C H A P T E R F O U R

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

INTRODUCTION AND ISSUES IDENTIFICATION

There are two wetland assemblages in the Jamaica Bay watershed, salt marshes and freshwater wetlands. Freshwater non-tidal wetlands are typically found in depressions where surface runoff or over bank flooding from streams or rivers collects for extended periods of time, or where ground water intersects the land surface. Historically, several types of freshwater wetlands occurred throughout the watershed, including deep marsh, shallow marsh, shrub swamps, lowland swamp forest, upland swamp forest, and wet meadow (Mockler, 1991).

Prior to Euro-American settlement, it is estimated that there were about 16,000 acres of salt marsh in Jamaica Bay (USFWS, 1997, see Volume 1 of the JBWPP, Figure 4.3.1). At first, salt marshes were used by the settlers as pasturelands for livestock. Later, as farming was replaced by manufacturing in the New York City region, salt marshes were filled with debris and then later developed. Large areas of salt marsh were filled with garbage and converted to landfills, which were subsequently converted to parks and commercial and other private uses. As of 1971, only about 4,000 acres of salt marsh remained in the Bay (National Academy of Sciences and National Board of Engineering, 1971).

From a habitat standpoint, as well as an economic perspective, the Jamaica Bay salt marshes are critical for three groups of animals: shellfish, finfish, and waterfowl. Several species of invertebrates including fiddler crabs and ribbed mussels spend essentially all of their lives in the salt marsh. Numerous fish species spend all or part of their lives in or around the salt marsh. Mullet and menhaden feed and mature in shallow waters at high tide. Striped bass and shad pass by salt marshes from the ocean on their way to rivers to spawn. Large numbers of waterfowl and other birds use the salt marsh during their spring and fall migrations, and some stay for the summer to nest.

Over the years, a significant amount of effort has been taken to identify potential ecological restoration locations around Jamaica Bay. To further enhance existing open spaces, a Jamaica Bay restoration and conservation project inventory was undertaken. This inventory is summarized in Volume 1, Chapter 4.11 of the Watershed Protection Plan and shown in Volume 2, Figure 4.6 later in this document. Substantial ground verification efforts and outreach to the many responsible groups will be required to determine the present status of the previously identified restoration or conservation projects. Figure 4.6 highlights the project locations within the watershed, the implementing authority, and the current status of development based on literature searches. As observed, there are numerous land protection and restoration projects spanning the perimeter and interior of the Jamaica Bay estuary, with multiple entities engaged in ecosystem restoration and land protection. The inventory was developed based on a review of available publications and the input of key stakeholders in the watershed, but has recognized data gaps. Thus, it is still considered to be in “Draft” format, but is potentially a key starting point to begin to prioritize past inventory restoration exercises. Substantial ground verification efforts and outreach to the many responsible groups will be required to determine the present status of identified restoration or conservation projects. The JBWPP encourages the use of this map to assess the current potential for restoration. The status of funding for the various projects

should also be evaluated. The refinement of the Jamaica Bay Conservation and Restoration Project Inventory will allow effective coordination between the entities involved in ecosystem conservation and restoration in Jamaica Bay, and the prioritization of remaining sites to occur.

Federal, state, and city agencies, as well as local environmental groups, have been very active in restoring and preserving open spaces along the shoreline of Jamaica Bay and, to a lesser degree, portions of the upland watershed. However, the upland portion of any watershed plays a key role in its ability to help buffer and protect the health and ecological functions of receiving waterbodies by controlling runoff and filtering upland pollutants before they are dispersed downstream. To address these issues, typical watershed management plans include measures to protect stream corridors, riparian forest buffers, freshwater wetlands and other types of open space designed to preserve the ecological health of the watershed and the receiving waterbodies. In the case of Jamaica Bay's watershed, many of these natural features have been developed and a very small percentage of those original protective natural processes that function at a high rate of attenuation remain within the watershed. Significant habitat complexes have been fragmented and displaced; measures must then be developed to accommodate the highly developed and populated watershed of Jamaica Bay in an environmentally-sustainable manner.

Significant steps have been taken by the NYCDEP to address some of these important watershed issues. Over the last five years, projects have been implemented that provide significant ecological benefits today and for future generations. Additional projects by NYCDEP are currently in the design phase and are expected to be implemented within the next two years. NYCDEP is actively designing and restoring complex environmental restoration projects along the perimeter of Jamaica Bay that will provide access to public open spaces, create additional wildlife habitat and in some cases provide stormwater management elements to improve water quality. The substantial and varied ecological benefits provided by each of these projects will further remediate the harmful effects of past land use activities.

This chapter addresses the following two major objectives:

1. Restore salt marsh islands in the Bay, and
2. Preserve and enhance natural areas along periphery of the Bay and watershed.

OBJECTIVE 2A: RESTORE THE SALT MARSH ISLANDS IN JAMAICA BAY

Current Programs

A pilot restoration project was initiated by NPS in 2003 on the two acre Big Egg Marsh. Using an innovative technique known as "thin-layer" sediment spraying to raise the salt marsh elevation, the project has been deemed successful as 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) that was funded by multiple agencies, including NYCDEP, was completed at Elders Point East in 2006. This restoration will provide additional information on appropriate salt marsh restoration techniques and viability for application to other sites as monitoring data is compiled and analyzed. Additional restoration of Elder's Point West and

potentially Yellow Bar, which is also expected to be funded by a multi-agency partnership, is scheduled to begin during the summer of 2008. In addition, 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.

Management Strategy 2a1: Prioritize the restoration of additional salt marsh islands (Black Wall, Ruler's Bar, Duck Point, etc.).

STRATEGY DESCRIPTION

It has been estimated that at the time of European settlement, Jamaica Bay originally contained approximately 16,000 acres of perimeter and interior wetlands of smooth cordgrass (*Spartina alterniflora*), a primary flora of vegetated tidal wetlands. Along the perimeter, an estimated 12,000 acres have been lost to dredging and fill placement, mostly within the last century. However, in recent years, observations have indicated that the interior salt marsh islands have been disappearing at an increasing rate.

The following information taken from the Jamaica Bay Improvement Commission Report (1907) provides a snapshot of some of the conditions of Jamaica Bay in 1907:

- 4,200 acres of salt marsh islands within the Bay;
- Rockaway Peninsula was primarily low sand dunes with potential for over-wash from ocean;
- Rockaway Inlet was deep (~50');
- 450,000 tons of oysters harvested annually;
- Tidal exchange of nearly 24 billion gallons two times a day;
- Rockaway Peninsula was 16,250 ft (>3 miles) shorter and grew at a rate of 232 ft per year from 1835 through 1905; and
- Population within watershed less than 350,000.

The ecological restoration and enhancement of salt marsh island wetland complexes within Jamaica Bay is important in sustaining and supporting the many varied ecosystems that exist within the Bay. A principle determining factor in the development of a watershed protection plan for Jamaica Bay has been the unexplained loss of the interior salt marsh islands. There is consensus among all parties that the salt marsh islands within Jamaica Bay are disappearing and that the loss has accelerated over the years. However, despite an active ongoing research effort, the exact mechanism of salt marsh island disappearance has not yet been identified; many theories have been put forth, no single cause has been identified that can adequately explain the loss. While additional research efforts are required to identify the exact causes of salt marsh loss a prioritization of the potential restoration efforts of remaining wetland islands is essential. Defining these priorities is not only critical to their long term success but is also important in allocating scarce resources in the most cost-effective manner to achieve the goal of establishing stable wetland complexes.

Future restoration actions must continue to minimize these losses while recognizing that the reasons for wetland loss are varied and evolving, and that the prioritization of restoration projects must be able to adapt and incorporate new information as it becomes available. Therefore, to help with the prioritization of future salt marsh island restoration efforts, an analysis of the current state of each salt marsh island and the potential for successful restoration efforts at each location is necessary. This analysis provides the framework to begin the "triage" of the islands to determine where best to focus efforts given the limited resources within the region, and to provide the most ecological benefit.

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. The evaluation and prioritization of the salt marsh island restoration efforts needs to be accomplished through a review of past studies and restoration efforts and how these are applicable in balancing potential immediate opportunities with the desire to provide the greatest restoration efficiency and sustainable benefit.

ANALYSIS OF WETLAND LOSSES

At least two attempts to quantify the wetland loss within the Bay have been completed. One study was undertaken by the NYSDEC in 2001 and another more recent study was completed by the Jamaica Bay Advisory Committee in 2007. While both studies concluded that wetland loss is occurring at an accelerated rate, the reference material (*e.g.*, high resolution aerial imagery), analysis tools and methods and the years evaluated to calculate wetland loss for each study are different. Therefore, a direct comparison of the conclusions from these separate studies is not possible and is not inferred by this report. They are provided below for reference purposes only. To place Jamaica Bay in context of other regional wetland issues, the analysis below begins with a discussion of wetland losses found in other areas of New York State.

Wetland Losses in Other Locations

The NYSDEC has been researching and monitoring wetland loss in other locations of New York State, including estuaries in Nassau and Suffolk Counties, Long Island. These monitoring efforts were developed by the NYSDEC to evaluate the effectiveness of the existing wetland regulations. The areas evaluated include the following:

- Manhassett Bay
- Nissequogue River
- Stony Brook Harbor
- Flax Pond
- Mount Sinai Harbor.

While there have been smaller total observed losses of wetland acreage in these areas, the rate of loss has ranged from 0.091 acres per year to a high of 1.86 acres per year, with an average loss of 0.650 acres per acre of wetland complexes, slightly less than that of Jamaica Bay. The data collected for these sites is incomplete in terms of the measurements taken in 1994 and 1999. That is, a measurement was not always recorded for each site in each of the assessed years. Therefore, an uninterrupted analysis of the actual rate of loss for the referenced period is difficult to ascertain. While the total loss over the 25-year period is less than that of Jamaica Bay, it is worth noting that these wetlands are disappearing in a non-eutrophic system. It is also worth noting that other wetland

systems in the region have been expanding inland over the last 20 years. For example, Shinnecock Bay and Moriches Bay on the eastern end of Long Island have gained 161 acres and 100 acres of tidal wetlands, respectively, from 1974 to 1995 as a result of landward movement of the tidal wetland systems. This inland migration of wetland systems is severely constrained within the Jamaica Bay environment and this is not a viable option for potential wetland expansion

In the wetland systems that have sustained losses, according to the NYSDEC, the reasons for the loss are speculative in many cases, but the leading causes include, *"wave energy, erosion, sand accretion, sediment budget disruption, subsidence, dredging and sea level rise. The loss of wetlands to permitted and unpermitted human activities was too small to be detected. The main cause of wetlands destruction has shifted from human caused factors such as filling to natural factors such as storms and flow restrictions."* In addition, in many of these locations, direct disturbance (*e.g.*, dredging) or other alterations are not apparent and loss continues to occur.

NYSDEC Wetland Analysis of Jamaica Bay

Unlike the previous sites, NYSDEC and others have observed significant wetland loss within Jamaica Bay. NYSDEC's analysis revealed that between 1867 and 1924 *Spartina alterniflora* (smooth cordgrass) coverage within the Bay varied slightly (±10 acres per year) but there was no overall observed trend (*i.e.*, no long term loss or accretion) during this time. Nor'easters and the occasional hurricanes would destroy portions of the wetlands but these areas would eventually recover during less active meteorological periods. According to the NYSDEC study, more significant changes to the wetland ecosystem appear to have occurred during the period from 1924 to 1974 (Figure 4.1). During this time, 780 acres of wetlands were lost to direct filling and another 510 acres were lost due to unknown reasons, for a loss rate of slightly more than 10 acres per year. The study also showed that between 1974 and 1994 a total of 526 acres were lost to unknown reasons, for a loss rate of slightly more than 26 acres per year. The final assessment period was from 1994 and 1999 where the observed losses were a total of 220 acres, for a loss rate of 44 acres per year. The NYSDEC analysis stated that additional research was required to explain the significant wetland losses, but did include sediment budget disruption, sea level rise, dredging, wave energy, erosion, inlet stabilization, mussel dams and eutrophication as potential contributing factors. Since the writing of that report, the importance of mussel dams as a contributing factor in wetland loss has diminished.

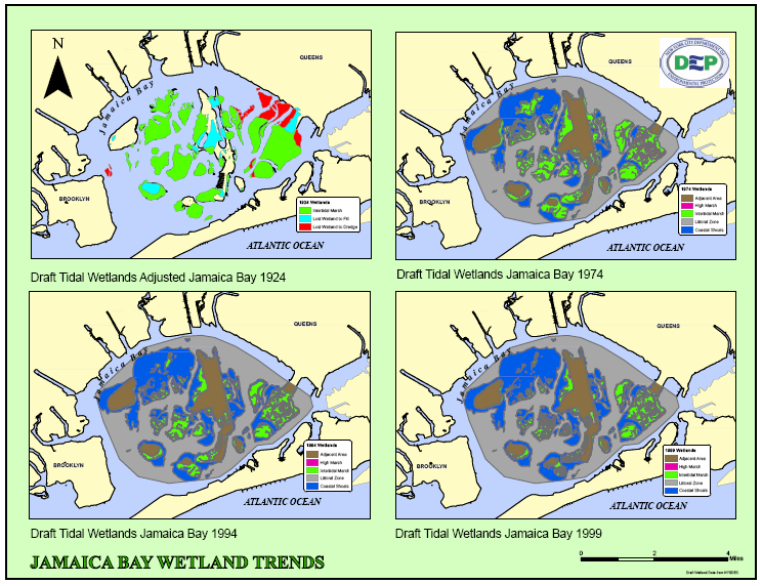

FIGURE 4.1 Trends in Jamaica Bay wetlands losses, 1924-1999

Using GIS data obtained from NYSDEC for the 2001 wetland analysis, a summary of the wetland loss for each salt marsh island complex is shown below.

TABLE 4.1. Wetland Losses in Jamaica Bay Between 1974 and 1994 (Data Source: NYSDEC)

Wetland Complex	1974 GIS Analysis (ACRES)	1994 GIS Analysis (ACRES)	Wetland Loss (ACRES)	Percent Of Wetland Loss	Orientation of Most Loss
Elder's Point	98	29	69	-70.4%	North and southwest
Duck Point	112.8	42.2	70.6	-62.5%	North
Pumpkin Patch	50.3	18.3	32	-63.6%	Northeast
Nestepol	8.8	0.63	8.17	-92.84%	Gone
Stony Creek	83.8	46.03	37.77	-45.07%	North and west
Yellow Bar	180.2	146.4	33.8	-18.76%	No trend
Black Wall	41.8	35.4	6.4	-15.31%	Slight north
Rulers Bar	17.9	7.8	10.1	-56.42%	Slight north and east
Black Bank	158.5	107.5	51	-32.18%	West
Little Egg	122.5	81.2	41.3	-33.71%	Southwest and northeast
Big Egg	78.4	60.0	18.4	-23.47%	North
Jack's Hole	125.1	50.8	74.3	-59.39%	North
East High	136.02	73.8	62.22	-45.74%	North and southeast
Joco Marsh	361.03	212.7	148.33	-41.09%	Slight north (center)
Silver Hole	112.7	60.0	60.0	-46.76%	Slight north (center)
Winhole Hassock	6.43	1.6	4.83	-75.12%	North
East Island (Perimeter)	23.4	19.54	3.86	-16.50%	Northeast
Canarsie Pol (Perimeter)	48.1	22.6	25.5	-53.01%	North and southwest
Ruffle Bar (Perimeter)	55.3	26.0	29.3	-52.98%	North (slight center)
Total	1,821.08	1,050.5	770.58	-42.3%	

A review of these data indicates that there is substantial variability among the wetland complexes with respect to their average yearly relative rate of loss. Joco Marsh appears to have the highest rate of loss at 5.93 acres per year and Black Wall having the lowest among the salt marsh island complexes at 0.256 acres per year. Black Wall also has one of the lowest percentages of total loss over the referenced 25-year period, at 15.31% and a total loss of 6.4 acres, while Joco Marsh has lost 41% of total wetlands at nearly 149 acres.

