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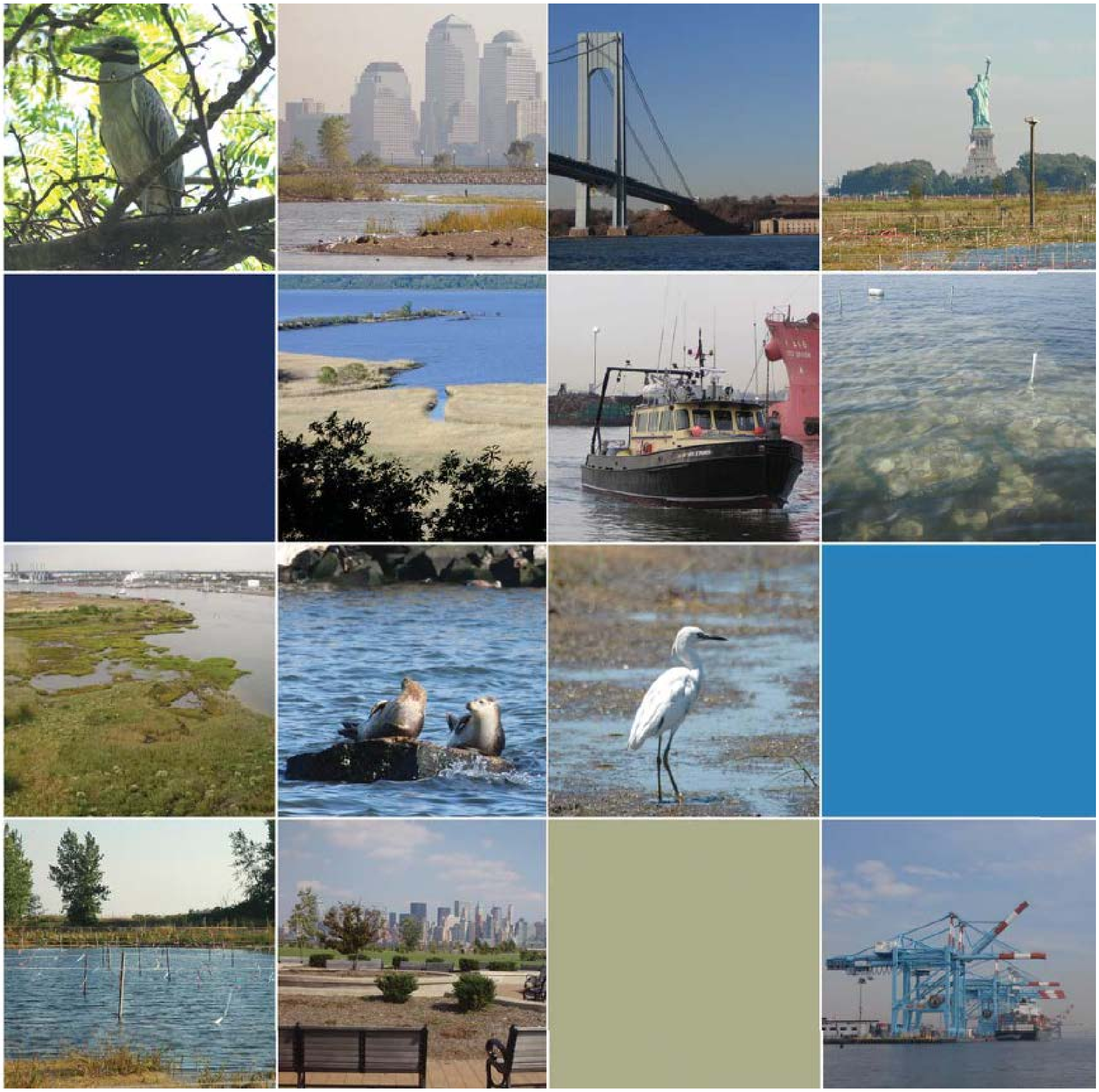
Appendix E-1
Alternatives Development - Jamaica Bay Package

Draft Integrated Feasibility Report &
Environmental Assessment
February 2017

Prepared by the New York District
U.S. Army Corps of Engineers



Executive Summary

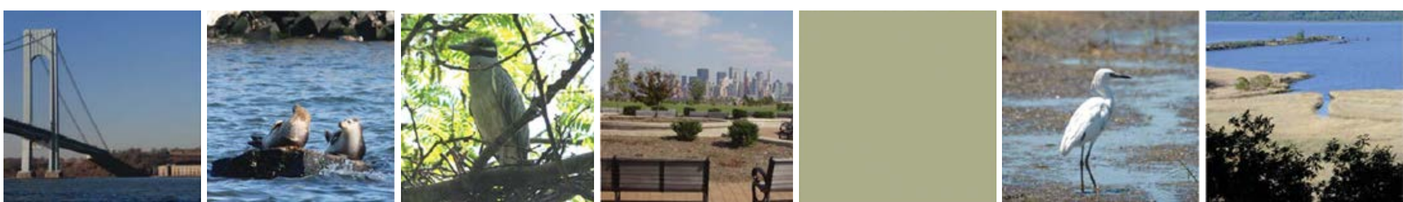
Jamaica Bay is about eight (8) miles long, four (4) miles wide, and covers an area of approximately 26 square miles. The bay spans the southern portions of the two (2) most populated boroughs in the New York City, Brooklyn (Kings County) and Queens (Queens County), and the western boundary of Nassau County. The bay is fringed by remnant salt marshes, heavily modified tidal creeks, disturbed upland ecosystems, parks, landfills, dense residential communities, commercial and retail facilities, public transportation, and John F. Kennedy International Airport. The bay itself is composed of salt marsh islands, mudflats, tidal creeks, navigational channels, and open water.

In the 19th and 20th centuries, through a series of human actions, extensive habitat losses resulted in the severe degradation of much of the remaining habitats and the bay's chemical, physical, and biological environment. These actions included the filling of marshes and open water areas, hardening of shorelines, altering of the bathymetry of the bay bottom, inputs from raw and treated sewage, combined sewage overflow, and landfill leachates, which impaired the ability of Jamaica Bay to function as an ecological system.

The Jamaica Bay, Marine Park, Plumb Beach Feasibility Study (Jamaica Bay "source" study) was initiated in 1996 to improve the environmental quality of Jamaica Bay and restore its historical productivity and diversity. Of the original body of 39 sites initially identified as restoration candidates (USACE 1997), eight (8) were ultimately chosen for more detailed study, design, and implementation during the implementation of the "source" study.

In the first phase of screening, nine (9) sites were eliminated due to constraints that were expected to greatly increase the monetary costs and reduce the ecological benefits of any restoration proposal, such that the costs would outweigh the benefits. The initial stage of screening left 30 possible sites. These sites then went through an extensive collaborative planning process that involved many agency workshops and meetings that included both one-on-one and interagency sessions with the non-federal sponsor New York City Department of Environmental Protection, United States Fish and Wildlife Service, National Oceanic Atmospheric Administration United States Environmental Protection Agency, National Park Service, New York State Department of Environmental Conservation (NYSDEC), New York State Department of State, Port Authority of New York and New Jersey and New York City Department of Parks and Recreation (NYC Parks). The process also involved community meetings with the Jamaica Bay Taskforce, community boards, borough presidents' offices (Queens and Brooklyn) and several public meetings over more than a year. This extensive input resulted in screening down to 10 sites to be examined in detail. Eventually, two (2) of these sites, Gerritsen Creek and Upper Spring Creek (North), were spun off as studies under the Continuing Authorities Program (CAP) to take advantage of bond funds received by NYC Parks.

At initiation of the Jamaica Bay "source" study, the problems with the loss of marsh islands had not been identified. When NYSDEC completed its Geographic Information System-based surveys and actually quantified the extensive losses suffered since only the mid-1970s, the Jamaica Bay "source" study process was already into its detailed investigations of the eight (8) sites. The resource agencies met on several occasions to discuss this newly identified, serious issue and in consensus, it was determined that the islands would be investigated under a separate parallel track using the CAP authority (See Appendix X-5, Jamaica Bay Marsh Island Package). Therefore, the Jamaica Bay "source" study focused on sites along the perimeter of the bay. In addition to their overall ecological value to the bay system as a whole, the eight (8) perimeter sites also act as a buffer for the center of



bay from the densely urban setting, and will protect, ecologically and from future storm events, future restoration attempts in the center of the bay.

The alternatives in this appendix emphasize ecosystem restoration activities that involve modification of hydrology and/or aquatic habitat. Habitats targeted include wetlands, riparian and other aquatic systems, but also include adjacent maritime forest and grasslands as appropriate. These latter habitats were perhaps the most severely impacted over time with few remaining, yet they functioned as an integral part of the total ecosystem. They add substantially to the value and functions of the adjacent wetland and aquatic communities but are generally not formulated objectives of any of the alternatives considered. These actions are essential to the project as a whole as they offer on-site dredge material disposal options and provide a buffer that helps protect and sustain the marsh communities long-term.

The Evaluation of Planned Wetlands (EPW) technique was used to determine baseline ecosystem function at the each site evaluating the six (6) major wetland functions, or functional capacity indicators (FCIs):

- Shoreline bank erosion control (SB);
- Sediment stabilization (SS);
- Water quality (WQ);
- Wildlife (WL);
- Fish tidal fish (FT), non-tidal stream/river (FS), non-tidal pond/lake (FP)]; and
- Uniqueness/heritage (UH).

The FCIs are multiplied by the wetland assessment area (WAA), the approximate acreage of studied wetlands at a site, to derive the functional capacity units (FCUs). The FCIs represents the "quality" of functional capacity per unit area, whereas the FCUs represent the "quantity" of functional capacity. The results of the EPW baseline scores for the six (6) project sites as calculated in 2004, and validated in 2015 as part of the Rockaway-Jamaica Bay Reformulation Study, verified existing conditions had not significantly changed and are documented in this report.

Alternative development and alternative concept designs are presented in Final Concept Report (USACE, 2003) and summarized in this appendix, presenting only the baseline conditions figures and final tentatively selected plan design. The EPW scores from spring 2004 and preliminary costs (USACE, 2003b) were used for cost effectiveness/ incremental cost analysis to determine the approved recommended alternative at the "source" study's Alternatives Formulation Briefing in January 2010.

Prior to finalizing the report, Hurricane Sandy devastated the region and this study was named in Interim Report 2 of Sandy Recovery Act (PL-135). The sites were subsequently included in the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study for consideration as natural or nature-based features for coastal storm risk management (CSRM) benefits. Of the eight (8) shoreline sites, including Dead Horse Bay, Fresh Creek, Spring Creek South, Hawtree Basin, Bayswater Point State Park, Brant Point, Dubos Point, and Paedegat Basin, two (2) sites, Spring Creek South and Paerdegat Basin, were advanced by other regional partners. The existing conditions were confirmed in 2015 and selected alternatives were reexamined and optimized, if appropriate. The optimization resulted in slight modifications to the Fresh Creek, Brant Point and Dubos Point sites that would be borne 100 percent by the local sponsor, if deemed appropriate, to provide secondary CSRM benefits. Dead Horse Bay, Hawtree Point, and Bayswater Point State Park remained unchanged and did not require any modifications to improve resilience of the site and provide secondary CSRM benefits.

Executive Summary

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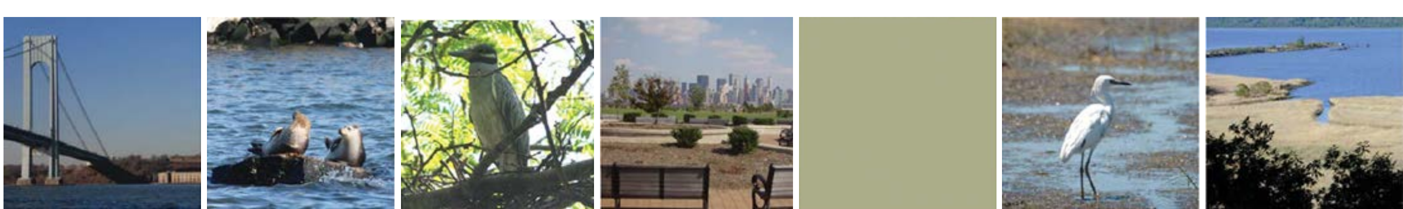

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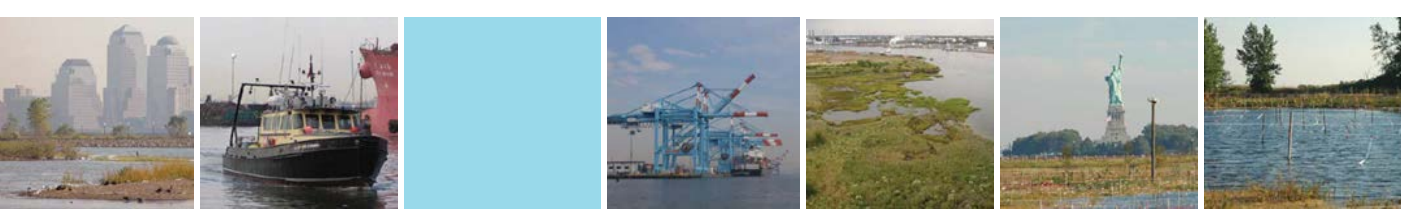


1 Introduction

This alternative development package focuses on the assessment and alternatives development for the restoration plans previously evaluated and selected as part of the Jamaica Bay, Marine Park and Plumb Beach, New York, Environmental Restoration Feasibility Study (Jamaica Bay "source" study) and subsequently developed in the East Rockaway to Rockaway – Jamaica Bay Reformulation Study and this Hudson River Estuary (HRE) Feasibility Report/Environmental Assessment (FR/EA). The goal of the Jamaica Bay "source" study was to develop a comprehensive restoration strategy to improve the environmental quality of Jamaica Bay and restore its historical productivity and diversity.

Restoration candidates were identified and screened resulting in a focused array of eight (8) sites selected for more detailed study, design, and implementation. Table 1 lists the recommended Jamaica Bay shoreline/perimeter sites.

Table 1: Jamaica Bay Feasibility Study Project Sites

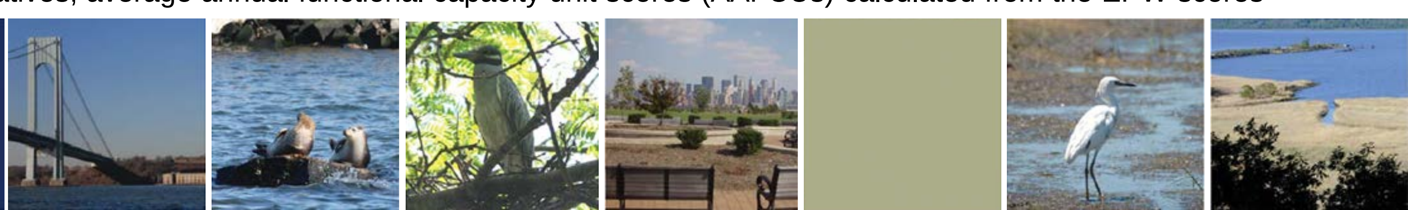
Site
Dead Horse Bay
Fresh Creek
Hawtree Point
Bayswater Point State Park
Dubos Point
Brant Point

As part of the Jamaica Bay "source study", a successful Alternative Formulation Briefing was held in January 2010 and obtained approval for advancement of these six (6) sites to be recommended as part of the tentatively selected plan (TSP). Two (2) of the original eight (8) sites, including Paerdagat Basin and Spring Creek South, were advanced by other regional partners.

Prior to finalizing the report, Hurricane Sandy devastated the region in October 2012. The Jamaica Bay "source" study was included in the Second Interim Report to Congress (11 March 2013) pursuant the Disaster Relief Appropriations Act (Public Law 113-2, January 2013). An *Initial Assessment to Confirm Federal Interest* (USACE, 2014; Attachment A) was prepared in order to re-examine these restoration sites as opportunities for natural/nature based features (NNBFs) that would provide coastal storm risk management (CSRM) benefits, coastal resiliency, and sustainability within Jamaica Bay. The Second Interim Report includes the objective of: "Improving resilience of our coastal areas by pursuing an approach that reflects the relationships between natural, social, and built systems."

Subsequently, the planning effort was included in the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study for consideration of these restoration projects to serve as NNBFs as part of the perimeter plan providing CSRM benefits to the surrounding communities. The existing conditions and baseline ecosystem function at each site was validated in August 2015 by the reformulation team and the restoration designs were reevaluated. The East Rockaway Inlet to Rockaway Inlet andJamaica Bay Reformulation Study has since selected a storm surge barrier as the TSP, rather than the perimeter plan. Therefore, the original restoration sites identified in the Jamaica Bay "source" study are now included in the HRE FR/EA for recommendation.

This appendix documents the screening of restoration opportunities, the development of alternatives for the focused array of sites, Evaluation of Planned Wetlands (EPW) results for baseline conditions and alternatives, average annual functional capacity unit scores (AAFCUs) calculated from the EPW scores



from 2004, as well as the findings of the field investigations and desktop studies. This appendix also contains information on the suggested CSRM measures that were identified as part of the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study that could be investigated in the future and implemented by a non-federal sponsor.

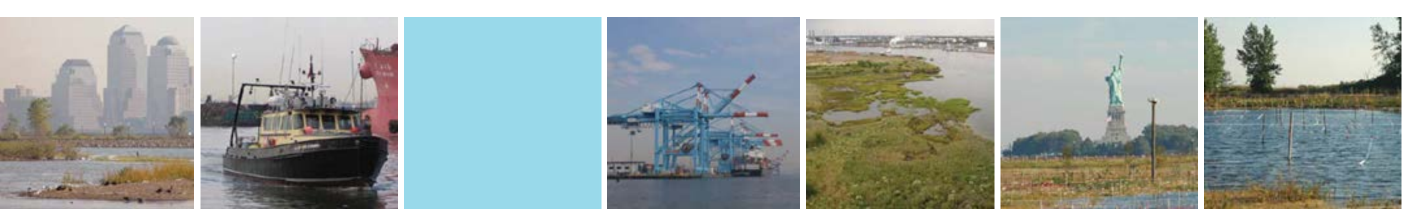
2 Project Area Context

Jamaica Bay is a tidal waterway in an urban area which is connected to the lower bay of New York Harbor by Rockaway Inlet. The bay is located 17 miles south and east of the Battery in Manhattan and 22 miles from midtown Manhattan. Jamaica Bay is about eight (8) miles long, four (4) miles wide, and covers an area of approximately 26 square miles. The bay spans the southern portions of the two (2) most populated boroughs in the New York City, Brooklyn (Kings County) and Queens (Queens County), and the western boundary of Nassau County. The bay is fringed by remnant salt marshes, heavily modified tidal creeks, disturbed upland ecosystems, parks, landfills, dense residential communities, commercial and retail facilities, public transportation, and John F. Kennedy (JFK) International Airport. The Belt Parkway bisects its northern boundary and two (2) large man-made intrusions, Flatbush Avenue and Cross Bay Boulevard, bisect it east to west. The bay itself is composed of salt marsh islands, mudflats, tidal creeks, navigational channels, and open water.

The study area is located within portions of the Gateway National Recreation Area (GNRA), which includes the Jamaica Bay Wildlife Refuge. Both GNRA and the wildlife refuge are operated by the National Park Service (NPS). The GNRA is the nation's first urban park and was created in 1972 to preserve the scenic beauty, flora/fauna, and recreational opportunities of the estuaries and beaches in New York City and Sandy Hook, New Jersey; it encompasses 26,000 acres, 9,155 of which are part of the wildlife refuge (GNRA, 2003). The wildlife refuge, located along Cross Bay Boulevard, is the only urban wildlife refuge in the New York Bight region. In 2015, 3.8 million people visited the Jamaica Bay portion of the Gateway National Recreation Area, roughly three (3) times the number that visit Everglades National Park and comparable to the number of visitors to Yellowstone and Yosemite National Parks (Sanderson, et. al., 2016).

Lying within the Atlantic Coastal Plain geological province, Jamaica Bay consists of loose unconsolidated cretaceous to recent sediments resting on deeply buried crystalline rock floor. The loose sediments are associated with past glaciation periods that resulted in an outwash plain. This sandy plain merged into the historical tidal marshes and barrier island beaches. Over time, physical and biological processes molded Jamaica Bay into a highly productive ecosystem.

Under the National Estuary Act of 1987, the United States Environmental Protection Agency (USEPA) has designated the New York Bight and NY/NJ Harbor as an estuary of national significance. Within the Comprehensive Conservation and Management Plan, signed by the governors of both states as well as the heads of all the major federal, state and local agencies with jurisdiction in the estuary and managed under the Harbor Estuary Program, Jamaica Bay is specifically targeted as a valuable ecosystem in need of protection and restoration. The bay was also identified as significant estuarine habitat by the United States Fish and Wildlife Service (USFWS) in *Significant Habitats and Habitat Complexes of the New York Bight Region* (USFWS, 1999), as a major migratory stopover point along the Atlantic Flyway migration route under the National Waterfowl Management Plan, and a significant coastal habitat under the Coastal Zone Management Act. As an ecological area in a city, the Jamaica Bay system also provides critical seasonal or year-round support to 214 species that are on either state or federal endangered and threatened species list (NYCDEP, 2007).



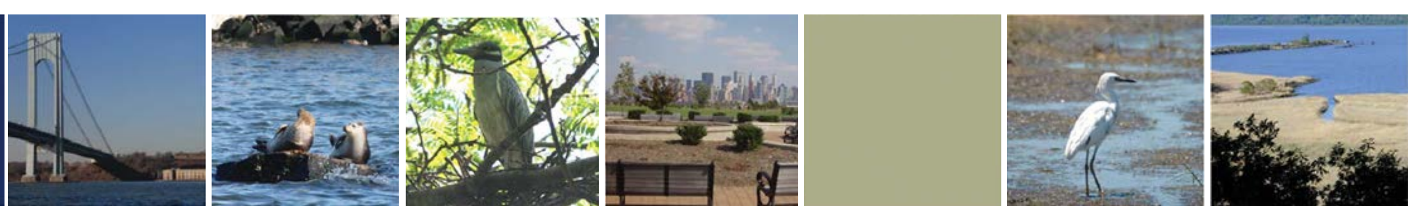
Jamaica Bay was also the subject of a New York City law (Local Law 71), enacted in 2005, requiring the development of a protection plan to preserve and restore its natural and related values. Specifically, the Jamaica Bay Watershed Protection Plan (NYCDEP, 2006) addresses wetland loss, water quality, habitat loss, and ecological degradation. The City of New York and the NPS signed an agreement in 2012 to co-manage Jamaica Bay as an integrated social ecological system. Under the new partnership, approximately 10,000 acres of federal and city-owned parks in and around Jamaica Bay would be jointly managed and initiatives created to improve ecosystem services such as recreation space, public access, and public education, while advancing research on issues related to resilience in Jamaica Bay (NYC Parks, 2015). The Jamaica Bay – Rockaway Parks Conservancy was formed in 2013 to support this partnership.

The Science and Resilience Institute at Jamaica Bay (SRIJB), also established in 2013, aimed at increasing understanding of urban watersheds through resiliency-focused research and to engage government and community stakeholders to work together towards a more resilient ecosystem. The SRIJB is supported by a research consortium led by the City University of New York and represents a partnership among academic institutions, government agencies, non-governmental organizations and community groups.

The implementation of the Jamaica Bay "source" study and ongoing HRE restoration feasibility were conducted in coordination with project partners and various advisory committees including:

- New York City Department of Environmental Protection (NYCDEP) Jamaica Bay Watershed Protection Plan Advisory Committee composed of United States Army Corps of Engineers (USACE), NPS, Port Authority of New York and New Jersey (PANYNJ), National Resources Defense Council (NRDC), Jamaica Bay Eco Watchers, Stony Brook University and a representative from Community Activists.
- The SRIJB Public Agency Committee (PAC) comprised of representatives from public agencies that are involved in planning, management and regulatory oversight of Jamaica Bay. The PAC includes the USACE, NPS, USEPA, Federal Emergency Management Agency (FEMA), US Department of Housing and Urban Development (HUD), New York State Department of Environmental Conservation (NYSDEC), New York State Governor's Office of Storm Recovery (NYSGOSR), New York State Department of Transportation, PANYNJ, New York City Department of City Planning, NYCDEP, New York City Department of Parks and Recreation (NYC Parks), New York City Office of Emergency Management and New York City Office of Recovery and Resilience,
- SRIJB Stakeholder Advisory Committee (SAC) is comprised of representatives from community-based, environmental, environmental justice and other civic organizations in Jamaica Bay. The SAC includes The American Littoral Society, Jamaica Bay EcoWatchers, The Nature Conservancy, The Trust for Public Land, Hudson River Foundation, Eastern Queens Alliance, Environmental Defense Fund, National Park Conservation Association, National Wildlife Foundation, NYC Audubon, Regional Plan Association and Rockaway Waterfront Alliance.
- SRIJB Consortium is composed of nine (9) research institutions including City University of New York, Columbia University Earth Institute, Cornell University, Institute of Marine and Coastal Sciences/Rutgers University, NASA Goddard Institute for Space Studies, New York Sea Grant, Stony Brook University, Stevens Institute of Technology, Wildlife Conservation Society.
- Jamaica Bay Task Force, which includes members from most organizations listed above.

As a result of the above and ongoing coordination with partners, many of the recommendations within this FR/EA are important components of the regional plan to restore Jamaica Bay. These restoration



projects were also identified as important components of the regional strategies and recommendations to provide CSRM benefits and ecosystem services to the surrounding communities following Hurricane Sandy. PlaNYC (NYC, 2013a), the New York City Special Initiative for Rebuilding and Resiliency's (SIRR) plan (NYC, 2013b), New York State 2100 Commission Report *Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure* (NYS, 2003), and other documents, provided recommendations to create a more resilient New York City during the recovery efforts of Hurricane Sandy. For Jamaica Bay specifically, the SIRR identified the study and installation of wetlands for wave attenuation in Howard Beach and further flood risk reduction improvements within Jamaica Bay (Coastal Protection Initiative 14) and complete living shorelines and floating breakwaters for wave attenuation in Brant Point, Queens (Coastal Protection Initiative 17), one of the recommended sites. Within the New York State 2100 report, the tidal wetlands of Jamaica Bay were singled out as examples of protective natural infrastructure as a part of the state's flood risk management strategy.

The six (6) sites recommended in this FR/EA, will provide ecosystem benefits and potential CSRM secondary benefits serving as NNBFs within Jamaica Bay while complementing other ongoing efforts including coastal restoration at Spring Creek South, Spring Creek North, Howard Beach- New York Rising Community Reconstruction Plan (NYSGOSR, March 2014), and many other partner efforts outlined in Appendix B Ongoing Efforts Appendix.

