New York/New Jersey Harbor Estuary Program Habitat Workgroup 2001 Status Report

A Regional Model for Estuary and Multiple Watershed Management

New York/New Jersey Harbor Estuary Program
Habitat Workgroup

A regional partnership of federal, state, interstate, and local agencies, citizens, and scientists working together to protect and restore the habitat and living resources of the estuary, its tributaries, and the New York/New Jersey Bight

City of New York/Parks & Recreation
Natural Resources Group

Rudolph W. Giuliani, Mayor
Henry J. Stern, Commissioner
Marc A. Matsil, Chief, Natural Resources Group
Chair, Habitat Workgroup, NY/NJ Harbor Estuary Program

Status Report Sponsors

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This document is approved by the New York/New Jersey Harbor Estuary Program Policy Committee.

The Policy Committee's membership includes the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, New York State Department of Environmental Conservation, New Jersey Department of Environmental Protection, New York Local Government Representative (New York City Department of Environmental Protection), New Jersey Local Government Representative (Newark Watershed Conservation and Development Corporation), and a Representative of the Citizens/Scientific and Technical Advisory Committees.

Funds for this project were provided through settlement funds from the National Fish and Wildlife Foundation.

April 2001

Cover: Blue mussels (Mytilus edulis), *North Brother Island, Bronx*
Opposite: Pelham Bay Park, Bronx

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Introduction

The New York/New Jersey Harbor Estuary Program (HEP) was formed to protect the harbor's watersheds and to restore a healthy and productive ecosystem to full beneficial uses. A dynamic system covering 42,128 square kilometers, the New York/New Jersey Harbor Estuary and Bight extend from the limits of tidal influence to the harbor transect. The area supports a diverse biotic assemblage within a sprawling urban landscape.

HEP, one of 28 National Estuary Programs established under Section 320 of the Clean Water Act, is a unique regional partnership of citizens, scientists, and federal, state, interstate, and local agencies. The HEP Comprehensive Conservation and Management Plan (CCMP) serves as a blueprint for the management of the harbor and bight. It includes long-term strategies and intermediate actions designed to protect, restore, and enhance habitat. It offers guidance for development of management strategies to prevent pollution and reduce toxins, pathogens, nutrients, and floatable debris. The U.S. Environmental Protection Agency (EPA) approved the CCMP in March 1997. The EPA Region II Administrator and the Governors of New York and New Jersey signed it in August 1997.

This report is a celebration of the environmental achievements of the participants in the Harbor Estuary Program: government agencies, conservation organizations, and individuals.

It is also a warning. Despite our best efforts, bulldozers are poised to develop many of the region's natural lands. Cumulative urban impacts - including channelization, sediment deposition, relative sea level rise, and nutrient loading - have taken their toll, eroding marshes in Jamaica Bay and the Arthur Kill. These ecosystems serve as reminders of our natural legacy. They protect the economic interests of our neighborhoods with their ability to absorb flood flows from catastrophic weather events and bioremediate contaminants. They reduce the sediment and nutrient burdens of the NY/NJ Harbor - while supporting remarkable wildlife populations.

Habitat is the central focus of the CCMP because of its critical importance to the environmental health of the region. The HEP Habitat Workgroup (HWG) was formed to fulfill the habitat objectives of the CCMP. The habitat program seeks to restore and maintain an ecosystem that supports an optimum diversity of living resources on a sustained basis; preserve and restore ecologically important habitat and open space; encourage watershed planning to protect habitat; foster public awareness and appreciation of the natural environment; minimize erosion and decrease soil and water loading of sediment and pollutants to the harbor/bight; and increase public access, consistent with maintaining the harbor ecosystem.

There has been great debate in the HWG about wetland regulatory guidelines. The present guidelines - resulting in one-to-one or three-to-one mitigation replacement acreage in public works projects and damages claims - are too conservative. We are uncertain that wetlands mitigation as it is practiced maintains the goal of no loss or no net loss.

Introduction

In 1999, the U.S. Fish & Wildlife Service (F&WS), working with the HWG, released its visionary report *Significant Habitats and Habitat Complexes of the New York Bight Watershed.* The report identifies regionally significant habitats and species populations, and threats to them both. The ongoing HWG prerogative, the HEP Acquisition and Restoration Priority Map, targets sites within these habitats. It provides the foundation for many of the habitat-oriented projects in the NY/NJ Harbor. Sixty acquisition sites and 88 restoration projects have been identified.