TABLE 4.2. Average Wetland Loss Rate (Data Source: NYSDEC)

Wetland Complex	Avg. Loss Rate per year	Orientation
East Island (Perimeter)	0.154	North and South west
Winhole Hassock	0.193	North
Black Wall	0.256	Northeast
Nestepol	0.327	Gone
Rulers Bar	0.404	North and west
Big Egg	0.736	No trend
Canarsie Pol (Perimeter)	1.020	Slight north
Ruffle Bar (Perimeter)	1.172	Slight north and east
Pumpkin Patch	1.280	West

TABLE 4.2. Average Wetland Loss Rate (Data Source: NYSDEC)		
Wetland Complex	**Avg. Loss Rate per year**	**Orientation**
Yellow Bar	1.352	Southwest and northeast
Stony Creek	1.511	North
Little Egg	1.652	North
Black Bank	2.040	North and southeast
Silver Hole	2.108	Slight north (center)
East High	2.489	Slight north (center)
Elder's Point	2.760	North
Duck Point	2.824	Northeast
Jack's Hole	2.972	North and southwest
Joco Marsh	5.933	North (slight center)

Jamaica Bay Advisory Committee Wetland Analysis of Jamaica Bay

Like the NYSDEC evaluation of wetland losses within Jamaica Bay, The Jamaica Bay Advisory Committee Wetland Analysis of Jamaica Bay lists sediment deprivation, hardening of shorelines, eutrophication, the extension of Rockaway Peninsula, stabilization of Rockaway Inlet, bathymetry and tidal circulation as potential contributing factors to wetland losses within the Bay. The main difference between this report and the previous NYSDEC study is the review of more recent higher resolution (post-2003) aerial photography and satellite imagery to determine the actual total salt marsh island acreage and the actual salt marsh island loss within the Bay The Jamaica Bay Advisory Committee Wetland Analysis of Jamaica Bay provides an updated and accurate representation of salt marsh island losses within the Bay.

TABLE 4.3. Jamaica Bay Wetlands Acres (Data Source: JBAC, 2007)					
	East High	**Yellow Bar**	**Black Wall**	**Elders Point**	**Pumpkin Patch**
1951 Analysis (Acres)	155	184	46	142	88
1974 Analysis (Acres)	125	131	37	50	24
1989 Analysis (Acres)	90	117	29	20	19
2003 Analysis (Acres)	57	93	25	11	12
2005 Analysis (Acres)	34	80	12	11	7

The average rate of loss during the period from 1951 through 2003 ranged from a low of 0.33 acres per year in 1989 at Pumpkin Patch to a high of 4 acres per year in 1974 at Elder's Point (Table 4.4). Generally, the average loss rate per year of these wetland complexes has declined since 1974, with the exception of East High which has seen nearly a two-fold increase in loss rate. As indicated above, the period from 2003 to 2005 is shown as having substantial losses far greater than in previously referenced periods.

Prior to the summer 2006 restoration of Elder's Point, 131 acres of the original 142 acres had been lost through 2005 and 34 acres of the original 46 acres of Black Wall had been lost.

TABLE 4.4. Jamaica Bay Wetland Losses (accrual/year), 1974-2005

Wetland Complex	Avg. Loss Rate Per Year				
	Baseline	1974	1989	2003	2005
East High	155	1.30	2.33	2.36	11.50
Yellow Bar	184	2.30	0.93	1.71	6.50
Black Wall	46	0.39	0.53	0.29	6.50
Elder's Point	142	4.00	2.00	0.64	0.00
Pumpkin Patch	88	2.78	0.33	0.50	2.50

Challenges in the data interpretation include the various yearly natural and anthropogenic fluctuations that are not readily observed. Major changes within the watershed, the Bay (*e.g.* dredging channels) and significant meteorological events have likely played a significant role in earlier marsh building and marsh destruction. During quiet meteorological years, wetland systems are able to gain acreage, and in years of above normal events the wetland acreage is usually lost to wave and wind erosion. To accurately detect the likely variable yearly changes and develop potential correlations to significant events within the watershed (*e.g.*, eutrophication and development) and meteorological events prior to 1974 and 1951, an annual review of aerial images dating back to the earliest year available would provide a better sense of the annual fluctuations and possible correlations to observed gains or losses. Without this extremely expensive (perhaps cost-prohibitive) and time consuming analysis, the losses are viewed mostly in the context of eutrophication, and in the absence of recognizing significant alterations to the natural features of the watershed, including but not limited to, altered tidal circulations, bathymetry and the westward extension of the Rockaway Peninsula (Figure 4.2) have likely played significant roles in contributing to wetland losses. At a minimum, it is recommended that a detailed annual review of wetland losses within an agreed upon reference time take place to develop a greater understanding of the anthropogenic and natural causes of wetland loss fluctuation.

FIGURE 4.2, Rockaway Peninsula Extention

These two studies have raised important issues and demonstrated that wetland loss within Jamaica Bay is significant and, despite differences in loss rate values of the two studies, both show a serious decline in total wetland acreage.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

As described numerous times in this document, Jamaica Bay's ecologically-rich, providing food and habitat for migratory and resident bird populations, serving as an important home for coastal plant species, wetlands, resident animal species, providing natural pollutant filtering capabilities and protection from storm surges. The ecological integrity of the wetland systems within the Bay is vital to the many varied species and ecosystems that comprise the Bay. The wetland complexes are an important component of the ecological puzzle of Jamaica Bay, and restoration efforts by many varied partners is essential in maintaining their presence.

Technical

One of the most challenging obstacles to restoring the salt marsh island complexes within Jamaica Bay will be securing the vast amounts of appropriate substrate material for the rebuilding of marsh elevation. While a detailed topographic survey of each salt marsh island within the Bay is required to determine the exact amount required, assuming 1951 total acreages and a minimum two foot depth of material at each of the wetland complexes analyzed by the Jamaica Bay Advisory Committee, is approximately 1.5 million cubic yards. Considering that dredged sand from Rockaway Inlet represents approximately 250,000 cubic yards of material every 2 to 3 years, this leaves a substantial shortfall in required material (USACE, 2005). A combination of restoration efforts with alternative wetland perimeter protection measures is potentially a more attractive option. Shoreline protection measures that can be designed to reduce wave velocities and induce sediment accretion along the margins of salt marsh islands would provide for the natural "rebuilding" of wetlands. See the wave attenuator pilot study under Strategy 2a2 for further information).

Cost

In addition to securing the vast amounts of suitable substrate for rebuilding the marsh elevations, the cost to do so will also presents a significant challenge that needs to be addressed. Using the restoration costs for the recently completed Elder's Point project of approximately $500,000/per acre as a guide, Table 4.5 presents the projected salt marsh island restoration costs.

TABLE 4.5. Projected Salt Marsh Restoration Costs (5 Locations)

Wetland Complex	Cubic yards of material	Restoration Costs
East High	390,427	$60,500,000
Yellow Bar	335,573	$52,000,000
Black Wall	109,707	$17,000,000
Elder's Point	422,693	$65,500,000
Pumpkin Patch	261,360	$40,500,000
TOTALS:	**1,519,760**	**$235,500,000**

Restoration of five selected islands of 2007 JBAC update of wetland losses: $235,000,000.

RECOMMENDATION

Some salt marsh islands are more stable in terms of their size and relative losses and may provide a more effective restoration opportunity than those that are smaller in size and have high loss rates. A preliminary analysis (more research and uninterrupted monitoring is required to further inform the

decision making processes) reveals that the complexity involved in prioritizing wetland restoration sites is exceedingly challenging. Many factors must be considered including, but not limited to, access to the islands, securing clean material, and evaluating probabilities for long-term stability.

IMPLEMENTATION STRATEGIES

Establish Salt Marsh Islands Wetlands Priority Restoration Review Board

NYCDEP will continue to be a local sponsor with the USACE for future salt marsh island restorations within Jamaica Bay. As a local sponsor, NYCDEP has recently committed $4.1 million to restore sections of Elder's Point and possibly Yellow Bar. NYCDEP encourages the participation and coordination of other local sponsors to better leverage limited existing resources.

To help expedite this process, it is recommended that within six months of the final JBWPP that a Salt Marsh Islands Wetlands Priority Restoration Review Board, coordinated by NYCDEP, of multi-agency and local environmental group representation, possibly developed under the proposed Jamaica Bay sub-workgroup of the HEP, would review restoration logistics and begin to establish a priority list of wetland restoration sites and potential funding sources. It is recommended that those wetland complexes that appear relatively stable based on the data analysis reviewed to date, be given higher consideration for potential restoration efforts as these likely have the greatest potential for buffering capacity and a reasonable expectation of long term stability than those identified with the most loss as these may have a high likelihood for failure in the short term.

Schedule: Prioritization process will determine restoration schedule.

Cost: Prioritization process will determine restoration costs. Costs for different restoration scenarios are provided above under the *Evaluation of Management Strategy*.

Complete the Restoration of the Jamaica Bay Marsh Islands Ecosystem Project (Elders Point and Yellow Bar) and the 8 JBERRT sites

The eight Jamaica Bay Ecosystem Research and Restoration Team (JBERRT) sites (including Dead Horse Bay, Paerdegat Basin, Fresh Creek, Spring Creek South, Hawtree Point, Bayswater State Park, Dubos Point, and Brant Point) have been identified as high priority restoration sites around Jamaica Bay. These sites have gone through an extensive review process and have excellent potential for restoration and providing environmental benefits. Conceptual plans and costs have already been developed for these projects. The Jamaica Bay Marsh Islands Ecosystem Project at Elders Point has been initiated. The Elders Point East marsh restoration was completed in Summer 2006 and the Elders Point West and Yellow Bar are currently seeking funding. Should funding become available, Elders Point West and Yellow Bar, and possibly other marsh islands could undergo restoration. The JBWPP strongly recommends that the funding for the eight JBERRT Projects and for Yellow Bar Hassock be secured and that the restoration efforts move forward.

Cost: The recommended efforts are currently unfunded.

Schedule: These efforts involve entities outside of NYCDEP; no time frames have been established.

Management Strategy 2a2: *Using information from Elders Point, existing literature and other salt marsh island restorations, examine various technologies of "non-hardened" wave attenuators to protect the windward and ice flow sides of salt marsh islands from wind and water erosion forces.*

STRATEGY DESCRIPTION

Recently restored salt marsh islands are extremely vulnerable to the damaging effects of wind and wave energies due to their limited vegetative cover and the limited benefits of sediment anchoring from an under developed root system. These areas are also vulnerable to erosive forces from ice flows during the winter months. The use of geotextile fabrics, temporary floating breakwater systems or other biodegradable materials may be effectively used to armor the vulnerable windward fringe of these marshes, allowing sufficient protection while *Spartina alterniflora* (Smooth Cordgrass) becomes fully established. Used in combination with other salt marsh island restoration efforts, these treatments may help to reduce the rate of loss of existing marsh islands and increase the protective benefits of previous restoration efforts. These systems have the potential to increase the capture of marsh building sediments and may allow the outward expansion of the wetland system.

Wave Attenuator. Source: Elemental Innovation, Inc.

The use of wave and wind energy reducing devices for the protection of tidal vegetation has been limited. However, using the wave energy protective methods utilized for the Elders Point restoration as a measure of their relative success over the long term will help inform future protective measures in salt marsh island restoration efforts. 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 for actual conditions within Jamaica Bay will be further vetted by NYCDEP.

A pilot project will be developed to test the recommended alternatives on an existing marsh island; success criteria will depend on the 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. The identification of potential funding mechanisms and a substantial multi-agency collaborative cost-sharing effort beyond the pilot study

will be required to implement a broader meaningful 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 and discussed with relevant agencies and local environmental groups.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

Wetland loss within Jamaica Bay over the last 100 years has been extensive and, based on several studies, the rate of loss has accelerated over the last few years. The loss of these salt marsh islands would diminish the ecological function of Jamaica Bay considerably, especially in regards to fisheries-nursery habitat and foraging habitat for shoreline birds. While physically restoring the salt marsh islands is the ideal solution, the time required to develop designs and issue construction contracts, the volume of suitable substrate needed, the enormous cost, and a coordination of collaborative partners does not make this a viable short-term option. A viable interim method is to evaluate alternative protection measures that have the potential to slow the current wetland loss rate, capture valuable marsh building sediments and potentially allow the natural expansion of the wetlands. When used in combination with restoration efforts, the use of the wave attenuators may provide important insight into the development of alternative short-term cost-effective protection measures.

Temporary floating wave attenuator.
Source: Elemental Innovation, Inc.

Technical

Floating breakwaters are typically designed to protect marinas from boat wakes but could possibly be modified to work in protecting wetland systems. It is expected that these would only be temporary until the edges of the marshes were stabilized and able to withstand some wave energy impacts. Shoreline areas susceptible to high wave energy typically require structural erosion controls to minimize the impact from wave action. In the case of Jamaica Bay where the salt marsh islands are already in a weakened condition, this potentially becomes even more important. Best Management Practices (BMPs) developed for the Chesapeake Bay Program (CBP) proposed "hardening" the shoreline with barrier-like structures, installing offshore breakwaters to dissipate incoming waves and/or creating headland control systems to allow adjacent embayments the opportunity to stabilize (CBP, 2006). Other structures, such as sea walls, revetments, groins and jetties could be installed to decrease the impacts of high-energy waves (Northcutt, 2001). NYCDEP does not believe that that these types of "hard-engineered" systems are appropriate for Jamaica Bay and believes that a softer, less structural method for salt marsh island protection is the preferred alternative.

More environmentally compatible erosion controls are suited in areas where the shoreline experiences low to moderate wave energy (CBF, 2007a). Depending on the slope and soil type of the shoreline, and associated labor and material costs, utilizing "softer" erosion and sediment control techniques can provide a temporary or permanent method to stabilize areas without significantly altering the natural composition and landscape.

The following provides a summary of the different types of environmentally-friendly erosion control techniques that could be applied within Jamaica Bay.

Coir Fabric Logs and Mats

Rolled erosion control products (RECOs), which includes erosion control blankets (ECBs) and turf reinforcement mats (TRMs), are becoming a cost-effective management tool to stabilize eroding shorelines (Dallaire, 2001). Made from natural, degradable fibers the RECOs can be used as the sole erosion control method or in conjunction with a planting regime (Allen and Leech 1997).

Coir is a coarse fiber obtained from the tissues surrounding the seed of the coconut palm (*Cocos nucifera*) (Royal Botanical Gardens, 2003). Mature brown coir fibers contain more lignin and less cellulose than flax and cotton, resulting in a stronger but less flexible material. Coir fibers are relatively waterproof and the only natural fiber resistant to saltwater damage.

While these have been mainly utilized in freshwater systems with primarily a one dimensional flow, tidal systems potentially represent a challenge with multi-dimensional flows (*e.g.*, ebb and flooding tides). Restoration efforts of eroded sections along water bodies such as the Yellowstone River in Montana (Tice, 2005), the Peachtree Creek in Georgia (Baxter, 2003) and the Whiskeytown Reservoir in northern California (Sloan, 2001) used coir logs and matting to stabilize banks and shorelines, minimize erosion and enhance vegetative growth. Coir logs supported by rock foots stabilized an area along College Creek in Maryland susceptible to low to medium wave energy (CBF, 2007b). Structural integrity of coir mats ranges between two to five years, sometimes more, depending on sunlight exposure and overall weathering (Dallaire, 2001).

A study of the efficacy of coir logs was conducted by the USACE during the restoration efforts for Elders Point Marsh in Jamaica Bay. The USACE surveyed the exposed coir logs in March and May of 2007. In general, the USACE reported it found that once the coir logs became exposed, they lacked the tensile strength to stay together for any great length of time in the Jamaica Bay wind and wave climate. The constant wetting/drying and sun exposure deteriorated them quickly also. Once the data from its bimonthly surveys become available, it will be evident whether the coir logs mitigated erosion at the island marsh. The USACE reported that the utility of coir logs was mostly during sand placement, as an initial berm for the pump-out settling area. The USACE reports that it does not plan to use them at Elders West.

It is likely that the failure of the coir logs at Elders Point Marsh was due more to the wetting and drying, as well as the sun exposure, than to the shear stresses exerted by the current and wave velocities within Jamaica Bay. It has been reported (Fischenich and Allen, 2000) that coir geotextile roll with coir rope mesh (staked only without rock bolster) can withstand a shear stress of 0.2 to 0.8 lb/ft^2. While somewhat coarse for this application, the hydrodynamic sub-model of the JBE Model seldom calculates shear stresses greater than 0.1 lb/ft^2. The use of coir geotextile roll may be more applicable for streambank erosion control than for a tidal system such as Jamaica Bay.