3 Site Screening

Numerous sites were identified for possible restoration within the bay during the early stages of the Jamaica Bay "source" study. Of the original body of 39 sites (USACE 1997), eight (8) were ultimately chosen for more detailed study, design, and implementation. The eight (8) individual sites should be considered as a related set of actions that work collectively to restore the bay's ecosystem. An ecosystem is a complex interaction of all of its components such that each new site enhances the value of existing habitats, and adds to the overall productivity and connectivity gained from constructing other sites; the benefit to the system being restored far exceeds the simple sum of all the individual site benefits. As more sites are restored, the system-wide benefits become greater, because the increased values expand beyond the boundary of the sites themselves. The focused array of the six (6) perimeter/shoreline sites resulted from the following screening process.

3.1 Initial Screening

The first phase of screening eliminated nine (9) sites based on the following characteristics that were expected to greatly increase the monetary costs and reduce the ecological benefits of any restoration proposal, such that the costs would outweigh the benefits:

- Held exclusively by private property owners.
- Constraints such as buildings, public roadways, and utilities that did not allow adequate space for the development of viable wetland restoration projects.
- Former industrial uses in which soils had been contaminated.
- Complex, unresolved stormwater management issues.

The initial screening left 30 sites as potential opportunities.

3.2 Second Screening

Since conducting detailed investigations on all 30 sites would have been cost prohibitive, the sites were further screened on the basis of their potential contribution to habitat restoration as determined by a panel of technical experts from the USACE, NPS, USFWS, USEPA, NYSDEC, New York State

Department of State (NYSDOS), NYCDEP, NYC Parks and interested local groups. The 30 sites were designated Tier 1 and Tier 2 sites. At the time of the original plan formulation for Jamaica Bay, limited study funds was a concern. Due to the amount of opportunities, it was decided that a second feasibility study report under a new feasibility cost sharing agreement would be undertaken. Accordingly, the second screening proceeded as originally planned to distinguish between Tier 1 sites and Tier 2 sites. Tier 1 sites were determined by ecological priority and include the following 12 sites: Gerritsen Creek, Spring Creek, Fresh Creek, Broad Channel, JoCo Marsh, Ruffle Bar, Dead Horse Bay, Hawtree Point, Brant Point, Dubos Point, Paedergat Basin and Bayswater Point State Park. Tier 2 sites were defined as sites that could be advanced in the future through spin-off feasibility studies.

In April of 2000, the NPS and USACE entered into an interagency agreement to conduct baseline assessments for the 12 sites. These federal agencies, along with the City University of New York Aquatic Research and Environmental Assessment Center at Brooklyn College, established the Jamaica Bay Ecosystem Research and Restoration Team (JABERRT), comprising 18 scientists from nine (9) institutions. From 2000 to 2001, JABERRT completed an extensive literature search and conducted a detailed inventory and biogeochemical characterization of Jamaica Bay, publishing its final report in 2002 (USACE, 2002). This report, along with the existing conditions report (USACE, 2002a), and conceptual designs and cost report (USACE, 2003) prepared for the Jamaica Bay Feasibility Study, served as the basis for identifying existing conditions and recommending restoration alternatives at each of the Jamaica Bay sites.

3.3 Third Screening

Of the 12 sites, four (4) were screened out as follows:

- JoCo Marsh and Broad Channel were removed from further consideration by NYCDEP based on water quality modeling.
- Gerritsen Creek was studied and implemented under the CAP authorization.
- Ruffle Bar was eliminated, as restoration of submerged aquatic vegetation (eelgrass) beds was no longer considered at the time.

Two (2) of the eight (8) sites that were selected as part of the Jamaica Bay “source” study were advanced through other programs and, therefore, were not included as part of the TSP. Between 2007 and 2010, the NYCDEP implemented restoration at Paerdegat Basin, one of the perimeter sites, and NYSDEC advanced the Spring Creek south perimeter site pursuant a FEMA Hazard Mitigation Grant awarded in 2013. The northern portion of Spring Creek was advanced by CAP program under Section 1135 (Project Modifications to Improve the Environment) (USACE, 2016).

The six (6) Jamaica Bay perimeter restoration sites included in the TSP were among the eight (8) sites that were chosen by the “source” study and represent a set of actions that would work collectively to restore the Jamaica Bay ecosystem.

3.4 Post Hurricane Sandy Re-evaluation

As identified in the previous chapters, a robust analysis of potential Jamaica Bay restoration sites were conducted between 2000 and 2010. However, Hurricane Sandy, a powerful storm effected Jamaica Bay in October, 2012. As a result of the devastation associated with Hurricane Sandy, the USACE has been tasked to address “coastal resiliency” and “long-term sustainability” in addition to the legacy USACE planning report categories of “economics, risk, and environmental compliance” (USACE 2013).

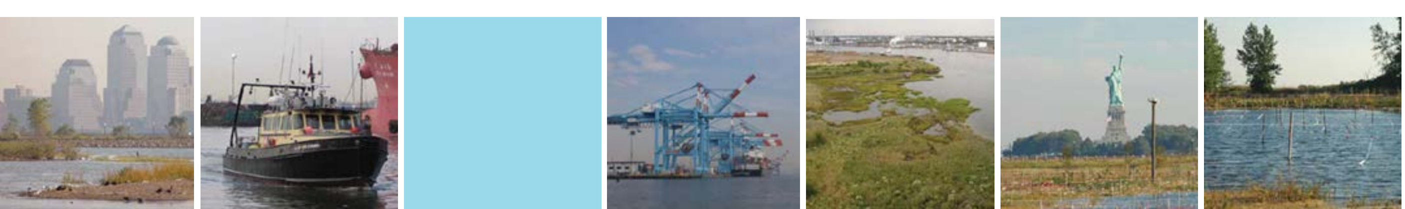
In 2015, the USACE Published *Memorandum for Record #8 Ecological Valuation of Alternatives & Assessment of Mitigation Requirements.* This document performed field work post Hurricane Sandy at 33 sites in Jamaica Bay, including the proposed restoration sites. Using a methodology based on the EPW methodology, the USACE scored the potential wetlands and exiting uplands at each site. During the formulation and finalization of the proposed alternatives for the HRE projects, the scores from the USACE's 2015 study were reviewed. The scores showed that the habitats within the proposed restoration sites had not dramatically changed in physical composition pre- and post-Sandy and that the wetlands, near shore tidal habitats and uplands would all benefit from the proposed restoration and that the costs for the selected restoration plans are warranted as they would provided substantial uplift.

4 Site-specific Existing Conditions and Future Without Project Conditions

Upon selection of the six (6) sites, site-specific detailed existing conditions and future without project conditions were developed. The existing conditions and restoration goals are summarized in Table 2 below. The *Existing Conditions, Future Without Project Conditions, Goals and Objectives Report* (USACE 2002a) includes a detailed discussion of the six (6) sites.

Table 2: Existing Conditions and Restoration Goals at each Jamaica Bay Shoreline/Perimeter Site

Site Name	Vegetative Characteristics	Physical Characteristics	Restoration Goals
Dead Horse Bay	• Common reed dominates. • Some grassland communities and secondary woodlands occur in the upland areas. • Very small, fragmented areas of salt marsh cordgrass still persist along the perimeter of the bay.	• Dredging has created deep water channels to the southwest of the study area. • A large marina exists at the mouth of the former Deep Creek between the north and south segments of the site. • Shoreline along south has experienced severe erosion and significantly been reduced in area.	• Reestablishment of salt marsh area in the north and south sections. • Incorporate a tidal creek system in the north restoration area. • Stabilize the solid waste landfill from erosive forces in the southwest and south shorelines. • Create dune habitat in the south restoration area. • Restore the tidal marsh west peninsula.
Fresh Creek	• Generally consists of a mix of common reed, mugwort, secondary woodlands, and Japanese knotweed. • Small patchy areas of salt marsh cordgrass and spike grass.	• Straightened channel approximately 16 feet deep, then shallower to the head end of the creek.	• Restore the remaining salt marshes. • Replace monotypic stands of vegetation with diverse native plantings. • Restore tidal marsh systems to increase total marsh acreage and offset both historical and future losses. • Create upland buffer habitat.



Site Name	Vegetative Characteristics	Physical Characteristics	Restoration Goals
Hawtree Point	• Dominated by common reed and mugwort as well as grasses, such as switchgrass.	• Extensive alteration and filling. • A deep water channel runs along the south side.	• Replace monotypic stands of vegetation with diverse native plantings. • Restore tidal marsh systems to offset both historical and future losses. • Create upland habitat to blend restoration areas.
Bayswater Point State Park	• Stand of mature woodlands. • Continuous band of salt marsh along the northeastern shore.	• Wave-driven erosion of the western shore has caused a loss of tidal wetlands in the area.	• Replace common reed areas with intertidal marsh and tidal creek system. • Create buffer of shrub edge habitat along. • Use shoreline erosion control structures to protect from erosion loss and also to create macroinvertebrate habitat.
Dubos Point	• Large inland salt marsh. • Black cherry woodland in western end overrun with Oriental bittersweet.	• Deteriorated bulkhead and eroded western shoreline.	• Replace monotypic stands of vegetation with diverse native plantings. • Use shoreline erosion control structures to protect from erosion loss and also to create macroinvertebrate habitat.
Brant Point	• Dominated by common reed and mugwort. • Some scrub/shrub and salt marsh communities.	• Shoreline along the north and west have experienced severe erosion and significantly been reduced in area.	• Replace monotypic stands of vegetation with diverse native plantings. • Restore tidal marsh systems to offset both historical and future losses. • Use shoreline erosion control structures to protect from erosion loss. • Create upland buffer habitat.

The future without project conditions at all sites will involve further expansion of invasive species and possible water quality degradation if improvements are not made to the water treatment plants and combined sewer outfalls (CSOs) that discharge into the bay. Current measures to improve water quality include the NYCDEP and NYSDEC CSO Abatement Program that will conduct environmental dredging of several tributaries to remove CSO mounds that contribute to nuisance odors and dissolved oxygen deficits within affected waterbodies. Fresh Creek is among the targeted waterbodies for this program.

Commercial and residential development pressures, both upland such as more impervious surfaces, earth moving activities, rerouting of rainfall runoff, and below mean low water (MLW) such as modifications to the Belt Parkway and other roadway bridges, JFK International Airport runway modifications, navigation channel maintenance activities, bulkheading, are likely to cause further degradation. Erosion and illegal filling and dumping at certain of the recommended restoration sites

along the periphery of the bay are also expected to continue, causing further degradation of the habitat and loss of wetlands.

Average rates of erosion were developed based on historical aerial photographs depicting the shifting shorelines between 1959 and 1996 the following sites:

- Dead Horse Bay north: -0.03 feet/year.
- Dead Horse Bay south: -1.24 feet/year.
- Bayswater Point State Park: 0.6 feet/year.[1]
- Dubos Point: -3.0 feet/year.
- Brant Point: -3.0 feet/year. [2]

However, because the waterline shifts depending on the tides, the vegetation lines were also digitized from the same aerial photographs as a reference feature and factor into the average rates of shoreline change.

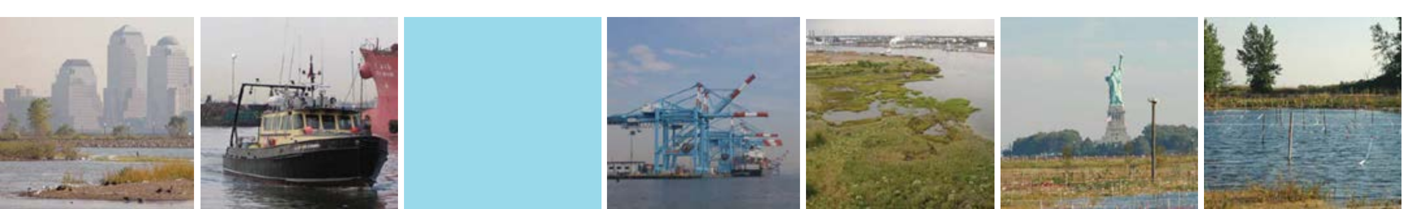
On the 1996 aerial photograph, the vegetation line matched existing habitats found along the shoreline, either the seaward limit of low marsh or the landward limit of beach habitat. This vegetation line delineated on the 1996 aerial served as the baseline for this analysis. Thus it was assumed that future erosion would move the seaward limit of the low marsh first, or the habitat landward of the beach, and then impact the next habitats landward. To determine the future without project conditions, the historic rate of shoreline change was extrapolated 50 years into the future through multiplying the average yearly rate of erosion for each site by 50 years for the life of the project.

Erosive processes convert habitats from low marsh, coastal dune, or scrub/shrub, to habitats that are typically found seaward of the vegetation line such as beach, mudflat, shallow water, or deep water. Equilibrium beach profile theory (Dean, 1977) was applied to determine the future habitat types of the areas that will erode in 50 years. This theory states that as shorelines erode, the shape and characteristics of the shoreline remain relatively the same. The average width of the existing beach, mudflat, and shallow water habitats were estimated. For the future without project conditions, the widths were multiplied by the linear length of shoreline to estimate the future acreages for these habitat types. However, if the existing acreages for these habitats were more than the average width multiplied by the linear length of shoreline, the existing acreages were assumed for the future without project conditions.

At the Dead Horse Bay and Bayswater Point State Park sites, based on the series of historical photographs in the vicinity of the most eroded sections of their shorelines, it appears that the deep water has always been very far from the shoreline. For these sites, the future upland habitat losses would turn into mudflat habitat instead of deep water. For Dubos Point and Brant Point, where deep water is close to shore, future upland habitat losses would turn into deep water. Water habitat is the same as deep water habitat for the purposes of the present analysis.

At Dead Horse Bay, no shoreline erosion is at the northern part of the site. Here, the future without project conditions with respect to erosion of the shoreline is expected to be similar to existing

[1] The western portion of the Bayswater Point State Park shoreline is eroding at a rate of -1.2 ft/year, while the northern portion is accreting at the rate of +1.3 ft/year, producing an average of nearly 0 ft/year for the site as a whole.
[2] Additional details can be found in Section 5 of the Engineering Appendix.



conditions. At the southern part of the site, some parts of the shoreline are eroding as much as 5.2 feet/year. Shallow water and deep water habitat acres remained the same in the existing and future without project condition habitat summaries, as a constant width of these habitat types were not prominent features. The future beach acres was calculated by averaging the existing beach width (85 feet) and multiplying it by the linear length of the eroded shoreline (1400 feet). Only the mudflat habitat increased dramatically in the future without project condition.

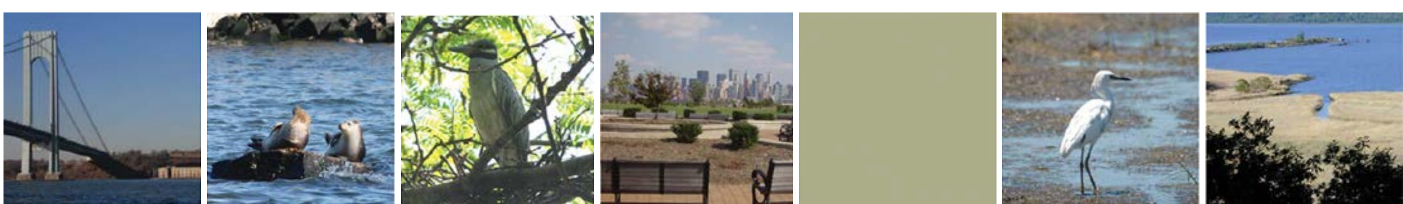
The section of the Bayswater Point State Park shoreline that faces west experiences -1.2 feet/year of erosion. The calculated wave height for that shoreline is 3.8 feet for the 50-year, wind-generated wave, which could be why a seawall was originally built on the shoreline. If the remnants of the seawall were removed, it is very likely that the shoreline would experience erosion rates far greater than -1.2 feet/year. However, this analysis will only project the average erosion rate of -1.2 feet/year to determine future without project conditions shoreline in 50 years. It was assumed that the eroded habitats would be converted to mudflat, as deep water is over 400 feet from the existing eroding shoreline in most places. The average existing beach width was assumed to be 18 feet, and the length of the eroding shoreline is 1000 feet. The shallow water and deep water habitat acres remained the same for the existing conditions and the future without project conditions, as constant widths for these habitat types were not prominent features. The section of the Bayswater Point State Park shoreline that faces north is accreting at a rate of +1.3 feet/year. Thus, future habitat conversions due to erosion were not calculated in this stretch of the site.

For Dubos Point, the shoreline is eroding at an average rate of -3.0 feet/year. Similar to the Bayswater Point State Park site, the existing shore protection structures, while in a severe state of disrepair, is still mitigating the erosion rates. Since the deep water habitat is close to shore, it was assumed that deep water habitat would be gained at the expense of the upland habitat after 50 years of future without project condition erosion. Assuming equilibrium beach profile theory, the average widths of 102 feet and 72 feet were assumed for mudflat and shallow water, respectively, for future without project conditions. The shoreline length is 3026 feet. The width of the existing beach was highly variable, so the existing beach acreage was assumed for the future without project condition.

For Brant Point, the average erosion rate was -3.0 feet/year. Similar to Dubos Point, deep water is close to shore, so the deep water habitat would gain at the expense of upland habitats in the without project future conditions. The beach, mudflat and shallow water habitat acreages remained the same for existing and future without project conditions.

5 Alternative Development

Alternatives were developed based on existing data (JABERRT, 2002), Evaluation of Planned Wetlands assessment (Section 6), field observations, and photographic records. Alternatives were evaluated based on local site constraints, standard biological and physical parameters for salt marsh restoration, and other design guidelines developed during a series of planning and design team meetings. The basic alternative layouts were developed in accordance with the overall project goal of restoring the largest acreage of salt marsh possible and the guiding ecological principles for salt marsh restoration. Projects that involve creating or restoring wetlands are subject to a set of chemical, physical, geological and biological design requirements. The first and foremost set of requirements is connected to the physiological limitations and environmental requirement for marsh vegetation establishment and growth, predominantly focusing on achieving the proper target elevations relative to the tide and benchmark data from a nearby reference marsh. After the description of the derivation of



restoration alternative benefits and costs, site-specific planning criteria, alternatives, and their evaluation are presented.

The original bay was marked by a complex interaction of diverse habitats. Maritime forests and grasslands made up a large component of the undisturbed bay complex. They supported and therefore increased the value of the wetland and aquatic habitats by providing cover, alternate food sources, and breeding habitats to many of the species that characteristically inhabit adjacent salt marshes, mudflats and shallow water habitats. To the extent possible, plans that included on-site use of excavated materials to reduce overall costs while also creating adjacent maritime communities were included in the design plans. This reflects the collaborative planning process that sought to take advantage of relatively low-cost opportunities to restore historical diversity and to improve the value and success of the accompanying wetland/aquatic restoration, while also providing a practical buffer to human intrusions into the newly restored marshes and adjacent habitats. When this was not possible, alternatives that took advantage of opportunities to reproduce these now nearly vanished estuarine habitats at relatively low additional costs were also considered, to more closely replicate the totality of habitats and balance that historically made up the bay's interrelated ecosystem. These measures address the full ecological diversity of the system as a whole, thereby compounding the direct benefits and success that would result from restoring only the wetland/aquatic component of an interconnected and integrated estuarine system.

The restoration measures proposed for the site alternatives are based on the target ecosystem characteristics (TECs). The restoration measures proposed were categorized into the TECs. Different ecological restoration techniques are associated with the proposed ecological restoration measures. Table 3 categorizes and explains each restoration measure and the techniques proposed for the Jamaica Bay sites.

Table 3: Ecological Restoration Measures for Jamaica Bay Perimeter Sites

TEC	Measure	Description	Techniques
Wetlands (Coastal Wetlands)	Emergent wetland creation	Excavating and filling areas to create an emergent wetland to replace upland invasive areas to provide a habitat that is less likely to become revegetated with the same upland invasive species.	• Low marsh wetlands. • High marsh wetlands
	Forested and/or scrub/shrub wetland creation	Excavating and filling areas to create a forested and/or scrub/shrub wetland to provide continuous fringe habitat around and shade for fish habitat (from trees/shrubs).	• Coastal scrub/shrub.
	Invasive species removal with native plantings	Removal of non-native plants and replanting those areas with plants native to the ecosystem. Invasive species removal will be in coordination with other ecological restoration measures	
Shorelines and Shallows	Bank stabilization	Establishing and implementing measures to prevent and/or fix erosion and stabilize the embankment.	• Training structures. • Hard structures. • Dune. • Riprap.

TEC	Measure	Description	Techniques
	Riparian buffer	Establishing and implementing measures to prevent and/or fix erosion and stabilize the embankment.	• Coastal scrub/shrub. • Coastal maritime forest.
Fish, Shellfish and Benthic Habitat and Sediment Control/Nutrient Load Reduction (Habitat for Fish, Crab, & Lobsters)	Channel regrading	Regrading channel to improve to level of dissolved oxygen (DO) and improve water quality by modifying the channel's hydrologic and hydraulic characteristics.	
	Tidal creek/ channels	Creation of small tidal creek/channels to support low and high marsh wetland communities.	
	Forebay/ sediment basin	Creation of forebay/sediment basin to capture sediment laden water and reduce the amount of sediment from settling in the channel.	

5.1 Dead Horse Bay

5.1.1 Existing Conditions, Constraints, and Potential Actions

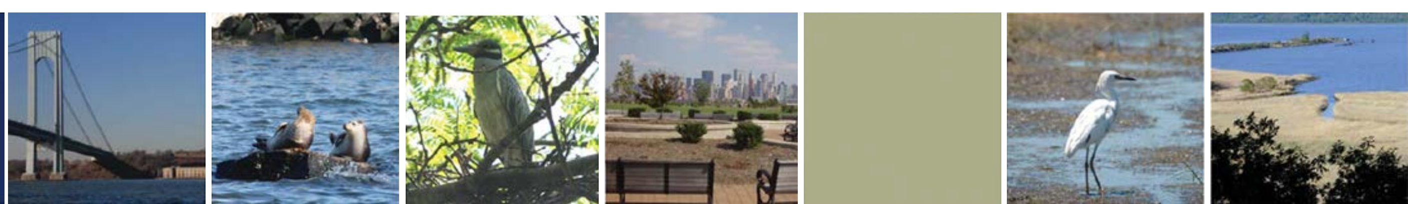
The name Dead Horse Bay comes from a horse rendering facility in the southwestern portion of the project area. Prior to 1941, this site was essentially undisturbed. NYC Parks covered most of the marsh area and the southern portion of the open water with landfill in the 1950s. Historical topographic maps show that the filling took place between 1948 and 1951. The fill used was described as "great mounds of garbage from Queens and Brooklyn flattened into compact layers with sand carpeting 1 to 2 feet thick." The 1941 coastal chart shows that tidal marsh remained in the northern portion of the site, even after construction of the Belt Parkway. Fill of this area apparently occurred during the 1950s in connection with the construction of the Marine Park. With the entire area historically filled, a solid waste landfill to the south and erosion claiming the west peninsula of Dead Horse, restoration opportunities include reestablishment of salt marsh with a tidal creek in the north, and dune-beach creation, shoreline stabilization, and marsh restoration in the south. Figure 1 shows the baseline existing conditions of the site.

Environmental stressors on the site are the following:

- Historic loss of marshes.
- Erosion and exposure of the solid waste landfill.
- Presence of extensive areas of non-native, invasive plant species.

The following actions at Dead Horse Bay would contribute to the overall restoration of Jamaica Bay:

- Stabilizing the solid waste landfill from erosive forces along the southwest and southern shores.
- Replacing monotypic stands of vegetation with diverse native plantings.
- Restoring tidal marsh systems to offset both historical and future losses.
- Creating transitional habitat to blend restoration areas back into surrounding areas and buffer them from future impacts.
- Creating dune habitat in the high energy southern parcel.
- Shoreline protection strategies to both address erosion and provide macroinvertebrate habitat.



Site-specific planning constraints for Dead Horse Bay include:

- Moderate to long fetch with active shore zone.
- Covering of the historic marsh with fill, including the solid waste landfill in the southern project area placed after 1948.
- Steep slopes on the southwest and southern shorelines.
- Possible presence of rare, threatened, or endangered species.
- Presence of contaminants that may need more detail to interpret the significance of specific restoration activities.

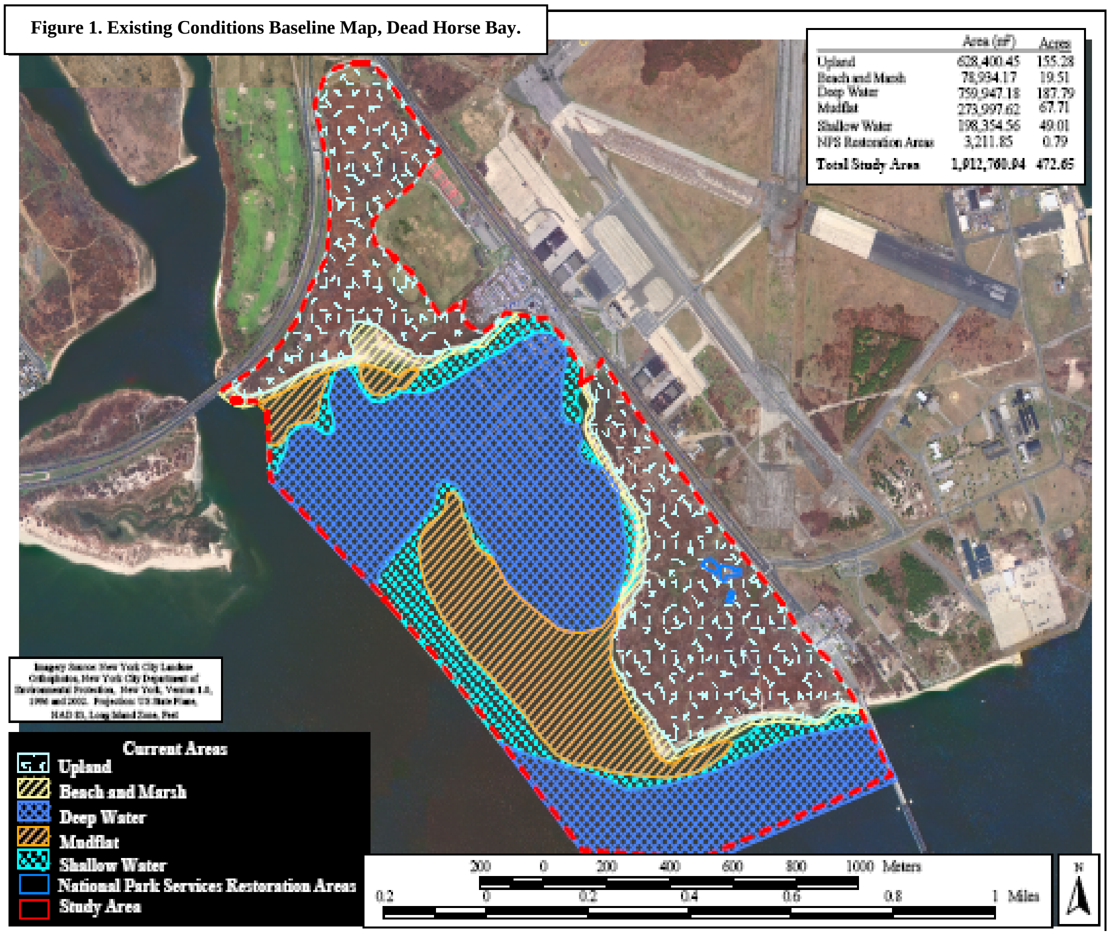


Figure 1: Dead Horse Bay Existing Conditions Baseline Map

5.1.2 Alternatives

Five (5) alternative scenarios were developed for Dead Horse Bay (USACE, 2003). The specific design elements associated with each restoration alternative are discussed below, along with the no action alternative.