More than $100 million is committed to HEP priority habitat restoration and acquisition projects. The NYS Clean Water/Clean Air Bond Act and the City of New York awarded $20 million to NYC Parks and NYS Department of Environmental Conservation (DEC) to restore HEP priority sites. Natural resources damages claims, public works mitigations, and grants are funding several of New York City's most comprehensive forest restorations, as well as salt marsh and freshwater wetland and riparian projects in the Arthur Kill, Jamaica Bay, and Long Island Sound. NYC Parks/Natural Resources Group is overseeing an additional $40 million in restoration projects with monies recovered from damages claims, public works mitigations, and grants. NYS DEC has channeled monies for public works mitigations and damages into several HEP priority sites, including the Alley Pond Park watershed, Terra-Peninsula Preserve, and Dreier-Offerman Park. The Army Corps of Engineers, teaming up with several partners, has initiated restoration studies for Jamaica Bay, the Bronx River, and the NY/NJ Harbor. These include many HEP restoration priorities.

Over the past five years, the City has acquired more than 1,500 acres of natural land in HEP priority watersheds. These are now part of the NYC Parks emerald empire. In New Jersey, there is great anticipation of the implementation of the Garden State Preservation Trust Act, which will protect significant natural areas forever. NJ DEP recently acquired property at the headwaters of the Rahway River, and has committed $15 million for the next three years for HEP acquisition priorities. Last year's efforts commenced with a letter to President Clinton from the New York and New Jersey Senate delegation requesting that $30 million be earmarked for HEP acquisition and restoration priority sites. This was a critical step towards the costly acquisition of threatened New York and New Jersey habitat. Much more is needed.

The HWG encourages land stewardship through educational initiatives. Not-for-profit environmental organizations, including NY/NJ Baykeeper, conduct bioengineering workshops for volunteers on the Rahway River and elsewhere, and provide teacher training. Volunteers are instrumental to many Habitat Workgroup projects, providing the many hands needed to complete a successful restoration, from seed collection to plant propagation to planting.

The HWG is making an impact on environmental regulation as well. HEP made great progress last year protecting wetlands through coordination of the permitting process. The Agreement of Coordination (AOC) among the U.S. Army Corps of Engineers, NYS Department of State, NYS

Wetlands and forests may have developed *in situ* for thousands of years, increasing biomass and biodiversity over time. As complex ecosystems, wetlands have myriad functions. They furnish critical habitat for wildlife and vegetation, improve water quality, and provide flood control. While state-of-the-art restorations and creations can "build" wetlands that look natural, there is considerable controversy as to how long it will take, if ever, for these created or restored systems to function like high-quality natural wetlands. Successful replacement of wetlands is usually measured only at the grossest structural level – replacement of dominant vegetation cover type. This does not account for the full complement of the wetland ecosystem, including development of peat substrate, invertebrate populations, storage of essential nutrients, and development of nutrient cycles. Forest restorations take decades longer to recover full structural and functional values. The protocols for replacement acreage to compensate for these damaged ecosystems need to be increased to reflect lost ecological use.

Land acquisition replacement, given the dearth of existing natural systems in the harbor, becomes critical. Our priority is to secure and protect public and private properties that remain undeveloped. These are situated at the headwaters (*i.e.* swamp and oak forests) or within the watersheds that support the valuable few remaining natural resources of NY/NJ Harbor. Many of these wetlands and headwater forests are unregulated and unprotected. Development within them would spell disaster for adjacent coastal marshes and adversely affect water quality.

When acquisition is not possible, rigorous restoration must serve as a substitute. Damaged habitat does not necessarily return without intervention. The HWG has documented, through long-term monitoring supported by the NY/NJ Harbor Oil Spill Trustees, that unrestored salt marsh destroyed by oil spills in 1990 has not returned either through voluntary seed or through plant recruitment. After a decade, the sites remain denuded and continue to erode; the ecosystem's structure and function have not recovered. Still, most restorations fail to return systems to a state resembling the original habitat. The success of salt marsh and forest restorations often takes years to verify. Standard and comprehensive five-year monitoring protocols, such as those developed by the HWG - the first of their kind in the nation - should be required in any mitigation program to ensure restoration success. These monitoring protocols serve as indicators that help us gauge our success, correct our failures, and study recovery over time - and must always be predicated on sound-science principles.