Jute Fabric Mesh and Mats

Jute is the common name given to the fiber extracted from the stems of plants belonging to the genus *Corchorus* (Rowel and Stout, 1998). Two commercially viable species, *C. capsularis* and *C. olitorius*, provide the raw plant fiber used to create the erosion control mats. The fibers develop in the phloem, or bast, region of the plant stem. Exposure to sunlight for approximately 350 hours causes a 50% reduction in strength of jute, but jute fibers typically last upwards of two years (Dallaire, 2001).

Commonly used as the mesh or netting for mats and logs made from other fiber materials, jute fabric could be used alone to protect shorelines from erosive forces. Krenitsky *et al.* (1998) compared erosion control materials in a rainfall-simulated study on two sites with different soil types and slopes of 8 and 14 to 21 percent. The authors found that only jute reduced runoff and sediment loss at both sites.

Because of the limited observed application of wave and wind energy reducing methods for the protection of vegetation in a tidal system, an alternative approach is necessary. At this point, no one protection method to slow salt marsh island and sediment loss can be considered too small for evaluation and will likely require a multi-faceted approach of using several erosion control techniques in combination with one another.

Other Natural Fiber Materials

Straw and excelsior constitute the remainder of the natural fibers used to manufacture ECBs. The Pennsylvania Department of Transportation uses light- to heavy-duty straw blankets to protect freshly graded and seeded slopes ranging from 25 to 50 percent, which typically last from three to four months (Dallaire, 2001). The manufacturing of excelsior blankets stitching together aspen wood shavings in a manner that eliminates the need for netting, favorable for areas that require rapid germination and frequent maintenance (Tice, 2005). The blankets typically last between two and four years (Dallaire, 2001). However, their use within a saline environment like that of Jamaica Bay has not been evaluated.

Shellfish

While ribbed mussels were identified as a potential contributing factor in wetland loss by not permitting the marshes to fully drain at low tide, other alternative bioengineering techniques could be employed to stabilize shorelines and minimize erosion that could include oyster restoration. Bushek and Kreeger (2007) observed mussel colonies stabilizing *Spartina alternifora* patches along eroded shorelines in Gandy's Beach, New Jersey in 2006. Marsh shoreline restoration efforts in South Carolina included installing concrete-coated wooden stakes for oyster recruitment and growth, a by-product of which was a natural breakwater for the incoming waves. Two oyster reefs developed by the NRCS in Texas decreased erosion rates by half, permitting grass planting immediately after reef establishment (Kaspersen, 2000). NYCDEP will implement a pilot oyster reef restoration near the mouth of one of the tributaries; however, in consultation with others, a modification or supplement to this pilot could include developing a protective oyster reef along an edge of an eroding marsh. However, as the oyster restoration is considered a long term effort, alternative short term wave attenuators will still need to be put in place for salt marsh island protection.

Cost

See *Implementation Strategies* below for cost information for a pilot study. Costs for a broader effort will be based on information gathered from the pilot.

Legal

Installation of any type of erosion control devices in Jamaica Bay for marsh protection would require permits from various regulatory authorities potentially including the following:

- NYSDEC;
- USACE;

- US Coast Guard; and
- NPS.

RECOMMENDATIONS

It is recommended that the City install a pilot wave attenuator at a selected salt marsh island to be determined in consultation with appropriate agencies and environmental groups. This would be done through the *Implementation Strategies* listed below.

IMPLEMENTATION STRATEGIES

Salt Marsh Island Wave Attenuator Pilot Study

Develop and implement a pilot study to determine if the installation of a wave attenuator around a section of a salt marsh island would be a cost-effective method to slow the rate of wetland loss and accrete marsh building sediments. NYCDEP will implement this pilot study and consult with other local resource management agencies to determine the selection of a specific salt marsh island and to evaluate the effectiveness of the wave attenuator.

Schedule: Pilot study will be developed through a proposed contract. A contractor is anticipated to be retained by mid-2008. Pilot to be initiated in Fall 2008.

Cost: $576,000.

FIGURE 4.3. Conceptual placement of wave attenuators, Yellow Bar; Source: NYCDEP

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OBJECTIVE 2B: PRESERVE AND ENHANCE NATURAL AREAS ALONG PERIPHERY OF BAY AND WATERSHED

Current Programs

Pennsylvania and Fountain Landfills

NYCDEP is responsible for the remediation and closure of two inactive hazardous waste sites, the Pennsylvania Avenue and Fountain Avenue Landfills, both situated abutting Jamaica Bay. Although restoration of these sites is not required as part of the remediation, due to the location of these landfills within a sensitive environmental area NYCDEP took a pro-active lead stewardship role in developing an innovative and comprehensive ecological restoration plan for these properties that is consistent with and will enhance the existing natural features of Jamaica Bay. In addition, the ecologically sound end-use design plan, with input from local community groups, also considered future passive public uses in the post-landfill remediation phase.

FIGURE 4.4 Pennsylvania Landfill Restoration; Source: NYCDEP

This project represents the largest ecological restoration effort ever undertaken in New York City and will provide significant habitat and environmental improvements for Jamaica Bay. The planting plan includes over 40 native tree and shrub species and over 30 forb (wildflowers) and graminoid (grasses) species. To ensure that a sufficient number of plants would be available for the planting phase of the project, NYCDEP initiated a three year contract growing program at several area nurseries for the approximately 35,000 trees and shrubs that will be required. The contract growing of these plants enabled NYCDEP to use local provenance plant material that is best acclimated to our soil and climate conditions and ensures the dissemination of local genotypes. In addition, this plan also enabled the use of plants that are not readily available in the nursery trade. The use of seed-grown plants has been maximized to the greatest extent possible to increase the genetic diversity of the plant community. Genetically diverse and locally adapted plants provide increased disease resistance and drought tolerance. NYCDEP also provided detailed soil specifications, requiring a soil that was high in sand content. Sandy soils, common to coastal regions, are typically low in nutrients. The low nutrient status of these

Wildflowers and warm seasonal grasses provide habitat for rare grassland birds; Source: NYCDEP

sandy soils allows the growth of coastal plants and also tends to limit the invasion by undesirable non-native and nuisance plant species.

The first planting began at the Pennsylvania Landfill in Spring 2006 and the first planting at Fountain Landfill began in Spring 2007. Because of the large size of the total restoration area and the vast number of plants, in time the landfills will become a regional seed source to disseminate the reintroduced native species to other parts of the New York City metropolitan area. Migratory birds will be attracted to this green space and during resting and feeding will move plant propagules into and out of the site. The actual restoration limits have the potential to extend far beyond the physical restoration due to the size and geographic location of the landfills.

As with all NYCDEP ecological restoration projects, unique specifications and designs for each project are developed that incorporate appropriate environmental information for the desired ecosystems with the goal of providing the maximum ecological benefit and function. In addition, the species selection for these projects are based on their ecological plant community associations and environmental setting to provide much greater ecological value, sustainability and biodiversity than placing individual and "out of context" specimens that do little for long-term environmental sustainability. The use of extirpated indigenous coastal flora that have been absent from much of the New York City ecological landscape since the early 20th Century is an integral component of the designs for each of these projects. Their reintroduction allows the dissemination of these species propagules beyond the actual physical restoration boundaries, thus enhancing their ecological significance.

The development of soil specifications that favor the growth of coastal communities is a key element in the design of ecological restoration projects and will aid in their long-term sustainability. This ecosystem restoration approach provides the greatest habitat function and ensures the long-term stability of the sites by enhancing the natural buffering capacities of the restored habitats; increasing resilience to natural environmental variations. Each of these restoration sites significantly contributes to improving the ecology of the Bay by restoring degraded lands to productive wildlife habitats, increasing plant biodiversity and providing natural attenuation of stormwater through nutrient uptake, contaminant sequestration, plant evapotranspiration and groundwater infiltration. In addition, because of their size and spatial connectivity within the landscape, the positive cumulative effects from each of these restorations are further enhanced.

The following concepts used for the Pennsylvanian and Fountain Landfill restoration projects should serve as the model for developing future coastal upland restoration projects around the perimeter of the Bay:

- Initiate contract growing of most plant material
  - Maximize the use of seed-grown plants
  - Limit the use of cuttings when seed germination is difficult or slow

- Develop a soil sample collection program for analysis from existing plant communities targeted for restoration to closely "mimic" natural soil conditions of proposed plant communities:
  - higher sand content soils
  - low organic matterlow nutrients
  - low pH

- Use smaller plant material – will acclimate faster to site and grow healthier
- Use varying sizes of same species to "mimic" a natural and uneven aged stand
- Use high wildlife value and low maintenance warm season grasses over conventional low wildlife value and high maintenance cool season "erosion control" grasses
- Select appropriate plant material for site and existing environmental conditions (aesthetics should be considered least)
- Specify seasonal planting schedules for the various plant species
- Limit provenance of plant material to within a 150-mile radius of the planting site

Idlewild Restoration Planting

- Specify mycorrhizal (symbiotic association between fungus and plant roots) soil inoculants to help restore soil biological diversity and activity (not necessary in intact natural systems).

Idlewild Park

Idlewild Park is situated within the critically important headwaters of Jamaica Bay. NYCDEP in coordination with New York City Department of Parks and Recreation (NYCDPR) completed a significant restoration effort in 1997, resulting in the restoration of 16 acres of indigenous coastal grasslands and woodlands, five acres of tidal wetlands and 2.5 acres of freshwater wetland. The NYCDEP continues to maintain an active presence in restoring additional sections of the park through its association with the Eastern Queens Alliance (EQA) and the NYCDPR Natural Resources Group (NRG).

NYCDEP has participated in student planting projects organized by the EQA and is assisting with EQA's Master Plan efforts for the continued environmental restoration of the 110-acre park and for expanded community use of this valuable local natural resource. The NYCDEP continues to issue vegetation management contracts to control invasive plants and to restore additional areas. When feasible, restoration requirements resulting from other projects that are not possible at the site of disturbance are directed to Idlewild Park to help expedite the restoration process.

Aerial view of Idlewild Park;
Source: NYCDEP

Paerdegat Basin

The ecological restoration of Paerdegat Basin is associated with the NYCDEP's current efforts to treat and capture CSOs to improve water quality within the basin and ultimately within Jamaica Bay. The construction of a 50 million gallon CSO storage facility will capture sanitary wastewater and stormwater during rain events for subsequent processing and treatment at the Coney Island WPCP after the rain event has ceased (see Management Strategy 1c2 for additional information on this project). The ecological restoration component of this project is currently in the design stage and has an expected construction start date of mid to late 2009. Highlights of this project include the restoration of 15 to 20 acres of tidal wetland, creation of 40 to 50 acres of an indigenous coastal grassland/shrubland and a six acre Ecology Park. Stormwater from surrounding streets will be directed into the restoration area to create freshwater wetlands and attenuate pollutants from upland sources. NYCDEP is also collaborating with NYCDPR to develop an extensive "Greenstreet" planting along a long stretch of Bergen Avenue (see Management Strategy 3b1). These elements have the potential to capture significant volumes of stormwater runoff from surrounding streets. The Paerdegat Basin project site was also evaluated for restoration under the JBERP.

The six-acre Ecology Park will be designed to showcase many of the ecosystems present within New York City and will enable a close-up view of these communities. The NYCDEP expects the Ecology

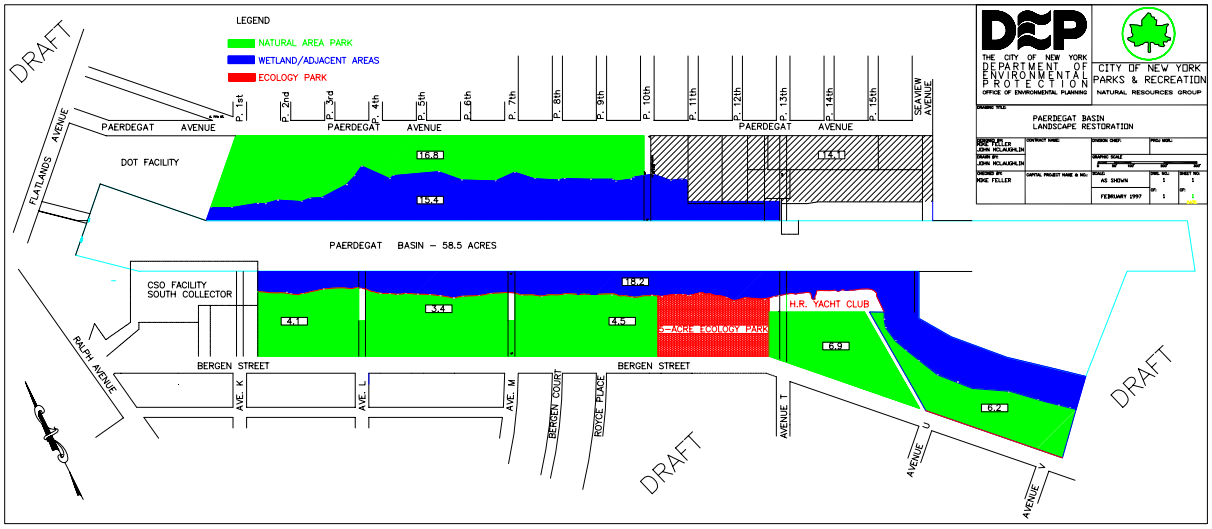


FIGURE 4.5 Paerdegat Basin Restoration Plan; Source: NYCDEP

Park to be an important environmental tool in helping area residents and students to gain an understanding of the many ecosystem types found within New York City and the important stewardship role that they have in helping to maintain the delicate ecosystem. It also provides the opportunity to create additional research topics within an array of closely located and varied ecosystems.

Springfield Gardens

As with the Idlewild project, this restoration project is associated with NYCDEP's current efforts to alleviate flooding in southeast Queens (see Management Strategy 1b2 for additional information on the Southeast Queens Drainage Plan). Some of the restoration areas overlap with the Idlewild restoration and provide a large contiguous restoration area. Creating connectivity is an important consideration when designing restoration efforts within the watershed. The project has restored two acres of tidal wetland and two acres of indigenous coastal woodlands. An additional two acres of tidal wetland and coastal grasslands will be restored during 2007.

Springfield Gardens Tidal Wetland; Source: NYCDEP

Innovative "Bluebelt" type designs are currently being developed to improve the habitat and water quality of Springfield Lake (see Management Strategy 3b3) and the downstream tidal channel that is connected to Thurston Basin. The re-grading of the lake shoreline, invasive plant removal and the planting of freshwater wetland plants will help to restore much of the lost ecological function of this important community resource. The restoration of the tidal channel will allow greater tidal flushing for improved water quality to the backwaters of Jamaica Bay. The design of this project is consistent with the goals of the Master Plan for Idlewild Park currently being developed by the EQA.

Management Strategy 2b1: 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.

STRATEGY DESCRIPTION

Over the last 25 years, surveys of Jamaica Bay's open shoreline areas have identified adjacent upland buffers that could be restored and/or acquired for potential restoration and enhancement of vegetation communities and wildlife habitat. The identification of open natural areas for potential restoration and acquisition opportunities were included in the following reports:

- *Buffer the Bay (Trust for Public Land and NYC Audubon, 1987)*
- *Buffer the Bay, Revisited (Trust for Public Land and NYC Audubon, 1992)*
- *Restoration of Natural Resources Through the Jamaica Bay Damages Account: Reconnaissance Phase Report (NYSDEC, 1993)*
- *Jamaica Bay Draft Comprehensive Management Plan (NYCDEP, 1994)*

- *Navigation Channels and Shoreline Environmental Survey (USACE, 1997)*
- *Harbor Estuary Program Priority Acquisition and Restoration Site List (HEP)*
- *NY/NJ Harbor Estuary Program, 2004 revised list*
- *Needs and Opportunities for Environmental Restoration in the Harbor Estuary Regional Planning Association (May, 2003)*
- *Jamaica Bay Study Area Report (USACE, 2004)*
- *New York State Open Space Plan (NYSDEC, 2007)*

A review of these reports indicates that many of the sites that were identified and considered to be valuable habitat have been protected and transferred to the NYCDPR, New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) and the NPS. According to the Regional Plan Association (RPA) (2003), "Land preservation in Jamaica Bay, with a few exceptions such as some Arverne/Edgemere watershed sites, is virtually complete…" The recommended larger sensitive natural area properties within Jamaica Bay, that have been successfully protected, include the following locations:

Paerdegat Basin
Spring Creek
Brant Point
Dubos Point
Pennsylvania Landfill
Four Sparrow Marsh
Fresh Creek Basin
Bayswater State Park
Vernam Barbadoes Peninsula
Edgemere Landfill
Fountain Landfill

However, a review of these reports also indicates that some of the recommended properties were eventually developed (*i.e.*, Vandalia Dunes), and the full acquisition status of other recommended properties has not been fully realized (*e.g.*, Four Sparrow Marsh). In the case of the Arverne Urban Renewal location, although a large section has been developed, an area of approximately 30 acres was set aside for natural area protection and wildlife habitat through the efforts of local environmental groups and discussions with NYCDPR.