5.1.2.1 No Action Alternative

In the absence of federal action, the north parcel will remain heavily dominated by invasive species and considerably degraded from its past ecological values. In addition, the southern parcel will continue to experience shoreline erosion with continued exposure of the landfill materials.

5.1.2.2 Alternative 1: Fringe marsh system.

Alternative 1 replaces existing monotypic common reed stands in the northern portion of the site with a fringe marsh system and native maritime forest species. The eroding shoreline and landfill in the southern portion of the site will be covered with approximately 46,000 cubic yards of clean fill and sand from the northern portion of the site, as a least-cost disposal option for the excavated materials. The sand will be also used to create dunes along the edge of the water. Overall this alternative will create dunes on approximately 31 acres and restore 10 acres of low marsh and three (3) acres of high marsh. In relation to the other aquatic restoration mentioned, 87 acres of maritime forest will be restored to act as a protective buffer and provide habitat for the species that utilize the area.

5.1.2.3 Alternative 2: Fringe marsh system with trash removal.

Alternative 2 includes all the elements of Alternative 1. It adds the removal of 31 acres of the landfill closest to the water which sits on top of and covers up the old existing marsh. The use of geotextile tubes is necessary to stabilize the remaining landfill and to prevent future erosion along the southern bank. With removal of the landfill, the fringe marsh will be able to support native wetland plant species with high habitat value.

5.1.2.4 Alternative 3: Tidal channel marsh system.

Alternative 3 maximizes marsh habitat by creating a tidal channel in the northern portion of the site and regrading the existing upland common reed stand to salt marsh elevations. A tidal channel of approximately four (4) acres will be built in the northern parcel and approximately 31 acres of low marsh and seven (7) acres of high marsh will be restored. The eroding shoreline will be left as is, but approximately 664,000 cubic yards of clean fill and sand from the northern portion of the site will be placed on top. The sand will be used to create dunes along the edge of the water and to restore the maritime forest. Overall this alternative creates approximately 28 acres of dunes on the site and consequently restores over 60 acres of maritime forest. Roughly nine (9) acres of existing beach will be preserved in the north.

To stabilize the tidal creek and protect the existing beach habitat, training structures will be created on the banks at the mouth of the creek. The structure is estimated to extend 150 to 200 feet in length, out to a depth of six (6) to eight (8) feet, from both banks of the tidal creek. The training structure will be four (4) feet wide at the top and 25 feet wide at the base, extending to just over MHW. The other hard points are situated mostly on existing beach and upland areas, but will also raise above MHW to protect during storm surges. The structure will be made of rock with an overall trapezoidal shape. The rocks will be placed randomly within the shape to create various size interstitial spaces that can be used as refuges by various species. During the plans & specifications phase, transplanting oysters or mussels onto the rock structures as they are built will be considered to create a healthy habitat with shellfish before algae and epiphytes colonize the rock.

5.1.2.5 Alternative 4: Tidal channel marsh system and trash removal prior to dune construction in the south.

Alternative 4 includes all the elements of Alternative 3, as well as the removal of 31 acres of landfill in the southern portion. With removal of the landfill, the fringe marsh will be able to support native wetland plant species with high habitat value. The removed trash will be replaced with approximately 669,000 cubic yards of clean fill and sand from the northern portion of the site. The area will also be stabilized with geotextile tubes beneath the dunes to avoid erosion of the site back into the remaining landfill.

Materials will be excavated from the water's edge and reused on site to the extent possible, creating dunes further inland that are capped by clean sands from the restoration at the north of the site. Excavated materials that cannot be reused onsite will be removed and processed at a registered landfill facility. The sand will be used to create dunes along the edge of the water and to restore a buffer to the maritime forest. Overall, the project will remove landfill and create dunes on approximately 27.7 acres of the site and will restore 61 acres of maritime forest on the southern parcel of the project area. Roughly nine (9) acres of existing beach will be preserved in the north.
To stabilize the tidal creek and protect the existing beach habitat, training structures will be created on the banks at the mouth of the creek. The structure is estimated to extend 150 to 200 feet in length, out to a depth of six (6) to eight (8) feet, from both banks of the tidal creek. The training structure will be four (4) feet wide at the top and 25 feet wide at the base, extending to just over MHW. The other hard points are situated mostly on existing beach and upland areas, but will also raise above MHW to protect during storm surges. The structure will be made of rock with an overall trapezoidal shape. The rocks will be placed randomly within the shape to create various size interstitial spaces that can be used as refuges by various species.

5.2 Fresh Creek

5.2.1 Existing Conditions, Constraints, and Potential Actions

The Fresh Creek site is located on public land that has no permanent residents. The site consists of parkland owned by NYC Parks. This area was historically a marshland surrounding a small tidal creek. The creek was dredged and widened in the early 1920s and much of the marsh was filled. The site encompasses 146.1 acres that include beach, grassland marsh, mature woodlands, shrubs, and invasive plants (Figure 2).

The soil is composed of poorly-sorted sandy gravel. All soil samples showed substantial amounts of gravel, sand and silt. The deposition of historic fills has been irregular at this site. The project area is located within the floodplain of Fresh Creek/Jamaica Bay. Due to extensive filling, the areal extent floodplain has been severely reduced from its historical limits. Only the tidal basin and its attached tidal wetlands are currently located within the 100-year floodplain.

The Fresh Creek site has poor water quality and poor benthic habitat from past dredging and existing combined sewer outfalls, along with the historic loss of wetland due to filling. The site is surrounded by dense urban development and subject to CSO and other runoff.

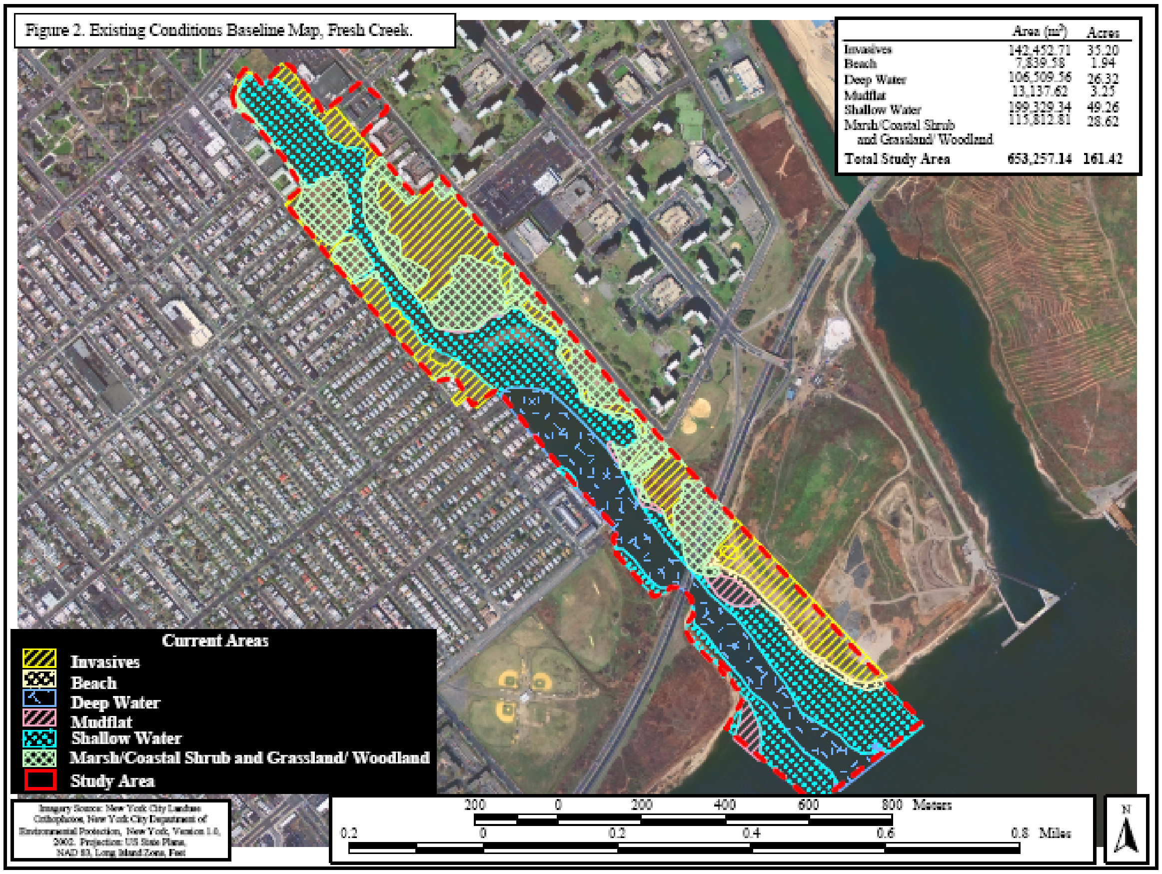
Environmental stressors on the site include:

- Loss of salt marshes.
- Sediment contamination.
- Poor benthic habitat.
- Fills deposited on historic wetlands.
- Presence of extensive areas of non-native, invasive plant species.
- Presence of a CSO at the head of the basin.
- Straightened and deepened creek with no finger tributaries.
- Poor water quality at the head of Fresh Creek.

The following actions at Fresh Creek would contribute to the overall restoration of Jamaica Bay:

- Restoration of lost salt marshes of Fresh Creek.
- Restoring tidal marsh systems to offset both historical and future losses and to filter the output of the CSO until the outfall can be improved or rerouted.

- Replacing monotypic stands of vegetation with diverse native plantings.
- Restoring tidal marsh to the maximum extent possible.
- Enhancing existing marshes by filling in and re-vegetating ditches.
- Blend restoration areas back into surrounding areas and buffer them from future impacts.
- Improving benthic habitat through water quality and sediment improvement.
- Basin bathymetry reconfiguration to promote optimal circulation.
- Beneficially reuse the excavated fill onsite.



- **Figure 2: Fresh Creek Existing Conditions Baseline Map**

Site-specific planning constraints for Fresh Creek include:

- Presence of contaminants that may need more detail to interpret the significance of specific restoration activities.
- CSO discharges.
- Potential presence of rare, threatened and endangered plant species.

5.2.2 Alternatives

Six (6) alternative solutions were developed for Fresh Creek and the specific design elements associated with each restoration alternative, as well as the no action alternative, are discussed below.

5.2.2.1 No Action Alternative

Without restoration, it is anticipated that the amount of invasive species within the project area could forge into existing native vegetation (USACE 2002a). In August 2016, NYCDEP initiated a $56.5 million upgrade to reduce flooding, improve reliability of drinking water delivery and making the roadways safer that will improve the health of Fresh Creek and Jamaica Bay by nearly 200,000,000 gallons of CSO input annually.

5.2.2.2 Alternative 1: Tidal marsh system continuous around basin.

Invasive species-dominated areas will be restored to salt marsh or native coastal scrub/shrub, grassland or forest habitat by grubbing, regrading, and planting. Approximately 6.3 acres of low marsh, 1.7 acres of high marsh, and 9.7 acres of transitional coastal shrub zone will be restored. As a consequence of the other aquatic restoration mentioned, 4.5 acres of buffer maritime forest will be restored. This alternative does not includes basin filling. Consequently, this alternative has the least impact on the existing bottom habitat, but also eliminates any improvements to water quality.

5.2.2.3 Alternative 2: Tidal marsh system continuous around basin with bottom filled from head to edge of deep dredged channel.

This alternative is similar to Alternative 1, with the addition of some recontouring within the basin. Recontouring would only be done at the head of the basin through about half of the underwater community, regrading the area from -3.2 feet to -4 feet below MLW. This is expected to improve flushing at the head of the basin and improve dissolved oxygen. Vegetation plantings and acreages in this alternative are the same as in Alternative 1.

5.2.2.4 Alternative 3: Tidal marsh system continuous around basin with head of basin filled to intertidal elevations and tidal channel marsh system established.

This alternative includes basin filling only at the head of the creek, raising the level of the bottom to intertidal levels, creating marsh and tidal creek habitat. This will decrease residence time of water at the head of the creek, and increase the amount of wetland habitat created. With this alternative, a 2.1-acre channel will be created, along with 13.0 acres of low marsh and 2.4 acres of high marsh. As in Alternative 1, an incidental 4.5 acres of forest will be restored, and 11 acres of coastal scrub/shrub will be created. The amount of coastal scrub/shrub is increased slightly from previous alternatives to create a transition zone in the northwest corner of the site.

5.2.2.5 Alternative 4: Tidal marsh system continuous around basin with bottom filled from head to Jamaica Bay.

Alternative 4 maximizes water quality improvements by improving the tidal prism throughout the basin. Recontouring would occur in three (3) steps, from -3.2 feet to 4) feet below MLW from -4 feet to -8 feet below MLW, and from -8 feet to -10 feet below MLW at the mouth. This includes the filling of an existing 19-foot deep dredged channel in the southern portion of the basin. Vegetation plantings and acreages in this alternative are the same as in Alternative 1.

5.2.2.6 Alternative 5: Tidal marsh system continuous around basin with head of basin filled to intertidal elevations and tidal channel marsh system established and with the remainder of the basin filled to Jamaica Bay.

This alternative combines Alternatives 3 and 4. The habitat improvements are exactly the same as Alternative 3. The head of the basin will be filled to create tidal marshes and creeks, however this alternative includes recontouring the basin to the mouth of Fresh Creek. This is expected to substantially improve flushing throughout the basin. Overall benefits include the increased amount of wetland, improved DO, and capping of existing contaminated sediments in the creek.

This alternative will also create a small detention pond at the head of Fresh Creek. Improvements to the existing CSO in this area have been postponed. As a result, the detention basin has been added and is expected to slow the water, allowing fallout of suspended materials. With annual or biannual clearing of this pond by the sponsor until the CSO is abated, much of the contaminants can be removed. Water from the CSO will leave the pond through a sinuous tidal creek passing through native salt marshes.

Wetlands are known to remove many organic and inorganic contaminants from the water column and are often used to treat wastewater (DeBusk 1999). Removal efficiency depends on many factors but averages 71 percent for total suspended solids, 55 percent for nitrates, 26 percent for ammonia, 41 percent of orthophosphates, and 31 percent of total phosphorus (DeBusk 1999). As such, this design is expected to improve water quality in Fresh Creek as well as protect Jamaica Bay until CSO improvements can be completed. During the plans and specifications phase, allowing the outflow from the CSO detention basin to go to a sheet flow across the marsh vegetation to allow better suspended solids/nitrate trapping will be evaluated.

5.3 Hawtree Point

5.3.1 Existing Conditions, Constraints, and Potential Actions

In the early 1900s, a canal was dug at the southern end of Hawtree Creek to create Hawtree Basin. Hawtree Point was filled during the development of the communities of Howard Beach and Hamilton Beach. The Hawtree Point site is located on public land with no permanent residents and includes Charles Memorial Park, which encompasses approximately 2.1 acres. The total area of the site is approximately 16.7 acres (Figure 3).

The developed shoreline is characterized by pile- and bulkhead-supported houses that extend over the water. Along undisturbed portions of the existing tidal marsh, the banks of the channels have a steep gradient that rises into the marsh. Narrow mud flats fringe the undeveloped tidal marshes at low tide. The soils consist of organic peat within the tidal marsh, and silts within the channel.

Within undeveloped portions of the site, the cover type consists of a high marsh community dominated by saltmeadow cordgrass, with patches of marsh elder and common reed. A narrow, ten-foot wide fringe of saltmarsh cordgrass is present along the channel edge. The area to the south consists of unvegetated sediments and sparse stands of saltmarsh cordgrass. Patches of low marsh are present between buildings located around the project site. Hawtree Point contains non-native plants that are continually disturbed by the use of all-terrain vehicles (ATVs) along the shoreline.

The wetland areas on site cover only about 1.6 acres and are surrounded by invasive species including mugwort, common reed, and Japanese knotweed. Much of the upland at this site is occupied by the Charles Memorial Park that includes recreational facilities and a large mown area. There are also approximately 1.64 acres of invasive species, 0.44 acres of grassland, and 0.08 acres of secondary woodland.

Environmental stressors on the site are the following:

- Presence of monotypic stands of non-native invasive plant species.
- ATV use along shoreline.

- Filled wetlands.
- Presence of contaminants.

The following actions at Hawtree Point would contribute to the overall restoration of Jamaica Bay:

- Expanding and protecting existing tidal marsh systems by improving surrounding habitat and erecting barriers to off-road vehicle use.
- Replacing monotypic stands of vegetation with diverse native plantings.
- Blend restoration areas back into surrounding areas, discourage re-infestation of invasive species, and protect wetlands from future impacts.

Site-specific planning constraints for Hawtree Point include:

- Presence of contaminants which may require additional data and/or evaluation.
- Close proximity to JFK International Airport restricting site access and minimizing waterfowl habitat creation (flight risk).
- The Charles Memorial Park covers over two (2) acres of the site.

Figure 3. Existing Conditions Baseline Map, Hawtree Point.

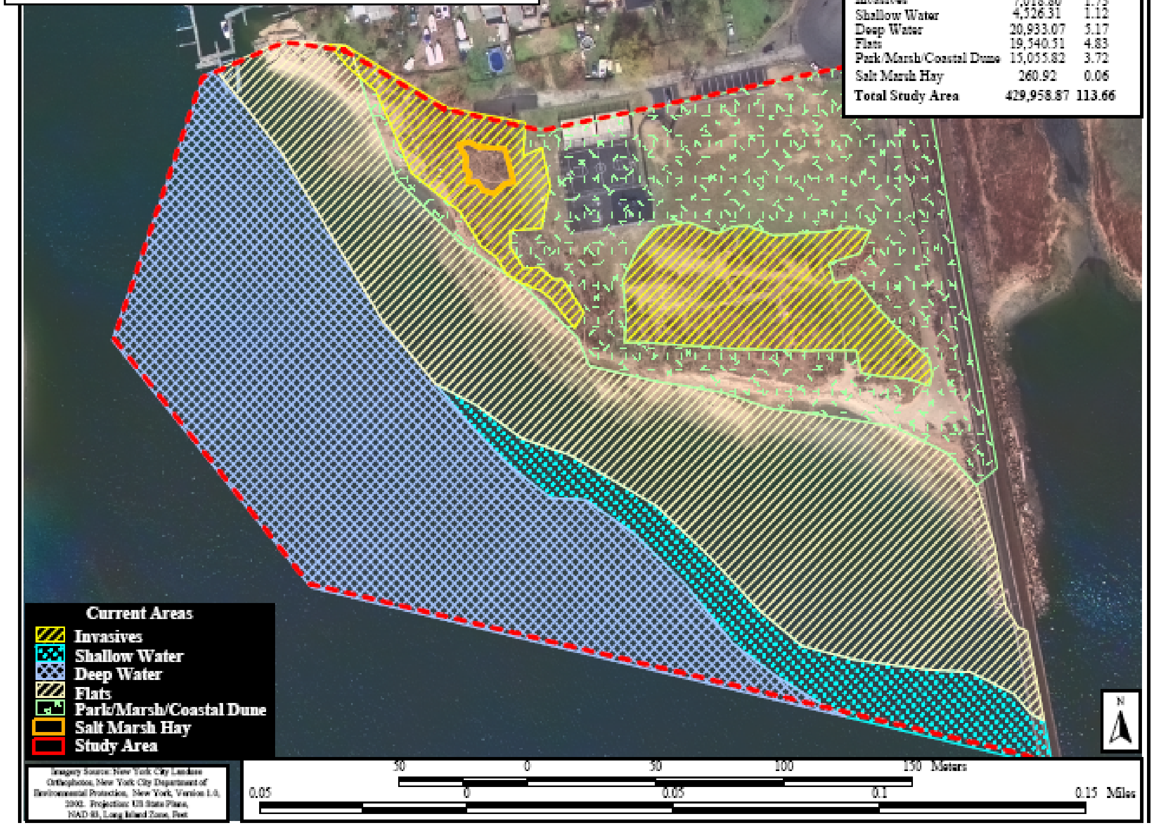


Figure 3: Hawtree Point Existing Conditions Baseline Map

5.3.2 Alternatives

Within the limited confines of Hawtree Point, two (2) solutions were developed. A large-scale plan for Hawtree Point was considered in the preliminary screening round. However, after discussions with the Port Authority of New York and New Jersey, security considerations due to the proximity of this site to JFK International Airport led to the elimination of the large-scale plan from further analysis. The specific design elements associated with a scaled-down restoration alternative as well as the no action alternative are discussed below.

5.3.2.1 No Action Alternative

Without restoration, it is anticipated that the site will remain heavily dominated by invasive species, considerably degraded from its past ecological values.

5.3.2.2 Alternative 1: Coastal dune restoration in invasive dominated areas.

Alternative 1 recovers 1.7 acres of coastal scrub/shrub and grassland habitat from the existing invasive dominated areas. Some regrading and grubbing would remove the invasive species and native grasses and shrubs will be planted at the site. This alternative also includes the creation of a natural barrier to motorized vehicles. By placing boulders along the boundary of the restoration area, the newly created habitats, as well as the preserved existing marshes, will be protected. Through implementation of this project, a 0.07-acre existing patch of salt marsh hay will be excavated and replaced. This area is currently being invaded by the surrounding invasives. Salt marsh hay will be planted in the location after the excavation and regrading of the surrounding land. The net amount of wetland habitat will be the same before and after project implementation.

5.4 Bayswater Point State Park

5.4.1 Existing Conditions, Constraints, and Potential Actions

Historical documents indicate that the predominant upland areas within the site are natural rather than fill. The area is currently vegetated with a grassland, small tidal marshes, monocultures of invasive species (common reed), and native and opportunistic woody vegetation. In 1991, when the park was dedicated, a member of the Audubon Society noted, “Bayswater Point has a number of special natural features including the last patch of mature native oak forests on Jamaica Bay.” The deteriorating bulkhead is no longer protecting the shoreline against erosion. Figure 4 shows the existing conditions of the Bayswater Point State Park site.

Environmental stressors on the site are the following:

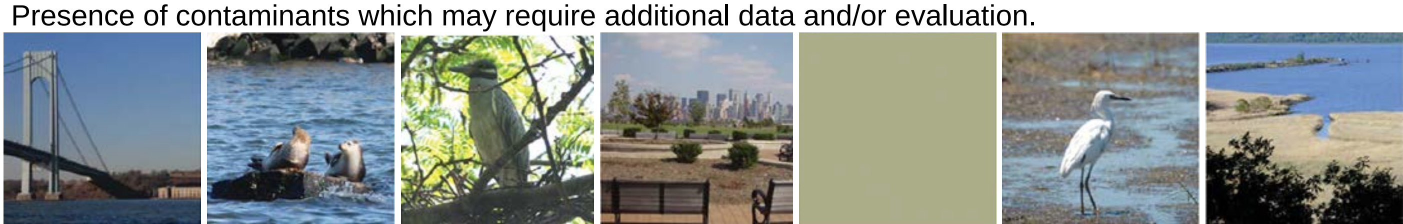
- Presence of extensive areas of non-native invasive plants.
- Potential loss of habitat due to erosion and deteriorating seawall.

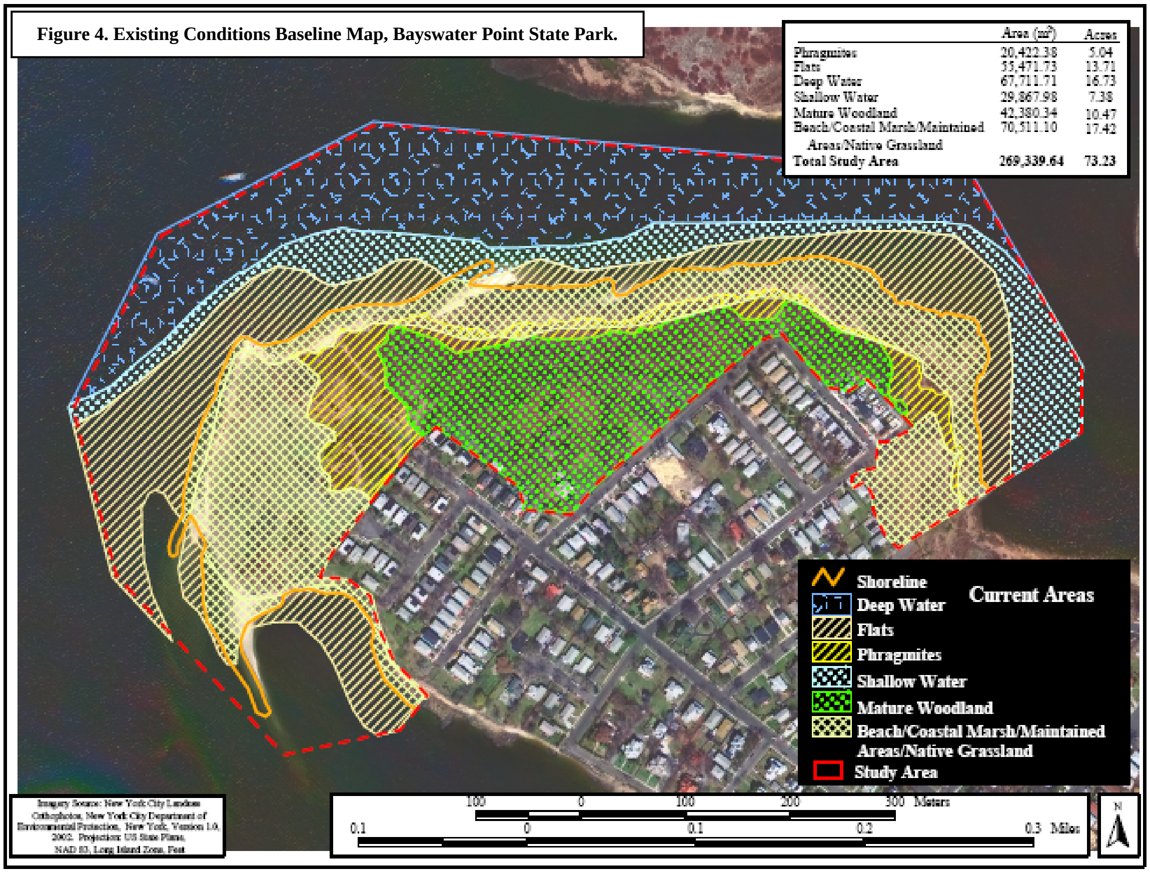
The following steps at Bayswater Point State Park would contribute to the overall restoration of Jamaica Bay:

- Replacing common reed dominated areas with intertidal marsh and a tidal creek system.
- Address the failing bulkhead through the use of strategically placed shoreline erosion control structures to protect existing and restored habitat from erosion loss and also to create macroinvertebrate habitat.
- Integrating proposed restoration areas with the existing native vegetation communities in particular the mature woodland.

