.

If determined to be beneficial and feasible to establish a centralized process or mechanism for disseminating Jamaica Bay related information, partnerships and appropriate roles will be identified for the implementation of the strategy. In addition, different funding opportunities will be explored and various media to publicize how best to access the centralized information will be identified.

Potential Management Strategy 5b2:

Promote access to and use of the Jamaica Bay Institute as a centralized research and information repository to coordinate watershed-related research.

GNRA's Jamaica Bay Institute currently operates as an information library and research entity for Jamaica Bay. It maintains the Jamaica Bay Resources Library, a central repository for data and information about the watershed, containing over 3,000 books, reports, theses, maps, and other materials relating to the natural and cultural resources of the Jamaica Bay Watershed. Promoting the continued use of JBI as a centralized research and data repository would help to coordinate research needs and restoration projects in Jamaica Bay.

Strategy Assessment Approach

The strategy assessment approach entails additional communication and discussion with the JBI, the Education Coordinating Committee, and other related groups mentioned above to identify the full range of potential applications of the Resources Library and how the above groups can partner to provide information about the Resources Library via organizational websites, printed materials and other media. The assessment of this strategy will be closely linked with the approach to assess Potential Management Strategy 5b1 above.

If determined to be beneficial and feasible to promote access to and use of the JBI's centralized information, partnerships, needed resources and appropriate roles will be identified for the implementation of the strategy and different funding opportunities will be explored. Based on these discussions with the JBI and other interested parties, opportunities to enhance the effectiveness and utility of the Jamaica Bay Resources Library in the future may be identified such as augmenting its on-line data retrieval capabilities, allowing researchers and agency staff to upload relevant publications and materials remotely, and improving the search tools and functions.

Objective 5c: Raise awareness of Jamaica Bay-related issues among young people to promote local environmental stewardship during childhood.

Issue

Young children learn about the natural environment best through first-hand exploration in the landscape. Playing on the beaches, in stream channels, or in forested lands within their neighborhood affords an early awareness of wild plant and animal communities, and provides an

essential connection to the natural world. Without this opportunity, children can grow up "disconnected" from the native landscape and, therefore, may have little perspective of their ability to influence, or be influenced by these natural environments. Especially in the ultra-urban environments typical in many of the neighborhoods in the Jamaica Bay watershed, it is essential to provide some awareness of the reciprocity between human use and environmental condition, and inspire some "value" to maintaining ecological health. Instilling some measure of environmental awareness at a young age, through education and direct experience, may help to encourage stewardship as the child becomes an adult. In the classroom, this can be accomplished by offering environmental science in the curriculum starting at an early age. Outside of the classroom, this can be achieved by offering programmed opportunities for children to participate in stewardship and other hands-on activities which offer direct connection with natural areas in the Jamaica Bay watershed.

Current Programs

The GNRA Jamaica Bay Unit currently offers educational programs for grades 4 – 12, including an overnight "ecology camp" at Floyd Bennett Field's "Ecology Village," as well as several day-long programs that utilize natural areas in Jamaica Bay to explore and learn about marine sciences, wetlands areas, and beach/dune habitats. In addition, NPS is a cooperating agency along with NYCDEP for Operation Explore. NYCDEP also targets fifth and sixth graders with its annual Art and Poetry Contest in which Jamaica Bay is one of this year's themes. These agencies as well as other governmental and non-governmental entities participate in NY/NJ HEP educational activities including Estuary Live. These and other groups have also been participating in the Jamaica Bay Watershed Education Coordinating Committee that was formed as part of the *Jamaica Bay Watershed Protection Plan* development process. Finally, the New York City Department of Education's (NYCDOE) Scope and Sequence provides the structure and themes to ensure that students meet the standard requirements for the following year's curricula in science and other subjects.

Potential Management Strategy 5c1:

Design, develop, implement, and evaluate new and enhanced multi-disciplinary, inquiry-based environmental education curricula for K-12 grade students that include opportunities to learn about Jamaica Bay's ecological systems, introduce environmental careers, and facilitate environmental stewardship.

Modifying curricula to incorporate watershed-specific educational opportunities and promoting the teaching of watershed science and ecology in the classroom will ensure that children are academically introduced to local environmental issues. In addition, there are great opportunities to incorporate inquiry-based learning techniques, such as environmental research projects, environmental laboratory projects, and other projects which utilize the natural environments of Jamaica Bay while teaching scientific methods. Finally, facilitating interaction between students and the large community of professional scientists, planners, engineers, and resource managers in the watershed can introduce a multitude of careers and professional education opportunities of which the students may otherwise be unaware.

Strategy Assessment Approach

The strategy assessment approach relies on the activities of the Jamaica Bay Watershed Education Coordinating Committee which meets regularly to discuss current curricula and programs in the New York City area that could be tailored to include Jamaica Bay-related issues

or expanded for implementation in the Jamaica Bay watershed. The Committee has identified the subject areas and specific topics that K-12 students should know about Jamaica Bay, its watershed and ecological system. The next step is to align existing curricula and programs with these topics to identify gaps, if any, in education curricula and resources including field trip sites and programs, class visits, textbooks, multi-media materials, etc. Finally, the program developed will be aligned with the NYCDOE's Scope and Sequence to ensure consistency with current education standards.