In many of these reports, similar criteria were established to prioritize available sites. In no order of relative importance, the following criteria were used to determine site priorities for Buffer the Bay, Revisited:

- Biotic diversity: the variety of plant and animal species;
- Habitat diversity: variety of the landscape considering factors such as relief and topography;
- Size: parcels of greater acreage generally have greater potential as plant and animal habitat;
- Integrity: degree of alteration of the landscape and flora and fauna by past or present human activity;
- Proximity to other protected areas, leading to larger and less fragmented habitat suitable for reclamation; and
- Degree of present threat of change or development.

When larger vacant parcels were more abundant within the watershed and along the shoreline, this approach of prioritizing and selecting properties for acquisition was fairly simple to apply. However, now that many of the remaining vacant parcels are small in comparison to the previously identified properties, and discontinuous from larger parcels and from one another, the approach to prioritization

becomes more challenging. Therefore, the approach used to assess the remaining vacant land for potential acquisition and restoration within the Jamaica Bay watershed was to focus on an area extending out approximately one mile inland from the shoreline of Jamaica Bay, and apply similar criteria as that used for identifying the priority vacant parcels under "Buffer the Bay" and other property inventory reports. With a few exceptions, a GIS analysis of potential properties within the watershed indicates that the majority of the vacant land within this one mile range and in most other portions of the watershed consists of small parcels (*e.g.*, 77% < 10,000 sq ft in size). As such, the selection of priority parcels should have multiple objectives in terms of their habitat and restoration opportunities, as well as their ability to function as potential stormwater management properties, and additional public open space and additional urban habitat. Because the remaining properties are small and in many cases discontinuous, the approach also used "clustering" assemblages of properties to maximize their potential for habitat improvements, open space and stormwater management opportunities.

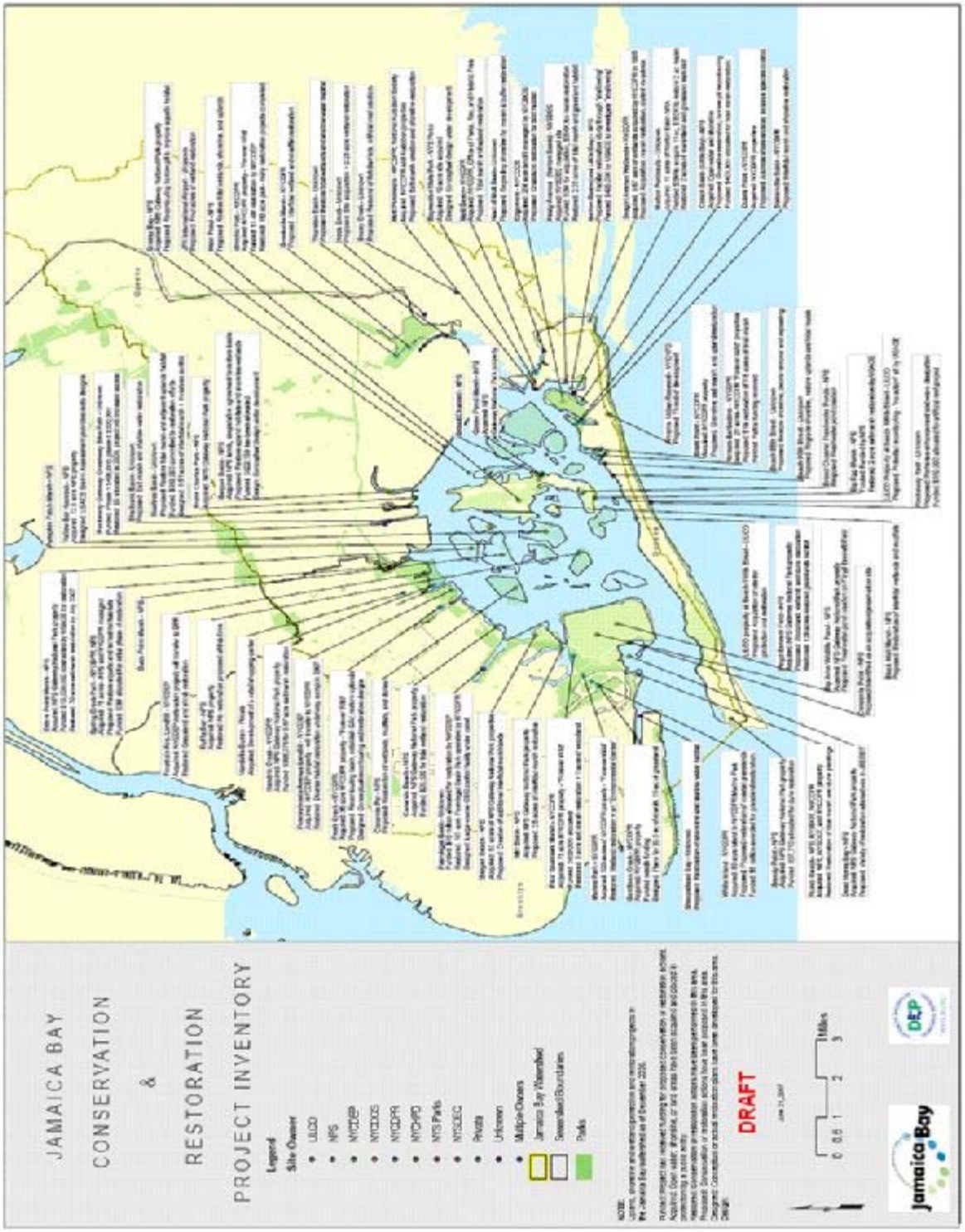


FIGURE 4.6. Jamaica Bay Conservation & Restoration Project Inventory; Source: NYCDEP

Edgemere Acquisitions

Approximately six acres of land in the Edgemere section of Queens, currently under the jurisdiction of the HPD, have been identified for potential transfer to the NYCDPR. While initial discussions with NYCDEP, HPD and NYCDPR have identified potential properties, issues with adjacent landowner encroachment, and securing the sites to prevent illegal dumping and site assessments still need to be finalized. Additional private sites in this area may also be available to enhance ecological connectivity.

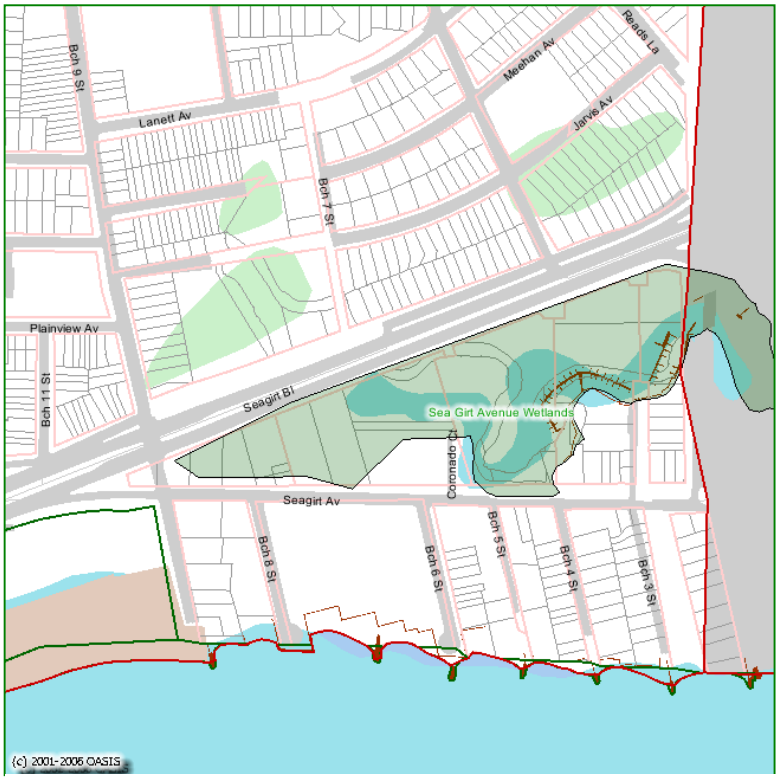
TABLE. 4.6. POTENTIAL EDGEMERE AQUISITION PARCELS

BLOCK	LOT	SIZE (sq ft)
15961	61	3,200
15961	63	11,000
15961	83	4,000
15961	85	4,000
15961	87	2,500
15961	97	3,000
15961	100	4,000
15961	110	62,700
15962	19	17,237
15962	28	3,823
15962	30	5,704
15962	33	8,187
15962	54	5,305
15963	1	30,492
15963	21	8,967
15963	30	3,831
15963	32	1,915
15963	36	1,915
15963	38	1,915
15963	39	1,915
15963	40	1,915
15963	41	1,915
15963	42	1,915
15963	43	1,915
15963	44	1,915
15963	45	1,915
15963	47	1,600
15963	48	1,600
15963	54	2,000
15963	55	1,915
15964	55	10,659
15964	58	8,000
15964	62	1,600
15964	63	1,600
15964	64	1,600

FIGURE 4.7 Edgemere Properties: Source: NYCDEP

TABLE. 4.6. POTENTIAL EDGEMERE AQUISITION PARCELS		
BLOCK	**LOT**	**SIZE (sq ft)**
15964	65	1,600
15971	16	4,459
15971	21	9,071
	TOTAL:	248,013 sq ft (6 acres)

Other Sites



In addition to the properties listed above, additional properties were identified within a one mile radius of the Bay for potential land conservation and restoration opportunities. This was done through a GIS analysis of **PLUTO™** map data. (© 2003-2007, NYCDCP). Both public and private properties were reviewed. Each parcel was evaluated for habitat and open space potential, using environmental criteria such as parcel size, the proximity of the parcel to existing open space, parkland, and potential for restoration and stormwater management opportunities.

The analysis identifies vacant publicly and privately-owned properties within the one mile radius zone, and shown as the "cluster areas" on the map below, as having the greatest potential for environmental benefits. Cluster areas were reviewed to be consistent with previous selection criteria (*e.g.*, size, proximity to the shoreline, other properties that increase their cumulative value, and to existing parks and open space) from other parcel inventory surveys. However, unlike the previous parcel inventory studies, this analysis evaluated the numerous smaller parcels to make the best determination of what would make the most ecological sense and provide ancillary benefits such as stormwater management, when considered cumulatively. Although there are additional public and private properties within the watershed, both within the one mile radius and beyond, the "cluster area" properties (in addition to those previously listed from HPD) represent those that closely match the criteria of other surveys and are expected to provide the most benefits. These cluster areas will require "ground-truthing" to verify their current status.

A summary of the public parcels indicates that they range in size from 30 sq ft to nearly 16 acres and include a total of 214 properties with a combined total of 208 acres. A total of 166 (approximately 77%) of the parcels are 10,000 sq ft or less, 33 (approximately 17%) are between 10,001 and 35,000

sq. ft. and 13 (approximately 6%) are greater than 35,001 sq ft. in size. The recommendation for the public properties within these "cluster areas" is to place a "study hold" until each property can be fully assessed for potential environmental benefits and stormwater management

If public properties within "cluster areas" were determined to be available and beneficial for acquisition based on field verification and research into status, they could be proposed to be transferred to NYCDPR and NPS. If acquired, these parcels would be set aside for future restoration and stormwater management.

Private parcels comprise a smaller total area, approximately 120 acres within the "cluster areas," but are represented by a much larger total of 942 individual parcels. The parcels range in size from as small as 15 sq ft to as large as almost 10 acres in size. Private parcels are not actively being considered for purchase, as negotiations with each land owner is required and significant funding would be needed from sources (*e.g.*, Trust for Public Land) other than NYCDEP to secure these parcels (see "Costs" below).

Approximately 0.67 acres of Seagirt Avenue wetlands, located in Far Rockaway, Queens, were acquired by the NYCDPR in September, 1995. However, this Plan supports the recommendation for the acquisition of additional Seagirt Avenue properties by others (*e.g.*, Trust for Public Land). The Seagirt site is considered a high-priority acquisition site by the New York/New Jersey Harbor Estuary Program and is also identified on the New York State Open Space list for acquisition. The site contains a tidal creek and is located adjacent to NYCDPR property and has the potential for restoration enhancement and stormwater management options.

In addition to identifying new acquisitions for restoration projects at this time, it is recommended that the existing restoration projects within Jamaica Bay should be prioritized and implemented. In particular, restoration and funding should focus on the completion of the USACE's Jamaica Bay Marsh Islands Ecosystem Restoration Project (Elders Point East and West and Yellow Bar) and the eight JBERRT sites for which conceptual designs have been prepared. These project sites are identified as Dead Horse Bay, Paerdegat Basin, Fresh Creek, Spring Creek South, Hawtree Point, Bayswater State Park, Dubos Point, and Brant Point. These projects are significant because they have evolved from the myriad of proposed projects, are large scale projects, and are based on existing needs. These are projects that have been identified by the many experts who are familiar with the detailed research that has been performed and the ongoing physical and biological processes within the Bay. In addition, significant studies have already been performed at these sites which will streamline the implementation process. This baseline data provides the necessary information needed for preparing permit applications and construction specifications.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

The intent of the parcel review was to identify those properties closest to the Bay, as these are the most sensitive properties and would likely provide the greatest potential for upland buffering protection and additional habitat in close proximity to Jamaica Bay. The potential exists for some of these locations to provide additional tidal wetland perimeter restoration and the opportunity to restore adjacent coastal upland systems with a greater plant species diversity than under existing conditions. In some cases the areas would provide an important connection to some of the fragmented natural areas around the Bay. Enhancing connectivity with these larger adjacent properties can also create

wildlife corridors. Preservation ensures that development, with its associated stormwater runoff issues, soil changes and the potential for introducing invasive plant species, does not occur in sensitive areas along the Bay.

The restored areas would provide additional "green" open space in one of the most densely developed watersheds in the country. With careful planning and coordination, it is possible that some of these locations could provide additional public access to the Bay. Lastly, any vacant parcels could be restored utilizing BMPs to treat stormwater runoff resulting in improvements to the water quality of the Bay.

Technical issues

While the acquisitions themselves do not face significant "technical" hurdles, restoring the ecological functions of the sites do. Ensuring that future restoration work has the greatest potential to be self-sustaining involves detailed design and ecological landscape planning. In addition, parcels will need to be assessed for historic, cultural or contamination related issues before site work can begin. Site work may require clean-up of contamination and removal of debris and structures prior to restoration.

Cost

The transfer of existing public properties to NYCDPR or NPS would entail minimal cost.

Legal

While any property transaction involves legal issues, if private property were to be purchased, it would need to be from a willing seller. The City is not proposing condemnation of private property in order to acquire open space.

High property values within New York City make private land purchase a very expensive proposition and substantial funding would be required. With the assumed current market real estate value of $55 per square foot for residentially-zoned areas and $100 per square foot for commercially-zoned areas within the Jamaica Bay watershed, the anticipated purchase cost for the 120 acres of privately-owned "cluster" properties, would be approximately $298 million (see Table 4.7). Aside from the acquisition costs for the private parcels, as previously mentioned there may also be a need to remove existing structures and to address contamination issues, significantly raising the final cost of restoration.

TABLE 4.7. Estimated Acquisition Costs		
Brooklyn and Queens		
Residential	Square Footage	4,600,000
	Acquisition Cost	$255 million
Commercial	Square Footage	265,452
	Acquisition Cost	$27 million
Industrial	Square Footage	376,730
	Acquisition Cost	$17 million
	Acreage Total	121
	Acquisition Cost Total	$298 million

Purchasing private properties and restoring public and private lands on this scale would require a significant collaborative effort to identify potential funding opportunities. Multiple entities would need to work together to fundraise and secure funding from a variety of government agencies, private organizations and other entities.