Site-specific planning constraints for Bayswater Point State Park include:

- Presence of known cultural resources in park area.
- Other unknown historic cultural resources may be present.
- Continuing public access to the park.
- Presence of contaminants which may require additional data and/or evaluation.





	Area (m^2)	Acres
Phragmites	20,422.38	5.04
Flats	55,471.73	13.71
Deep Water	67,711.71	16.73
Shallow Water	29,867.98	7.38
Mature Woodland	42,380.34	10.47
Beach/Coastal Marsh/Maintained Areas/Native Grassland	70,511.10	17.42
Total Study Area	269,339.64	73.23

Figure 4: Bayswater Point State Park Existing Conditions Baseline Map

5.4.2 Alternatives

For Bayswater Point State Park, four (4) alternative scenarios were developed.

5.4.2.1 No Action Alternative

In the absence of federal action, the areas currently dominated by invasive species will remain so indefinitely. This site experiences severe erosional forces which have caused the existing seawall to fall into disrepair. As such, existing marshes, beaches, and grasslands could be lost. In 2014, NYS Parks and Recreation identified that the statewide Invasive Species Strike Team freed a significant area Bayswater State Park from rampant invasive species (NYS PRHP, 2014). The New York State Office of Parks, Recreation and Historic Preservation, the land owner has indicated no plans to change the general land use or to do major restorations at the site.

5.4.2.2 Alternative 1: Tidal channel marsh system with coastal dune system.

Alternative 1 removes invasive-dominated areas by regrading and creating a tidal channel and associated salt marsh. A tidal channel of approximately 0.21 acres will be built to create about 2.0 acres of low marsh and 0.4 acres of high marsh. Approximately 0.7 acres of beach/dune will also be created. Through selective removal of invasive/non-native vegetation, the mature woodland stands will be restored and replanted with native, appropriate vegetation to prevent the spread of invasive species into the aquatic habitat and to provide a protective buffer for the marsh system.

The low marsh areas will be planted from an elevation of 0.2 feet to 2.3 feet. High marsh areas will be planted from an elevation of 2.3 feet to 2.6 feet. All existing areas of marsh or native species will be preserved to the extent possible. If restoration requires the disturbance of these areas, plants will be salvaged for replanting at the site after regrading is complete. To stabilize the tidal creek and protect the existing beach and salt marsh habitat, training structures will be created on the banks at the mouth of the creek. The training structures will be made of rock placed in a trapezoidal cross section. During the plans and specifications phase, transplanting oysters or mussels onto the rock structures as soon as they are built will be considered as a means to create a healthy habitat before algae and epiphytes colonize the rock.

5.4.2.3 Alternative 2: Tidal channel marsh system with coastal protection tidal pool approach system.

This alternative is similar to Alternative 1, but with the addition of creating a tidal pool to the west of the creek/marsh complex. The tidal pool will cover approximately 0.6 acres and in addition to adding a tidal pool habitat will also allow the creation of an additional 0.5 acres of low marsh. This area currently includes small patches of salt marsh and switchgrass, as well as some mown areas that are mugwort dominated.

This alternative includes more armoring of the point to protect the area from erosion. Hard structures will cover approximately 0.6 acres. This area is currently shrubby tidal marsh and beach above MHW. The training structures will also still be required to protect the mouth of the tidal channel.

5.4.2.4 Alternative 3: Tidal channel marsh system with coastal protection buried T-groin system.

This alternative also integrates the tidal creek and marsh system of Alternative 1, but adds in the creation of a T-groin system and coastal dune restoration. The tidal creek area of restoration is exactly the same as in Alternatives 1 and 2. The T-groin system would allow further inundation of tides creating 0.4 acres of shallow water and creating 0.5 acres of low marsh. Approximately 1.0 acre of dunes and beach will also be constructed behind the groins. Low and high marsh will be planted in between rocks where tidal inundation and wave climate permit habitat survival.

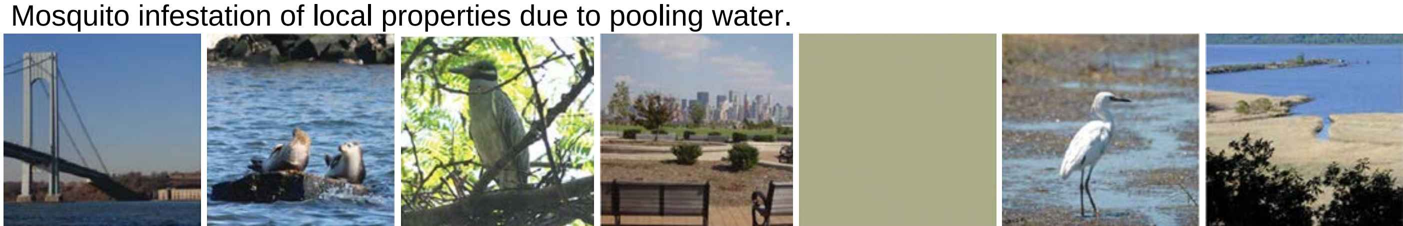
5.5 Dubos Point

5.5.1 Existing Conditions, Constraints, and Potential Actions

Prior to the 1920s, Dubos Point was covered by a large salt marsh; however, subsequent development and filling activities have disturbed the site. The shoreline of the entire site is bordered by approximately 50-foot-wide bands of low marsh. The zonation of cover types vary from tidal marsh to upland scrub/shrub and old fields. The scrub/shrub is formed primarily by winged sumac, bayberry, black cherry, blackberry and marsh-elder mixed with common reed and goldenrods. The old field community is a mix of forbs and grasses. The soils within the uplands are derived from fill material consisting of loamy sand and large pieces of concrete. Figure 5 shows the existing conditions on the Dubos Point site.

Environmental stressors on the site are the following:

- Non-native, invasive plant species.
- Erosion due to high energy littoral zone along western and northern shorelines.
- Mosquito infestation of local properties due to pooling water.



- Dumped trash and debris.
- Fill material.

The following actions at Dubos Point would contribute to the overall restoration of Jamaica Bay:

- Address shore erosion through placement of environmentally sensitive structures.
- Selectively remove invasive species monocultures and replace with diverse native vegetation to prevent the spread of invasive species into the aquatic habitat.
- Incorporate protective strategies to guard against future dumping while still allowing passive recreation uses.
- Enhance circulation of tidal water throughout site to reduce mosquito populations.

Site-specific planning constraints for Dubos Point include:

- Presence of existing salt marsh which may be affected by restoration activities.
- Presence of contaminants that may need investigation prior to restoration activities.
- Existing dilapidated coastal shore protection structures.

The river and aquatic environment in the project area was highly engineered with the goal of conveying water past large arterials (e.g., rail lines, roads, etc.) with little thought to potential impacts on the local ecology. The restoration measures consider these needs and were designed to keep the current alignment while utilizing environmental engineering techniques that result in an immediate ecological uplift and increase fish habitat.

Figure 5. Existing Conditions Baseline Map, Dubos Point.

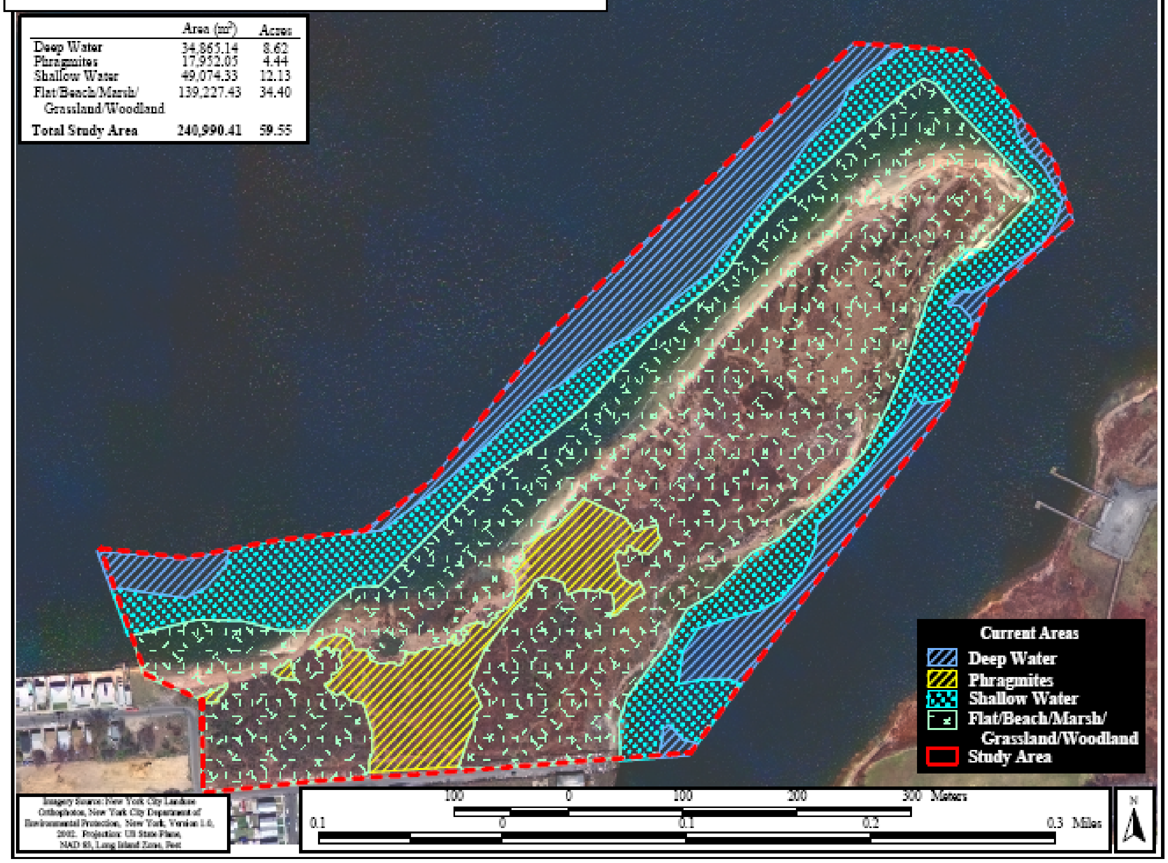


Figure 5: Dubos Point Existing Conditions Baseline Map

5.5.2 Alternatives

Four (4) alternative solutions were developed for Dubos Point. The specific design elements associated with each restoration alternative and the no action alternative are discussed below.

5.5.2.1 No Action Alternative

This site is highly erosive and without restoration, it is anticipated that erosion will continue with the loss of remaining salt marsh. It is also expected that invasive species will continue to spread throughout the site, further decreasing salt marsh at Dubos Point.

5.5.2.2 Alternative 1: Tidal channel marsh system.

This alternative restores marsh by creating tidal channels in an existing filled common reed stand and regrading the area to salt marsh elevations. Tidal channels of approximately 0.7 acres will be built to create about 3.5 acres of low marsh and 0.6 acres of high marsh. Tidal channels in the northern tip will also be reopened to allow salt water flushing and fish migration to alleviate the local overabundance of mosquitoes. The project will include excavation of approximately 24,400 cubic yards of soil to create the channels and tidal creeks. This soil will be used for landscaping onsite. By removing mugwort-dominated areas the project will incidentally restore 2.0 acres of maritime forest. Native canopy trees, understory trees, shrubs, forbs, and ferns will be planted here to prevent the spread of invasive species into the aquatic habitat. The low marsh areas will be planted from an elevation of 0.1 feet to 2.5 feet. High marsh habitat will be planted from an elevation of 2.5 feet to 3.4 feet. The existing pilings will remain and will continue to offer some protection to the salt marsh on the point.

5.5.2.3 Alternative 2: Tidal channel marsh system with limited toe dike protection.

This alternative is similar to Alternative 1, with the only difference being the amount of toe protection installed. This alternative utilizes the existing piles, replacing only the ones that have failed. Restoration plans, vehicle barriers, and vegetation plantings for this alternative are the same as in Alternative 1.

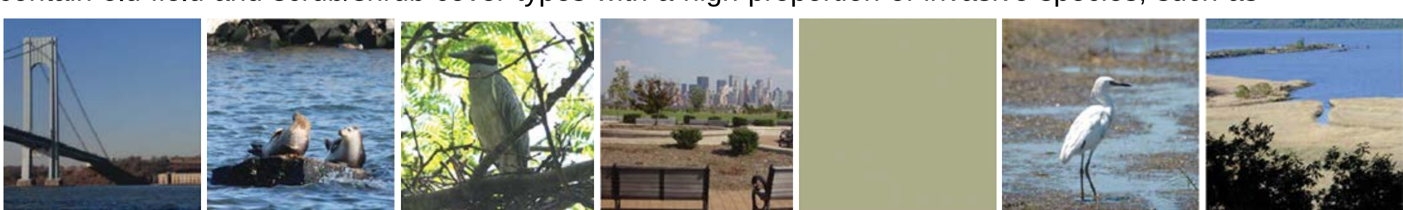
5.5.2.4 Alternative 3: Tidal channel marsh system continuous toe dike protection.

Alternative 3 includes all the elements of Alternative 1 and maximizes marsh habitat protection by implementing toe protection surrounding the entire western and northern shore. The north and west shorelines are exposed to high wave velocities from Jamaica Bay. Soldier piles were installed in the past, and still exist on the site but are beginning to fail. In the areas of failure, the erosion is quite obvious. Toe protection in this alternative includes the use of soldier piles or its equivalent, placed to the level of MLW, along the entire shoreline replacing all of the existing piles.

5.6 Brant Point

5.6.1 Existing Conditions, Constraints, and Potential Actions

Brant Point was part of the Arverne development until the turn of the 20th century; development of this area was restricted to a section of the peninsula. The uplands are largely disturbed and consist of fill material. The shoreline consists of a steep-banked, high marsh zone. The high marsh area contains salt meadow cordgrass as the dominant plant species within an area along the shoreline. Toward the interior of the site, marsh-elder, seaside goldenrod, and common reed become more prominent. The fill areas contain old field and scrub/shrub cover types with a high proportion of invasive species, such as



mugwort, common reed, and common ragweed. A grounded barge offshore has acted as an erosion control device and created high quality benthic habitat behind the structure. Figure 6 shows the existing conditions of the Brant Point site.

Environmental stressors on the site are the following:

- Covering of the historic marsh with fill material.
- Extensive dumping of soil, trash and debris.
- Presence of invasive, non-native plant species.
- Shoreline erosion and wetland losses.

The following actions at Brant Point would contribute to the overall restoration of Jamaica Bay:

- Address the chronic shoreline erosion to arrest the continual loss of land by incorporating structures that mimic the proven sediment trap strategy of the grounded barge, which also enhance macroinvertebrate habitat.
- Restoring tidal marsh systems to offset both historical and future losses.
- Create salt marsh habitat after addressing shoreline erosion threat.
- Establish protective transitional buffers for restored salt marsh areas.
- Prevent future indiscriminate dumping on the parcel.
- Use excavated materials to create upland habitat zones.

Site-specific planning constraints for Brant Point include:

- Presence of contaminants which may require additional data and/or further evaluation.
- Private ownership of portions of the site;
- Close proximity to adjacent dense residential community. The narrow streets, resulting confining geometries of a narrow road network, and sensitive receptors, would likely result in some construction timing and access approvals, beyond that of a less developed or industrial area.

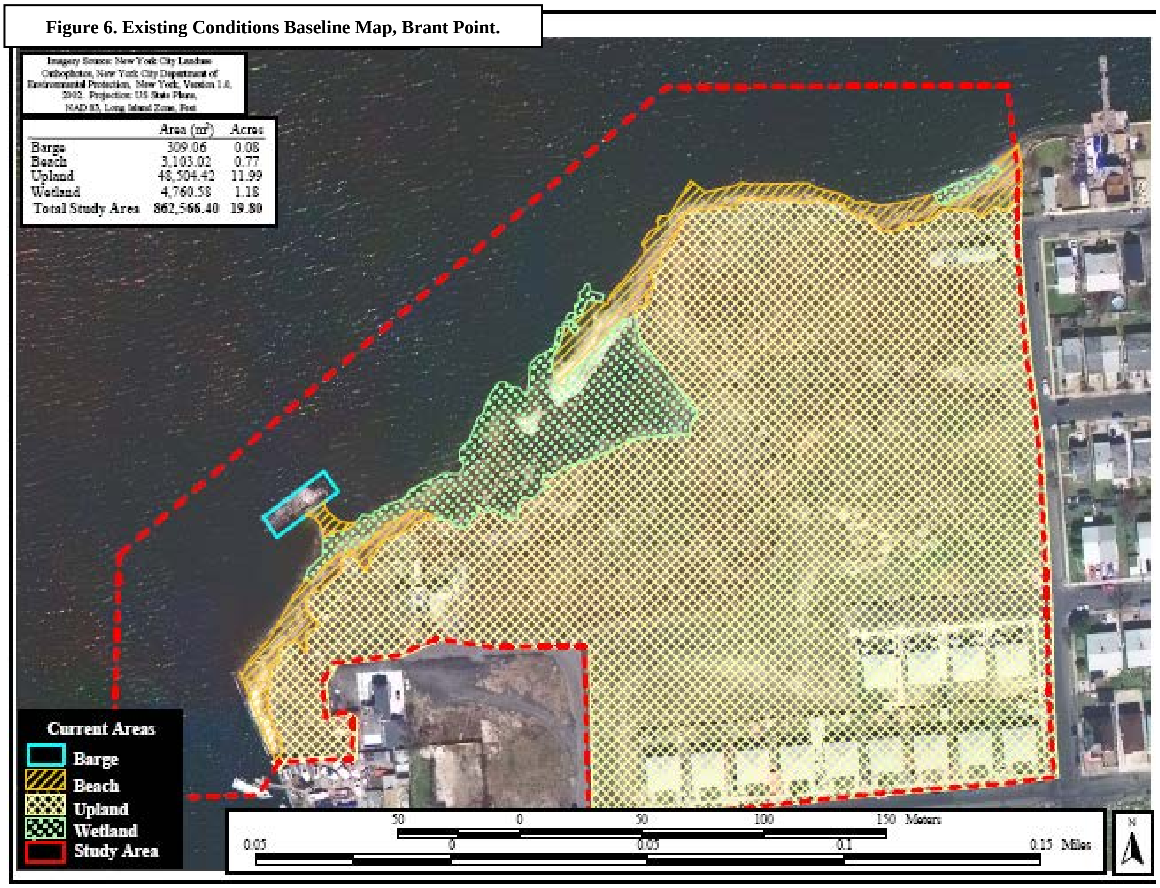


Figure 6: Brant Point Existing Conditions Baseline Map

5.6.2 Alternatives

Three (3) alternative solutions were developed for Brant Point. The specific design elements associated with each restoration alternative and the no action alternative are discussed below.

5.6.2.1 No Action Alternative

In the absence of federal action, Brant Point will continue to experience wetland loss due to erosion and illegal dumping and filling at the site. Upland areas are also expected to continue to degrade due to illegal dumping.

5.6.2.2 Alternative 1: Tidal fringe marsh system.

This alternative protects the existing 1.2 acres of marsh, but also restores an additional 1.9 acres of low marsh, 0.7 acres of high marsh, 2.5 acres of meadow, and 2.4 acres of maritime forest to prevent the spread of invasive species into the aquatic habitat. The low marsh areas will be planted with *Spartina alterniflora* from an elevation of 0.0 feet to 2.3 feet. High marsh habitat will be planted from an elevation of 2.3 feet to 3.2 feet. Coastal meadows will be planted with native forbs and shrubs. The maritime forest area will include the planting of canopy trees, understory trees, ferns, forbs, and shrubs. Soil excavated to regrade for the marsh creation will be used for onsite landscaping.

5.6.2.3 Alternative 2: Tidal fringe marsh system with offshore breakwaters.

In addition to the tidal fringe marsh of Alternative 1, Alternative 2 maximizes marsh habitat protection and creates macroinvertebrate habitat by creating offshore rubble mounds. The grounded barge at this site shows that offshore structures are capable of protecting the marshes and creating beneficial habitat for macroinvertebrates. Three (3) rock mounds are needed to protect the point from the ongoing erosion. These rubble mounds will have a footprint of approximately 0.36 acres total. The mounds will be placed at –2 feet to 3 feet at MLW and will be approximately 7 feet above MHW. The mounds will be approximately 6 feet wide on the top, 40 feet to 45 feet wide at the base, and about 140 feet long. The rocks will be placed randomly within a trapezoidal shape to create interstitial spaces of various sizes that can be used as refugia by various species. During the plans and specifications phase, transplanting oysters or mussels onto the rock structures as soon as they are built will be considered at as a means to create a healthy habitat with shellfish before algae and epiphytes colonize the rock.

6 Evaluation of Planned Wetlands

An EPW assessment for Jamaica Bay was conducted in the spring of 2004 and was verified in August 2015. The EPW process is described in Appendix X. In 2004, functional capacity index (FCI) calculations were performed in a Microsoft Excel© spreadsheet using the equations presented in the EPW manual (Bartoldus et al., 1994); all equations and spreadsheet cell references were validated.

6.1 Evaluation of Restoration Alternatives - EPW Results

The 18 restoration alternatives and six (6) baseline or no action alternatives for the Jamaica Bay sites were evaluated by predicting the expected habitat output using peak functional capacity units (FCUs). The EPW evaluates a site on six (6) major wetland functions (Table 4). The FCUs were computed on an average annual basis, taking into consideration that the outputs achieved may vary over time.[3] For example, a maritime forest environment may take 30 years to reach maturity and function at maximum capacity, compared to low marsh that will mature and be functional within five (5) years of construction. In the case of Jamaica Bay, upland benefits were not counted through the EPW analysis, so that example does not directly apply.

Table 4: EPW Major Wetland Functions

Function	Definition
Shoreline Bank Erosion Control (SB)	Capacity to provide erosion control and to dissipate erosive forces at the shoreline bank.
Sediment Stabilization (SS)	Capacity to stabilize and retain previously deposited sediments.
Water Quality (WQ)	Capacity to retain and process dissolved or particulate materials to the benefit of downstream surface water quality.
Wildlife (WL)	Degree to which a wetland functions as habitat for wildlife as described by habitat complexity.
Fish (FL) Tidal Fish (FT) Non-tidal Stream/River	Degree to which a wetland habitat meets the food/cover, reproductive, and water quality requirements of fish.

[3] ER 1105-2-100, paragraph E-36c.(1)

Function	Definition
Non-tidal Pond/Lake	
Uniqueness/Heritage (UH)	Presences of characteristics that distinguish a wetland as unique, rare, or valuable.

6.1.1 Dead Horse Bay

Five (5) alternatives were considered for the Dead Horse Bay restoration site:

- Alternative 0: No action alternative.
- Alternative 1: Fringe marsh system in the north without trash removal in the south.
- Alternative 2: Fringe marsh system in the north with trash removal in the south.
- Alternative 3: Tidal channel marsh system in the north without trash removal in the south.
- Alternative 4: Tidal channel marsh system in the north and trash removal prior to dune construction in the south.

Figure 7 shows the comparison of the FCUs for each alternative at Dead Horse Bay.

Shoreline Bank Erosion Control: The Dead Horse Bay site is subject to shoreline erosion, particularly in the southern parcel. Alternative 4 (FCU = 159.4, FCI = 0.94) shows the highest functionality for SB, while the lowest is the no action alternative (FCU = 76.6, FCI = 0.57). Alternative 4 is greatly improved with regard to this function by the large increase in wetland habitat to be created, the stabilized sand dunes in the south, and the training structures in the north. The existing steep, erosive bank coupled with the lack of stabilizing vegetation lower the score for the no action alternative.

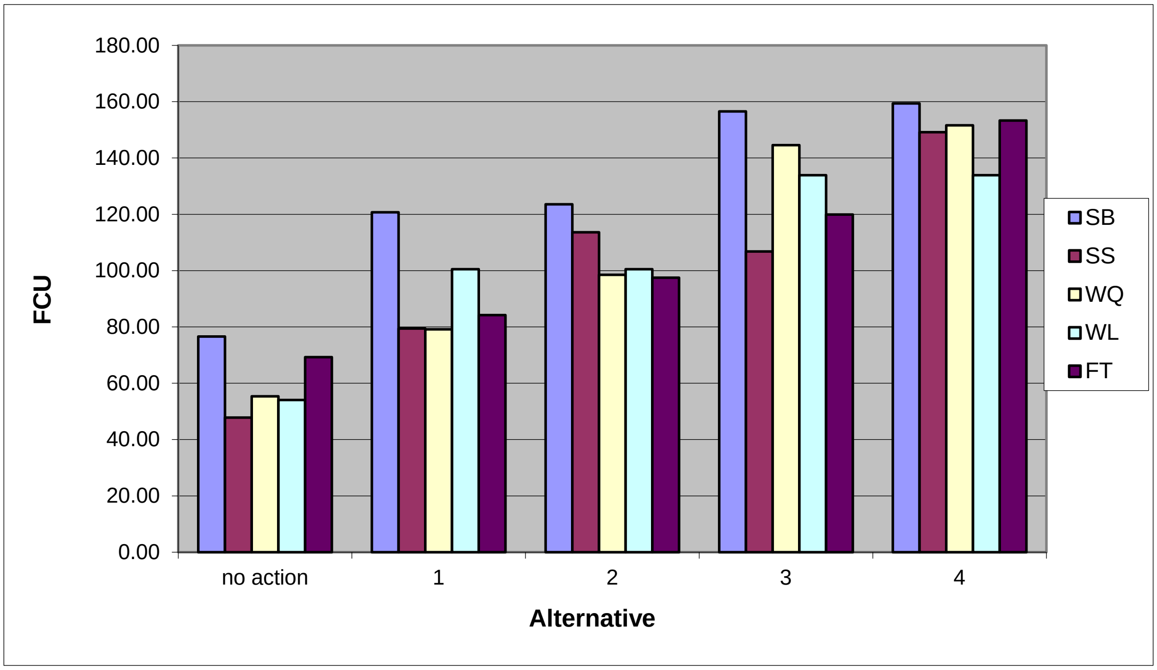


Figure 7: FCU Outputs for Each Alternative at the Dead Horse Bay Restoration Site.