If determined to be beneficial and feasible to develop and implement K-12 curricula specific to Jamaica Bay based on the above approach, the Education Coordinating Committee will first engage NYCDOE in a review of the proposed program and discussions of potential implementation strategies. The appropriate partnerships, required resources and roles will be identified for the implementation of this strategy and different funding opportunities will be explored. Additional implementation strategies to be developed include the design of a coordinated outreach approach to educators and schools within the watershed to promote available and relevant educational resources and materials and the design of a method for field testing or evaluating the program upon implementation.

Potential Management Strategy 5c2:

Design, develop, implement and evaluate new and enhanced multi-disciplinary, inquiry based environmental education programs outside of school-time (after school, on weekends, or during summer vacations) for young people to learn about Jamaica Bay's ecosystems and environmental careers, and to facilitate environmental stewardship.

Programs and activities that promote environmental education and stewardship for school-age children can occur outside of the classroom, as continuing education programs, volunteer programs, summer camp programs, or environmental education programs specifically-designed to introduce children to the environmental sciences. With a Jamaica Bay orientation, these programs can be used to augment existing research projects, facilitate a citizen-based monitoring effort, or simply allow exploration of the natural areas within and around the Bay.

Strategy Assessment Approach

A similar strategy assessment approach as identified above would be employed by the Education Coordinating Committee based on its findings for Potential Management Strategy 5c1.

Potential Management Strategy 5c3:

Create multi-media resources including DVDs or videos that feature the Jamaica Bay watershed and ways young people interact with and learn from the Bay's ecological system.

Providing a variety of educational tools and resources for teachers and educators to use will allow Jamaica Bay-specific educational curricula to be more easily adopted in the classroom, and distributed among schools in the watershed. Estuary Live, hosted by the NY/NJ HEP on September 29, 2006, is a good example of an interactive program that involved many different environmental education partners and high school students from the watershed in an hour-long live web broadcast from Big Egg Marsh. The nationwide broadcast focused on the importance of coastal wetlands to people and nature, the disappearance of salt marshes in Jamaica Bay, and the roles we can all play in understanding and improving the health of the estuary. Approximately 500 nationwide registrations, including entire schools, were received to watch the live broadcast ,

and over 200 students emailed questions during the broadcast. Using Estuary Live as a model, different media and various technologies (*e.g.*, web conferencing, web streaming) may provide effective and efficient means for delivering educational messages to broad audiences and supplementing curricula targeted toward specific audiences.

Strategy Assessment Approach

A similar strategy assessment approach as identified above would be employed by the Education Coordinating Committee based on its findings for Potential Management Strategy 5c1. Based on preliminary lessons learned from examples implemented previously, this assessment will consider the costs and time expended to develop multi-media resources versus the perceived benefits in environmental education, particularly when considering the different types of technologies available.

Potential Management Strategy 5c4:

Design, develop, implement, and evaluate professional development opportunities for elementary through high school formal and non-formal educators.

To successfully implement Jamaica Bay-specific educational material in the classroom, it is necessary to instruct the educators about the wide range of scientific, social, cultural, and historical information in the watershed, as well as the environmental issues. Providing them with the necessary tools and instructional techniques to facilitate the Management Strategies presented in Objective 5a will allow the Jamaica Bay watershed to truly become a "living classroom."

Currently, the GNRA Jamaica Bay Unit offers teacher workshops for ranger-guided and teacher-led school programs to discover, explore, and measure and compare environmental conditions in different habitats around the estuary. As part of Operation Explore, NPS along with its cooperating agencies provide teachers with full day training sessions to teach teachers about coastal plants, animals and environmental conditions at GNRA and then compare them with upstate forest, aquatic, farm and community environments. NYSDEC offers professional development opportunities for K-12 teachers including Project WET, Project WILD, and Flying WILD which range from 3 to 6 hour training sessions and provide teachers with manuals, curricula and activities to use in the classroom.

Strategy Assessment Approach

A similar strategy assessment approach as identified above would be employed by the Education Coordinating Committee based on its findings for Potential Management Strategy 5c1. A major consideration for the committee when further developing this strategy and professional development opportunities is to determine whether offering accreditation hours detracts from the content and lessons learned in teacher training programs and the subsequent application of the training in the classroom.

Potential Management Strategy 5c5:

Develop a series of interpretive exhibits at GNRA facilities and beyond.