RECOMMENDATION

It is recommended that multiple entities work together to acquire and restore "cluster areas" along the periphery of the Bay and other key parcels such as the Seagirt Wetlands in Far Rockaway, Queens. In addition, sites previously identified for restoration should be actively pursued and completed. This would be accomplished through the *Implementation Strategies* listed below.

IMPLEMENTATION STRATEGIES

Transfer HPD Properties in the Edgemere Section of Queens to DPR

Continue the process to transfer the approximately six acres of HPD properties in the Edgemere section of Queens to the NYCDPR. Provide site assessments and secure the sites. Once acquired, restoration plans will need to be developed. Work with multiple entities to design and implement restoration plans for these sites.

Cost: Restoration costs have not been developed and these efforts are currently unfunded.

Schedule: No time frames have been established for the transfer.

Pursue Acquisition and Restoration Efforts in Cluster Areas

Work with the New York City Department of Citywide Administrative Services (DCAS) to determine the status of all subject properties and the ability to place a "study hold" on them. Field verify the areas to determine potential ecological benefits, prior to acquisition. Work with multiple entities to design and implement restoration plans for these sites.

Cost: Restoration costs have not been developed and are currently unfunded.

Schedule: NYCDEP will determine status, field verify the sites, and work to place study holds on applicable sites within six months.

Acquire Seagirt Avenue Wetland Properties, Far Rockaway, Queens

Multiple entities should leverage funds to acquire the Seagirt Avenue wetland properties located in Far Rockaway, Queens. This site is on the high priority acquisition list for the HEP and also a high priority on the New York State Open Space list.

Schedule: This effort involves entities outside of NYCDEP; no time frames have been established.

Track and Inventory Restoration Sites

NYCDEP will continue to develop and distribute the Jamaica Bay Conservation and Restoration Project Inventory as a tool for inter agency coordination and prioritization. The JBWPP encourages other entities to use this as the base map for developing and monitoring restoration efforts within Jamaica Bay. NYCDEP will engage other relevant agencies to refine and update this inventory to make it a more effective restoration tool. The creation of a portal such as a web-access database to allow the inventory to be viewed and updated by stakeholders as projects are developed and implemented is one option to allow the greatest access. Coordination of this portal will need to take place among the various stakeholders of the Bay.

Management Strategy 2b2: Prepare a GIS map of existing and /or potential locations that could benefit from grassland, woodland, and shrubland restoration and prioritize restoration sites.

STRATEGY DESCRIPTION

At the time of European settlement, the upper watershed and upland perimeter of Jamaica Bay was dominated by a contiguous expanse of forest and maritime scrubland, interspersed with early successional grassland habitat. Most of these habitats have been lost to development or have been degraded by invasive species and poor soil conditions; however, there are isolated fragments of these habitats still present in undeveloped areas. Historically, these areas supported a high diversity of plants and animals, and aided in the filtering and processing of nutrients and sediments that drained from the upper watershed. In particular, native 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. The restoration, protection, and creation of additional grassland, woodland, and shrubland habitats would provide benefits for plant and animal species, and could be integrated with urban stormwater runoff management practices. Active monitoring of restored upland habitats will aid in the effective management of these areas, and maximize the ecological benefits.

As part of the closure and remediation of the Pennsylvania and Fountain Avenue Landfills, native coastal grassland, woodland and shrubland habitats are being restored, providing some one of the largest expanses of contiguous high-quality upland habitat in the watershed. Approximately half of the 370 acres of the two landfills sites are reserved for coastal woodland and shrubland habitat; the remaining areas are being restored to native coastal grasslands. In addition, there are plans by NYCDPR and HPD to restore an additional 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 (GNRA) 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 New York City Audubon Society.

An inventory and assessment of upland habitat complexes in the watershed must be performed to better understand the current extent and condition of these areas. 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. Opportunities for additional large-scale restoration of grassland habitat may be very limited within the upper sections of the Jamaica Bay watershed; however, some upland areas around the periphery of the Bay may afford opportunities to enhance ecologically unproductive areas to more productive and diverse grassland and woodland habitats. Active monitoring and management of these areas is necessary to determine the success of restored areas, and prevent infestation by invasive species.

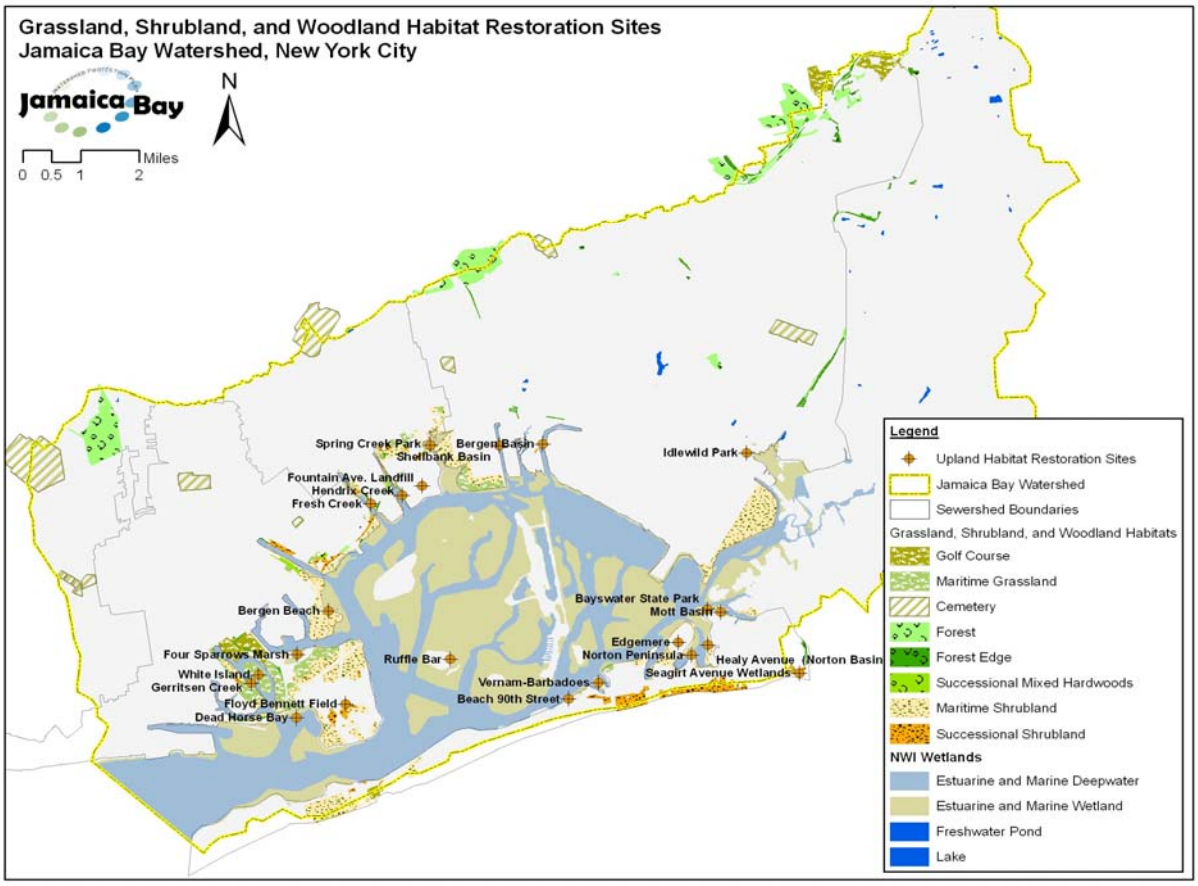


Figure 4.9 Grassland/Shrubland/Woodland Habitat Restoration Sites in Jamaica Bay Watershed; Source: NYCDEP

Grassland, woodland, and shrubland habitat complexes tend to occur around the perimeter of the Jamaica Bay estuary, comprising a natural buffer between the wetlands areas and the urbanized portions of the watershed. Major disturbances to these areas include fragmentation, removal for urban

infrastructure, and invasive species. During the past couple of decades, numerous resource management agencies active in the Jamaica Bay watershed including NPS, USACE, USFWS, NYCDEP, NYCDPR, RPA, New York City Audubon Society and the HEP have performed natural resource assessments, and identified areas that could benefit from land protection or habitat restoration actions. Many of these acquisition and restoration sites are comprised of grassland, woodland, and shrubland habitats. The current status of the acquisition/restoration of these sites varies tremendously some areas have already experienced habitat restoration and protection; others have been identified as areas that would greatly benefit from these actions, but no actions have yet occurred.

Proposed Restorations and Potential Additional Restoration Enhancement Opportunities

Currently identified grassland, woodland, and shrubland habitat complexes in the watershed are displayed in Figure 4.9.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

The combination of upland and wetland habitats within many of the sites supports diverse native vegetation assemblages, and provides essential habitat to an array of avian, insect, and mammal species that exist within the watershed. In addition, these complexes around the perimeter of the Bay function as a shoreline buffer, providing important protection from storm surges and helping to stabilize the shoreline. These buffer areas also provide water quality benefits, buffer sensitive wetlands and shallow water habitats from urban areas, and increase the diversity of habitat types along the shoreline. In addition to their wildlife habitat value, these areas provide aesthetic beauty and serve as potential passive and active recreational features for visitors and residents in the watershed.

Technical

Many of these sites have been previously identified for their potential restoration opportunities. Some of these restorations have occurred, while others may not have been funded, therefore, an assessment will need to be performed to determine their current status. In addition, many of these assessments are greater than 10-years old and will require updated restoration potential assessments and costs to determine current opportunities. See also Management Strategy 2b1 for additional technical issues associated with restoration efforts.

Legal

USACE and NYSDEC permits will be required for most restoration efforts occurring at these properties. Additional permits and permission will likely be required of NYCDPR and the NPS on areas under their jurisdiction.

Cost

Updated restoration costs have not been developed and the funding status for many of these restorations is unclear at this time, but it is highly likely that many of these proposals remain unfunded.

RECOMMENDATION

Because these sites have already been identified by multiple entities engaged in conservation and restoration of Jamaica Bay habitats, it is recommended that where applicable that these plans be updated to reflect current conditions. Additional grassland, woodland, and shrubland habitat restoration sites likely exist around the perimeter of the Bay and in the upland areas of the watershed, but these sites have yet to be identified by local resource management agencies.

IMPLEMENTATION STRATEGY

Create a Current Inventory and Prioritize Restoration Efforts

Complete updated inventory of all existing upland habitat locations and coverage to create a base GIS mapping and information data layer that can be used by restoration practitioners in developing and leveraging future ecological restoration designs. Develop, map and prioritize a list of potential sites for restoration of these habitat types.

Cost: $400,000 for existing conditions research, mapping, evaluation, threats assessment, prioritization of restoration opportunities and new site potential.

Schedule: Approximately one year to inventory existing sites, conditions and coverage, GIS mapping of sites, condition and coverage and cross referencing of all invasive species control actions. However, much of this effort involves entities outside of NYCDEP and multiple agency coordination and cooperation is required.

Management Strategy 2b3: Prepare a GIS map of existing and potential dune and beach habitats that could benefit from restoration and prioritize restoration sites.

STRATEGY DESCRIPTION

Beaches and dunes are important 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 (*Amaranthus pumilus*), seabeach knotweed (*Polygonum glaucum*), and Schweinitz's flatsedge (*Cyperus schweinitzii*). 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.

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 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.

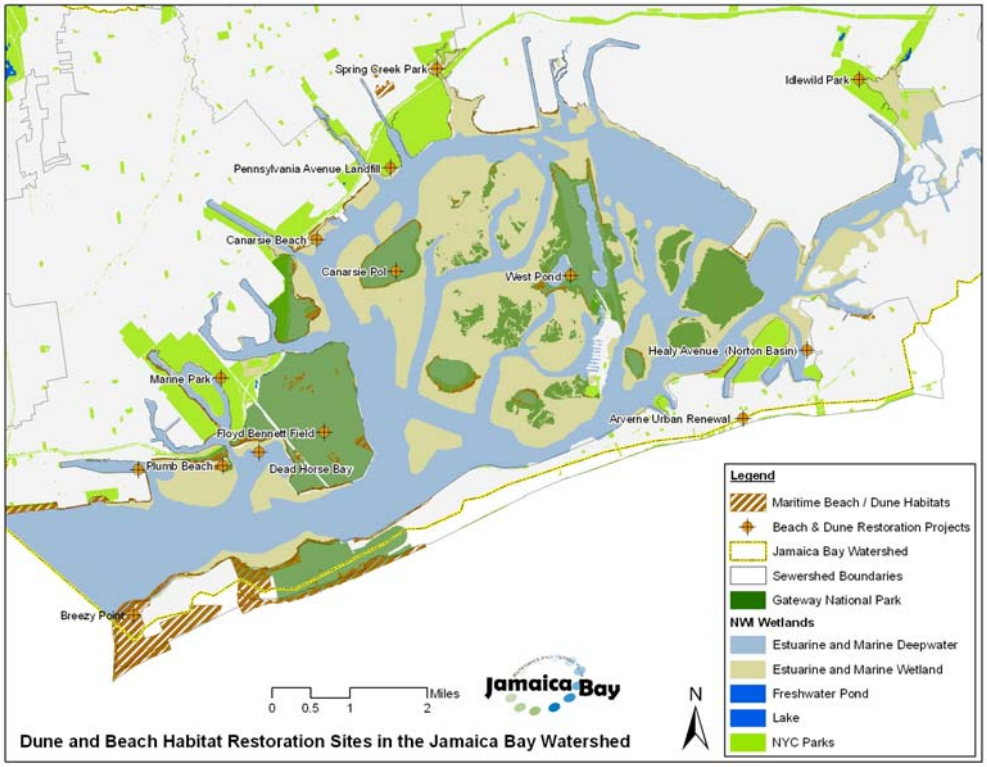


Figure 4.10 Maritime Dune/Beach Habitat Restoration Sites in Jamaica Bay Watershed; Source NYCDEP

The enhancement and restoration of additional beach habitats will increase biodiversity and improve existing wildlife habitats. The identification of existing dune and beach habitat in Jamaica Bay is an important first step in evaluating additional sites for restoration, either to augment / improve existing habitat, or to create or restore new areas to this habitat type. An inventory of their location and area coverage, physical characteristics and the plant and animal species that utilize them will help to inform and guide the potential restoration of new sites.

Previous and Current Dune and Beach Habitat Assessments

Over the last years, numerous resource management agencies active in the Jamaica Bay watershed, including the NPS, USACE, USFWS, NYCDEP, NYCDPR, RPA, Audubon Society and the HEP, have performed natural resource assessments, and identified areas that could benefit from land protection or habitat restoration actions. Many of these acquisition and restoration sites are comprised of maritime dune and beach habitats. However, ground-truthing is required to determine the current status and condition of the restoration of these sites; some areas have already experienced beach and dune habitat restoration and protection, others have been identified as areas that would greatly benefit

from these actions, but no actions have yet occurred. Discussions with appropriate agencies and organizations is necessary to begin to develop a current inventory of potential locations.

The locations of currently identified maritime dune and beach habitats in the watershed are displayed in Figure 4.10.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

Dune and beach habitats are home to many rare, threatened, and endangered animal species that utilize the Bay during the summer season and during spring and fall migratory runs. Several species of plants are found nowhere else in the area. These sand complexes also provide important protection from storm surges and when vegetated help to stabilize the shoreline with highly specific plant species well adapted for dynamic environmental conditions. The enhancement and restoration of additional dune and beach habitats will increase biodiversity and improve existing wildlife habitats.

Technical Issues

Depending on the location and remoteness of the dune restoration, equipment access to the site may be limited. Also, seasonal restrictions may be in place if working near existing dune beach habitat to prevent disturbance of protected wildlife populations. In other cases where land access is possible, the use of heavy equipment is likely prohibited due to the impacts to this fragile plant community. To minimize disturbance, additional measures will raise costs and time to the effort of restoring dune and beach habitat.