Sediment Stabilization: The SS score is highest in Alternative 4 (FCU = 149.1, FCI = 0.88) and lowest in the no action alternative (FCU = 47.8, FCI = 0.36). The greatest difference in the FCU is due to the

amount of wetland to be created in Alternative 4, as well as the permanent removal of garbage and the erosive zone from the southern shore.

Water Quality: The large difference in the acreage of wetland to be created again boosts the functional capacity of the site for the first alternative. Alternative 4 has the highest water quality function (FCU = 151.6, FCI = 0.9) and the no action alternative has the lowest (FCU = 55.4, FCI = 0.41). The stabilization of the southern banks, removal of garbage from the shoreline, and size of the restored wetlands constituted the main difference in the FCI scores of the alternatives.

Wildlife: Both alternatives 3 and 4 had the highest wildlife function, each at FCU = 133.9 and FCI = 0.79. Again, the no action alternative showed the lowest functional scores (FCU = 54.1, FCI = 0.40). Removal of invasive species, diversification of the habitats, interspersion of water, and size of the wetlands established increased the wildlife function for alternatives 3 and 4.

Fish-Tidal: The no action alternative rates an FCU of 69.3 and an FCI score of 0.52. All four (4) alternatives improve that score, with Alternative 4 creating the greatest increase (FCU = 153.3, FCI = 0.91). The stabilization of the shoreline, removal of the landfill debris from the shoreline, and the increase in wetlands explain the increase in the functional capacity of the site with the restoration.

Uniqueness/Heritage: Jamaica Bay has been designated as a special natural waterfront area (SNWA) and each site is located on parkland. The FCI of all alternatives, including the no action alternative, is 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitats at the site.

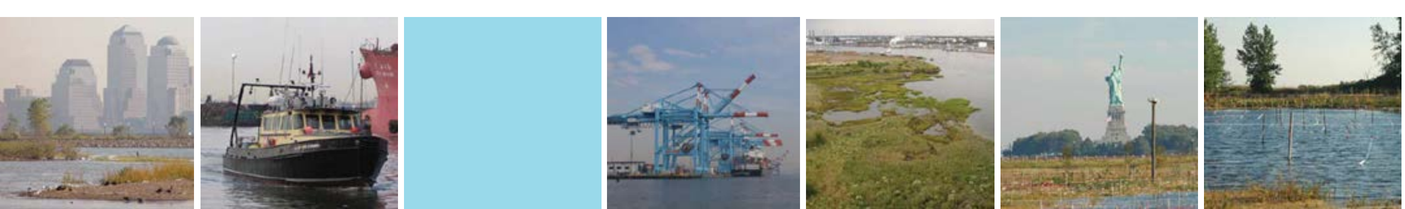
Based on the EPW assessment, all four (4) alternative restoration plans create improvements to the functionality of the site. However, Alternative 4 produces the greatest increase in FCI and FCU for all functions.

6.1.2 Fresh Creek

Six (6) alternatives have been considered for the Fresh Creek restoration site:

- Alternative 0: No action alternative.
- Alternative 1: Tidal marsh system continuous around basin with no bottom filling.
- Alternative 2: Tidal marsh system continuous around basin with bottom filled from head to edge of deep dredged channel.
- Alternative 3: Tidal marsh system continuous around basin with head of basin filled to intertidal elevations and tidal channel marsh system established.
- Alternative 4: Tidal marsh system continuous around basin with bottom filled from head to Jamaica Bay.
- Alternative 5: Tidal marsh system continuous around basin with head of basin filled to intertidal elevations and tidal channel marsh system established and with the remainder of the basin filled to Jamaica Bay.

Figure 8 shows the comparison of the functional capacity units for each alternative at Fresh Creek.



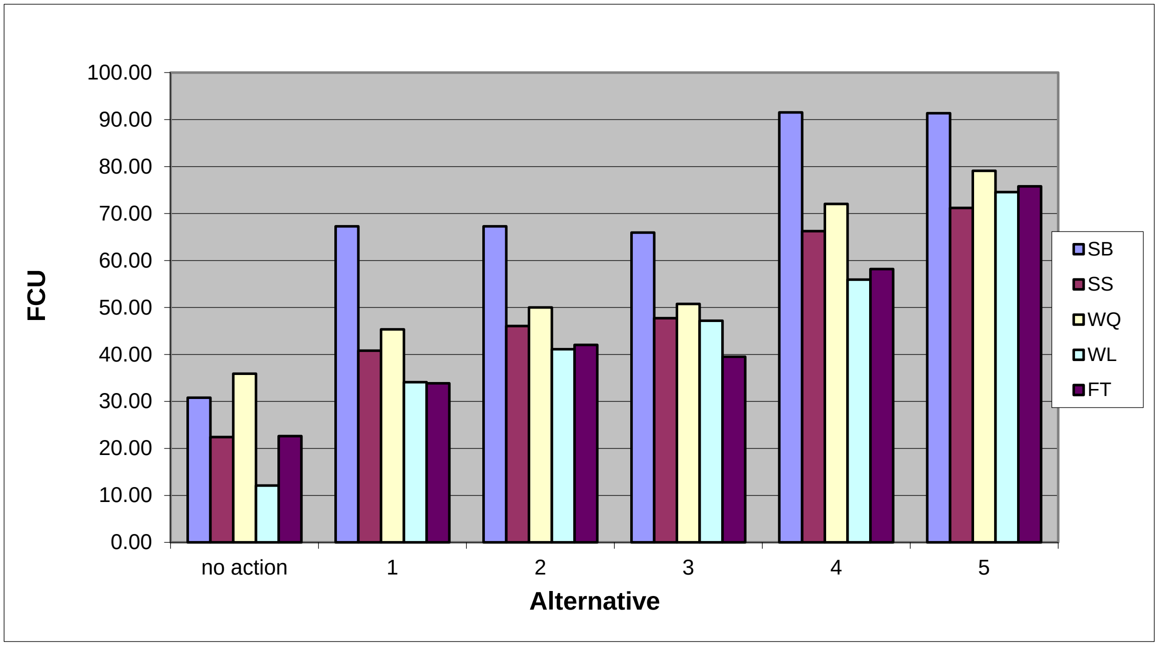


Figure 8: FCU Outputs of Each Alternative at the Fresh Creek Restoration Site.

Shoreline Bank Erosion Control: The creation of marsh and the regrading of the shoreline as seen in the proposed restorations greatly improve erosion control at this site. All the restoration alternatives have high FCI levels (FCI = 0.96). The difference in the amounts of restored wetland and bottom habitat creates highest FCU numbers for Alternatives 4 and 5 (FCU = 91.6 and FCU = 91.0 respectively). The lowest function for SB is the no action alternative (FCU = 30.8, FCI = 0.49).

Sediment Stabilization: The FCU for SS is highest in Alternative 5 (FCU = 71.2, FCI = 0.75) and lowest in the no action alternative (FCU = 22.4, FCI = 0.36). The increase in wetland along the shoreline creates the greatest improvement in the function of the site for sediment stabilization.

Water Quality: The improvement from flushing the basin and the improved sediment characteristics increase the WQ functionality by decreasing the disturbance element in the assessment. Also, the increase in wetland acreage boosts the FCUs of the site for the alternatives. Alternative 5 has the highest WQ function (FCU = 79.1, FCI = 0.83) and the no action alternative has the lowest (FCU = 35.9, FCI = 0.21).

Wildlife: Alternative 5 has the highest wildlife function (FCU = 74.6; FCI = 0.79) and again, the no action alternative showed the lowest functional scores (FCU = 12.1, FCI = 0.21). Removal of invasive species, diversification of the habitats, interspersion of water, amount of wetlands habitat, and improved water quality/capping of contaminated sediments increased the wildlife function for Alternative 5.

Fish-Tidal: The no action plan rated an FCI score of 0.36 and an FCU of 22.6. All four (4) alternatives improve that score, with Alternative 5 creating the greatest increase (FCU = 75.8, FCI = 0.79). The increase in wetlands and dissolved oxygen, and the improvement in the sediment quality, explain the increase in the functional capacity of the site with the restoration.

Uniqueness/Heritage: The FCI of the no action alternative and Alternative 1 have lowered scores (FCI = 0.83) due to the poor water quality and the lack of endangered species at this site. It is anticipated

that with improved water quality and improved habitat characteristics rare species may begin using the site, therefore the FCI of alternatives 1, 2, 4, and 5 are all 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitat at the site.

Based on the EPW assessment, all five (5) alternative restoration plans create improvements to the functionality of the site. However, Alternative 5 produces the greatest increase in FCI and FCU for most functions.

6.1.3 Hawtree Point

Two (2) alternatives have been considered for the Hawtree Point restoration site:

- Alternative 0: No action alternative.
- Alternative 1: Coastal dune restoration in invasive dominated areas.

Figure 9 shows the comparison of the FCUs for the no action and action alternatives at the Hawtree Point restoration site.

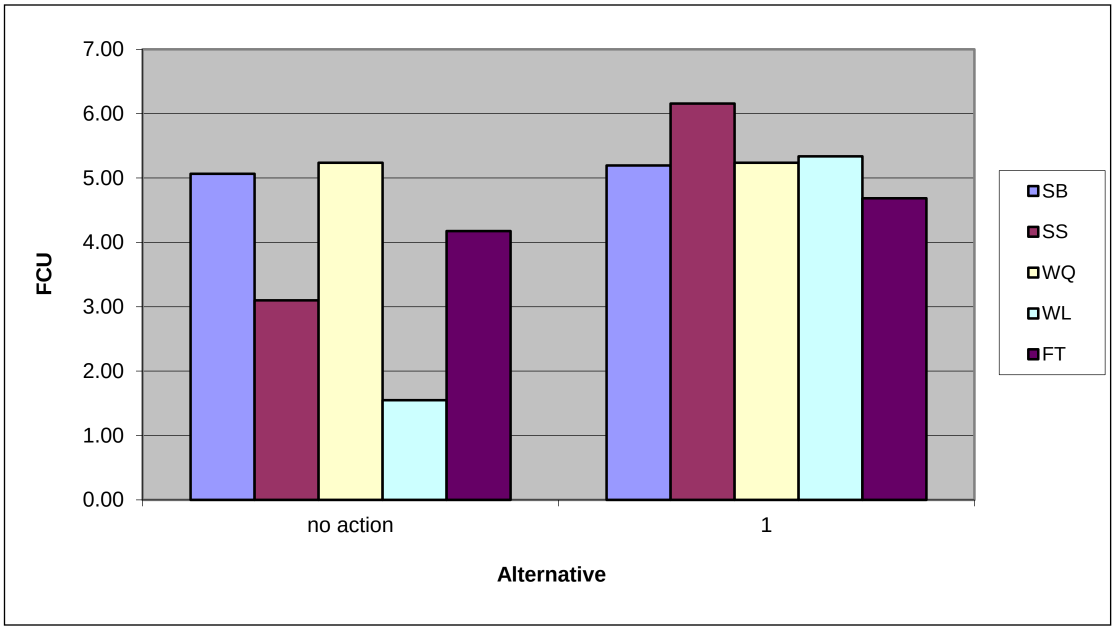


Figure 9: FCU Outputs of Each Alternative at the Hawtree Point Restoration Site.

Shoreline Bank Erosion Control: This site has only one action alternative that does not greatly change the amount of tidal habitat at the site. Therefore, the SB function does not show much change due to the restoration. Alternative 1 has slightly higher functionality due to the decrease in vehicular disturbance to the shore (FCU = 5.2, FCI = 0.76), but the no action alternative is only very slightly lower (FCU = 5.1, FCI = 0.75).

Sediment Stabilization: Sediment stabilization functionality improves with the restoration project due to the decrease in disturbance by vehicles at the site. The FCU for SS increases with Alternative 1 (FCU = 6.2, FCI = 0.91) from the no action alternative (FCU = 3.1, FCI = 0.46).

Water Quality: There is no effect on water quality at this site (FCU = 5.2, FCI = 0.77) for the action and no action alternatives.

Wildlife: The wildlife values show the greatest change in function with the restoration at the site. Removal of invasive species, diversification of the habitats, and removal of the vehicular disturbance increases the function with the action alternative. Alternative 1 has the highest wildlife function (FCU = 5.3; FCI = 0.79). The no action alternative had a lower functional score (FCU = 1.6, FCI = 0.23).

Fish-Tidal: A slight increase is created in the functionality of this site with regards to tidal fish by the proposed restoration. Alternative 1 has a higher function (FCU = 4.7, FCI = 0.69) than the no action alternative (FCU = 4.2, FCI = 0.61) due to the decrease in disturbance and the increase habitat diversity.

Uniqueness/Heritage: The FCI of the existing condition and the restoration alternative is 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitat at the site.

This site, compared to the other Jamaica Bay shoreline sites, is relatively small and the restoration planned is not large. However, based on the EPW assessment, the action alternative will improve the overall functionality of the site.

6.1.4 Bayswater Point State Park

Four (4) alternative scenarios were developed for the Bayswater Point State Park restoration site:

- Alternative 0: No action alternative
- Alternative 1: Tidal channel marsh system with coastal dune system.
- Alternative 2: Tidal channel marsh system with coastal protection tidal pool approach system.
- Alternative 3: Tidal channel marsh system with coastal protection buried T-groin system.

Figure 10 shows the comparison of the functional capacity units for each alternative at Bayswater Point State Park.

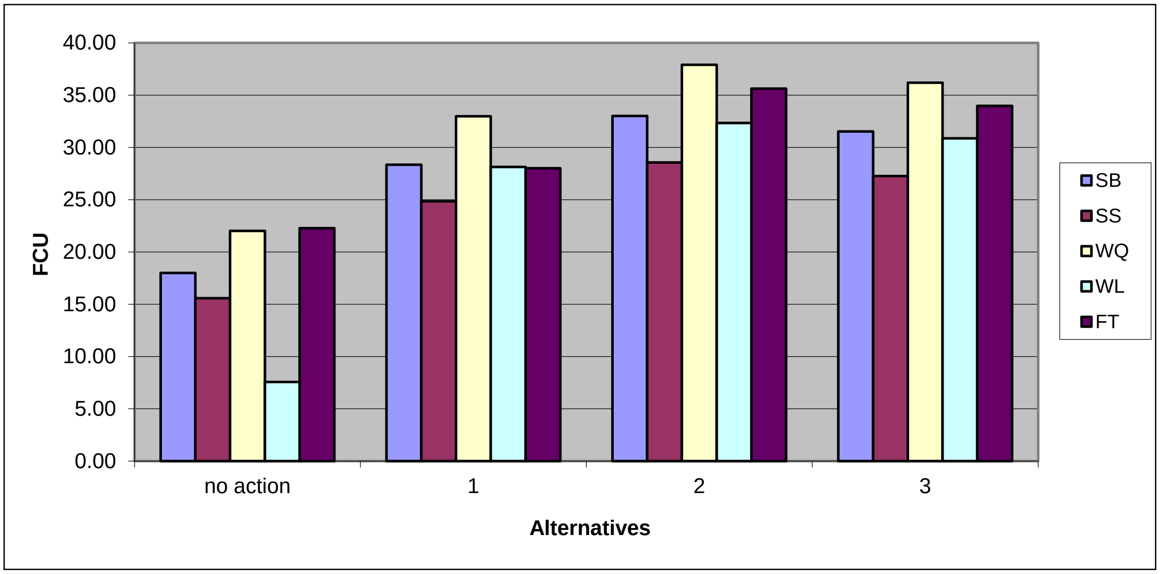


Figure 10: FCU Outputs of Each Alternative at the Bayswater Point State Park Restoration Site.

Shoreline Bank Erosion Control: The Bayswater Point State Park site is subject to shoreline erosion, particularly along the northeast point. Alternative 2 (FCU = 33.0, FCI = 0.8) shows the highest functionality for SB, while the lowest is the no action alternative (FCU = 18.0, FCI = 0.54). Alternative 1 improves the SB functionality of the site by the increase in created wetland habitat and the inclusion of hard structures to protect existing and created habitats. Alternative 2 also protects the shoreline, but creates less tidal habitat and therefore has a slightly lower FCU (FCU = 33.0, FCI = 0.8).

Sediment Stabilization: The SS score is highest in Alternative 2 (FCU = 28.6, FCI = 0.69) and lowest in the no action alternative (FCU = 15.6, FCI = 0.47). All of the action alternatives improve functionality of the site with respect to this function (FCI = 0.69), however the difference in amount of habitat created increases the FCU for Alternative 2.

Water Quality: The difference in the acreage of tidal habitat again boosts the functional capacity of the site for the Alternative 2. All action alternatives show a FCI of 0.92, however Alternative 2 has the most FCUs at 37.9, and the no action alternative has the lowest overall scores (FCU=22.0, FCI=0.66).

Wildlife: The no action alternative has the lowest functional scores (FCU = 7.6, FCI = 0.23). The action alternatives all increase the FCI to 0.79, but as Alternative 2 creates the most habitat, it also has the highest FCU at 32.3. Removal of invasive species, diversification of the habitats, interspersion of water, and size of the wetlands established increased the wildlife function for the alternatives.

Fish-Tidal: The no action plan rates a FCI score of 0.67 and an FCU of 22.3. Alternative 2 creates the greatest increase in functionality (FCU=35.6, FCI=0.87). The stabilization of the shoreline and the increase in wetlands explain the increase in the functional capacity of the site with the restoration.

Uniqueness/Heritage: Jamaica Bay has been designated as a SNWA and each site is located on existing parkland, therefore the FCI of the existing condition and the restoration alternatives are all 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitat at the site.

Based on the EPW assessment, all three (3) alternative restoration plans create improvements to the functionality of the site. However, Alternative 2 produces the greatest increase in FCI and FCU for all functions.

6.1.5 Dubos Point

Four (4) alternatives have been considered for the Dubos Point restoration site:

- Alternative 0: No action alternative.
- Alternative 1: Tidal channel marsh system in invasive dominated areas without any coastal protection measures implemented.
- Alternative 2: Tidal channel marsh system in invasive dominated areas with toe protection installed at failed locations.
- Alternative 3: Tidal channel marsh system in invasive dominated areas with continuous toe dike protection along the western and northern shorelines.

Figure 11 shows the comparison of the functional capacity units for each alternative at Dubos Point.

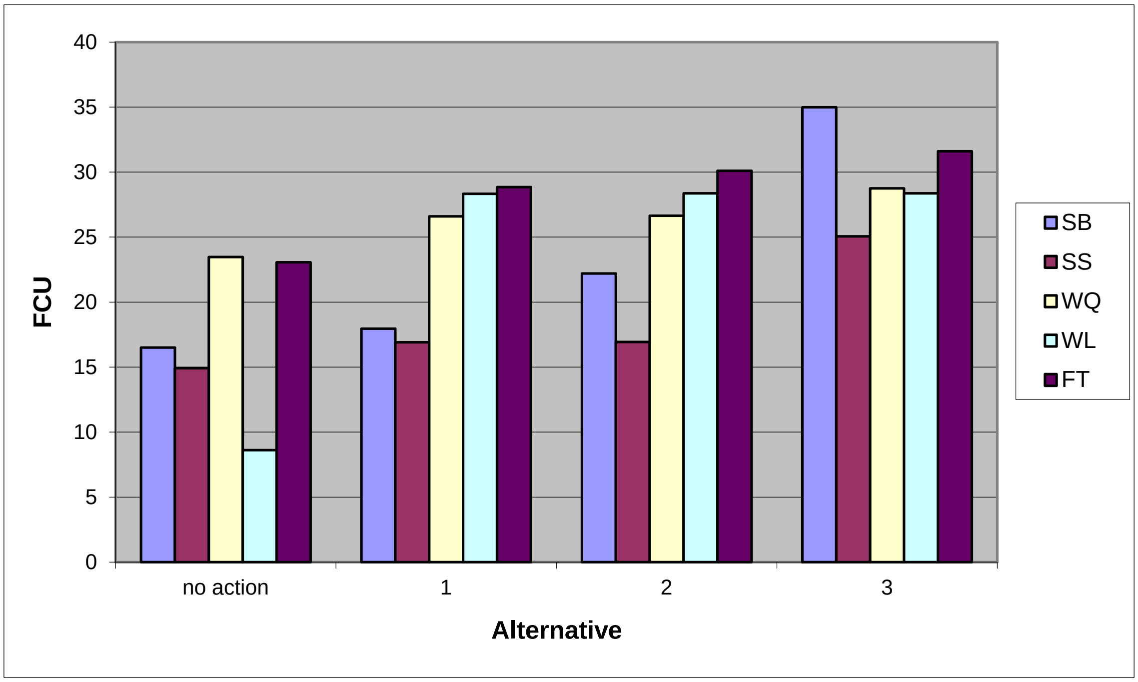


Figure 11: FCU Outputs of Each Alternative at the Dubos Point Restoration Site.

Shoreline Bank Erosion Control: The Dubos Point site is subject to shoreline erosion, particularly along the eastern coast. Alternative 2 (FCU =34.94, FCI = 0.97) shows the highest functionality for SB, while the no action alternative (FCU = 16.4, FCI = 0.52) and Alternative 1 (FCU = 18.0, FCI = 0.50) are the lowest. Alternative 3 improves the SB score by the increase in created wetland habitat and the inclusion of hard structures to protect existing and created habitats. Alternative 2 also protects the shoreline but on a shorter term than Alternative 3 (FCU = 22.2, FCI = 0.61).

Sediment Stabilization: The FCU for SS is highest in Alternative 3 (FCU = 25.0, FCI = 0.69) and lowest in the no action alternative (FCU = 14.82, FCI = 0.47). Alternatives 1 and 2 have identical SS scores (FCU = 16.9, FCI = 0.47) due to the continued shoreline erosion issues without continuous toe protection.

Water Quality: The WQ function is a measure of the ability of a wetland to retain and process particulate or dissolved materials, benefiting downstream water quality. Alternative 3 has the highest water quality results (FCU = 28.70, FCI = 0.80). All other alternatives have an FCI of 0.74, with the no action alternative having the lowest FCU score (FCU = 23.31) as it has a smaller amount of wetland habitat than the action.

Wildlife: The no action alternative has the lowest functional scores (FCU=8.56, FCI=0.27). The action alternatives all increase the FCI to 0.79, with FCUs of 28.33. Removal of invasive species, diversification of the habitats, interspersion of water, and size of the wetlands established increased the wildlife function for the alternatives.

Fish-Tidal: The no action plan rate an FCI score of 0.68 and an FCU of 21.54. Alternative 3 creates the greatest increase in functionality (FCU = 30.13, FCI = 0.0.84). Shoreline stabilization and the increase in wetlands explain the increase in the functional capacity of the site with the restoration.

Uniqueness/Heritage: Jamaica Bay has been designated as a SNWA and each site is located on existing parkland, therefore the FCI of the existing condition and the restoration alternatives are all 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitat at the site.

Based on the EPW assessment, all three (3) alternative restoration plans create improvements to the functionality of the site. However, Alternative 3 produces the greatest increase in FCI and FCU for all functions.

6.1.6 Brant Point

Three (3) alternatives have been considered for the Brant Point restoration site:

- Alternative 0: No action alternative.
- Alternative 1: Tidal fringe marsh system transitioning into maritime forest without shore protections.
- Alternative 2: Tidal fringe marsh system transitioning into maritime forest with offshore breakwaters.

Figure 12 shows the comparison of the functional capacity units for each alternative at Brant Point.

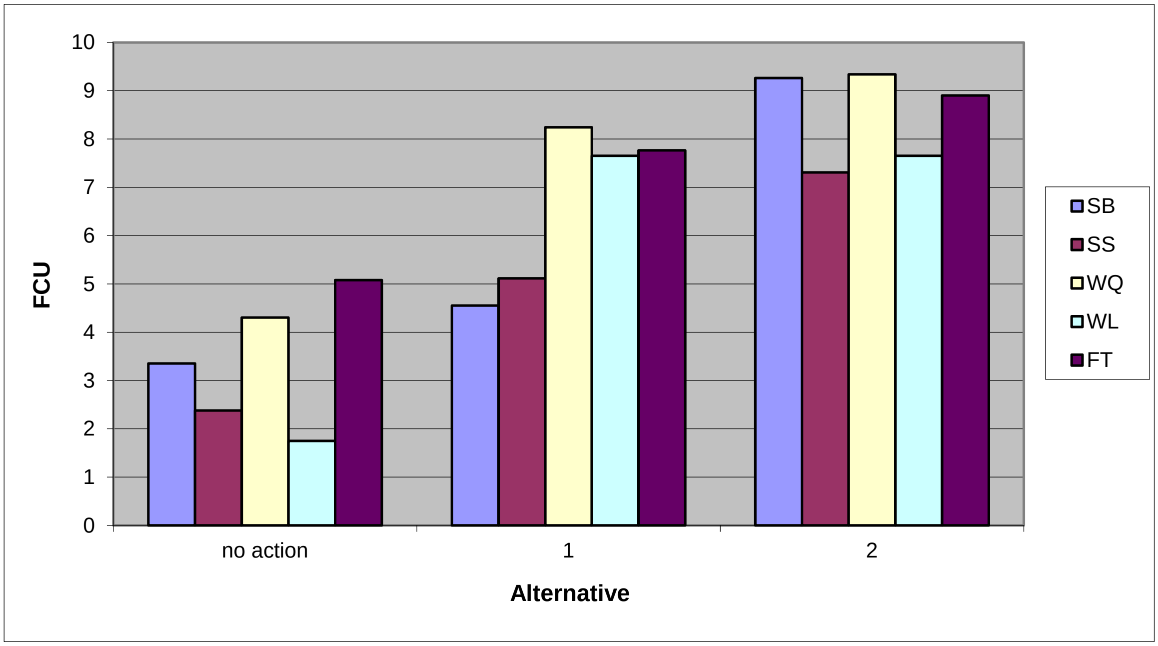


Figure 12: FCU Outputs of Each Alternative at the Brant Point Restoration Site.