The HWG has fulfilled several habitat objectives of the CCMP, six of which are highlighted in this report: identification of acquisition and restoration priorities and sources of funding for acquisition and restoration activities; encouragement of watershed planning and protection of critical watersheds; examination of zoning options for enhanced habitat protection; establishment of long-term monitoring protocols and criteria for habitat restoration and acquisition; strengthening of wetlands permitting coordination and procedures; and training sessions on habitat restoration options and natural resources stewardship.

Department of Environmental Conservation, and NYC Department of City Planning, completed in March 2000, is one of the first attempts in the nation to coordinate the permit-issuing process at the local, state, and federal levels. The US EPA and F&WS recently released *Wetlands of Staten Island, New York: Valuable Vanishing Urban Wildlands*, an addition to the National Wetland Inventory and a guideline for greater protection of the Arthur Kill/Kill van Kull and Raritan Bay wetlands.

Despite these measures, salt marsh, freshwater wetlands, and adjacent forests continue to be destroyed in HEP priority sites, most recently at Cheesequake State Park, New Jersey, and Outerbridge Ponds, Staten Island. Existing penalties for violations of the Clean Water Act seem inadequate and fail to act as a deterrent. Regulators should levy penalties that adequately reflect these losses (structural and functional) including restoration, long-term monitoring, and habitat acquisition replacement.

The Habitat Workgroup, with tireless participation from federal, state, and municipal agencies, not-for-profits, and environmental advocacies, serves as the catalyst for a sustainable harbor. Much of the work accomplished by the NY/NJ Harbor Estuary Program is due to the efforts of Habitat Workgroup participants. Thank you for your dedication, vision, and accomplishments. Special thanks to NYC Parks Commissioner Henry J. Stern and former EPA Regional Administrator Jeanne Fox for their vision and support; NYC Parks/Natural Resources Group staff Surangi Punyasena, Erica Newman, Cristina Rumbaitis-del Rio, and Stacey Dinstell for their efforts in coordinating Habitat Workgroup initiatives; and the wonderful staff at the Hudson River Foundation and US EPA for their logistical support.

The ecologist Aldo Leopold admonished, "Civilization is not the enslavement of a stable and constant earth. It is the state of mutual and interdependent cooperation between human animals, other animals, plants, and soils which may be disrupted at any moment by the failure of any of them." The conservation movement is, at the very least, an assertion that the interactions between man and land are too important to be left to chance.

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Site of a planned habitat restoration project near the mouth of the Rahway River

Section 1

Acquisition and Restoration Priorities

I.
HEP Priority Watersheds

The New York/New Jersey Harbor and Bight are situated within one of the most densely populated areas of the country. Over 20 million people live and work in this economic hub. This crowded urban matrix contains the remaining open areas that support the wetland, aquatic, coastal, and forest communities of the New York metropolitan area. Without preservation and restoration of these significant habitats, the surprisingly rich species diversity of the New York/New Jersey Harbor Estuary would diminish. Seventy-five percent of the region's historic wetlands, and much of its forests and grasslands, have disappeared in the last century, leaving many species that were once common to the area threatened, endangered, or locally extinct. Despite recent improvements in the environmental conditions of the harbor and its tributaries, fish consumption advisories and beach closures are still common, and some fish and shellfish populations are in decline.

The New York/New Jersey Harbor Estuary Program (HEP) recognizes that protecting and restoring the region's open spaces will significantly improve the environmental conditions of the estuary. HEP has targeted three watersheds as areas of primary concern and ecological importance: the Arthur Kill, the Hackensack Meadowlands, and Jamaica Bay. Watersheds are defined by hydrology and the habitat they support, and represent a logical basis for managing natural resources. HEP advocates a watershed-ecosystems management approach to habitat acquisition and restoration, acknowledging that the estuary will be protected only when hydrologically connected upland systems are protected.

The following information was adapted from the U.S. Fish & Wildlife Service's *Significant Habitats and Habitat Complexes of the New York Bight Watershed.*

A. Arthur Kill

The Arthur Kill complex includes the northwestern corner of Staten Island in New York City, adjacent portions of the Arthur Kill and Kill van Kull in both New York and New Jersey, and tributaries and wetlands feeding into the Arthur Kill from Union and Middlesex Counties, New Jersey. The freshwater wetlands and forested buffers are extremely important because they encompass the few remaining open spaces in the urban core. The buffers serve as feeding and roosting habitat for waterfowl and as migratory stopover habitat for songbirds and raptors. The complex includes important nesting and foraging areas for several species of heron, egret, ibis, gull, and other waterfowl. This area also includes native plant communities at their northeastern limit, introducing many regionally rare species.