Legal

Depending on the location of the site and restoration activities to be performed, NYSDEC, USACE and USFWS permits may be required. If the restoration site occurs on NYCDPR or NPS administered lands, permits from those entities may also be required.

Cost

Updated restoration costs have not been developed and the funding status for many of these restorations is unclear at this time, but it is highly likely that many of these proposals remain unfunded.

RECOMMENDATION

Because these sites have already been identified by multiple entities engaged in conservation and restoration of Jamaica Bay habitats, it is recommended that further beach / dune habitat restoration be facilitated according to the following process:

- Update the current status of the beach/dune habitat restoration projects indicated in Figure 4.10 above.

- Coordinate with NYCDPR, HPD, NPS, USFWS, USACE, NYSDEC and local environmental groups in the restoration of these beach/dune habitat sites to leverage existing funding and maximize restoration efforts.

IMPLEMENTATION STRATEGY

In coordination and collaboration with multiple agencies and environmental groups, update inventory of all existing dune and beach habitats and coverage to create a base GIS map. This information can be then used by restoration practitioners in developing and leveraging future ecological restoration designs.

Cost: $400,000 for existing conditions research, mapping, evaluation, threats assessment, prioritization of restoration opportunities and new site potential. Note: *Cost to perform this work includes work suggested under Strategy 2b3 and does not represent an additional cost.*

Schedule: Will be developed through a proposed contract. A contractor is anticipated to be retained by mid-2008. Work to be initiated in Fall 2008.

References

Yozzo, D.J., Rhoads, J.M., Wilber, P., Nuckols, W., Hollen, L. and Will, R. 2001. Beneficial uses of dredged material for habitat creation, enhancement, and restoration in NY/NJ Harbor. U.S. Army Corps of Engineers, New York District, New York, N.Y.

Management Strategy 2b4: Identify habitats of listed species and suggest projects that would support the recovery of animals and plants that are listed as RTE.

STRATEGY DESCRIPTION

A number of species that occur in the Jamaica Bay watershed are listed by the federal or state government as rare, threatened, or endangered (RTE). The commonality between these RTE species is that the specific habitat conditions necessary for their survival have been severely degraded, leading to a decline in species health and population. The success of an RTE species requires effective management and an understanding of the specific habitat conditions necessary for the successful restoration of each species. As ecosystem restoration occurs throughout the watershed and Jamaica Bay, 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 specific habitat conditions necessary for the long-term survivability of the species will not have established immediately after the initial restoration.

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.

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 was developed. In addition, a preliminary review of the habitats necessary for the survival and propagation of those species was evaluated,

identified, and assessed for their ability to provide the requisite ecological conditions. Consultation with other natural resource agencies and environmental stakeholder groups is necessary to further refine potential habitat locations. The integration of this information into ongoing and proposed restoration and enhancement plans will assist in the support and recovery of those RTE species, and may be additional criteria to consider in the prioritization of future habitat restoration efforts.

New York State Classification Codes

The following legal definitions and codes are used to describe rare, threatened, and endangered species in the State of New York and the United States (from the New York Natural Heritage Program (NYNHP) - http://www.acris.nynhp.org/ranks.php).

New York State Legal Status for Animals

Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6 NYCRR Part 182.5.

E - Endangered Species: any species which meet one of the following criteria: Any native species in imminent danger of extirpation or extinction in New York. Any species listed as endangered by the United States Department of the Interior, as numerated in the Code of Federal Regulations, 50 CFR 17.11.

T - Threatened Species**:** any species which meet one of the following criteria: Any native species likely to become an endangered species within the foreseeable future in NY. Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the 50 CFR 17.11.

SC - Special Concern Species: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

P - Protected Wildlife (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.

U - Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.

G - Game (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

New York State Legal Status for Plants

The following categories are defined in regulation 6 NYCRR Part 193.3 and apply to Environmental Conservation Law section 9-1503.

E - Endangered Species: listed species are those with: 5 or fewer extant sites, or fewer than 1,000 individuals, or restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or species listed as endangered by U.S. Department of Interior, as enumerated in 50 CFR 17.11.

T - Threatened**:** listed species are those with: 6 to fewer than 20 extant sites, or 1,000 to fewer than 3,000 individuals, or restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or listed as threatened by U.S. Department of Interior, as enumerated in 50 CFR 17.11.

R - Rare: listed species have: 20 to 35 extant sites, or 3,000 to 5,000 individuals statewide.

V - Exploitably Vulnerable**:** listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.

U - Unprotected**:** no state status.

Federal Classification Codes

Federal Legal Status for Plants and Animals

The categories of federal status are defined by the United States Department of the Interior as part of the 1974 Endangered Species Act (see 50 CFR 17). The species listed under this law are enumerated in the Federal Register vol. 50, no. 188, pp. 39526 - 39527.

LE: The element is formally listed as endangered.

LT: The element is formally listed as threatened.

PE: The element is proposed as endangered.

PT: The element is proposed as threatened.

C: The element is a candidate for listing.

LE,LT: The species is formally listed as endangered in part of its range, and as threatened in the other part; or, one or more subspecies or varieties is listed as endangered, and the others are listed as threatened.

LT,PDL: Populations of the species in New York are formally listed as threatened, and proposed for delisting.

(LE): If the element is a full species, all subspecies or varieties are listed as endangered; if the element is a subspecies, the full species is listed as endangered.

LT,T(S/A): One or more subspecies or populations of the species is formally listed as threatened, and the others are treated as threatened because of similarity of appearance to the listed threatened subspecies or populations.

PS: Partial status: the species is listed in parts of its range and not in others; or, one or more subspecies or varieties is listed, while the others are not listed.

Documents and databases from The USFWS, NMFS, Jamaica Bay Wildlife Refuge, NPS GNRA, and NYNHP were reviewed in an effort to determine the rare, threatened and endangered species within the Jamaica Bay Watershed. The final list of species includes those that are listed under the Federal Endangered Species Act of 1973, along with New York State listed species whose status in the Jamaica Bay Watershed were listed as rare, threatened or endangered (Table 4.8).

Habitat criteria for the relevant RTE species were defined according to documented habitat preferences by the relevant species (Table 4.9). Several species that are federally–listed are not likely to occur in Jamaica Bay, but were included to provide a complete range of potentially-viable RTE vegetation and wildlife.

Habitat Categories

The habitat requirements were categorized into general land cover types occurring in the Jamaica Bay watershed, to allow a determination of which RTE species may frequent those areas. These are:

- Bareground
- Coastal Rock
- Coastal Scrub
- Dune
- Grassland
- Landscape
- Landscape Corridor
- Shrubland
- Freshwater
- Woodland
- Woodland Edge
- High Salt Marsh
- Low Salt Marsh
- Low Salt Marsh Salt Panne
- Intertidal Mudflat
- Maritime Beach
- Maritime Dune

TABLE 4.8. Rare, Threatened, and Endangered Species in Jamaica Bay Watershed

Species		Listing		
Common Name	**Latin Name**	**Global**	**Federal**	**State**
American wigeon	Anas americana			R
gadwall	Anas stepera			R
short-eared owl	Asio flammeus			I/P/S/E
long-eared owl	Asio otus			P/P
red-shouldered hawk	Buteo lineatus			T/S
piping plover	Charadrius melodus	R	FT	I/E
Northern harrier*	Circus cvaneus			R/T/S
blackpoll warbier	Dendroica striata			R/P
snowy egret	Egretta thula			I/R/P
peregrine falcon*	Falco peregrinus	R	E	I/E

TABLE 4.8. Rare, Threatened, and Endangered Species in Jamaica Bay Watershed				
Species		Listing		
Common Name	Latin Name	Global	Federal	State
American coot	Fulica americana			R
common loon	Gavia immer			R/P/S
American oystercatcher	Haematopus palliatus			R/P
least bittern	Ixobrychus exillis			R/P/S/T
black crowned night heron	Nycticorax nycticorax			R/P
osprey	Pandion haliaetus			T/S
Northern parula	Parula americana			R/P
double-crested cormorant	Phalacrocorax auritus			R/P
pied-billed grebe*	Podylimbus podiceps			R/P/T
clapper rail	Rallus longirostrus			R/P
least tern	Sterna antillarum			R/E/T
Roseate tern	Sterna dougallii		FE	I/E
Foster's tern	Sterna forsteri			CI/P
common tern*	Sterna hirundo			R/T
common barn-owl	Tyto alba			R/P/S
FINFISH				
blueback herring	Alosa aestivalis			R/U
bay anchovy	Anchoa mitchilli			R/U
mummichog	Fundulus heteroclitus			R/U
naken goby	Gobiosoma bosci			I-R/U
seaboard goby	Gobiosoma ginsburgi	?		I-R/U
inland silverside	Menidia berylina			I-R/U
Atlantic tomcod	Microgadus tomcod			I-R/U
grubby sculpin	Myoxocephalus aenaeus	?		R/U
summer flounder	Paralichthys dentatus	?		I/R/U
Atlantic needlefish	Stongylura marina			I-R/U
Northern Pepefish	Syngnathus fuscus	?		R/U
hogchoker	Trinectes maculatus			R/U
REPTILES				
loggerhead	Caretta caretta	R	T	T/Z
green turtle	Chelonia mydas		T	
leatherback turtles	Dermochelys coriacea		T	
Kemp's ridley sea turtle	Lepidochelys kempii	CI	FE	CI/E
diamondback terrapin	Maclemys t. terrapin			SC/U
AMPHIBIANS				
eastern spadefoot	Scaphiopus h. holbrookii			R/U/S
MARINE MAMMALS				
humpback whale	Megaptera novaeangliae		E	
harbor seal	Phoca vitulina			R/P
sperm whale	Physeter catodon	I	FE	E
bottlenose dolphin	Tursiops truncates			R/U
BUTTERFLIES				
tawny emperor	Asterocampa clyton			R
Appalachian azure	Celastrina neglectamajor			R

TABLE 4.8. Rare, Threatened, and Endangered Species in Jamaica Bay Watershed				
Species		Listing		
Common Name	Latin Name	Global	Federal	State
TREES				
Virginia pine	Pinus virginiana			R/E
willow oak	Quercus phellos			CI/E
SHRUBS				
Houghton's umbrella-sedge	Cyperus houghtonii			R
Schweinitz's flatsedge	Cyperus schweinitzii			I/R
HERBACEOUS				
field-dodder	Cuscuta pentagonia			I/R
smartweed dodder	Cuscuta polygonorum			CI/R
seabeach knotweed	Polygonum glaucum	R		R/RU
silverweed	Potentilla anserina ssp. pacifica			I/R
heart-winged sorrell	Rumex hastatulus			CI/T
WILDFLOWERS				
smooth bur-marigold	Bidens laevis			I/R
seabeach knotweed	Polygonum glaucum	R		R/U
heart-winged sorrell	Rumex hastatulus			RI/T

TABLE 4.9. Rare, Threatened, and Endangered Species Habitat Preferences	
Species	
Common Name	**Notes on Habitat Preferences**
BIRDS	
American wigeon	Prefers deeper lakes or wide, slow-moving sections of river surrounded by grass/forb or shrub-covered lands
gadwall	Grasslands and marshes.
short-eared owl	Broad expanses of open land with low vegetation, such as grasslands or low-structured open shrublands.
long-eared owl	Trees/grass-forbs; riparian habitat nearby.
red-shouldered hawk	Extensive, mature to old-growth woodlands, especially bottom hardwoods, riparian areas, and flooded deciduous swamps feed along the wooded margins of marshes, often close to cultivated fields and natural openings
piping plover	Large expanses of short, sparse grasslands for nesting and foraging, and wetland complexes for foraging.
Northern harrier*	Grasslands and open habitats characterized by tall, dense vegetation, and abundant residual vegetation, wet or dry grasslands, fresh to alkali wetlands, lightly grazed pastures, croplands, fallow fields, oldfields, and brushy areas
blackpoll warbier	
snowy egret	Freshwater sites, dry fields, but most frequently in brackish and sheltered saltwater areas.
peregrine falcon*	Usually nest on cliffs, typically 45 m (150 ft) or more in height. They will also nest on off-shore islands and ledges on vegetated slopes
American coot	grassland to woodland ponds, lakes, slow-moving streams, or rivers.
common loon	Deeply indented shorelines having multiple bays and numerous islands surrounded by boreal or mixed forest.
American oystercatcher	Coastal salt marshes and sand beaches.
least bittern	Coastal zone. Freshwater emergent marsh is used, especially if cattail is present. In addition, pond and lake margins with emergent vegetation.
black crowned night heron	In annual grasslands, riparian deciduous types, medium/large woodlands. Ponds, lakes, marshes, slow streams with pools, or rivers.

TABLE 4.9. Rare, Threatened, and Endangered Species Habitat Preferences	
Species	
Common Name	**Notes on Habitat Preferences**
osprey	Near water, primarily lakes, rivers, and coastal waters with adequate supplies of fish.
Northern parula	Associated with bottomlands and swamps, where they inhabit mature coniferous and deciduous forests in which Spanish moss is an important component of the nesting habitat.
double-crested cormorant	Rocky cliffs and islands.
pied-billed grebe*	Marshes, sluggish streams, ponds 18 acres or less, and some emergent vegetation.
clapper rail	79% smooth cordgrass (*Spartina alterniflora*), 20% black rush (Juncus roemerianus), and 1% salt flats or salt meadows (Hon *et al.,* 1977)
least tern	Favor islands or sandbars along large rivers for nesting.
Roseate tern	Rocky coastal islands, outer beaches or salt marsh islands.
Foster's tern	Large saltwater and freshwater marshes; also found on marshy bays, marshy edges of streams and lakes, sloughs, dikes in evaporation ponds, estuarine islands, marshes adjacent to barrier beaches, and dredge-spoil islets.
common tern*	Mainly near water, often on islets, and usually in areas with little or no vegetation. Inhabits sparsely vegetated sandy islands, barrier beaches, marshy islands, small island in salt marshes, or low, small, rocky islands in lakes and rivers. After nesting, typically found along shorelines, on exposed rocks and old pilings, and inshore over shallow coastal waters.
common barn-owl	Grasslands, marsh, lightly grazed pasture.
FINFISH	
blueback herring	Migrate from ocean waters to spawn in freshwater rivers and streams when water temperatures reach between 10.5 degrees C and 14 degrees C
bay anchovy	Shallow water estuarine and inshore coastal water species (can exploit a larger range).
mummichog	Benthopelagic, eurohaline species. They are commonly found in salt water marshes, tidal creeks and in sheltered shores. The fish's upper salinity limit is reported to be 106 to 120.3 parts per thousand (ppt).
naken goby	Shallow estuarine habitats like patches of oysters, oyster reef, salt marsh and bare sand/mud substrate, but it is most abundant in tide pools and subtidal areas with oyster shell.
seaboard goby	
inland silverside	
Atlantic tomcod	Generally occurring in brackish water but occasionally in freshwater.
grubby sculpin	
summer flounder	
Atlantic needlefish	
Northern Pepefish	
hogchoker	
REPTILES	
loggerhead	Nest on ocean beaches, generally preferring high energy, relatively narrow, steeply sloped, coarse-grained beaches.
green turtle	Shallow, protected areas, nesting on high energy, southern, sand beaches.
leatherback turtles	
Kemp's ridley sea turtle	Nearshore and inshore waters extensive swamps or large bodies of open water having seasonal narrow ocean connections.
diamondback terrapin	Unpolluted saltwater emerge to mate, nest, and bask in the sun on coastal dunes or narrow sandy beaches.