Shoreline Bank Erosion Control: The Brant Point site is subject to severe shoreline erosion. Alternative 2 (FCU = 9.26, FCI = 0.95) shows the highest functionality for SB, while the lowest is the no action alternative (FCU = 3.31, FCI = 0.46). Alternative 2 improves the functionality of the site with regard to SB by the increase in wetland habitat to be created and the inclusion of hard structures to protect existing and created habitats.

Sediment Stabilization: The FCU for SS is highest in Alternative 2 (FCU = 7.31, FCI = 0.75) and lowest in the no action alternative (FCU = 2.35, FCI = 0.33). Improvements in the wetland habitat and the shoreline protection improve the scores for this site with both action alternatives.

Water Quality: Alternative 2 has the highest water quality results (FCU = 9.34, FCI = 0.96). The no action alternative has the lowest WQ function at this site (FCU = 4.25, FCI = 0.59).

Wildlife: The no action alternative has the lowest scores (FCU = 1.73, FCI = 0.24). The action alternatives all increase the FCI to 0.79, and the FCU to 7.65. Removal of invasive species, diversification of the habitats, and size of the wetlands established increased the wildlife function for the alternatives.

Fish-Tidal: The no action plan rates an FCI score of 0.69 and an FCU of 5.02. Alternative 2 creates the greatest increase in functionality (FCU = 8.9, FCI = 0.91). Shoreline stabilization and the increase in wetlands improves the functional capacity of the site with the restoration.

Uniqueness/Heritage: Jamaica Bay has been designated as a SNWA and each site is located on existing parkland, therefore the FCI of the existing condition and the restoration alternatives are all 1.0. The FCU was not calculated, as the uniqueness of the site was not considered to be a function of the size of the wetland habitat at the site.

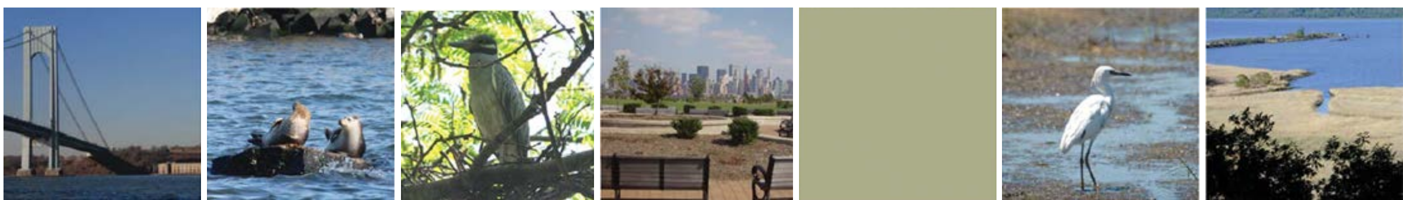
Based on the EPW assessment, both alternative restoration plans create improvements to the functionality of the site. However, Alternative 2 produces the greatest increase in FCI and FCU for all functions.

6.2 Average Annualized Functional Capacity Units

AAFCUs for each site and each of the alternatives are presented in Appendix B. AAFCUs were calculated for Years 2, 20, and 50. For Year 2, it was assumed that the Jamaica Bay sites would realize all 5 functions by end of year one (1). For Year 20, it was assumed that stabilized banks would contain 10 percent more wetlands than Year 1. For Year 50, it was assumed that all wetlands would realize a 5 percent loss due to erosion.

The following calculations were used:

AAFCUs = Cumulative FCUs ÷ Number of years in the life of the project, where:
Cumulative FCUs = Sum (T2 -T1)[(((A1*F1) +(A2*F2)) / 3) + (((A2*F1) + (A1*F2)) / 6)] and where:
T1 = First Target Year time interval
T2 = Second Target Year time interval
A1 = Area of available wetland assessment area at beginning of T1
A2 = Area of available wetland assessment area at end of T2
F1 = FCI at beginning of T1
F2 = FCI at end of T2
* = multiplied by
/ = divided by
Note: Rounding results in minor summation and multiplication variability of the presented data.



In accordance with planning guidance, the outputs, expressed in FCUs, were computed on an average annual basis, taking into consideration that the outputs achieved may vary over time (Table 5).[4] For example, a maritime forest environment may take 30 years to reach maturity and function at maximum capacity, compared to low marsh that will mature and be functional within 5 years of construction. In the case of Jamaica Bay, upland benefits were not counted through the EPW analysis, so that example does not directly apply.

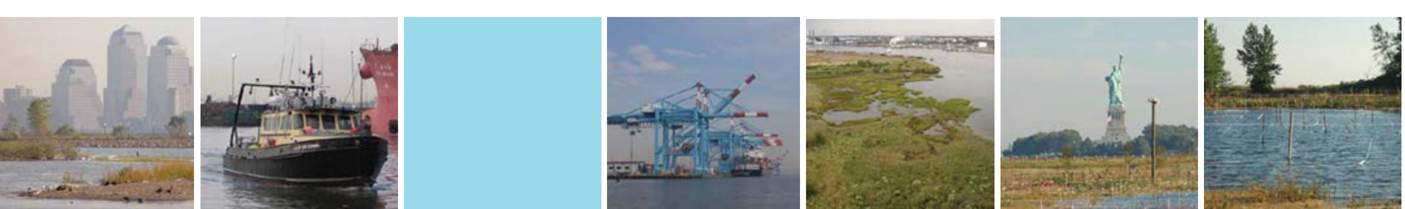
Table 5 : Peak Functional Capacity Units and Average Annual Functional Capacity Units for each Jamaica Bay Shoreline/Perimeter Site Alternative.

Alt No	Alternative Description	Peak Output (FCUs)	Avg. Ann. Output (AAFCU)
0	Dead Horse Bay: No action	0	0
1	Dead Horse Bay: Fringe marsh	161	116
2	Dead Horse Bay: Alt 1 + trash removal	231	166
3	Dead Horse Bay: Tidal creek	359	334
4	Dead Horse Bay: Alt 3 + trash removal	444	413
0	Fresh Creek: No action	0	0
1	Fresh Creek: Tidal marsh	96	88
2	Fresh Creek: Alt 1 + channel filling	129	119
3	Fresh Creek: Alt 1 + basin head filling	136	126
4	Fresh Creek: Alt 1 + basin filling to Jamaica Bay	230	208
5	Fresh Creek: Alt 4 + detention basin	266	246
0	Hawtree Point: No action	0	0
1	Hawtree Point: Coastal dune restoration	7.5	6.5
0	Bayswater Point State Park: No action	0	0
1	Bayswater Point State Park: Tidal channel with coastal dunes	57	41
2	Bayswater Point State Park: Tidal channel with tidal pool	82	76
3	Bayswater Point State Park: Tidal channel with T-groin protection	74	69
0	Dubos Point: No action	0	0
1	Dubos Point: Tidal channel	33	24
2	Dubos Point: Alt 1 + limited toe protection	38	27
3	Dubos Point: Alt 1 + continuous toe protection	62	58
0	Brant Point: No action	0	0
1	Brant Point: Tidal marsh	17	12
2	Brant Point: Alt 1 with shore protection	34	27

7 The Tentatively Selected Plan and Optimization

The AAFCUs restoration outputs and the project first level costs (Appendix L) were utilized inputs for the cost effectiveness/ incremental cost analysis (CE/ICA) as outlined in the CE/ICA Appendix M. These six (6) perimeter sites were previously approved as the TSP by USACE at the Alternative

[4] ER 1105-2-100, paragraph E-36c.(1)



Formulation Briefing in January 2010 and represent a set of actions that would work collectively to restore the Jamaica Bay ecosystem (see Appendix K- one pagers).

Following Hurricane Sandy, which severely impacted portions of New York and New Jersey in October 2012, the sites were evaluated further as part of the East Rockaway to Rockaway Inlet and Jamaica Bay Reformulation Study, to potentially be incorporated into the perimeter plan alternative as NNBFs. However, the storm surge barrier was recommended as the tentatively selected reformulation study's flood risk management measure. The six (6) remaining perimeter restoration sites are included in the recommendation for the Jamaica Bay Planning Region.

Data collected for the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study confirmed the existing conditions, and the feasibility of the proposed designs were verified and slightly optimized where appropriate to improve the site's resiliency and secondary CSRM benefits. The TSPs for each site are described and included below. During preconstruction engineering design, the partners should consider adding such CSRM features to three (3) of the project sites, paid for by the local sponsor, including Fresh Creek, Dubos Point and Brant Point. The TSPs are described below and future CSRM features are noted if appropriate.

7.1 Dead Horse Bay

Alternative 4 was the TSP for Dead Horse Bay. The selected alternative would maximize marsh habitat by creating a tidal channel in the northern portion of the site. On the southern point, approximately 31 acres of landfill at the shoreline would be removed and replaced with clean fill and sand from the northern portion of the site. The landfill removal would also enable the fringe marsh to support native wetland plant species with high habitat value. Additionally, the fill and sand would be covered with maritime plants and trees to stabilize the fill, which would be placed over 61 acres, act as a protective buffer for intertidal habitat, and create additional habitat associated with maritime forests that constitute a major historical feature within the bay and are integral to the ecosystem. Landfill materials would be excavated from the water's edge, and reused on site as much as possible and capped by clean sand to create dunes further inland. Excavated materials that could not be reused onsite would be removed and processed at a registered landfill facility. Dunes will be created on approximately 27.7 acres of the site and will restore 61 acres of maritime forest on the southern parcel of the project area. Roughly nine (9) acres of the existing beach will be preserved to the north. The TSP for the Dead Horse Bay restoration site is shown in Figure 13.

In the absence of restoration, the north parcel would remain heavily dominated by invasive species and considerably degraded from its past ecological values. In addition, the southern parcel would continue to experience shoreline erosion with continuing exposure of the landfill materials.

Figure 13: Tentatively Selected Plan for the Dead Horse Bay Restoration Site

7.2 Fresh Creek

Alternative 5 is the TSP for Fresh Creek. The preferred alternative at Fresh Creek includes basin filling and re-contouring. The head of the basin would be filled to create tidal marshes and creeks, the basin would be re-contoured to the mouth of Fresh Creek, ending at approximately 10 feet below MLW. Re-contouring the basin would decrease water residence time, thus improving the dissolved oxygen levels and water quality. Approximately 42.4 acres of shallow water through channel regrading will be restored. Under this alternative, a 1.5-acre tidal creek system with habitat for fish, crab and lobster, and protective buffers would be created. The other restoration measures will include 13.6 acres of low marsh, 2.5 acres of high marsh and 11.3 acres of maritime forest. The TSP for the Fresh Creek restoration site is shown in Figure 14.

It is anticipated that without restoration the Fresh Creek site would remain a degraded, low quality habitat. The invasive species within the project area could spread into the existing native vegetation. In addition, previously anticipated combined sewage outfall improvements by the City of New York have been delayed indefinitely and there are currently no known restoration plans for the site.

This option optimizes the restoration potential based on the August 2015 observed field conditions at the site by ARCADIS as reported in the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study. The optimization resulting from the new upland development does not affect total wetland and channel restoration effectiveness.

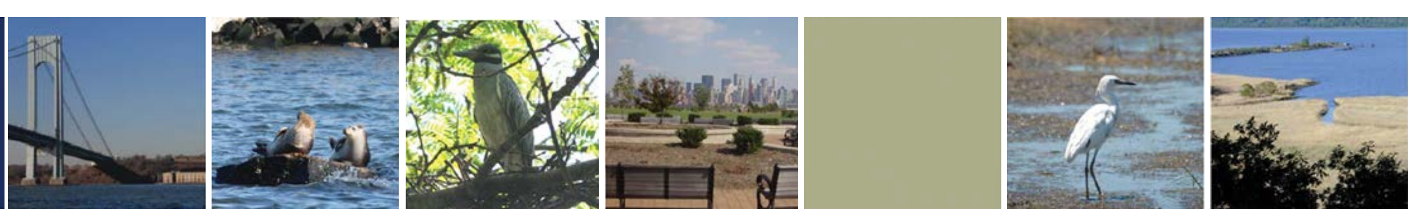


Figure 14: Tentatively Selected Plan for the Fresh Creek Restoration Site

7.3 Hawtree Point

Within the limited confines of Hawtree Point, only one (1) solution was developed. Alternative 1 restores 1.7 acres of coastal scrub/shrub and grassland habitat from the existing invasive species-dominated areas. Regrading and grubbing would remove the invasive species and native grasses and shrubs would be planted. Through implementation of this project, a 0.07-acre existing patch of salt marsh hay will be excavated and replaced. This alternative also includes the creation of a barrier to motorized vehicles. By placing boulders along the boundary of the restoration area, the newly created habitats as well as the preserved existing marshes will be protected from vehicle access, but will still be accessible to pedestrians. Alternative 1 is recommended with an end goal of restoring disturbed areas to healthy coastal habitat and protecting existing marshes. The TSP for the Hawtree Point restoration site is shown in Figure 15.

Although restoration opportunities are somewhat limited on site due to the presence of contaminants, the close proximity to JFK International Airport and the Charles Memorial Park covering 2.1 acres of the site, this site is recommended for restoration. Without restoration, it is anticipated that the site will remain heavily dominated by invasive species and considerably degraded from its past ecological values

The East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study included a suggestion to add a structural CSRM measure proposed along the inland perimeter of the site to be combined with the living shoreline approach.

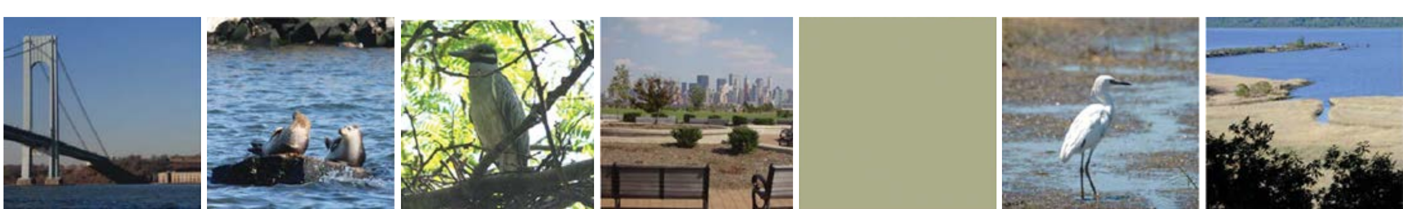


Figure 15: Tentatively Selected Plan for the Hawtree Point Restoration Site

7.4 Bayswater Point State Park

Alternative 2 is the TSP for Bayswater Point State Park. The TSP for Bayswater Point State Park would remove invasive-dominated communities by re-grading and creating a tidal channel and associated salt marsh. It would also protect the eroding point with the construction of hard structures. The total restoration would total 5.0 acres including 2.6 acres of low marsh, 0.3 acres of high marsh, 0.8 acres of creek/pool with habitat for fish, crab and lobster, 0.5 acres of beach/dune and 0.8 acres of hard structures. Hard structures will cover approximately 0.6 acres including armoring of the point and training structures at the mouth of the channel to protect the area from erosion. The TSP for the Bayswater Point State Park restoration site is shown in Figure 16.

Without restoration, this site would continue to experience severe erosional forces that have already caused the existing seawall to fall into disrepair. This could lead to the demise of existing marshes, beaches, and grasslands. In addition, this area would continue to be dominated by invasive species.

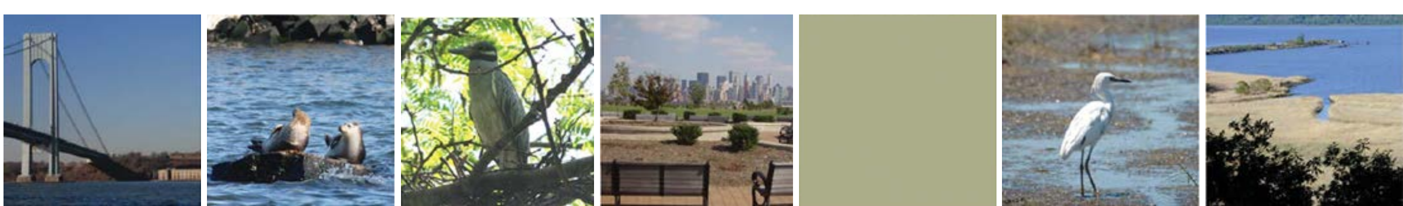


Figure 16: Tentatively Selected Plan for the Bayswater Point State Park Restoration Site

7.5 Dubos Point

Alternative 3, is the TSP for Dubos Point, would maximize marsh habitat protection by implementing a training structure along the entire western and north shores. These shorelines are currently exposed to high wave forces from Jamaica Bay and existing protective measures are beginning to fail. This alternative also would restore approximately two (2) acres of coastal and maritime forest, 3.3 acres of low marsh, 0.9 acres of high marsh and 0.7 acres of creating tidal channels, which provides habitat for fish, crab and lobster, in existing uplands currently dominated by common reed, and by regrading the area to elevations suitable for tidal salt marsh establishment. The TSP for the Dubos Point restoration site is shown in Figure 17.

Dubos Point is currently highly eroded and it is anticipated that without restoration the remaining salt marsh would be lost. In addition, invasive species would keep spreading throughout the site, further decreasing the value of the remaining salt marsh.

The East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study included a suggestion for optimization and modification of the TSP to replace coastal maritime forest with a hardened CSRM measure along the inland (i.e., southern) perimeter of the site. The costs of this measure would be borne 100 percent by the non-federal sponsor. A small modification to the tidal channel would be made with the use of hand tools as a means and method for the restoration effort.

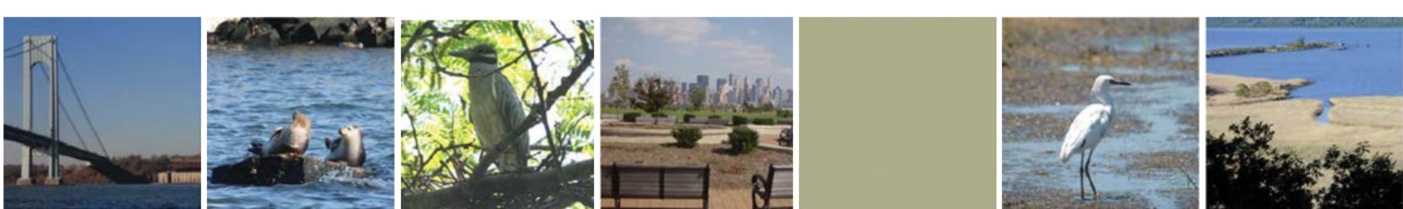


Figure 17: Tentatively Selected Plan for the Dubos Point Restoration Site

7.6 Brant Point

Alternative 2 is the TSP for Brant Point. The selected alternative would restore 1.9 acres of low marsh and 0.7 acres of high marsh and associated habitats, as well as approximately 2.4 acres of coastal and maritime forest. The alternative also would create approximately 2.5 acres of meadow, or grasslands, and protect already existing marsh habitat present at the site. The TSP would maximize habitat protection by implementing a training structure along the north shores. These shorelines are currently exposed to high wave forces from Jamaica Bay and existing protective measures are beginning to fail. The TSP for the Brant Point restoration site is shown in Figure 18.

The absence of restoration work would lead to continued wetland loss due to erosion and illegal dumping and filling at the site. In addition, further upland areas would continue to reduce the expansion of the invasive and non-native habitat species. The restoration at the site would improve the habitat conditions, prevent erosion, and prevent illegal dumping with proper signage.

The East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study included a suggestion for the potential modification of the design to replace some habitat along the inland perimeter (southern and eastern) of the site with a hardened CSRM measure, such as a floodwall. If this were to be implemented, the floodwall would be implemented by the non-federal sponsor at 100% cost.

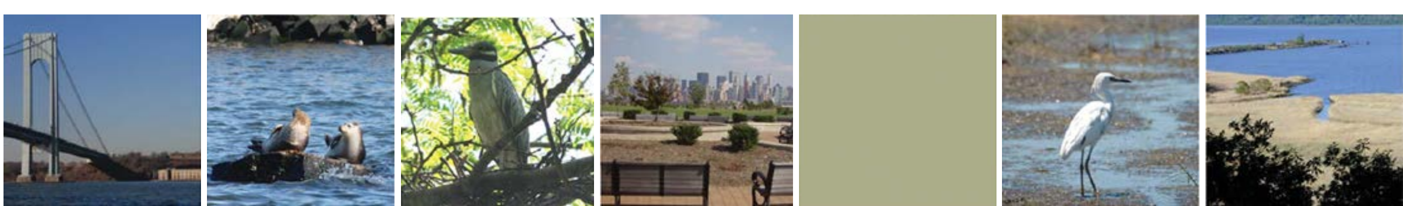


Figure 18: Tentatively Selected Plan for the Brant Point Restoration Site

ATTACHMENT A

JAMAICA BAY, MARINE PARK AND PLUMB BEACH, NY FEASIBILTY STUDY INITIAL ASSESSMENT

Jamaica Bay, Marine Park and Plumb Beach, New York Feasibility Study Coastal Restoration

Initial Assessment to Confirm Federal Interest

January 2, 2014

US Army Corps of Engineers
BUILDING STRONG®

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Environmental
Protection

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December 11, 2013

Colonel Paul Owen
Commander and District Engineer
U.S. Army Corps of Engineers
New York District
26 Federal Plaza
New York, NY 10278-0090

Re: Coastal Restoration Feasibility Study

Dear Colonel Owen:

This letter represents New York City Department of Environmental Protection's (DEP's) commitment to complete the Jamaica Bay, Marine Park, Plumb Beach Coastal Restoration Feasibility Study. DEP is the local sponsor pursuant to the Feasibility Cost Share Agreement executed in 1996. As a result of the Feasibility Study included in the U.S. Army Corps of Engineers (Corps) Interim Report #2 to Congress under the P.L. 113-2, The Disaster Relief Appropriations Act, 2013, the Corps has been directed at full federal expense, to expedite and complete the existing Feasibility Study with the purpose of addressing flood and storm risk reduction, shoreline resiliency and environmental sustainability.

DEP agrees with the content and conclusions outlined in the New York District's Initial Assessment documenting federal interest and the need to fulfill the remaining components of the 1994 multi-purpose authorization for erosion control and hurricane protection.

DEP looks forward to our continued partnership to complete the (Feasibility Study in an expeditious manner. Restoring and protecting Jamaica Bay and the surrounding region have been and will remain one our long-term top priorities.

Sincerely,

Carter H. Strickland, Jr.

c: Anthony Ciorra, Chief, Civil Works Branch Managing Division
Leonard Houston, Chief, Environmental Analysis Branch
Joseph Seebode, Deputy District Engineer for Civil Works
Frank Santomauro, Chief, Planning Division
Lisa Baron, Project Manager, Civil Works Branch
Peter Weppler, Chief, Ecosystem Coastal Section
Dan Zarrilli, Director of Resiliency, Mayor's OLTPS
Angela Licata, Deputy Commissioner, DEP
Pinar Balci, Director, DEP
John McLaughlin, Director, Ecological Services DEP

An "Initial Assessment" was required to reaffirm Federal interest in providing coastal storm damage reduction for the Jamaica Bay area as outlined in the Feasibility Cost Share Agreement (FCSA) Amendment (September 23, 2013; executed December 20, 2013):

"WHEREAS, the Government has determined that, as a result of Hurricane Sandy's impacts on structures and infrastructure in the Jamaica Bay area, expanding the ongoing efforts to include a study of coastal storm damage reduction warrants further review, subject to an initial assessment to reaffirm the Federal interest in providing coastal storm damage reduction for the Jamaica Bay area;

WHEREAS, if the Federal interest is reaffirmed, the Government and Non-Federal Sponsor desire to expand the Study to address coastal storm damage reduction, which includes the activities and tasks required to identify and evaluate alternatives and the preparation of a decision document that, as appropriate, recommends a coordinated and implementable solution."

This Initial Assessment supports the conclusion that the scope and nature of the coastal storm damage problems warrants Federal participation in expanding the ongoing Study. Therefore, the U.S. Army Corps of Engineers (USACE), New York District (NY District) has determined that additional feasibility-level analysis is warranted and the Draft Interim Feasibility Study should be expanded and completed utilizing Disaster Relief Appropriations Act (DRAA) 2013 funds.

1.0 Federal Interest & Authorization

The determination of positive Federal interest in coastal storm risk management for Jamaica Bay is based on the results of the Jamaica Bay Reconnaissance Study (1994), and is reaffirmed in positive recommendations of the Focus Area Analysis for the New York Bay and Its Tributaries, and Jamaica Bay (2013), which is part of the ongoing North Atlantic Coast Comprehensive Study (NACCS). The findings of Federal interest are reinforced by strong interest and support from New York State and New York City, as expressed in their respective reports. These reports are discussed below in Section 1.2 of this Initial Assessment.

1.1 Study Authorization and Reconnaissance Recommendation

The Jamaica Bay, Marine Park and Plumb Beach, New York Feasibility Study was authorized by a resolution adopted by the Committee on Public Works and Transportation of the United States House of Representatives on August 1, 1990. This resolution authorized a study "to determine the feasibility of improvements for beach erosion control, hurricane protection and environmental improvements in Jamaica Bay including environmentally sensitive areas along Plumb Beach, Brooklyn, New York."

The Reconnaissance Study, completed in January 1994, presented the following specific recommendations and conclusions including (pps. 77-79, para. 199-209):

"*199. A reconnaissance study was performed to assess erosion control, storm damage protection and flood control problems within the study area and identify if sufficient Federal interest exists to pursue implementation of a Federal project.*

200. The study identified that storm erosion continues to be an ongoing process at Plumb Beach. This study identified problems and locations where shoreline erosion and storm recession will threaten public property. Flood damages continue to be a problem at Arverne.

201. A detailed analysis of costs and benefits at Plumb Beach produced a BCR of 1.9 with net benefits of $116,000. Therefore, this study has demonstrated a Federal Interest for implementing shore protection projects at this location. An analysis of benefits at Arverne produced a BCR of 1.9 with net benefits of $698,900. The study demonstrates a Federal Interest for implementing the flood control project at Arverne.