Currently, the GNRA uses interpretative signage to describe natural features and ecological processes that can be observed at different locations throughout the Jamaica Bay Unit including the Jamaica Bay Wildlife Refuge. NYCDEP recently provided GNRA with information and illustrative materials developed as a result of the *Jamaica Bay Watershed Protection Plan*

planning process to date for a temporary display at the Jamaica Bay Wildlife Refuge. This information could become a permanent display and a system of interpretative exhibits could be expanded significantly to allow additional educational opportunities for visitors. In addition, interpretive signage in other locations outside of the GRNA system, developed in conjunction with *Public Use and Enjoyment* Objectives 3a and 3b, would allow public educational opportunities to be expanded throughout the watershed.

Strategy Assessment Approach

The strategy assessment approach will involve discussions with GNRA Jamaica Bay Unit to determine the current and future programming of interpretive space within GNRA facilities. Based on the outcomes of these discussions and if space is available, NYCDEP will review its existing interpretive exhibits to determine application to GNRA facilities and reach out to other education providers to fill in any gaps in Jamaica Bay-related information. In addition, the assessment of this strategy will involve a review of other potential locations for interpretive exhibits such as City parks, schools and community centers throughout the watershed. This strategy will rely on the curricula developed by the Education Coordinating Committee as well as the *Final Jamaica Bay Watershed Protection Plan* to formalize relevant issues, current efforts and necessary future actions to public officials and local, state and federal agencies.

If determined to be beneficial and feasible to develop a series of interpretive exhibits, partnerships and appropriate roles will be identified for the implementation of the strategy and different funding opportunities will be explored.

Objective 5d: Raise awareness of Jamaica Bay-related issues through creating an informed citizenry.

Issue

Citizen awareness of environmental conditions in the Jamaica Bay watershed is reliant on research and scientific investigations to ascertain physical, ecological, and biological trends, as well as the effective broadcast of this information to citizens and stakeholders. The transfer of information necessary to allow stakeholders the ability to make good, informed decisions can be enabled through scientific conferences, organization of research efforts, and utilization of service learning opportunities for higher education.

Current Programs

Currently, there are at least a dozen active Jamaica Bay natural resource and ecological educational programs for people of all ages within the watershed. Offered by civic groups and New York City and state agencies, the educational opportunities vary from awareness raising and field trips to presentations and grant writing workshops. Information is available on several websites, including the JBRMIN website and the JBI website (www.nature.nps.gov/jbi/index.htm), which publish information about current research topics, scientific investigations, and scientific reports relating to the Jamaica Bay watershed. The JBI website contains summaries of current research efforts, and priority research needs in the watershed. The JBI organized and led a 2004 conference on the status and trends in the Jamaica Bay estuary.

Potential Management Strategy 5d1:

Organize a "State of the Bay" scientific symposium every two years to bring together researchers, academicians, civic groups, community members, resource managers and

agencies to coordinate and guide scientific investigations and report scientific findings related to the Jamaica Bay watershed.

There is already considerable momentum to build upon for developing the above strategy further. Jamaica Bay is currently an epicenter of research and scientific investigations for major academic institutions throughout New York City and Long Island, as well as the focus of ongoing research efforts by many federal, state, and City agencies. In addition, Jamaica Bay has been the subject of several targeted "research symposiums" in the last 6 years, beginning with the Blue Ribbon panel investigations on myriad salt marsh island research efforts, to a JBI March 2004 conference on the state of the Bay, to a recent "Borrow Pit Workshop" hosted at Stony Brook University in the summer of 2006, which brought together scientists and managers to compare research and discuss the borrow pits in the Jamaica Bay estuary. The formalization of a bi-annual "State of the Bay" conference would allow this type of information-sharing and coordination between the citizens and the scientific community to continue, and potentially compel more research efforts in the watershed. In addition, the symposium could be timed with the bi-annual *Jamaica Bay Watershed Protection Plan* update process.

Strategy Assessment Approach

The strategy assessment approach involves using the JBI's March, 2004 conference as a model for the development of the "State of the Bay" symposium. Discussions will be arranged with other governmental and non-governmental organizations to design and develop a symposium based on scientific investigations and the *Jamaica Bay Watershed Protection Plan*. This strategy will utilize the *Final Jamaica Bay Watershed Protection Plan* to determine potential symposium themes or agendas based on the issues, current efforts and necessary future actions as formalized in the *Jamaica Bay Watershed Protection Plan*.

If determined to be beneficial and feasible to organize a bi-annual scientific symposium based on the above approach, the appropriate partnerships, required resources and roles will be identified for the implementation of this strategy and different funding opportunities will be explored.

Potential Management Strategy 5d2:

Enhance and support university-led research programs and college-level student research related to the Jamaica Bay watershed.

University-based research efforts in the Jamaica Bay watershed are essential sources of information on the physical, ecological, and biological conditions in the Bay and upper watershed, and provide the foundation for wise management decisions by natural resources regulatory agencies. In addition, as slated ecological restoration projects in the Bay progress, university-led research efforts provide the best potential for continued active monitoring of these completed efforts, forming the basis of an adaptive ecological restoration strategy in Jamaica Bay. To ensure the continued interest in and funding for research efforts in Jamaica Bay, coordination between academic institutions and resource management agencies is essential. The "State of the Bay" symposium discussed in Management Strategy 5d1 above may provide a forum for that, but other opportunities should be recognized and capitalized upon. Securing public funding to drive these research efforts, and organizing and prioritizing potential research needs is necessary.