TABLE 4.9. Rare, Threatened, and Endangered Species Habitat Preferences	
Species	
Common Name	**Notes on Habitat Preferences**
AMPHIBIANS	
eastern spadefoot	Fields, farmland, dunes and woodlands with sandy or loose soils. Breed in temporary bodies of water (*e.g.*, vernal pools), flooded fields and forested wetlands.
MARINE MAMMALS	
humpback mammals	
harbor seal	Shallow areas where sandbars, rocks and beaches are uncovered during low tides.
sperm whale	Deep waters.
bottlenose dolphin	
BUTTERFLIES	
tawny emperor	Woodlands near Hacklberry sites, densely wooded areas, dry woods, fence rows, open woods, parks.
Appalachian azure	
TREES	
Virginia pine	Forested rocky ridges & ravines, it is often seen growing on abandoned farmlands, roadsides, and other disturbed areas.
willow oak	Transitional communities between swamps and upland mesic forests.
SHRUBS	
Houghton's umbrella-sedge	Dry, open, rocky summits; the exposed fine sand of a large esker with heavily eroded sand gullies; and a broad, gently sloping sandplain.
Schweinitz's flatsedge	Swamp, edge of swamp riverside cove, calcareous border of a seepy creek on marsh edge.
HERBACEOUS	
field –dodder	Lowland grassland and grassy woodland, riparian vegetation, freshwater wetland (seasonal) and saline and subsaline wetland
smartweed dodder	Open areas and partial shade
seabeach knotweed	Exposed sandflats above high tide line to dunes, but occasionally submerged during storms or exceptionally high tide.
silverweed	Wetlands, generally below 500 ft, coastal areas.
heart-winged sorrell	
WILDFLOWERS	
smooth bur-marigold	Swamps, shores.
seabeach knotweed	Maritime beaches.
heart-winged sorrell	Old fields

TABLE 4.10. Rare, Threatened, and Endangered Species Habitat Communities in the Jamaica Bay Watershed

Species		Habitat Requirements																	
Common Name	**Latin Name**	Baregound	Coastal Rock	Coastal sand	Coastal Shrub	Dune	Grassland	Landscape	Landscape Corridor	Shrubland	Freshwater	Woodland	Woodland Edge	High Salt Marsh	Low Salt Marsh	Low Salt Marsh Salt Panne	Marsh Intertidal Mudflat	Maritime Beach	Maritime Dune
BIRDS																			
American wigeon	Anas americana				X		X			X	X								
gadwall	Anas stepera						X							X	X	X	X		

TABLE 4.10. Rare, Threatened, and Endangered Species Habitat Communities in the Jamaica Bay Watershed

Species		Habitat Requirements																	
Common Name	**Latin Name**	Bareground	Coastal Rock	Coastal sand	Coastal Shrub	Dune	Grassland	Landscape	Landscape Corridor	Shrubland	Freshwater	Woodland	Woodland Edge	High Salt Marsh	Low Salt Marsh	Low Salt Marsh Salt Panne	Marsh Intertidal Mudflat	Maritime Beach	Maritime Dune
short-eared owl	Asio flammeus				X		X			X					X				
long-eared owl	Asio otus				X		X			X	X	X	X						
red-shouldered hawk	Buteo lineatus						X					X	X						
willet	Catoptrophorus semipalmatus						X							X	X	X	X	X	X
piping plover	Charadrius melodus			X	X						X			X					
Northern harrier*	Circus cvaneus						X							X	X	X	X	X	
blackpoll warbier	Dendroica striata																		
snowy egret	Egretta thula						X				X			X	X	X			
peregrine falcon*	Falco peregrinus		X																
American coot	Fulica americana						X				X	X							
common loon	Gavia immer				X													X	
American oystercatcher	Haematopus palliatus			X		X								X	X	X	X	X	X
least bittern	Ixobrychus exillis		X	X	X						X			X	X	X	X	X	X
black crowned night heron	Nycticorax nycticorax						X				X	X		X	X	X	X	X	X
osprey	Pandion haliaetus										X			X	X	X	X	X	X
Northern parula	Parula americana										X	X							
double-crested cormorant	Phalacrocorax auritus		X																
pied-billed grebe*	Podylimbus podiceps										X			X	X	X	X	X	X
clapper rail	Rallus longirostrus													X	X				
least tern	Sterna antillarum			X		X												X	X
Roseate tern	Sterna dougallii		X											X	X	X	X		
Foster's tern	Sterna forsteri			X							X			X	X	X	X	X	
common tern*	Sterna hirundo		X								X			X	X	X	X	X	X
common barn-owl	Tyto alba						X				X			X	X	X	X	X	X
FINFISH																			
blueback herring	Alosa aestivalis										X								
bay anchovy	Anchoa mitchilli													X	X				
mummichog	Fundulus heteroclitus													X	X	X	X	X	X
naken goby	Gobiosoma bosci													X	X	X	X	X	X
seaboard goby	Gobiosoma ginsburgi																		
inland silverside	Menidia berylina																		
Atlantic tomcod	Microgadus tomcod													X	X	X	X	X	X
grubby sculpin	Myoxocephalus aenaeus																		
summer flounder	Paralichthys dentatus																		
Atlantic needlefish	Stongylura marina																		
Northern Pepefish	Syngnathus fuscus																		
hogchoker	Trinectes maculatus																		
REPTILES																			
loggerhead	Caretta caretta		X	X														X	
green turtle	Chelonia mydas																		
leatherback turtles	Dermochelys coriacea																		
Kemp's ridley sea turtle	Lepidochelys kempii		X	X		X					X			X	X	X	X	X	X

TABLE 4.10. Rare, Threatened, and Endangered Species Habitat Communities in the Jamaica Bay Watershed

Species		Habitat Requirements																	
Common Name	**Latin Name**	Bareground	Coastal Rock	Coastal sand	Coastal Shrub	Dune	Grassland	Landscape	Landscape Corridor	Shrubland	Freshwater	Woodland	Woodland Edge	High Salt Marsh	Low Salt Marsh	Low Salt Marsh Salt Panne	Marsh Intertidal Mudflat	Maritime Beach	Maritime Dune
diamondback terrapin	Maclemys t. terrapin					x								x	x	x	x	x	x
AMPHIBIANS																			
eastern spadefoot	Scaphiopus h. holbrookii				x	x	x			x		x	x						
MARINE MAMMALS																			
humpback whale	Megaptera novaeangliae																		
harbor seal	Phoca vitulina		x	x	x													x	x
sperm whale	Physeter catodon																		
bottlenose dolphin	Tursiops truncates																		
BUTTERFLIES																			
tawny emperor	Asterocampa clyton									x		x	x						
Appalachian azure	Celastrina neglectamajor																		
TREES																			
Virgina pine	Pinus virginiana		x				x		x				x						
willow oak	Quercus phellos										x		x						
SHRUBS																			
Houghton's umbrella-sedge	Cyperus houghtonii		x	x														x	x
Schweinitz's flatsedge	Cyperus schweinitzii										x			x	x	x	x	x	x
HERBACEOOUS																			
field-dodder	Cuscuta pentagonia						x				x	x	x	x	x	x	x	x	x
smartweed dodder	Cuscuta polygonorum						x												
seabeach knotweed	Polygonum glaucum			x		x												x	x
silverweed	Potentilla anserina ssp. pacifica													x	x	x	x	x	x
heart-winged sorrell	Rumex hastatulus																		
WILDFLOWERS																			
smooth bur-marigold	Bidens laevis													x	x	x	x	x	x
seabeach knotweed	Polygonum glaucum																	x	
heart-winged sorrell	Rumex hastatulus						x												

EVALUATION OF MANAGEMENT STRATEGY

Environmental

The identification and potential locations of RTE species allows restoration projects to integrate these species in the design phase, establish realistic restoration targets, and may help in establishing prioritization criteria in moving forward with restoration projects in the Bay. The restoration of RTE habitats will also aid in their long term recovery, improve wildlife habitat features and increase ecological diversity.

Technical

As with all ecological restoration projects, it is important to use those RTE plants that are suitable for the current environmental conditions of the site. Some physical alterations can be made, but if too much of the original system has been lost and appropriate environmental conditions can not be readily duplicated, the restoration of some species may not be practical. In addition, careful attention to the genetic origin of the plant material is critical in maintaining the ecological integrity of the restoration. Establishing criteria limiting the provenance of the source material is an important factor. Provenance restrictions are required on all NYCDEP restoration projects.

In areas where the potential for RTE species exists, the installation of non local provenance species should generally not be planted; importing species from elsewhere could potentially lead to damaging alteration of the gene pool of the remaining population (USFWS, 2004). Therefore, to the greatest extent possible the propagation of existing plant populations (seed preferred) of RTE species is desired and the limiting of provenance distance when existing populations are not sufficient for propagation purposes.

Cost

While there is not expected to be any additional cost to a restoration project to specify the use of RTE species, additional coordination of the design schedule to accommodate the propagation source and growing the material may be necessary.

Legal

Permits from relevant regulatory agencies may be required for the collection of seed and/or propagation of certain RTE species. In addition, the installation of these species may require special permission or notification of relevant government agencies.

RECOMMENDATION

It is recommended that government agencies and environmental stakeholders actively involved in restoration projects recognize the potential for RTE species for use in their projects. NYCDEP strongly supports and encourages the prioritization of restoration and conservation projects that incorporate RTE habitat criteria into their designs.

IMPLEMENTATION STRATEGY

Determine RTE Restoration Priorities and Targets

Ecological assessments of Jamaica Bay should continue to refine the Jamaica Bay habitat potential to provide an accurate identification of where current RTE critical habitat areas exist. In coordination and consultation with multiple agencies and other relevant stakeholder groups, determine realistic RTE restoration priorities and targets (*e.g.,* which species populations are the most desirable and practical to restore).

Cost: Costs have not been developed but are considered to be minimal and inclusive of existing site assessment and restoration efforts.

Schedule: In coordination with multiple agencies, by October 2008 establish the priority species that should be targeted for restoration and develop potential restoration locations.

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Management Strategy 2b5: Expand litter removal and reduction programs including beach clean-ups and request that DPR and NPS maintain trash receptacles on beaches and parks through the end of October.

STRATEGY DESCRIPTION

Source: Don Riepe (American Littoral Society)

The shorelines of Jamaica Bay and the beaches of Rockaway and Coney Island attract millions of visitors every year to take advantage of the cool waters, breathtaking views and the unique assemblages of the varied ecosystems. Unfortunately, the great use of these natural resources also comes with a price, the litter and debris that are generated by public use. To address this issue, the NYCDPR and the NPS maintain the trash receptacles at

these areas during the traditional summer beach use, from Memorial Day through Labor Day. However, while the weather beyond Labor Day is suitable for recreational use of these areas, the regular trash collection for these areas ends on Labor Day. With limited options for disposing of the waste, litter can be deposited along shorelines through wind and/or tides. Upland litter within the watershed has been identified as a primary source of floatable debris via discharge through CSO and storm drain outfalls. In this situation, the primary mechanism of floatables and debris entering the waterbodies and depositing along the shorelines is the through the direct discharge from these open recreational areas.

Source: Don Riepe (American Littoral Society)

To begin to address this issue and determine the extent of the debris along the shorelines, NYCDEP, in coordination with the American Littoral Society, has initiated a global positioning system (GPS) mapping effort of the debris piles around the perimeter of the Bay. In addition to the aesthetic issues, it has been asserted that these piles may be partly responsible for the suppression of the natural succession in some locations along the shoreline. With each tide cycle or storm event, the debris movement along the shoreline inhibits the growth of wetland and adjacent upland plants. It is also possible that the historic "rotating" debris piles from dilapidated piers and other near shore neglected structures (*e.g.*, floating docks) deposited years ago may also serve as the source for much of the debris that is reintroduced into the Bay by each spring and storm tide. Once the areas of debris along the shoreline of Jamaica Bay are inventoried and mapped, then a "master plan" can be developed that begins to prioritize the removal of these piles of debris.

Source: Jeanne Dupont (Rockaway Waterfront Alliance)

To help expedite this process and begin to tackle this large geographic issue within the Jamaica Bay, over the last 15-months NYCDEP has assisted in several beach clean-ups with several environmental groups, including the American Littoral Society and the Rockaway Waterfront Alliance and will continue to expand upon these efforts in the future. Hundreds of volunteers and thousands of hours of time have been devoted to cleaning up the shoreline areas of Plumb Beach and along the beaches of Far Rockaway. These volunteer efforts have removed over 300-cubic

Source: Jeanne Dupont (Rockaway Waterfront Alliance)

yards of debris from the shoreline, have prevented their re-entry into the waterways, and have allowed adjacent areas to naturally regenerate. They have also raised the awareness of the issues surrounding the damage that can be caused to the marine environment by floatables and other debris.

In addition to the debris removal, these volunteer efforts have also planted over 4,000 indigenous trees, shrubs, native grasses and wildflowers. The addition of these plantings will help to stabilize these areas, improve the ecological diversity of plant species and help in the future recruitment of additional coastal species. While the main focus of these efforts is to help to restore and improve the ecology and species diversity with Jamaica Bay, these volunteer efforts also begin to open up these areas for passive recreational use and enjoyment. A sense of stewardship is instilled in those who help out and this fosters further protection of these areas.

Community 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. NYCDEP, with continued support and collaboration with non-governmental partners, will continue these efforts to help reduce the presence of floatables and shoreline debris.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

As the weather typically remains warm for several weeks beyond Labor Day, these public areas continue to be used and generate waste. 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.

FIGURE 4.11 Beach Clean Up Efforts. Source: NYCDEP.

The intent of the beach clean-ups and plantings is to help restore and improve degraded areas near the shoreline of the Bay that have a direct and immediate influence on the ecology of the Bay. The removal of the debris along the shoreline not only improves the aesthetic qualities of the Bay but also provides the opportunity to allow the natural colonization and stability of indigenous vegetation types that greatly improves the ecological health and diversity of the Bay.

Technical

Depending on the location of the clean up, the access to the site may be limited by water entry only. In other cases where land access is possible, the use of heavy

equipment is prohibited due to wetland regulatory issues. To minimize disturbance, additional measures will likely add additional cost and time to the effort of removing shoreline debris.

Costs

See *Implementation Strategies* below for cost information.

Legal

For many of the beach clean up efforts and plantings, wetland permits may not be required. However, for those efforts that require the use of heavy equipment and/or access to the waters edge will require permits from NYSDEC and USACE. Also, depending on the location within the Jamaica Bay watershed, permits from NYCDPR and NPS may also be required.

RECOMMENDATION

A potential correctable source of floatable debris and litter is to extend the seasonal collection of trash receptacles in public parks and along near shore areas beyond the current collection end period of Labor Day.

IMPLEMENTATION STRATEGY

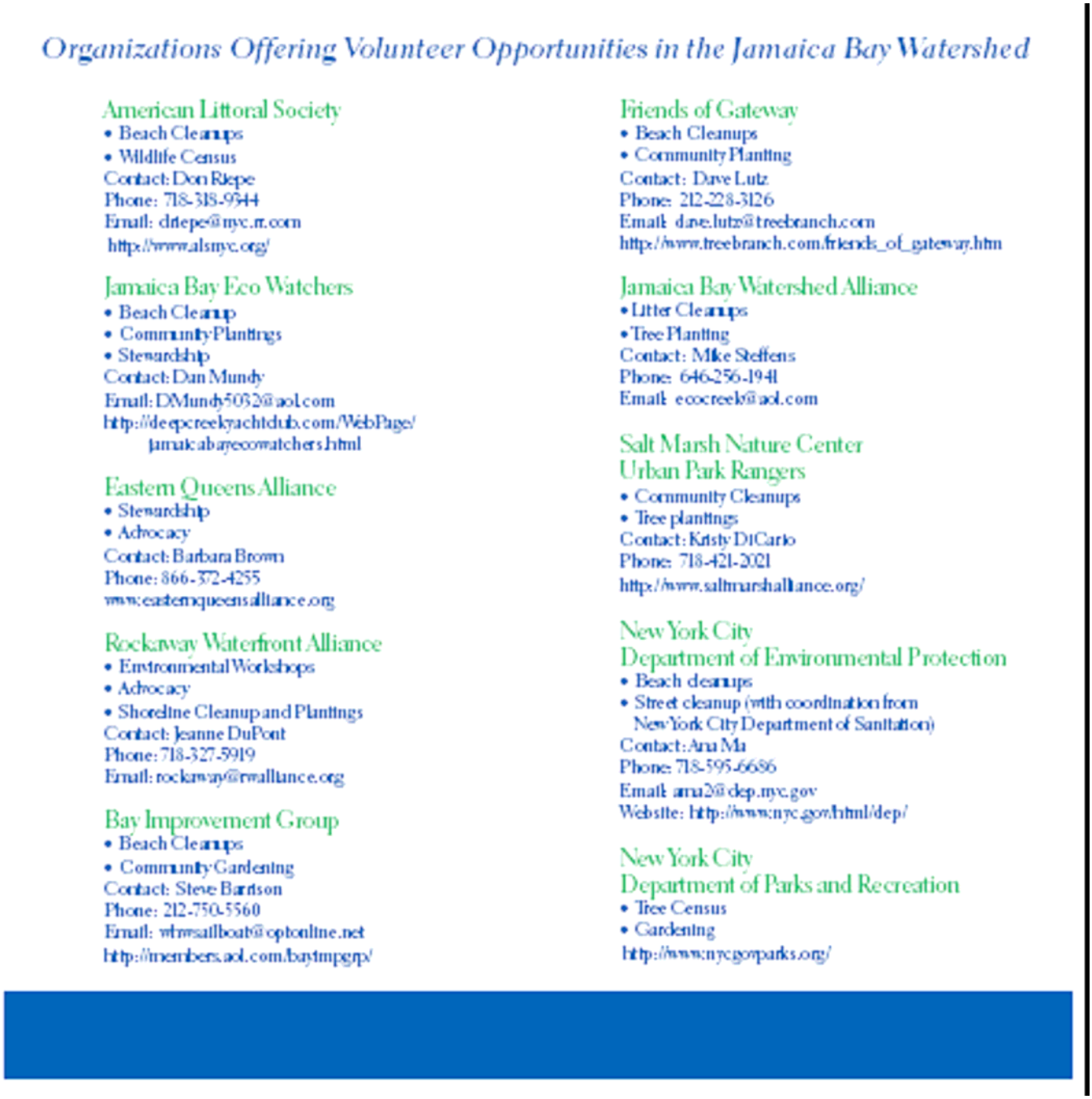
Continue Beach Clean Up Efforts

NYCDEP will work with NYCDPR to determine whether trash collection along the beaches and parks can be extended beyond Labor Day. In addition, NYCDEP will continue to work with local groups with future shoreline clean ups and restoration plantings. NYCDEP encourages participation from other agencies and organizations in these efforts. Figure 4.12 provides a list of some of the organizations within the watershed that can be contacted regarding volunteer opportunities to promote stewardship and environmental programs.