202. In addition to Plumb Beach and Arverne, the communities of Howard Beach and Broad Channel appear to economically viable as storm damage reduction/flood control efforts and should be further studied during the feasibility phase. The following paragraphs quantitatively summarize the needs and opportunities and constraints for these two areas to proceed into feasibility study.

203. Howard Beach has numerous buildings subject to flooding from Jamaica Bay that would benefit from a flood control project. This community has a long history of flood damages due to its ground elevations, some as low as 5 feet mean sea level. A 100-year level storm could flood an estimated 1,100 structures in Howard Beach. There are no apparent constraints to implementing a project at this location.

204. Broad Channel has a history of devastating flood damages. This community was struck by two recent storms, the extratropical storm of December 1992, and the storm of March 1993. Due to its low elevations, virtually all of Broad Channel's 250 structures would be flooded by a 100-year level storm. Additionally, the southwest corner of Broad Channel (Big Egg Marsh) consists of healthy marsh in need of environmental restoration (high marsh restoration). This would entail the removal of Phragmites (a common grass with tall reed-like stems and large plumes which infests wetland areas) and debris as well as regrading. A potential design constraint to implementing a project at Broad Channel is the presence of several finger canals located along its western border.

Further Studies Needed

205. The reconnaissance study demonstrated that Federal interest in shore protection studies exists. Considering the complexity of coastal processes in the area and the current lack of hard data, a feasibility study having a greater level of detail is required to formulate the most appropriate plan for any proposed shore *protection project. Additionally, proposed plans must be optimized to provide the highest level of protection while obtaining the greatest NED benefits.*

206. The proposed Feasibility Study, which follows a favorable Reconnaissance Report, is the second phase of the two phase planning process. The Feasibility Report documents the study and provides the basis for a decision on construction authorization of a project.

207. Within the Jamaica Bay study area, there have been a number of habitats identified which qualify under the Corps' Environmental Initiative Program as potential candidates for environmental improvements. Jamaica bay has the potential to become a "showcase" example of environmental restoration by the Corps under this program. For example, there are areas in need of Phragmites removal and replacement with marsh vegetation which appear feasible as environmental restoration initiatives. Locations such as Canarsie Beach (west of Canarsie Pier), the area between Hawtree and Bergen Basins and the southwest corner of Broad Channel are but a few of the areas identified in the Environmental Appendix as having potential for environmental restoration. Each of these potential restoration areas will be examined in further detail during the Feasibility Study

208. Activities that would further degrade existing water quality in Jamaica Bay would negatively affect the biological productivity of the area. Efforts should be made in the feasibility study to ameliorate water quality in the bay by improving water circulation and tidal flushing.

209. Additionally, the feasibility study will also include a "pre-feasibility" effort for Howard Beach and Broad Channel. These efforts are needed to ascertain the ability to each community to proceed into separate feasibility studies."

1.2 Regional Recommendations Post-Hurricane Sandy

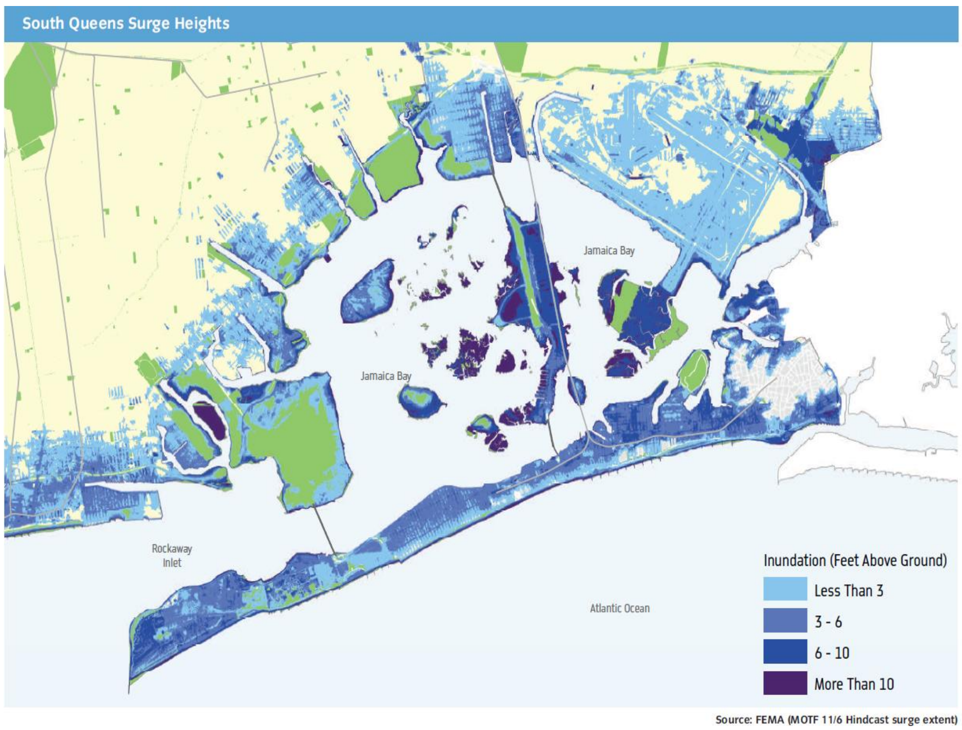
<u>PlaNYC: A Stronger, More Resilient New York (NYC, 2013)</u>

The Reconnaissance Study's recommendations to address erosion control and storm damage protection and flood control problems are further strengthened by the New York City Special Initiative for Rebuilding and Resiliency's (SIRR) plan to create a more resilient New York City during the recovery efforts of Hurricane Sandy (NYC, 2013). The New York City's report documents the impacts from Sandy and provides recommendations for initiatives to repair, restore and protect the shoreline for future storms.

As described within the report, Jamaica Bay is characterized as one of the region's most important and largest natural features, with many natural edges and marsh islands, some newly reconstituted. Here, portions of the shoreline have been filled in and hardened with bulkheads and revetments. Many of the areas surrounding Jamaica Bay are particularly low lying. Along and within Jamaica Bay and its tributaries, there is a wide array of neighborhoods, as well as several elements of critical city infrastructure, including transportation assets such as John F. Kennedy (JFK) Airport, marine terminals and wastewater treatment plants.

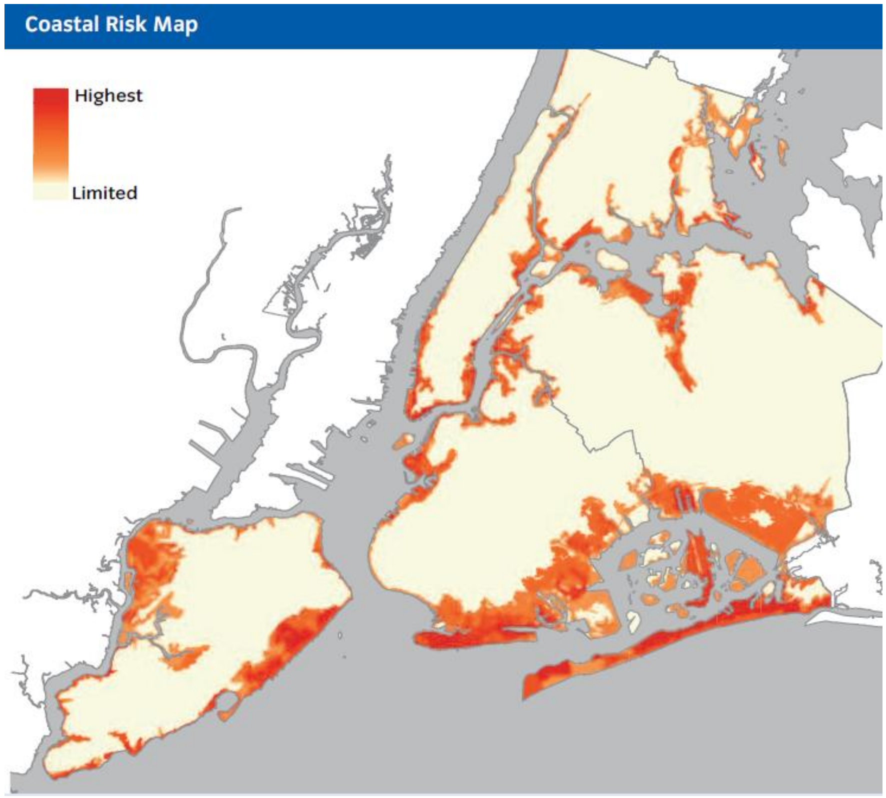
Hurricane Sandy caused flooding in southern Brooklyn, Queens and the Rockaway Peninsula via inundation directly from the ocean as water surged over Rockaway Peninsula as well as via Jamaica Bay functioning as "backdoor" channels, funneling ocean waters inland (Figure 1). Extreme water levels were observed as the storm peaked the evening of October 29, 2012, with peak surge elevations recorded at Broad Channel (9:18 p.m.,+10.4 *ft* [NAVD88]) and Howard Beach (9:23 p.m., +11.2 ft [NAVD88]).

Figure 1: Peak Surge Elevations from Inundation during Hurricane Sandy (NYC, 2013)



In the future, NYC's coastline and waterfront infrastructure face significant risks associated with storm surge, wave action and sea level rise (Figure 2). These risks will result in inundation, destructive waves and erosion of the coastline on a more regular basis.

Figure 2: NYC Coastal Risk Map (NYC, 2013)



To address high level coastal risk, NYC prepared a Comprehensive Coastal Protection Plan within the SIRR Report which proposes a broad range of coastal damage/risk reduction measures, coastal protection strategies, Phase 1 Initiatives and Full Build Recommendations (June 2013).The breadth of measures reflects the fact that various coastal areas in New York City face different risks and therefore require strategies that are tailored to specific needs. There is a list of four overarching coastal risk reduction strategies, the 37 Phase I Initiatives, and neighborhood specific strategies. As part of the SIRR Report preparation, NYC calculated cost benefit analyses for the Phase 1 initiatives to determine their effectiveness at reducing future risks. NYC concluded that the 37 Phase 1 Initiatives have an aggregate cost-benefit ratio that supports NYC moving forward with their implementation.

For Jamaica Bay specifically, the SIRR identifies the following initiatives:

1) Study and install wetlands for wave attenuation in Howard Beach and study further flood risk reduction improvements within Jamaica Bay (Coastal Protection Initiative 14).
2) Complete living shorelines and floating breakwaters for wave attenuation in Brant Point, Queens (Coastal Protection Initiative 17).

3) Call for USACE to develop an implementation plan to mitigate inundation risks through Rockaway Inlet, exploring a surge barrier and alternative measures (South Queens Initiative 1).
4) Develop an implementation plan to address frequent tidal inundation in Broad Channel and Hamilton Beach, incorporating international best practices (South Queens Initiative 2).
5) Complete short-term dune improvements on the Rockaway Peninsula (South Queens Initiative 3).

NYS 2100 Commission

On the state level, the Governor of New York convened the NYS 2100 Commission, which released a report, "Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure" (January 2013). This report discusses a broad range of proposed flood risk management strategies, including a storm surge barrier assessment for the New York metropolitan area; dredging of inlets; restoration of dunes, beaches, and barrier islands; repair and strengthening of critical hard infrastructure; and a resiliency strategy for New York Harbor through a combination of natural shoreline restoration and hard infrastructure improvements. Within the NYS 2100 report, the tidal wetlands of Jamaica Bay were singled out as examples of protective natural infrastructure as a part of flood risk management.

North Atlantic Coast Comprehensive Study (NACCS)

Building upon the SIRR and NYS 2100 reports, USACE has included Jamaica Bay in its Focus Area Analysis for the New York Bay, Its Tributaries, and Jamaica Bay (NYBTJB) as part of the North Atlantic Coast Comprehensive Study (NACCS) (USACE, 2013a). Focus Area Analyses were identified for areas within the NACCS areas that warranted additional analysis, and their purpose is to determine USACE Federal interest in coastal flood risk management in those areas. The NYBTJB Focus Area Analysis, scheduled for completion this year, identifies Federal interest in addressing coastal flood risk management in Jamaica Bay, based on the magnitude and history of reported damages, and the presence of non-Federal entities interested in partnering with USACE (USACE, 2013b).

2.0 Current Status of the Jamaica Bay, Marine Park and Plumb Beach Feasibility Study

On February 22, 1996, the USACE and the New York City Department of Environmental Protection (NYCDEP) signed a Feasibility Cost Sharing Agreement (FCSA) to investigate the environmental restoration opportunities in Jamaica Bay as an interim response to the study authority.

Restoration sites were selected in conjunction with input from environmental resource agencies, the NY/NJ Harbor Estuary Program (HEP) and the local sponsor. The Draft

Interim Feasibility Study Report recommended 8 restoration sites including Dead Horse Bay, Bayswater State Park, Dubos Point, Brant Point, Spring Creek, Fresh Creek, Hawtree Point and Paerdegat Basin. Agency Technical Review and Independent External Peer Review of the Draft Interim Feasibility Report were completed in 2011. At the time that Hurricane Sandy impacted NewYork, the Draft Interim Report was being revised to address HQUSACE Alternative Formulation Briefing Comments prior to release to the public.

Due to the study's inclusion in the Interim Report #2 in response to the Disaster Relief Appropriations Act PL113-2, the study will provide a re-examination of the restoration alternatives originally recommended in the Draft Interim FS Report for opportunities to incorporate natural/nature-based features (NBF) and protective features for coastal storm risk management (CSRM), coastal resiliency and sustainability. Interim Report #2 highlighted that "Improving resilience of our coastal areas by pursuing an approach that reflects the relationships between natural, social, and built systems." This long-term sustainability is a central theme in the approach to protect and preserve Jamaica Bay, an approach consistent with the above-referenced reports.

The Feasibility Study, in coordination with the East Rockaway to Rockaway Inlet, Jamaica Bay Reformulation, will also re-examine additional opportunities, measures and locations for CSRM benefits within Jamaica Bay. The USACE's 1994 Reconnaissance Study and the NYC SIRR Report, highlighted Howard Beach, Broad Channel and the Jamaica Bay Marsh Islands as potential areas of opportunity to integrate the protection and restoration of natural coastal features, resilient coastal zone management, structural and non-structural measures. In addition, NYC Department of Parks & Recreation requested the study to investigate opportunities at Sunset Cove. A summary report of the existing eight restoration alternatives was released August 12, 2013 as an outreach tool to obtain input for the re-evaluation.

The NYCDEP has indicated its support on proceeding with the proposed approach to complete the Feasibility Study as quickly as possible in order to include CSRM benefits and consider NYC and NY State's initiatives and recommendations (see letter of support from Mr. Carter Strickland, NYCDEP Commissioner, 11 Dec 2013).

3.0 Proposed Scope for Completion of Director's Report

The proposed scope to complete the Feasibility Study includes (but is not limited to):

- Update existing conditions & Future Without Project Conditions (Physical);
- Evaluate additional sites that may provide CSRM benefits (including Howard Beach, Broad Channel or Sunset Cove).
- Evaluate CSRM, coastal resiliency and sustainability measures for the existing recommended alternatives incorporating natural/nature-based features (NBF), protective features and structural measures;

- Integrate "Ecosystem Service Benefits of USACE Ecological Restoration Projects in the Coastal North East- Hurricane Sandy Case Study" Report from the NACCS Study Effort;
- Hold public outreach meetings throughout study to obtain input, coordinate with partners and present Corps' preliminary thoughts on modifying existing alternatives;
- Review and incorporate (where possible) ongoing partner recommendations as outlined in NYC Special Initiative for Rebuilding and Resiliency (SIRR) (June 2013) and other planning efforts;
- Coordinate with Partners and programs to leverage ongoing data collection and modeling efforts (Flood Control and Coastal Emergency [FCCE] modeling, NYC inundation modeling conducted by ARCADIS, etc);
- Coordinate with the East Rockaway to Rockaway Inlet, Jamaica Bay Reformulation and Hudson Raritan Estuary (HRE) Restoration Feasibility Study. Alternatives may be evaluated in greater detail or could be recommended for implementation of the Rockaway Reformulation; and
- Coordinate with the North Atlantic Coast Comprehensive Study (NACCS).

As the scope of the study has expanded to include quantification of CSRM benefits, it is anticipated that feasibility costs will exceed the $500,000 identified in Interim Report 2. The FCSA Amendment, executed 20 December 2013, estimated the cost for the Government to complete the Study is approximately $1,500,000.

4.0 Conclusion

As discussed in detail above, the following sources provide the support necessary to demonstrate the reaffirmation of Federal interest in providing coastal storm damage reduction for the Jamaica Bay area: the Federal Congressional authorization for the Study; recommendations presented in the Reconnaissance Report; proposed partner initiatives resulting from Hurricane Sandy; the Focus Area Analyses for the NACCS and the information available within the current Feasibility Study. Therefore, the NY District has determined that additional feasibility-level analysis is warranted and the Draft Interim Feasibility Study should be expanded and completed utilizing DRAA 2013 funds.

5.0 References

Committee on Public Works and Transportation, U.S. House of Representatives. 1990. Resolution Marine Park, Brooklyn, New York, Docket 2356

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NYS 2100 Commission. 2013. Recommendations to Improve the Strength and Resilience of the Empire State's Influence. Retrieved from http://www.governor.ny.gov/assets/documents/NYS2100.pdf

USACE. 1994. Jamaica Bay, Marine Park, and Plumb Beach, New York Combined Beach Erosion Control and Hurricane Protection Reconnaissance Study.

USACE. 2013a. DRAFT - North Atlantic Coast Comprehensive Study (NACCS).

USACE. 2013b. North Atlantic Coast Comprehensive Study Focus Area Analysis: New York Bay, Its Tributaries, and Jamaica Bay.

ATTACHMENT B

EVALUATION OF PLANNED WETLAND SUMMARY RESULTS

Table B-1: EPW Scores for the alternatives for Dead Horse Bay and Fresh Creek

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
1. Bank characteristics												
1a. Water contact with toe of bank												
a. No shoreline bank	1.0							1.0	1.0	1.0	1.0	1.0
b. Infrequent contact	1.0		1.0	1.0	1.0	1.0						
c. Occasional contact	0.7											
d. Moderate contact	0.5	0.5										
e. Frequent contact	0.1						0.1					
1b. Shoreline bank stability												
a. No shoreline onsite	1.0				1.0	1.0		1.0	1.0	1.0	1.0	1.0
b. minimal shoreline erosion (>75% of bank surface protected)	1.0		1.0	1.0								
c. bank erosion is moderate	0.5						0.5					
d. erosion is substantial (<25% of bank protected)	0.1	0.1										
2. Fetch												
a. <1.6 km (1 mile)	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. >1.6 km (1 mile)	0.1	0.1										
3. Shoreline structures/obstacles												
a. No structures	1.0	1.0			1.0	1.0						
b. Structures with minimal erosion	1.0		1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0
c. Structures w/ moderate erosion	0.5											
d. Structures w/ substantial erosion	0.1											
4. Disturbance												
4a. Disturbance at Site (sediment stabilization)												
a. None or minimal	1.0											
b. Potential for disturbance, but preventative action taken	1.0		1.0		1.0							
c. Moderate disturbance	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	Score	Existing	Alt 4	Alt 3	Alt 2	Alt 1	Existing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
d. Substantial periodic disturbance	0.1											
4b. Disturbance at Site (water quality)												
a. None or minimal	1.0		1.0		1.0							
b. Potential for disturbance, but preventative action taken	1.0											1.0
c. Moderate disturbance	0.5			0.5		0.5		0.5	0.5		0.5	
d. Substantial periodic disturbance or evidence of garbage dumping	0.1	0.1					0.1			0.1		
4c. Disturbance of wildlife habitat												
a. No or moderate disturbance	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. periodic disturbance for wildlife mgmt	1.0											
c. recent (w/in a year) substantial periodic disturbance	0.1											
4d. Disturbance of channel/ open water bottom												
a. channel/ open water absent	1.0											
b. no or minimal recent disturbance	1.0	1.0	1.0	1.0	1.0	1.0						
c. channel disturbed in past, but recovering	0.5							0.5	0.5			0.5
d. Channel/ open water recently disturbed or substantially altered to prevent recovery	0.1						0.1			0.1	0.1	
5. Surface runoff from upslope areas												
5a. Surface runoff from upslope areas (bank erosion)												
a. Surface runoff not a contributor to erosion	NA											
b. Runoff contribution minimal because of infiltration and drainage control	1.0											
c. Runoff causes moderate erosion	0.5											
d. Runoff causes substantial erosion	0.1											

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
5b. Surface runoff from upslope areas (bank and wetland erosion)												
a. Surface runoff not a contributor to erosion	NA											
b. Runoff contribution minimal because of infiltration and drainage control	1.0											
c. Runoff causes moderate erosion	0.5											
d. Runoff causes substantial erosion	0.1											
6. Exposure to waves from heavy boat traffic												
a. None or minimal boat traffic	1.0											
b. Protected from traffic by landform	1.0											
c. Protected from traffic by structure	1.0		1.0		1.0							
d. Exposed to moderate traffic	0.5	0.5		0.7		0.5	0.5	0.5	0.5	0.5	0.5	0.5
e. Exposed to heavy traffic	0.1											
7. Hydroperiod												
7a. Water level fluctuation												
a. Tidal wetland	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. No flux in water level	1.0											
c. Flux causes no erosion	1.0											
d. Flux causes erosion (no veg growth)	0.1											
7b. Most permanent hydroperiod												
a. Natural tidal hydroperiod, or if impounded mimics natural period	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. usually follows natural hydroperiod (periodically managed)	0.5											
c. does not or rarely follows hydroperiod	0.1											
7c. Spatially dominant hydroperiod												
a. regularly flooded (low marsh)	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. both irregular and regular flooding veg codominant (high and low marsh in equal proportions)	0.5	0.5										
c. irregularly flooded (high marsh)	0.2											

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	Score	Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
d. deep water (>2m at low tide)	0.1											
8.Sunlight - Hours of direct sunlight throughout shore												
a. >6 hours per day	NA	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. 3-6 hrs per day	0.5											
c. <3 hrs per day	0.1											
9. Substrate												
9a. Suitability for veg establishment												
a. Shoreline stable with or w/out veg	1.0							1.0	1.0	1.0	1.0	1.0
b. Shoreline is unstable. Substrate suitable for veg (med. or fine grain)	1.0	1.0	1.0	1.0	1.0	1.0	1.0					
c. Shoreline is unstable. Substrate unsuitable for veg (gravel, cobble)	0.1											
9b. Dominant substrate type												
a. Fine mineral soils or high organic content	1.0		1.0									
b. Medium sized sand	0.5				0.5		0.5	0.5	0.5	0.5	0.5	0.5
c. Course sand, bedrock, rubble, or cobble	0.1	0.1		0.1		0.1						
9c. Substrate suitable for fish												
a. >75% mud	1.0							1.0				1.0
b. 25-75% mud	0.5		0.5						0.5		0.5	
c. <25% mud (hard sand, rock, etc.)	0.2	0.2		0.2	0.2	0.2						
d. all hard material	0.1						0.1			0.1		
10. Veg characteristics during the growing season												
10a. Percent basal cover in upper shore (plants in contact with water)												
a. >75%	1.0		1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0
b. 51-75%	0.7				0.7	0.7						
c. 25-50%	0.5	0.5										
d. <25%	0.1											

Element and Selection of Scores	Score	Dead Horse Bay					Fresh Creek					
		Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
10b. Percent plant basal cover in entire wetland (in contact with water flow)												
a. >75%	1.0											1.0
b. 51-75%	0.7							0.7			0.7	
c. 25-50%	0.5		0.5	0.5					0.5			
d. <25%	0.1	0.1			0.1	0.1	0.1			0.1		
10c. Percent cover provided by leaf litter and debris on unvegetated areas												
a. >75%	1.0											
b. 51-75%	0.7											
c. 25-50%	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
d. <25%	0.1		0.1	0.1								
10d. Percent basal cover excluding lower shore												
a. all lower shore	NA											
b. >75%	1.0		1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0
c. 51-75%	0.7				0.7	0.7						
d. 25-50%	0.3	0.3										
e. <25%	0.1											
10e. Percent cover of rooted vascular plants in lower shore zone which are subject to erosion												
a. no lower shore zone	NA											
b. lower shore not subject to erosion	NA						1.0	1.0	1.0	1.0	1.0	1.0
c. >75%	1.0											
d. 51-75%	0.7											
e. 25-50%	0.5											
f. <25%	0.1	0.1	0.1	0.1	0.1	0.1						
10f. Percent cover of rooted vascular aquatic beds in lower shore												
a. no lower shore zone	NA											
c. >75%	1.0											

Element and Selection of Scores	Score	Dead Horse Bay					Fresh Creek					
		Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
d. 51-75%	0.7											
e. 25-50%	0.3											
f. <25%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10g. Plant height in upper shore zone												
a. Ave. plant height equal to or taller than ave. high water level	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. equal proportions of plants taller and shorter than MHW	0.8											
c. Ave. plant height shorter than MHW	0.5											
d. Vegetation absent	0.1											
10h. Plant height in entire wetland												
a. Ave. plant height equal to or taller than ave. high water level	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. equal proportions of plants taller and shorter than MHW	0.8											
c. Ave. plant height shorter than MHW	0.5											
d. Vegetation absent	0.1											
10i. Root structure in upper zone												
Wetland predominantly vegetated by:												
a. Herbs that form a root mat	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. intermediate condition	0.8											
c. Herbs that do not form root mat	0.5											
d. Woody species	0.5											
e. Vegetation absent	0.1											
10j. Root structure in entire wetland												
Wetland predominantly vegetated by:												
a. Herbs that form a root mat	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. intermediate condition	0.8											
c. Herbs that do not form root mat	0.5											
d. Woody species	0.5											
e. Vegetation absent	0.1											
10k. Vegetation in upper shore zone												

Element and Selection of Scores	Score	Dead Horse Bay Exist-ing	Dead Horse Bay Alt 4	Dead Horse Bay Alt 3	Dead Horse Bay Alt 2	Dead Horse Bay Alt 1	Fresh Creek Exist-ing	Fresh Creek Alt 4	Fresh Creek Alt 2	Fresh Creek Alt 1	Fresh Creek Alt 3	Fresh Creek Alt 5
Dominant plant cover:												
a. Persistent vegetation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. equal proportions of persistent and non-persistent vegetation	0.8											
c. non-persistent vegetation	0.5											
d. Veg absent	0.1											
10l. Vegetation in entire wetland												
Dominant plant cover:												
a. Persistent vegetation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. equal proportions of persistent and non-persistent vegetation	0.8											
c. non-persistent veg	0.5											
d. Veg absent	0.1											
10m. Vegetative Overhang (w/in 1ft of water surface) – non-tidal only		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10n. Estimate optimum % and relate abundance to that												
a. No shoreline onsite	NA											
b. Abundant (e.g. >1ft on 50% of shoreline)	1.0											
c. Moderate (e.g. >1ft on 30-45% of shoreline)	0.5											
d. Sparse (eg. >1ft on <20% of shoreline)	0.1											
10o. Aboveground plant biomass in wetland excluding lower shore – non-tidal only		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a. plant biomass is close to natural (without disturbance)	1.0											
b. 50-75% of potential due to disturbance	0.7											
c. 25-50%	0.3											