Strategy Assessment Approach

This strategy assessment approach is similar to the approach for 5b2 and it entails related communication and discussion with the JBI, the Education Coordinating Committee, and other related groups about JBI's Resources Library. The Resources Library already serves as a centralized information resource for past, current and future research related to the Bay. The focus of the assessment for this strategy includes discussions of how to improve access for university faculty and students to the Resources Library for their research needs and how to publicize existing research needs for faculty and students to take on as their own or as part of a team of researchers.

Potential Management Strategy 5d3:

Utilize service learning opportunities at higher education institutions and community organizations to create an informed citizenry.

Currently, there are at least a dozen active Jamaica Bay natural resource and ecological educational programs within the watershed. Offered by civic groups and New York City and state agencies, the educational opportunities vary from awareness raising and field trips to presentations and grant writing workshops. The purpose of this Management Strategy is to build upon these efforts by expanding the range of learning opportunities through active engagement in meaningful hands-on community service projects, where people of all ages gain skill and knowledge while exploring and discovering Jamaica Bay.

Strategy Assessment Approach

The strategy assessment approach will be to support these organizations by providing speakers, audio-visuals, literature, and promotional items related to floatable reduction, water quality, water conservation, stewardship of Jamaica Bay and other relevant environmental topics.

Objective 5e: Reduce polluting or damaging behaviors through community outreach and educational activities related to land use activities.

Issue

Littering, dumping, and vandalism occur in many urban communities, including those in the Jamaica Bay watershed. This can take the form of street litter, which ends up in the Bay via the storm drain system, or dumping refuse in open areas around in the watershed, creating an eyesore and degrading habitat. Water pollution from improper residential, commercial, or industrial waste disposal can end up in the storm drain system, and eventually drains to the Bay. Whether intentional or unintentional, these types of polluting behaviors can seriously degrade water quality and environmental conditions in the places that they occur. Anti-littering and anti-dumping campaigns, and education to promote the proper disposal of waste materials, can limit these types of destructive practices and help to remind residents that their actions have a direct influence on the condition of their local environmental resources. The proper placement of signage can often be used to great effect, in combination with public messages that discourage pollution.

Water use, landscaping practices, and energy use also have a direct impact on environmental conditions in the watershed. The more water that is used, the more treatment capacity must be provided by WPCPs prior to that water ending up in the Bay. In combined sewer areas, where treatment plant capacity is often exceeded, water conservation efforts can directly reduce the

amount of sewage entering the receiving waters of Jamaica Bay. The use of stormwater BMPs can also reduce the amount of water that ends up in the combined sewer system, and similarly affect water quality conditions. Through education and outreach, knowledge about how individual behaviors affect environmental conditions in the watershed, and recommendations for changing behaviors (through conservation and sound land use practices) to reduce the amount of impact can be passed along to watershed residents.

Current Programs

The NYCDEP will strengthen its ongoing public education and outreach program to promote stewardship of the Jamaica Bay area among residents and visitors. NYCDEP's public education program includes school programs, public education programs, volunteer programs, publications, promotional items, and a website that provides useful educational resources.

Public Education Programs: NYCDEP attends numerous outreach events during the year. Events are typically programmed upon request and include table top displays and outreach at fairs, festivals, and concerts, most of which are community based. Last year NYCDEP participated in community group events in the Jamaica Bay watershed that included presentations and table top displays at churches, professional associations, and the Boy Scouts, as well as events conducted at City parks and museums.

Volunteer Programs: NYCDEP leads and supports various volunteer cleanup and environmental programs. In 2006 the NYCDEP conducted two major volunteer cleanup events in the Jamaica Bay watershed and participated and contributed to additional initiatives by other organizations. These programs have a positive effect on the reduction of floatable litter through its physical removal and the environmental education messages inherent in these hands-on programs.

Publications: NYCDEP distributes or displays flyers, brochures, posters, and other publications at public outreach events. Most of this material is readily available on the NYCDEP website. Each piece of literature is targeted to a particular message, *i.e.*, water conservation, floatable litter prevention, etc.

Promotional Items: NYCDEP has developed numerous promotional items designed to communicate a targeted environmental message, *i.e.*, water conservation, floatable litter prevention, etc. and distributes hundreds of thousands of these items yearly.

NYCDEP Website www.nyc.gov/dep: The NYCDEP website constitutes one of the most accessible and far reaching portions of the NYCDEP public education program. The site has numerous pages and links that connect viewers to all manner of environmental education topics, including information on how New York City protects its water environment, pollution control programs, harbor water quality programs, floatable litter reduction, as well as information on how citizens can make a difference.