Schedule: NYCDEP will continue to collaborate with government agencies and environmental organizations in shoreline clean up and plant restoration efforts throughout Jamaica Bay and the watershed. No schedule has been established for the possible extension of litter collection along shoreline beaches and parks.

Cost: Shoreline Clean Ups and Restoration: Use of existing NYCDEP staff and resources is minimal, however, to expand the program additional resources from multiple agencies and organizations will be required.

Trash Receptacle Collection: approximately $125,000 for NYCDPR and $80,000 for NPS staff is required each year to maintain trash receptacles beyond Labor Day to October 31 along public beaches, parks and shoreline areas. Funding is not yet available.



Organizations Offering Volunteer Opportunities in the Jamaica Bay Watershed

American Littoral Society
- Beach Cleanups
- Wildlife Census

Contact: Don Riepe
Phone: 718-318-9544
Email: driepe@nyc.rr.com
http://www.alsnyc.org/

Jamaica Bay Eco Watchers
- Beach Cleanup
- Community Plantings
- Stewardship

Contact: Dan Mundy
Email: DMundy5032@aol.com
http://deepcreekyachtclub.com/WebPage/jamaicabayecowatchers.html

Eastern Queens Alliance
- Stewardship
- Advocacy

Contact: Barbara Brown
Phone: 866-372-4255
www.easternqueensalliance.org

Rockaway Waterfront Alliance
- Environmental Workshops
- Advocacy
- Shoreline Cleanup and Plantings

Contact: Jeanne DuPont
Phone: 718-327-5919
Email: rockaway@rwalliance.org

Bay Improvement Group
- Beach Cleanups
- Community Gardening

Contact: Steve Barrison
Phone: 212-750-5560
Email: whrwsailboat@optonline.net
http://members.aol.com/bayimpgrp/

Friends of Gateway
- Beach Cleanups
- Community Planting

Contact: Dave Lutz
Phone: 212-228-3126
Email: dave.lutz@treebranch.com
http://www.treebranch.com/friends_of_gateway.htm

Jamaica Bay Watershed Alliance
- Litter Cleanups
- Tree Planting

Contact: Mike Steffens
Phone: 646-256-1941
Email: ecocreek@aol.com

Salt Marsh Nature Center Urban Park Rangers
- Community Cleanups
- Tree plantings

Contact: Kristy DiCarlo
Phone: 718-421-2021
http://www.saltmarshalliance.org/

New York City Department of Environmental Protection
- Beach cleanups
- Street cleanup (with coordination from New York City Department of Sanitation)

Contact: Ana Ma
Phone: 718-595-6686
Email: ama2@dep.nyc.gov
Website: http://www.nyc.gov/html/dep/

New York City Department of Parks and Recreation
- Tree Census
- Gardening

http://www.nycgovparks.org/

FIGURE 4.12 Organizations Offering Volunteer Opportunities in the Jamaica Bay Watershed; Source: NYCDEP.

Management Strategy 2b6: 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.

STRATEGY DESCRIPTION

Many of the proposed restoration efforts occurring around the perimeter of the Bay have an important goal of removing invasive exotic vegetation. However, due to numerous 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 and the watershed. 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 goal of improving biodiversity of Jamaica Bay requires the eradication and future control of these lower quality opportunistic vegetation types.

Existing Vegetation Analysis

The 2002 JBERRT Report includes a vegetation analysis at 12 study sites within Jamaica Bay, 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.

An inventory of invasive species in the Jamaica Bay watershed was compiled from numerous sources, including documents and databases from the New York State Invasive Species Task Force; NPS GNRA, Jamaica Bay Unit; and NYCDEP. The 2002 JBERRT Report provided resources for identifying selected invasive species, and restoration plans associated with those species. The Draft Invasive Plant Management Plan for the GNRA Jamaica Bay Unit developed by the NPS provides specific invasive species targets and control strategies for areas within the Park. Table 4.11 presents a list of invasive species that are known to occur in the watershed.

The inventory is focused on vegetation and does not identify aquatic or macro-invertebrate species. This stems from the lack of sound information regarding the presence of invasive species other than plants in the Jamaica Bay watershed. Additional research within Jamaica Bay is required to determine the presence of additional problematic species.

TABLE 4.11. Invasive Species Known to Occur in the Jamaica Bay Watershed																
Species		Confirmed Location in Watershed														
Common Name	Latin Name	Floyd Bennett Field (Barren Island)	North-forty	Canarsie Pier	Plumb Beach	Bergen Beach	Fort Tilden	Breezy Point	Jacob Riis Park	North Garden	Dead Horse Bay	Fresh Creek	Willolake	Elder Point	Yellow Bar	Jamaica Bay Watershed
BIRDS																
house finch	Carpodacuas mexicanus															X
monk parakeet	Myiopsitta monachus															X
house sparrow	Passer domesticus															X
European starling	Sturnus vulgaris															X
Mute Swan	Cygnus olor													X	X	X
REPTILES																
red-eared slider	Trachemys scripta															X
MAMMALS																
feral dog	Canis familiaris															X
feral cat	Felis silvestris															X
house mouse	Mus musculus															X
Norway rat	Rattus norvegicus															X
black rat	Rattus rattus															X
TREES																
Norway maple	Acer pseudoplatanus															X
tree-of-heaven	Ailianthus altisima											X		X		X
SHRUBS																
autumn olive	Elzeagnus umbellata		X													X
European buckthorn	Rhamnus cathartica									X						X
VEGETATION-GRASS																
mugwort	Artemisia vulgaris											X				X
Curly grass	Carex kobomugli															X
spotted knapweed	Centaurea maculosa	X														X
mouse-eared chickweed	Cerastium fontanum															X
cypress spurge	Chamaesyche (Euphorbia) cyperasias															X
leafy spurge	Chamaesyche (Euphorbia) esula															X
lovegrass	Eragrostis sp.															X
purple loosestrife	Lythrum salicarai												X			X
Japanese stilt grass	Microstegium vimineum															X
Eurasian watermilfoil	Myriophyllum spicatum															X
common reed	Phragmites australis	X	X						X		X	X		X		X
Japanese knotweed	Polygonum cuspidatum	X														X
Mile-a-minute vine	Polygonum perfoliatum															X
cattail	Typha latifolia															X
EXOTIC VINES																
Japanese barberry	Berberis thunbergii															X
garlic mustard	Aliaria petiolata															X
multiflora rose	Rosa multiflora	X	X	X	X	X										X
porcelain berry	Ampelopsis breviligulata															X
VINES																
oriental bittersweet	Celastrus orbiculatus		X							X						X
Japanese honeysuckle	Lonicera japonica															X
wisteria	Wisteria sinensis															X
Poison Ivy	Toxicodendron radicans								X							X

Regionally, there are many invasive species that are likely to also occur in the Jamaica Bay watershed (Table 4.12).

The primary landowners of natural, open spaces in the Jamaica Bay watershed are the NPS and the NYCDPR. Additionally, NYCDOT and NYCDEP control significant areas of undeveloped lands in some part of the watershed. Finally, there are some private landholdings that are significant.

These open spaces are the areas that are susceptible to invasion by invasive species. Because there is such a wide distribution of land ownership, invasive species control responsibilities must be engaged individually by each land authority. The NPS is underway with an invasive species inventory and management plan within the GNRA Jamaica Bay Unit. NYCDPR has done some spot treatments for invasives species on some properties in Jamaica Bay, including Four Sparrows Marsh, but many NYCDPR properties still contain large stands of invasive vegetation, including: Brant Point, Dubos Point, Four Sparrows Marsh, Fresh Creek, and White Island.

The first step in invasive species control is understanding where invasive communities are located by performing an invasive species survey and an understanding of the biological and physical changes to a particular location that encourage these vegetation types (*e.g.*, anthropogenic soil changes). Once the invasive species have been identified and located, an invasive species management plan can be created to provide appropriate control measures for each area. Funding and implementing the plan requires a multi-year ongoing effort; invasive species control is difficult, and is best performed in conjunction with the restoration of native communities in the areas where invasive species control occurs, to prevent the recolonization of the area by other invasive communities. While this has occurred in some areas of the Bay, the extent of the invasive vegetation and the potential for the recolonization of other locations remains high.

TABLE 4.12. Invasive Species Know to Occur Regionally	
privet	Ligustrum vulgare
mimosa	Albizia julibrisin
catalpa	Catalpa bignonioides
Swallow-wort	Synanchum sp.
Chinese bush clover	Lespedeza cuneata
Scotch broom	Cytisus scoparius
Bell's honeysuckle	Lonicera x bella
Morrow's honeysuckle	Lonicera morrowii
ox-eye daisy, margarite	Leucanthemum vulgare
Tatarian honeysuckle	Lonicera tatarica
European fly honeysuckle	Lonicera xylostreum
white mulberry	Morus alba
Eurasian watermilfoil	Myriophyllum spicatum
reed canary grass	Phalaris arundinacea
Amur cork tree	Phellodendron amurense
Scotch pine	Pinus sylvestris
curly-leaf pondweed	Potamogeton crispus
common buckthorn	Rhamnus cathartica
black jetbead	Rhodotypos scandens
black locust	Robinia pseudoacacia

TABLE 4.12. Invasive Species Know to Occur Regionally	
eglantine; sweetbrier	Rosa eglanteria
red sorrel	Rumex acetosella
water chestnut	Trapa natans
siebold viburnum	Viburnum sieboldii
Chinese wisteria	Wisteria sinensis

The control of invasive species in the Jamaica Bay watershed will require each jurisdiction which manages natural open spaces in the watershed to perform an inventory and create an invasive species management plan.

EVALUATION OF MANAGEMENT STRATEGY

Environmental

Invasive species control increases the biodiversity and resilience of native communities, attracts desirable native wildlife and beneficial insect populations for greater pest management. The control of invasive species in the watershed and around Jamaica Bay is multiple agency effort and needs to coordinated and distributed among many partners, some of which are already engaging in these efforts.

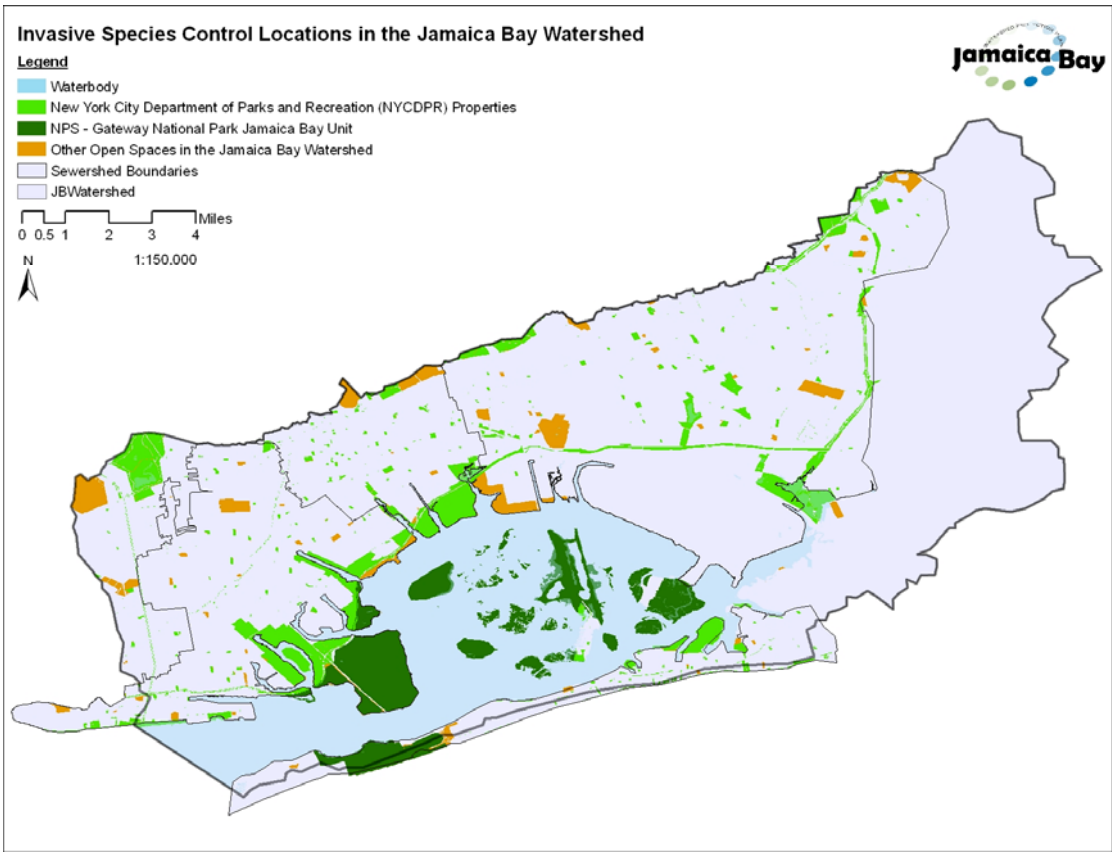


FIGURE 4.13 Open spaces in Jamaica Bay watershed – areas for invasive species control.
Source: NYCDEP

Technical

Invasive species control is expensive and laborious; it requires a dedicated effort and repeated application of control measures to be successful. Invasive species management efforts by a variety of land management entities will result in varied approach to invasives management, and may be applied more successfully in some location than in others. To avoid the duplication of non-effective treatment methods, the coordination of previous successful eradication methods is critical.

Legal

Depending on the location and control methods utilized, NYSDEC, USACE and USFWS permits and licenses (*i.e.*, certified herbicide applicator) may be required. Also, depending on the location within the Jamaica Bay watershed, permits from NYCDPR and NPS may also be required.

Cost

Cost: The cost for invasive species management is highly variable depending on the target species, level of infestation, amount of area infested, and diversity of environmental features. Costs per acre can range from $1,500 to $2,500 per acre for spray application only and does not include physical removal of invasive vegetation off-site or other restoration efforts.

RECOMMENDATION

NYCDEP in collaboration with multiple agencies and partners will initiate invasive species inventories on appropriate sensitive areas of the Jamaica Bay watershed, and subsequently formulate in partnership with other agencies and organizations an invasive species management plans for each area.

IMPLEMENTATION STRATEGY

NYCDEP will work with other government agencies and environmental organizations to promote the importance of invasive species management to the overall health and ecological function of the Jamaica Bay watershed Invasive species management plans that each land managing entity can implement will be developed in partnership with other agencies and organizations. Funding for invasive plant removal is not available.

Schedule: To be determined.