The Arthur Kill is a tidal strait, an appendage of the Hudson River, connecting the Kill van Kull and Newark Bay, to the north, with Raritan Bay and the Raritan River, to the south. Major freshwater

CCMP Objective H-1

Develop a comprehensive regional strategy to protect the Harbor/Bight watershed and to mitigate continuing adverse human-induced impacts.

CCMP Action H-4.4

Ensure that actions impacting habitat in the Harbor core area, in the aggregate, result in a net increase in the acreage and quality of aquatic habitat, where feasible and appropriate.

CCMP Action H-12.5

Identify and facilitate implementation of habitat acquisition and restoration projects.

A bird-watching blind in Richard W. DeKorte Park, Lyndhurst, New Jersey

Opposite:
Spartina *and* Salicornia *growing in a salt marsh pan in Jamaica Bay, Queens. Large concentrations of* Salicornia *indicate a high-salinity environment.*

inputs are fed from Fresh Kills and the Rahway and Elizabeth Rivers, which contribute about 38% of the total input, with the balance from smaller tributaries, sewage treatment plants, combined sewer overflows, and industrial discharges. The Arthur Kill is surrounded by one of the most densely populated coastal areas in the world and suffers from many use impairments, including heavy industry and major shipping vessel traffic. The resulting coastal erosion, degraded water quality, and contaminant loads of organics and metals are compounded by slow flushing rates.

The Arthur Kill complex includes four major habitat groupings: colonial wading bird breeding sites, or heronries, waterfowl foraging areas, freshwater marshes and wooded swamps, and upland forests. The foci of the complex are three island heronries: Shooter's Island Park Preserve and Prall's Island Preserve, managed by NYC Parks and the Audubon Society; and Isle of Meadows Preserve, managed by NYC Sanitation. Shooter's Island is an uninhabited bedrock and fill island in the Kill van Kull at the southern end of Newark Bay, partly in New Jersey and partly in New York. The island is partially wooded and has small patches of salt marsh. Prall's Island, in the Arthur Kill, was originally a high marsh island

on which dredged material was dumped, creating a central densely wooded upland area ringed by low marsh. Isle of Meadows, in Fresh Kills, supports vegetation similar to that of Prall's Island and contains areas of low and high tidal marsh along its northern and western shores.

The Arthur Kill complex is notable for its network of upland and wetland open space. These remaining natural communities support regionally significant fish and wildlife populations, including the great egret (*Ardea alba*), snowy egret (*Egretta thula*), tricolor heron (*E. tricolor*), glossy ibis (*Plegadis falcinellus*), and black-crowned night heron (*Nycticorax nycticorax*). The Arthur Kill complex supports seasonal and year-round populations of 178 species of special emphasis, incorporating 37 species of fish and 128 species of birds.

B. Hackensack Meadowlands

The Hackensack Meadowlands are in northeastern New Jersey, approximately seven miles west of Manhattan and five miles north of Newark. Its wetlands and open spaces support significant concentrations of waterfowl, wading birds, shorebirds, raptors, and anadromous and estuarine fish. The Meadowlands habitat complex includes the only remaining tidal wetlands and adjacent palustrine wetlands and uplands along the lower Hackensack River north of Jersey City. It also includes the aquatic and adjacent upland habitats of Overpeck Creek, which feeds into the Hackensack River at the complex's northeastern end. The Meadowlands cover approximately 3,400 hectares (8,400 acres) and constitute the largest remaining brackish wetland complex in the New York/New Jersey Harbor Estuary.

The habitat complex is bounded by the Conrail railroad tracks and Route 17 to the west and south, the New York, Susquehanna, and West-

ern Railroad tracks to the east, and Route 46 to the north; its northwest corner is bounded by the runways at Teterboro Airport. The Meadowlands are in the lower Hackensack River drainage, which flows into the northern end of Newark Bay and drains an area of about 522 square kilometers (202 square miles). The tidal range is 1.4 meters at the mouth of the river and 0.5 meters at the upstream tidal limit.