Street litter is tracked through the SLR system conducted by the Mayor's Office of Operations. In addition, the Litter Prevention Working Group (LPWG) represents one avenue for coordination among City, state, and federal litter prevention efforts.

New York City as a whole is also conducting a major city-wide anti-littering public awareness campaign; "STOMP Out Litter", a joint effort of the DSNY, the Mayor's Fund to Advance New

York City, and Waste Management, Inc., in conjunction with STOMP, the long-running New York hit theatre troupe, and Keep America Beautiful, the nationwide organization that sponsors beautification projects and mobilizes volunteers to achieve these goals. The campaign delivers its message through several methods, including print media, television and radio public service announcements, billboards, and posters, many featuring the cast of STOMP.

Finally, several volunteer cleanup and environmental programs have a positive effect on the reduction of floatables and litter, through the physical removal of litter and the hands-on environmental education messages inherent in these programs.

Potential Management Strategy 5e1:

Create a targeted campaign for developers, residents, and business owners to provide information about how to protect Jamaica Bay through on-site stormwater management techniques, wise use of household chemicals, water conservation, and energy conservation measures.

Educating businesses and residents in the watershed about sustainable water use, sustainable energy use, and low impact development can bring about reductions in the amount of pollutants entering the Bay, and savings in energy and water utility costs. Framing this type of educational campaign as both a long-term cost savings to businesses and residents, as well as a positive environmental action, will make these type of volunteer-based efforts more attractive (see also Objective 4c). Disseminating information about the methods to be implemented (including water and energy conservation techniques, proper disposal of toxic materials, invasive species management, landscaping techniques, and stormwater management techniques), the environmental and economic benefits (including taxpayer savings related to overall infrastructure costs, ratepayer savings for utilities, increased property values, enhanced community features, and improved overall watershed conditions), and providing a list of resources to further aid the individual, requires coordination between many City agencies, including the Mayor's Office of Sustainability, NYCDDC, and NYCDEP. This approach is meant to complement and provide the public education aspect to many of the Sound Land Use Objectives articulated in Category 4.

Strategy Assessment Approach

The strategy assessment approach involves the review of successful outreach campaigns in New York City and beyond. The Division of Pollution Prevention and Monitoring within the Bureau of Wastewater at the NYCDEP has made tremendous progress in the development of BMPs for the automotive industry. The BMPs being studied include workplace placards designed to educate workers on good housekeeping practices and provide establishments with literature that explain in greater detail the damage to the environment. BMPs will focus on key areas of concern such as chemical storage, facility upkeep, and typical daily operations in an effort to prevent or reduce impacts to from contaminated stormwater runoff. NYCDEP works with representatives of automotive associations and a Citizens Advisory Committee (CAC). The NYCDEP has taken a proactive approach in implementing anti-pollution strategies and projects that are cost effective, publicly accepted, and environmentally sound.

However, the further development and implementation of Management Strategy 5e1 is largely dependent on the results of the *Jamaica Bay Watershed Protection Plan* development process; this strategy entails utilizing the *Final Jamaica Bay Watershed Protection Plan* to formalize issues, current efforts, and necessary future actions related to water and energy conservation, on-

site stormwater runoff management, household chemicals, lawn care, invasive species, and related issues.

If determined to be feasible and beneficial, a variety of implementation strategies will be explored, including the use of existing outreach materials available from NYCDEP and other agencies, as well as the development of additional outreach materials as needed. These materials would be designed to touch upon a variety of issues to raise awareness among different target audiences about environmental sustainability in the Jamaica Bay watershed.

Potential Management Strategy 5e2:
Develop an expanded grease remediation program.

Grease is a byproduct of food preparation, and represents a source of pollution to Jamaica Bay, contributing to high levels of eutrophication and low dissolved oxygen. In addition, grease can coagulate in pipes, and restrict flow or cause blockages, causing maintenance problems for individual property owners and the City. One way of preventing grease discharges into our sewer systems is utilizing grease traps. Grease traps are devices that are installed in the waste line leading from sinks and floor drains of restaurants, kitchens, cafeterias, or other establishments where grease can be introduced into the sewer system. The primary purpose of grease traps is to prevent discharge and buildup of grease in the sewer system, thereby reducing the potential for clogging.

In May 2000, NYCDEP initiated the Grease Response Education and Enforcement Program in order to reduce the amount of fat, oil and grease discharges from food service establishments from entering the sewer system. This program approaches the problem with a combination of enforcement actions and public outreach and educational efforts, including foreign language materials which are distributed to restaurants. Educational efforts include trade show appearances, Community Board and other public meetings, direct mailings, informational hand outs, and NYCDEP website postings. Residential grease discharge is also a problem. NYCDEP distributes leaflets and promotional items reminding the public not to pour grease down the drain.

Strategy Assessment Approach
To address the problem of residential grease discharge, NYCDEP will investigate the development of an expanded grease disposal education program to reach out to residents via leaflets and promotional items. The focus on residents will complement the ongoing commercial grease trap education and enforcement program described above. Additional residential promotional items would also be investigated, such as free containers in which used cooking oil and grease could be deposited for disposal in the solid waste stream, thus preventing the accumulation of grease in the sewer system.