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
d. <25%	0.1											
11. Vegetation strata												
11a. Number of layers in wetland (not upland)												
a. 6 layers	1.0											
b. 5 layers	0.9											
c. 4 layers	0.7		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
d. 3 layers	0.5	0.5										
e. 2 layers	0.3											
f. 1 layers	0.1											
11b. Condition of layer coverage (consider canopy cover of each layer)												
a. equal portions and high percent cover (>40%) for each layer	1.0											
b. Intermediate	0.7		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
c. Predominantly 1 layre	0.3	0.3										
d. Low percent cover for each layer	0.1											
e. Predominantly unvegetated layer	0.1											
11c. Spatial pattern of shrubs and/or trees												
a. No woody or very few	1.0	1.0					1.0					
b. Irregular	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0
c. Regular	0.1											
11d. Difference in layers												
a. Planned wetland contains same layers as WAA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. Planned wetland doesn't contain same layers as WAA	0.1											
12. Cover types (see list)												
12a. Number of cover types in each layer at site:												
Decide minimum coverage and use this to determine which cover types to include in	# types	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Element and Selection of Scores	Score	Dead Horse Bay					Fresh Creek					
		Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
the evaluation.	/ 27											
Score= # wetland covertypes / 27 (total possible)												
12b. Ratio of cover types (canopy cover of each cover type in each layer)												
a. equal proportions	1.0											
b. intermediate	0.5		0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5
c. predominantly 1 cover type	0.1	0.1					0.1					
12c. Degree of covertype interspersion												
a. high	1.0											
b. intermediate	0.5		0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5
c. low or no interspersion (1 cover type)	0.1	0.1					0.1					
12d. Undesirable species												
a. Limited value vegetation absent	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0
b. Dominated by undesired species	0.1	0.1					0.1					
12e. Difference in cover types												
a. Planned wetland contains same cover types as WAA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. Planned wetland does not contain same cover types as WAA	1.0											
13.Vegetation/water proportions												
13a. Percent open water(any depth, including periodically inundated mudflats)												
a. about 50%	1.0										1.0	1.0
b. intermediate (10-30% or 70-90%)	0.5		0.5	0.5				0.5	0.5	0.5		
c. open water minimal or predominant	0.1	0.1			0.1	0.1	0.1					
13b. Degree of vegetation/water interspersion												
a. high	1.0		1.0	1.0							1.0	1.0
b. intermediate	0.5							0.5	0.5	0.5		

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
c. low or none	0.1	0.1			0.1	0.1	0.1					
14. Slope												
14a. Steepness of existing shore												
a. Gradual (ex:<10:1)	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0
b. Steep (ex:>10:1)	0.1	0.1					0.1					
14b. Steepness of vegetated shore												
a. Gradual (ex:<10:1)	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0
b. Steep (ex:>10:1)	0.1	0.1					0.1					
14c. Vegetated or unvegetated wetland slope (entire wetland)												
a. Slope is stable with or w/out veg	1.0		1.0	1.0	1.0	1.0						
b. Slope is stable. Erosion protection by leaf litter and debris	1.0							1.0	1.0	1.0	1.0	1.0
c. Slope is unstable	0.1	0.1					0.1					
15. Hydrologic condition												
a. Non tidal, isolated	NA											
b. Nontidal, inflow	NA											
c. Nontidal, throughflow with open pond	1.0											
d. Nontidal, throughflow with no pond	0.8											
e. Nontidal, broad wetland along and within a braided stream	0.3											
f. Nontidal, broad wetland along stream	0.3											
g. Nontidal, fringe wetland with big floodplain	0.1											
h. Nontidal, fringe wetland with no floodplain	0.1											
i. Tidal, predominantly low marsh	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
j. Tidal, equal proportions of high and low marsh	0.7											
k. Tidal, site predominantly high marsh	0.5											
16. Size												

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
16a. Wetland width - Is the site narrow (<2 ft wide)												
a. No	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
b. Yes	0.1	0.1										
16b. Wetland site size												
Does the site have low wildlife value because of its small size and poor surrounding conditions												
a. No	\1.0		1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
b. Yes ,	0.1	0.1					0.1			0.1		
16c. Fish habitat size												
Does it have a low value due to small size and surrounding area (urban) or b/c it is ephemeral?												
a. No	NA		1.0	1.0	1.0	1.0						
b. Yes	0.1	0.1										
17. Detention time												
a. Tidal wetland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. Information not avavilable	INA											
c. Adequate data exists to show detention time sufficient for effective nutrient removal	1.0											
d. ≥24 hours for 1 year storms	1.0											
e. 12-24 hours for 1 year storm	0.5											
f. <12 hours for 1 year storm	0.1											
18. Sheet vs.. Channel flow												
a. Tidal wetland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
c. >50% of the flow enters and passes through as sheetflow	1.0											
c. 10-50% is sheetflow	0.5											
d. flow is primarily in a channel	0.1											
19. Average surface water depth												

Element and Selection of Scores	Score	Dead Horse Bay Existing	Dead Horse Bay Alt 4	Dead Horse Bay Alt 3	Dead Horse Bay Alt 2	Dead Horse Bay Alt 1	Fresh Creek Existing	Fresh Creek Alt 4	Fresh Creek Alt 2	Fresh Creek Alt 1	Fresh Creek Alt 3	Fresh Creek Alt 5
a. Tidal wetland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. <15cm (6 in)	1.0											
c. 15-30cm (6-12 in)	0.8											
d. 30-61cm (12-24 in)	0.6											
e. 61-91cm (24-36 in)	0.4											
f. >91cm (36in)	0.2											
20. Water quality												
20a. Gross contamination												
a. Minimal or no potential for contaminant input	NA	NA	NA	NA	NA	NA						
b. Potential for contaminant input, but preventative measures taken	NA										1.0	1.0
c. Evidence of or known presense of highly toxic contaminants	0.1						0.1	0.1	0.1	0.1		
20b. Water Quality ratings												
Water quality rating for waterway:												
a. info not available	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
b. high	1.0											
c. moderate	0.5											
d. low	0.1											
20c. Evidence of nutrient sediment contaminant sources												
a. info not available	INA											
b. little or no contaminant input	1.0		1.0		1.0							1.0
c. moderate contaminant input	0.5	0.5		0.5		0.5		0.5	0.5		0.5	
d. high nutrient concentration	0.1											
e. high inorganic sediment input (sed plumes, etc)	0.1											
f. high contaminant input	0.1											
g. evidence of conditions known to stress fish	0.1						0.1			0.1		
20d. DO during summer												

		Dead Horse Bay					Fresh Creek					
Element and Selection of Scores	**Score**	**Exist-ing**	**Alt 4**	**Alt 3**	**Alt 2**	**Alt 1**	**Exist-ing**	**Alt 4**	**Alt 2**	**Alt 1**	**Alt 3**	**Alt 5**
a. info not available	INA											
b. usually > 5mg/L	1.0	1.0	1.0	1.0	1.0	1.0						1.0
c usually 2-5 mg/L	0.5							0.5	0.5		0.5	
d. Frequently <2mg/L	0.1						0.1			0.1		
20e. pH range												
a. info not available	INA											
b. 6.5 to 8.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	1.0	1.0	0.8	1.0	1.0
c. 5.0 to 6.5 or 8.5 to 9.5	0.5											
d. ≤5.0 or ≥9.5	0.1											
20f. Max mid-summer temperature in pools or littoral zone												
a. info not available	INA											
b. 68-90°F	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
c. 41-68°F or 90-104°F	0.5											
d. <41°F or >104°F	0.1											
20g. Maximum monthly average turbidity in summer												
a. INA	INA											
b. Low (<80 JTU, secchi depth <2m)	1.0	1.0	1.0	1.0	1.0	1.0						1.0
c. Moderate (~150 JTU)	0.5							0.5	0.5	0.5	0.5	
d. High (200 JTU, secchi depth =0m)	0.1						0.1					
21. Shape of edge												
21a. Shape of upland/wetland edge												
a. edge absent	NA											
b. irregular	1.0							1.0	1.0	1.0	1.0	1.0
c. regular, smooth	0.1	0.1	0.1	0.1	0.1	0.1	0.1					
21b. Vegetated wetland/water edge												
a. edge absent	NA											
b. irregular	1.0		1.0	1.0				1.0	1.0	1.0	1.0	1.0
c. regular, smooth	0.1	0.1			0.1	0.1	0.1					
22. Fish and wildlife attractors (in wetland												

Element and Selection of Scores	Score	Dead Horse Bay					Fresh Creek					
		Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
only)												
22a. Wildlife attractors												
Abundance of cover other than live vegetation												
a. Absent or sparse	NA=0	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Moderate to abundant	1.0		1.0	1.0								
22b. Fish attractors												
Abundance of cover other than live vegetation												
Estimate optimum cover in region, base abundance relative to this optimum												
a. Abundant	1.0		1.0									
b. Moderate	0.5											
c. None or sparse	0.1				0.1		0.1	0.1	0.1	0.1	0.1	0.1
d. Excessive (ex. 90% debris and garbage)	0.1	0.1		0.1		0.1						
23. Islands												
a. Upland islands present	1.0											
b. Upland islands not present	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
24. Obstruction to fish passage												
a. no barrier	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. barrier present, but modified to permit passage	NA											
c. barriers present for fish mgmt purposes	NA											
d. site isolated but utilized by fish	NA											
e. conditions present which curtail fish passage or interfere with migratory cycles	0.5											
f. Conditions present which impose absolute physical, chemical, or behavioral barriers to passage.	0.1											
25. Pool/riffle – non-tidal only												

Element and Selection of Scores	Score	Dead Horse Bay Existing	Dead Horse Bay Alt 4	Dead Horse Bay Alt 3	Dead Horse Bay Alt 2	Dead Horse Bay Alt 1	Fresh Creek Existing	Fresh Creek Alt 4	Fresh Creek Alt 2	Fresh Creek Alt 1	Fresh Creek Alt 3	Fresh Creek Alt 5
25a. Percent pool area in stream		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a. No stream onsite	NA											
b. Predominant (>50%)	1.0											
c. Low (20-40%)	0.5											
d. Sparse (<5%)	0.1											
25b. Average velocity during spawning and development		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a. Warmwater stream	NA											
b. No stream	NA											
c. INA	INA											
d. 30-70cm/sec	1.0											
e. 15-30cm/sec or 70-85 cm/sec	0.5											
f. <15cm/sec or >85cm/sec	0.1											
26. Bank undercut - non-tidal only		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a. No shoreline on site	NA											
b. Bank undercut present and providing abundant cover	1.0											
c. Bank undercut and providing moderate cover	0.5											
d. minimal bank undercut	0.1											
27. Spawning habitat - non-tidal only		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27a. Substrate												
a. gravel/rubble	1.0											
b. sand	0.5											
c. boulders, bedrock, or fines	0.2											
d. site not accessible during spawning	0.1											
27b. Spawning structures		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a. site not accessible during spawning	NA											
b. absent	NA											
c. present (gravel or rock shoals, reef, platforms, spawning box, etc.)	1.0											
27c. Drawdown of water during		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Element and Selection of Scores	Score	Dead Horse Bay Exist-ing	Dead Horse Bay Alt 4	Dead Horse Bay Alt 3	Dead Horse Bay Alt 2	Dead Horse Bay Alt 1	Fresh Creek Exist-ing	Fresh Creek Alt 4	Fresh Creek Alt 2	Fresh Creek Alt 1	Fresh Creek Alt 3	Fresh Creek Alt 5
spawning/dev												
a. none or minimal	NA											
b. moderate drawdown causing some loss	0.5											
c. drawdown sufficient to expose spawning substrate	0.1											
28. Available refuge during drought or freeze												
Is there an accessible water body with deep areas?												
a. Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. No	0.1											
29. Endangered species (state or federal)												
a. Wetland not w/in range of any T&E species	NA						0.5			0.5		
b. Wetland known to be inhabited by T&E species	1.0											
c. Wetland is critical habitat for T&E species	1.0		1.0	1.0				1.0	1.0		1.0	1.0
d. Wetland w/in range and suitable for these species	0.9	0.9			0.9	0.9						
30. Site contains or is part of a wetland that is considered rare or uncommon in the region.												
a. No	NA											
b. Yes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
31. Site has documented biological, geological, or other feature that is rare or unique in region												
a. No	NA	1.0	1.0	1.0	1.0	1.0						
b. Yes	1.0						1.0	1.0	1.0	1.0	1.0	1.0
32. Site contains historical or archeological												

Element and Selection of Scores	Score	Dead Horse Bay					Fresh Creek					
		Exist-ing	Alt 4	Alt 3	Alt 2	Alt 1	Exist-ing	Alt 4	Alt 2	Alt 1	Alt 3	Alt 5
sites												
a. No	NA											
b. Yes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
33. Site is a state or federal landmark												
a. No	NA											
b. Yes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
34. Site is hydrologically connected to a state or federal Wild and Scenic River												
a. No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. Yes	1.0											
35. Site is owned by a private or public conservation/preservation group												
a. No	NA											
b. Yes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
36. Site is a known scientific research site or used for other educational purposes												
a. No	NA											
b. Yes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table B-2: EPW Scores for the alternatives for Hatwree Point, Bayswater Point State Park, Dubos Point and Brant Point

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	Existing	Alt 1	Existing	Alt 1	Alt 2	Alt 3	Existing	Alt3	Alt 2	Alt 1	Existing	Alt 2	Alt 1
1. Bank characteristics													
1a. Water contact with toe of bank	1.0	1.0	0.5	1.0	1.0	1.0	0.5	1.0	0.5	0.5	0.1	1.0	0.1
1b. Shoreline bank stability	1.0	1.0	0.5	0.5	1.0	1.0	0.1	1.0	0.5	0.1	0.1	1.0	0.1
2. Fetch	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3. Shoreline structures/obstacles	1.0	1.0	1.0	1.0	1.0	1.0	0.1	1.0	0.5	0.1	1.0	1.0	1.0
4. Disturbance													
4a. Disturbance at Site (sediment stabilization)	0.1	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.5	0.5
4b. Disturbance at Site (water quality)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	0.5	0.5
4c. Disturbance of wildlife habitat	0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4d. Disturbance of channel	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5. Surface runoff from upslope areas													
5a. Surface runoff from upslope areas (bank erosion)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5b. Surface runoff from upslope areas (bank and wetland erosion)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Exposure to waves from boat traffic	0.5	0.5	0.5	0.5	1.0	1.0	0.5	1.0	0.5	0.5	0.5	1.0	0.5
7. Hydroperiod													
7a. Water level fluctuation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
7b. Most permanent hydroperiod	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
7c. Spatially dominant hydroperiod	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
8.Sunlight													
8a. Hours of direct sunlight	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
9. Substrate													
9a. Suitability for veg.	1.0	1.0	1.0	1.0	1.0	1.0	0.1	1.0	0.5	0.1	1.0	1.0	1.0

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	**Existing**	**Alt 1**	**Existing**	**Alt 1**	**Alt 2**	**Alt 3**	**Existing**	**Alt3**	**Alt 2**	**Alt 1**	**Existing**	**Alt 2**	**Alt 1**
establishment													
9b. Dominant substrate type	0.5	0.5	0.5	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.1	1.0	1.0
9c. Substrate suitable for fish	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
10. Veg characteristics during the growing season													
10a. Percent basal cover in upper shore (plants in contact with water)	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10b. Percent plant basal cover in entire wetland	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.0	1.0	1.0
10c. Percent cover provided by leaf litter and debris on unveg. areas	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10d. Percent basal cover excluding lower shore	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10e. Percent cover of rooted vascular plants in lower shore zone which are subject to erosion	1.0	1.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0	0.5	0.1	0.1	0.1
10f. Percent cover of rooted vascular aquatic beds	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10g. Plant height in upper shore zone	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10h. Plant height in entire wetland	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10i. Root structure in upper zone	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10j. Root structure in entire wetland	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10k Vegetation in upper shore zone	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10l. Vegetation in entire wetland	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10m. Vegetative Overhang (non-tidal)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	Existing	Alt 1	Existing	Alt 1	Alt 2	Alt 3	Existing	Alt3	Alt 2	Alt 1	Existing	Alt 2	Alt 1
10o. Above ground plant biomass in wetland excluding lower shore (non-tidal)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11. Vegetation strata													
11a. Number of layers in wetland	0.5	0.7	0.5	0.7	0.7	0.7	0.5	0.7	0.7	0.7	0.7	0.7	0.7
11b. Condition of layer coverage	0.3	0.7	0.3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.3	0.7	0.7
11c. Spatial pattern of shrubs and/or trees	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
11d. Difference in layers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12. Cover types (see list)													
12a. Number of cover types in each layer at site:	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2
12b. Ratio of cover types (canopy cover of each type in each layer)	0.1	0.5	0.1	0.5	0.5	0.5	0.1	0.5	0.5	0.5	0.1	0.5	0.5
12c. Degree of covertype interspersion	0.1	0.5	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.5	0.5
12d. Undesirable species	0.1	1.0	0.1	1.0	1.0	1.0	0.1	1.0	1.0	1.0	0.1	1.0	1.0
12e. Difference in cover types	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13.Vegetation/water proportions													
13a. Percent open water(any depth, including periodically inundated mudflats- use mid-tide level)	0.5	0.5	0.1	0.5	1.0	1.0	0.1	0.5	0.5	0.5	0.1	0.5	0.5
13b. Degree of vegetation/water interspersion	0.1	0.1	0.1	0.5	1.0	0.5	0.1	1.0	1.0	1.0	0.1	0.1	0.1
14. Slope													
14a. Steepness of existing shore	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	1.0	0.1
14b. Steepness of vegetated shore	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	1.0	0.1
14c. Vegetated or unvegetated wetland slope (entire wetland)	1.0	1.0	0.1	1.0	1.0	1.0	0.1	1.0	0.1	0.1	0.1	1.0	0.1

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	Existing	Alt 1	Existing	Alt 1	Alt 2	Alt 3	Existing	Alt3	Alt 2	Alt 1	Existing	Alt 2	Alt 1
15. Hydrologic condition	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
16. Size													
16a. Wetland width -Is the site narrow (<2 ft wide)	1.0	1.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
16b. Wetland site size	0.1	1.0	0.1	1.0	1.0	1.0	0.1	1.0	1.0	1.0	0.1	1.0	1.0
16c. Fish habitat size	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17. Detention time	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18. Sheet vs. Channel flow	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19. Average surface water depth	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20. Water quality													
20a. Gross contamination	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20b. Water Quality ratings	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
20c. Evidence of nutrient/ sediment/contaminant sources	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0
20d. DO during summer	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20e. pH range	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20f. Max mid-summer temperature in pools or littoral zone	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20g. Maximum monthly average turbidity in summer	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
21. Shape of edge													
21a. Shape of upland/wetland edge	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
21b. Vegetated wetland/water edge	1.0	1.0	0.1	1.0	1.0	1.0	0.1	1.0	1.0	1.0	1.0	1.0	1.0
22. Fish and wildlife attractors (in wetland only)													
22a. Wildlife attractors	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22b. Fish attractors	0.1	0.1	0.1	0.5	1.0	1.0	0.5	0.5	0.5	0.5	0.5	1.0	0.5

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	**Existing**	**Alt 1**	**Existing**	**Alt 1**	**Alt 2**	**Alt 3**	**Existing**	**Alt3**	**Alt 2**	**Alt 1**	**Existing**	**Alt 2**	**Alt 1**
23. Islands	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
24. Obstruction to fish passage	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25. Pool/riffle													
25a. Percent pool area in stream	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
25b. Average velocity during spawning and development	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
26. Bank undercut	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27. Spawning habitat													
27a. Substrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27b. Spawning structures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27c. Drawdown of water during spawning/dev	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28. Available refuge during drought or freeze	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29. Endangered species (state or federal)	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
30. Site contains or is part of a wetland that is considered rare or uncommon in the region.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
31. Site has documented biological, geological, or other feature that is rare or unique in region	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
32. Site contains historical or archeological sites	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
33. Site is a state or federal landmark	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
34. Site is hydrologically connected to a state or federal Wild and Scenic River	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

	Hawtree Point		Bayswater Point State Park				Dubos Point				Brant Point		
Element and Selection of Scores	**Existing**	**Alt 1**	**Existing**	**Alt 1**	**Alt 2**	**Alt 3**	**Existing**	**Alt3**	**Alt 2**	**Alt 1**	**Existing**	**Alt 2**	**Alt 1**
35. Site is owned by a private or public conservation/preservation group	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
36. Site is a known scientific research site or other educational purposes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table B-3: Equations to calculate the six Functional Capacity Indices (FCIs).

1. Shoreline Bank Erosion Control

#	Element	
(2)	Fetch	if result =0.1 for either element, then wetland site
(14a)	Steepness of shore	is unsuitable
(1a)	Water contact with toe	If result is NA, then STOP. SB FCI is NA If other record score → (1a) = ________ Erosion Potential (E)
(3)	Shoreline structures	(3)= ________
(2)	Fetch	
(4a)	Disturbance at site	
(5a)	Surface runoff	
(6)	Boat traffic	Average for elements with available scores = ________
(7a)	Water level flux	
(8a)	Hrs of sunlight	
(9a)	Substrate suitability	
(14b)	Steepness of shore	
(10a)	Plant cover	
(10e)	Rooted aquatic beds	
(10g)	Plant height	Equation #5 or #6 (see below) = ________
(10i)	Root structure	
(10k)	Veg persistence	

(3), the average for elements (2)–(14b), and Equation #5 or #6 → Average for elements with available scores = ________ Erosion Rate Influences (I)

Erosion Potential (E) and Erosion Rate Influences (I) → (E+I)/2 = ________ Shoreline Bank Erosion Control FCI

Equation #5: if 10 e is applicable=

$$\frac{10a(10g+10i+10k)+10e}{4}$$

Equation #6: if 10e is not applicable=

10a(10g+10i+10k)

2. Sediment Stabilization

#	Element		
(4a)	Disturbance at site	if both 4a and 7a = NA, record NA	= ________ Disturbance Factors (DF)
(7a)	Water level flux	If not, then record the lowest score from 4a or 7a	
(10b)	Plant cover		
(10c)	Leaf litter and debris	$\frac{10b(10j + 10l) + 10c(1-10b)}{2}$ = ________ Vegetation Characteristics (V)	
(10j)	Root structure		
(10l)	Vegetation persistence		
(14c)	Wetland slope	14c= ________ Slope Stability (S)	

(V+S)/2 = ________ Wetland Characteristics (W)

(DF + W)/2 =________ Sediment Stabilization FCI

3. Water Quality

#	Element	
(15)	Hydrologic condition	if result =NA, then STOP. Water Quality FCI is Not applicable. If score is selected, then continue.
(4b)	Disturbance at site	Average for elements with scores = ________ Limiting Factors (LF)
(7a)	Water level flux	
(16a)	Wetland width	
(1a)	Water contact with toe	Average for elements with scores = ________ Substrate Slope Characteristics (SS)
(5b)	Surface runoff	
(14c)	Wetland slope	

(SS+V)/2 = ________ Wetland

(LF+W)/2 = ________ Wetland Condidtion(C)

(10b) Plant basal cover
(10h) Plant height
(10l) Vegetation persistence

$\frac{10b(10h+10l)}{2}$ = ________

Vegetation Characteristics (V)

(9b) Dominant substrate
(15) Hydrologic condition
(17) Detention time
(18) Sheet vs. channel flow
(19) Ave. water depth

Average for elements with scores = ________

Water Contact Characteristics (W) (WC)

(C+WC)/2 = ________

Water Quality FCI

4. Wildlife

#	Element
(4c)	Disturbance of habitat
(20a)	Contamination
(16b)	Wetland size

If 4c, 16b, and 20a = NA, record NA

If any score = 0.1, record 0.1

→ =________

Features which reduce habitat value (F)

#	Element
(11a)	Layers
(11b)	Condition of layers
(11c)	Spatial pattern of shrubs/trees

Average for elements with scores = ________

#	Element
(12a)	Cover types
(12b)	Ratio of cover types
(12c)	Cover type interspersion
(12d)	Undesirable species

Average for elements with scores = ________

#	Element
(13a)	% open water
(13b)	Veg/water interspersion

Average for elements with scores = ________

#	Element
(21a)	Shape of edge
(22a)	Wildlife attractors
(23)	Islands

Average for elements with scores = ________

Average for available scores = ________

Habitat Complexity (HC)

(F + HC)/2 = ________

Wildlife FCI

5. Fish (tidal)

#	Element		
(24)	Obstruction to fish passage	If score = 0.1, STOP. There is no potential for providing fish habitat. If score >0.1 or NA, continue	
(1b)	Shoreline bank stability	Average for elements with scores = ________	Average for available scores = ________ Fish (tidal) FCI
(4a)	Disturbance at site		
(4d)	Disturbance in channel/open water		
(7b)	Most permanent hydroperiod		
(24)	Obstruction to fish passage		
(7c)	Spatially dominant hydroperiod	Equation #9 (see below) = ________	
(9c)	Substrate suitability		
(10d)	Plant cover		
(10f)	Rooted aquatic beds		
(21b)	Shape of water edge		
(22b)	Fish cover/attractor		
(20b)	Water quality ratings	If score available, record score for WQ. If information not available, continue	
(20c)	Nutrient/sediment/ contaminant sources	Average for elements with scores = ________ Water Quality (WQ)	
(20d)	Dissolved oxygen		
(20f)	Max. water temp.		

Equation #9:

$$\frac{7c[9c + (1-x)(10d) + (x)(10f) + 21b + 22b]}{4}$$

where x = portion of AREA which is represented by lower shore zone in

6. Uniqueness/Heritage

#	Element
(29)	Endangered species
(30)	Rarity
(31)	Unique features
(32)	Historical significance
(33)	Natural landmark
(34)	Connected to wild and scenic river
(35)	Park, sanctuary, etc.
(36)	Scientific research site

Average for elements with scores = ________

Uniqueness/

Heritage FCI