Biological function of the Meadowlands was initially altered by agricultural and industrial activities, and then later by mosquito and flood control measures. These changes drastically reduced wetland diversity, leading to the destruction of the cedar swamps and the concomitant invasion by common reed (*Phragmites australis*). In 1922, a dam was constructed on the Hackensack River in Oradell, cutting off most of the freshwater flow to the Meadowlands and allowing brackish water to intrude farther upriver. In recent years, filling of wetlands has reduced their extent by more than half, from about 8,100 hectares (20,000 acres) to about 3,400 hectares (8,400 acres).

The remaining large brackish marshes of the Hackensack Meadowlands are regionally significant. They support seasonal and year-round populations of 88 species of special emphasis and listed species, incorporating 29 species of fish and 55 species of birds, including peregrine falcon (*Falco peregrinus*), Cooper's hawk (*Accipiter cooperii*), northern harrier (*Circus cyaneus*), and short-eared owl (*Asio flammeus*). One such tidal wetland complex is on the western side of the Hackensack River in the southern part of the Meadowlands. This wetland complex consists of three sites: Kingsland Impoundment, Kearny Marsh, and Saw Mill Creek Wildlife Management Area.

The Hackensack River and the marshes in the Meadowlands regularly support 34 species of fish and provide important nursery habitat for both anadromous and marine species. Resident estuarine fish, such as the mummichog (*Fundulus heteroclitus*), are tolerant of fluctuations in salinity and the diminished water quality and dissolved oxygen levels that result from pollution and contaminated sediments.

C. Jamaica Bay

Jamaica Bay is situated on the southwestern tip of Long Island in the boroughs of Brooklyn and Queens, New York, and the town of Hempstead, Nassau County. The bay connects with Lower New York Bay through Rockaway Inlet and is the westernmost of the coastal lagoons on the south shore of Long Island. This habitat complex includes the entire Jamaica Bay estuarine lagoon, part of Rockaway Inlet, and the western part of the Rockaway Peninsula. It covers about 10,118 hectares (25,000 acres), with a mean depth of 4 meters (13 feet), a semidiurnal tidal range averaging 1.5 meters (5 feet), and a residence time of about 33 days.

Jamaica Bay is a shallow-water estuarine embayment that is subject to eutrophic events. Muddy, fine sand characterizes the eastern and northern sections, while fine to medium sands predominate in the southern and western sections. Bay sediments support a range of benthic species; 121 species were found in a 1983 survey. The substrate is prime feeding habitat for juvenile and adult winter flounder. The Plumb Beach area has a large contiguous mudflat where substantial numbers of horseshoe crab breed in late spring, attracting ruddy turnstone (*Arenaria interpres*) and red knot (*Calidris canutus*).

Dredging, filling, and development, including the construction of Floyd Bennett Field and John F. Kennedy International Airport, have impaired biological function of the bay. Erosion of the salt marsh islands has increased exponentially in the last decade. However, the complex still supports seasonal and year-round populations of 214 species of special emphasis and listed species, incorporating 48 species of fish and 120 species of birds, including peregrine falcon, least tern (*Sterna antillarum*), and northern harrier.

The extensive intertidal areas are rich in food resources, from the variety of benthic invertebrates to macroalgae, dominated by sea lettuce. Because of its position along the Atlantic Flyway, Jamaica Bay supports one-fifth of all known bird species in North America. The extensive salt marsh and upland islands provide nesting habitat for gulls, terns, waterfowl, and herons; foraging and roosting habitat for shorebirds and waterbirds; nesting and foraging areas for grassland birds; and habitat for butterflies and other insects.

II.
Priority Acquisition and Restoration Sites

The Priority Acquisition and Restoration Sites Map is the cornerstone of the HEP Habitat Workgroup's (HWG) efforts to create a comprehensive regional strategy for the New York/New Jersey Harbor Estuary. The map provides an evolving list of localities requiring funding for preservation or restoration and currently identifies 60 acquisition sites and 88 restoration projects.

Potential acquisition and restoration priority sites are identified and prioritized by the Acquisition and Restoration Subgroup of the HWG, which includes environmental experts and representatives from federal, New York, and New Jersey resource agencies. All sites are within the significant habitats identified by the US F&WS report *Significant Habitats and Habitat Complexes of the New York Bight Watershed* (see Part III of this section).

Criteria used to rate the recommended sites include: existence of species or communities that are rare or endangered at the federal, state, regional, or local level; existing and potential ecological value, size, structure, and function; economic considerations; and imminence of development. High priority and priority acquisition and restoration sites are denoted on the priority sites map on the following page.