Potential Management Strategy 5e3:
Heighten public awareness through a "Don't Dump, Drains to Jamaica Bay" message affixed to curb inlets, storm drains, and catch basins.

Many municipalities that exist next to environmentally-sensitive areas, including major cities in the Chesapeake Bay, San Francisco Bay, and Puget Sound watersheds, to name just a few, affix signage to curb inlets, storm drains, and catch basins to remind residents not to dump household or industrial waste directly into the storm drain system. This type of public awareness program

has been proven to effectively reduce the amount of liquid and solid wastes that end up in receiving waters. NYCDEP has designed a similar program for New York City and, as a result, NYCDDC has begun the gradual installation of the message - "Dump No Waste, Drains to Waterways" - next to the image of a fish on catch basin curb pieces. The message is installed during catch basin repair and curb reconstruction projects; consequently, the installation of the message on the City's 130,000 plus catch basins will occur over time per repair and reconstruction schedules. Painting the above message on catch basins was identified as a potential strategy to expedite communication of this issue and implant a heightened awareness of their relationship to the Bay and its watershed in the public.

Strategy Assessment Approach

The strategy assessment approach involves discussions of specific issues of concern (including public safety and the temporary lifetime of paint used in previous efforts) among various agencies related to printing anti-dumping messages on catch basin curb pieces.

If determined to be beneficial and feasible to implement temporary messages on a faster timeline than cast installations, various implementation strategies and funding opportunities will be explored. NYCSWCD has previously implemented a similar program with federal and state cost-sharing assistance; therefore, appropriate partnerships, required resources and roles will be identified to assist with the implementation of this strategy.

Potential Management Strategy 5e4:

Continue the long-term anti-littering campaign in schools, on the streets, with waterfront properties, and in public service announcements.

Street litter has been identified as a primary source of floatable debris in receiving waters. During rain events, street litter is washed through storm drains into the sewer system and can be discharged through CSO and storm sewer outfalls. Based on the SLR system through which the Mayor's Office of Operations tracks city-wide cleanliness, New York is the cleanest it has been in over 30 years. Continued support of litter prevention public education campaigns and cleanliness tracking will help the City maintain such cleanliness and reduce the discharge of floatables.

Strategy Assessment Approach

In addition to the citywide anti-littering public awareness campaign described under Objective 5e, NYCDEP will also continue to work with other agencies on citywide litter reduction strategies as part of the LPWG. Finally, NYCDEP will also support litter prevention public education campaigns by providing speakers, audio-visuals, literature, and promotional items related to floatable reduction, water quality, water conservation, stewardship of Jamaica Bay, and other relevant environmental topics.

Objective 5f: Increase the number of volunteers throughout the watershed by promoting volunteer opportunities in a coordinated manner and by providing meaningful volunteering experiences.

Issue

Some citizens learn most effectively and become more engaged in watershed protection not through efforts aimed at "teaching" them but through active engagement in the landscape. By

using their hands and feet and physically laboring in the areas they care for, they gain knowledge that they would never absorb from traditional learning methods. They also gain visceral connections with the landscape and solidify their commitment to it in ways which can modify their everyday practices toward greater resource conservation and protection. This Objective aims to expand upon existing programs and introduce new venues and opportunities for volunteering, including volunteer public landscape restoration and development, participation in service learning opportunities, and volunteering service-sector expertise toward *Jamaica Bay Watershed Protection Plan* efforts.

Current Programs

The following programs currently provide volunteer services to advance the environmental restoration, protection, or enhancement of the Jamaica Bay watershed:

- *American Littoral Society, Jamaica Bay Guardian:* Sponsors Operation Jamaica Bay Clean Sweep (removal of derelict boats from shoreline) and beach clean-ups; conducts wildlife censuses for the National Park Service.
- *Bay Improvement Group:* Maintains three community gardens; organizes clean-ups and sweep-ups of the waterfront and adjacent communities.
- *Friends of Gateway, Gateway Greenhouse Education Center at Floyd Bennett Field:* Oversees a volunteer program to cultivate trees, shrubs, and plants for New York City's public spaces; conducts beach clean-ups.
- *Jamaica Bay Watershed Alliance:* Hosts community clean-ups, tree planting programs to prevent runoff, and stewardship activities for school children.
- *Norton Basin/Edgemere Stewardship Group:* Conducts clean-ups of the wetland area at the edge of Norton Basin; maintains the small strip of land running along the South Shore of Norton Basin.
- *Salt Marsh Alliance:* Provides support for the Salt Marsh Nature Center in the form of volunteer labor (building maintenance, trail patrol, litter and graffiti clean-up, and repairs) and provision of supplies and equipment.
- *VolunteerNYC.org:* Committed to opportunities in the NYC region for volunteering.
- *New York Restoration Project:* Partners with individuals, community-based groups, and public agencies to reclaim, restore, and develop under-resourced parks, community gardens, and open space in New York City, primarily in economically disadvantaged neighborhoods.

Potential Management Strategy 5f1:

Work with City agencies and public interest groups to publicize volunteering events and opportunities.

Recruiting volunteers and effectively using volunteer labor is entirely dependent on the ability to interest and attract potential volunteers to participate in designated activities. In conjunction with Objective 5b, which outlines various methods for improving coordination and outreach among Jamaica Bay stakeholders, a more effective medium must be developed to effectively harness volunteers and allocate their time in meaningful ways. Probably the best opportunity is through the development of a centralized website or other community portal that has the ability to provide outreach to the citizens in Jamaica Bay communities, as presented in Management Strategy 5b1, as well as the formation of a Coordinating Committee to recognize the needs for volunteer labor and effectively allocate resources.

Strategy Assessment Approach

The strategy assessment approach for this strategy is similar to the approach for Management Strategy 5b1. Both involve discussions with education and outreach groups (such as JBTF, JBRMIN, and others) to discuss a mechanism for disseminating messages and encouraging community groups to interact, network and promote opportunities to participate in the restoration of Jamaica Bay. Meetings will continue between NYCDEP's Bureau of Communications and Intergovernmental Affairs and the above mentioned organizations, as well as other agencies which frequently rely on volunteers, to implement agency programs to work more closely and coordinate volunteering programs and events.

Potential Management Strategy 5f2:

Continue support for community, environmental advocacy, and volunteer groups to remove litter and other debris from accessible shoreline sites as well as upland areas.

Volunteers can be very effective at helping to remove debris and floatables that get washed onto the shoreline around Jamaica Bay, or keeping upland areas litter-free. Several on-going volunteer programs in New York City address litter-control issues (see Objective 5e), but there may be opportunities to augment these programs in the Jamaica Bay watershed (see Management Strategy 5e5).

Strategy Assessment Approach

In 2007, NYCDEP will be working with the DSNY in an interagency partnership to support volunteer clean up efforts. Every year, from April to October, under the support of the DSNY, volunteers conduct clean-up projects in their blocks, neighborhoods, and boroughs. Community groups, block associations, merchants associations, and concerned citizens contact the DSNY to reserve cleaning tools, such as brooms, rakes and shovels, which the DSNY makes available in short-term loans. After a clean up, DSNY promptly collects and removes the bagged waste. The program can be promoted to similar volunteer groups in the Jamaica Bay watershed, to assist them in taking advantage of the resources that are available under the clean up program.

In addition, NYCDEP will continue to organize and support multiple beach cleanups each year and provide the heavy equipment needed to help communities clean up large debris on their beaches.

Potential Management Strategy 5f3:

Provide opportunities for public involvement in watershed protection through hands-on community service projects.

As part of the development of an ecological restoration project at Paerdegat Basin, NYCDEP will implement a 6 acre Ecology Park designed to showcase many of the ecosystems present within New York City and enable a close-up view of these communities. The NYCDEP expects the Ecology Park to be an important environmental tool in helping area residents to gain an understanding of the many ecosystem types found within New York City and the important role the residents have in maintaining a delicate ecosystem. The park may be considered a timely educational resource given that volunteers are increasingly needed to complete ecological restoration projects and, particularly, to aid in labor-intensive tasks, such as beach grass planting or the planting of wetland plugs. This can reduce the costs associated with restoration, and simultaneously provide a hands-on learning experience for the volunteers. Several public interest

and research organizations within the watershed are presently organized to enable these types of volunteer services, or volunteer labor could be developed as part of a discreet restoration project in conjunction with the project team.

Strategy Assessment Approach

The strategy assessment approach involves discussion with DSNY, NPS, and NYCDPR about working more closely with these organizations and sharing volunteer efforts. As restoration projects become active, discussions with project partners will identify potential volunteer opportunities within the scope of the project. In addition, NYCDEP will continue to support these organizations' efforts by providing speakers, audio-visuals, literature, and promotional items related to floatables reduction, water quality, water conservation, stewardship of Jamaica Bay and other relevant environmental topics.

Potential Management Strategy 5f4:

Provide opportunities for urban plantings and creating landscapes that are community-organized and administered (such as community gardens).

Community gardens reclaim open space and use it for community needs, including food production and education. They encourage the "greening" of the urban landscape, and increase the environmental sustainability of a neighborhood. The New York City Community Gardens Coalition is an organization dedicated to maintaining a cooperative between communities to enhance the experience by sharing in techniques, plant medium, and fun. The Coalition is also dedicated to converting open space to gardens. There may be opportunities to foster the development of additional community gardens in the watershed by increasing the level of communication between City agencies and existing community garden clubs such as the Community Gardens Coalition, and making additional public resources available to them.