Approximately $200 million has been committed to HEP acquisition and restoration priority sites. Nearly $80 million for salt marsh and forest restoration, non-point source-pollution reduction, and habitat enhancement projects on the HEP Priority Restoration Sites List has been provided by the City of New York and the New York State Clean Water/Clean Air Bond Act, NYS and NJ 319 Funds, US EPA grants, damages claims, and public works mitigations since 1996. NJ DEP has secured funding for acquisition and restoration priorities through the Garden State Preserve Trust, the Green Acres Bond Act, and the Blue Acres Bond Act. NYC Parks has acquired hundreds of acres through land transfers from city agencies like NYC Economic Development Corporation (EDC) and through funding from the City of New York and the NY/NJ Harbor Oil Spill Trustees.

A map and tables highlighting progress made in protecting and restoring HEP priorities begins on page 24, and descriptions are provided in Parts IV and V of this section.

The original list and map of New York priority sites were endorsed by the HWG in September 1997 and ratified by the HEP Policy Committee in December 1997 and March 1999. The New Jersey priority sites list and map were endorsed by the HWG in March 1998 and ratified by the HEP Policy Committee in March 1999. Twelve additional Staten Island, Arthur Kill sites were ratified in November 2000.

CCMP Action H-11.3

Identify and inventory potential habitat restoration projects within the boundaries of significant coastal habitats as defined in the US F&WS report.

CCMP Action H-11.4

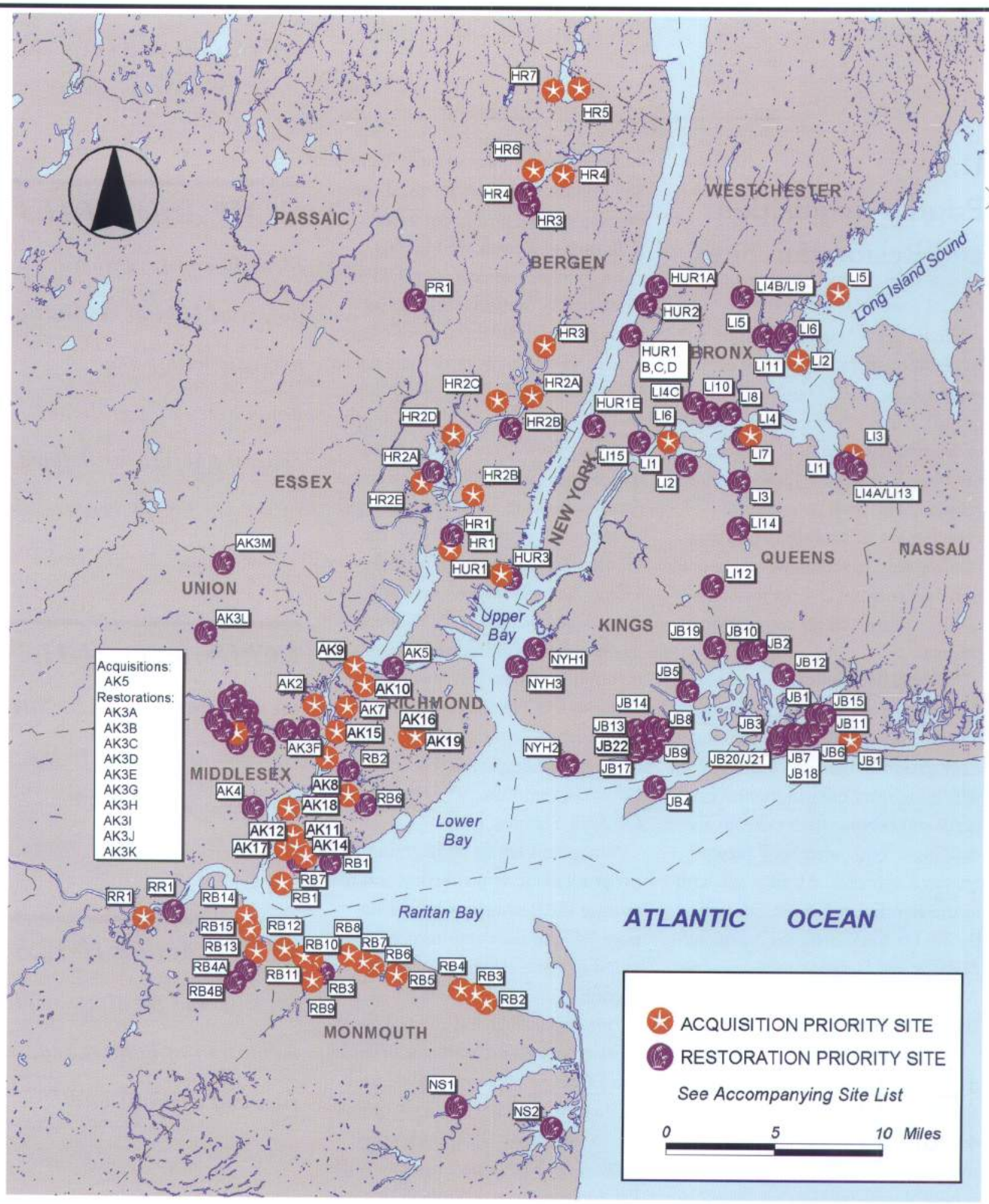
Identify and protect locally significant habitats in the Harbor area.