Strategy Assessment Approach

The strategy assessment approach involves continued meetings with NYCDEP's Bureau of Communications and Intergovernmental Affairs and organizations such as DSNY, NPS, and NYCDPR. A stewardship mapping pilot project, including potential community garden locations, will be arranged. In addition, NYCDEP will continue to support these organizations' efforts by providing speakers, audio-visuals, literature, and promotional items related to floatable reduction, water quality, water conservation, stewardship of Jamaica Bay and other relevant environmental topics.

CHAPTER 8 – CATEGORY 6, COORDINATION & IMPLEMENTATION

Chapters 3 through 7 describe specific objectives and potential management strategies targeted at the improvement of water quality, ecological conditions, and human uses of the landscape throughout the Jamaica Bay watershed. The successful execution of many final recommended strategies will require effective interagency coordination within New York City government, as well as collaboration with state and federal agencies, academic institutions, public interest groups, and community interests. Category 6: *Coordination and Implementation* will deliver the framework for the coordination of relevant stakeholders and agencies to implement the *Jamaica Bay Watershed Protection Plan*.

Currently, there is mutual interest in environmental improvements within Jamaica Bay; existing partnerships and collaborations among the range of entities engaged in environmental research and management in Jamaica Bay are already occurring. An example of this is the salt marsh restoration projects in the Bay interior, the result of successful collaboration between USACE, NYSDEC, NPS, NYCDEP, and a host of academic institutions and citizen groups. Additionally, as part of the develop of the *Jamaica Bay Watershed Protection Plan*, NYCDEP has been reaching out to other agencies, engaging them in the planning process, and identifying mechanisms by which coordination could be further leveraged to implement the potential management strategies.

Full development of interagency coordination and *Jamaica Bay Watershed Protection Plan* implementation methods cannot occur until the specific management strategies articulated in Chapters 3 through 7 are fully evaluated and prioritized. However, some preliminary objectives for improving coordination and ensuring implementation of the *Jamaica Bay Watershed Protection Plan* were developed as a result of interagency and public meetings held to date, and existing models of successful collaboratives in the New York City area. For example, a future "Jamaica Bay Collaborative" established specifically to coordinate the implementation of this *Jamaica Bay Watershed Protection Plan* could be modeled after, or incorporated into, the NY/NJ HEP which provides a working example of multi-agency coordination within the jurisdiction of our region. Using the NY/NJ HEP as a template, a "Jamaica Bay Collaborative" composed of federal (USEPA, USACE, NPS, NOAA, USFWS), state (NYSDEC), and City (NYCDEP, NYCDOT, NYCDDC, NYCDPR, NYCDCP) agencies with jurisdiction and interest in the Bay and its watershed, as well as non-governmental organizations such as the JBTF, American Littoral Society, Ecowatchers, and the NYC Audubon Society, could be formed. Or, the collaborative could introduce Jamaica Bay Watershed Management Strategies into existing NY/NJ HEP work groups such as toxics, habitat, nutrients, or others as appropriate, to monitor the implementation of specific strategies and adapt the strategies based on feedback from Jamaica Bay's ecological system.

The *Jamaica Bay Watershed Protection Plan* development team has submitted suggested additions to the Mayor's OEC for the pending revision of the *CEQR Technical Manual*. The objective is to assist the lead agency to determine whether a proposed project's location is within the watershed and provide guidance as to how to develop the project with minimal impact to the Bay. The suggested revisions incorporate guidance related to land conversions and impervious surfaces, enhanced stormwater runoff capture based on site characteristics such as soil type, and

landscaping with non-invasive species, as just a few examples. NYCDEP will continue to work with OEC on such guidelines to determine the feasibility and benefits of inclusion in the revised manual.

As part of implementation and coordination it would also be recommended that the existing Education Coordinating Committee formed as a result of the *Jamaica Bay Watershed Protection Plan* development process continue its efforts beyond K-12 in-school curricula to collaboratively implement other recommended management strategies intended to promote environmental stewardship through enhanced education opportunities, such as out-of-school programs and professional development opportunities for teachers.

The recommendations of the *Final Jamaica Bay Watershed Protection Plan* will require tough decisions to be made about commitments, future leadership of Jamaica Bay planning, and funding of programs and staff. Many of the potential management strategies will need additional and extensive information before they can be properly evaluated and recommended for implementation. Cost estimates for each potential strategy will need to be developed. When comparing costs to potential benefits, the evaluation exercise may be a subjective one at best. Also related to costs, the strategies that might be recommended in the *Final Jamaica Bay Watershed Protection Plan* will require new funding. Other than the potential for funding for those strategies that might link with the goals of the Mayor's Office of Sustainability and Long-term Planning, funding streams are uncertain. This will be the case for NYCDEP and other local, state and federal agencies that might be involved.

Between this *Draft* and the *Final Jamaica Bay Watershed Protection Plan*, the above coordination and implementation objectives as well as others included in the preceding chapters of this *Draft Jamaica Bay Watershed Protection Plan* will be discussed with the necessary participants, and implementation approaches for each will be identified.