CCMP Action H-12.5

Identify and facilitate implementation of habitat acquisition and restoration projects.

CCMP Action H-12.8

Seek opportunities for upland habitat acquisition.



NEW YORK - NEW JERSEY HARBOR ESTUARY PROGRAM

Habitat Workgroup

PRIORITY ACQUISITION & RESTORATION SITES

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Natural Resources Group
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Revised July 2000
NRG Map No.: 200007-04AV

Table 1.1

HEP Acquisition Priorities

(New Jersey sites italicized)

* – High Priority Site, as selected by HEP Habitat Workgroup
a – Does not appear on map
b – Needs more information
c – These sites have actions pending by the US EPA, US ACOE, NJ DEP, or NYC DEP. Please see addenda to HEP Acquisition and Restoration Priority Sites List.
1 – Funded by the NJ Garden State Preserve Trust (in progress)
2 – Funded by the NJ Green Acres Bond Act
3 – Funded by the FY 1998-1999 NJ DEP (in progress)
4 – Funded by the NJ Blue Acres Bond Act
5 – Funded by the NY/NJ Harbor Oil Spill Trustees
6 – Facilitated by the Trust for Public Land
7 – Funded by the City of New York/Parks & Recreation

ARTHUR KILL WATERSHED

AK1	*Morses Creek (a)*	*Tidal Wetland Acquisition, Preservation, & Enhancement*
AK2	*Piles Creek (*)*	*Tidal Wetland Acquisition, Preservation, & Enhancement*
AK3	*Rahway Riverfront Park (a)*	*Tidal Wetland Acquisition, Preservation, & Enhancement*
AK4	*Range Road Forest (*) (a)*	*Forest Acquisition & Preservation*
AK5	*Alfieri Site (*) (c)*	*Freshwater Wetland, Forested Floodplain Preservation*
AK6	*"Greenways to the Arthur Kill" (a) (2,5)*	*Acquisition & Preservation, Multiple Sites*
AK7	Graniteville Swamp Woods (*) (5)	Wet Woods / Headwaters of Old Place Creek
AK8	Additions to Arden Woods	Upland / Wetland Acquisition & Preservation
AK9	Arlington Marsh (*)	Tidal Wetland Acquisition & Preservation
AK10	Cable Avenue Woods (*)	Upland / Wetland Acquisition & Preservation
AK11	Canada Hill Forest	Upland / Wetland Acquisition & Preservation
AK12	Charleston / Kreisher Hill Woods (*) (c)	Upland / Wetland Acquisition & Preservation
AK13	Little Fresh Kills (*)	Tidal Wetland Acquisition & Preservation
AK14	North Mount Loretto Woods	Upland / Wetland Acquisition & Preservation
AK15	Neck Creek (*) (7)	Tidal Wetland Acquisition & Preservation
AK16	Northern Sea View (*) (c)	Woodland / Grassland Acquisition & Preservation
AK17	Outerbridge Ponds and Woods (*)	Upland / Wetland Acquisition & Preservation
AK18	Port Mobile Swamp Forest and Tidal Flats	Freshwater / Tidal Wetland Acquisition & Preservation
AK19	Pouch Camp	Upland / Wetland Acquisition & Preservation

Priority Sites Map

JAMAICA BAY WATERSHED

JB1	Seagirt Avenue Wetlands (*)	Salt Marsh, Upland Buffer

HUDSON RIVER WATERSHED

HUR1	*Liberty State Park*	*Permanent Protection for Natural Areas, Emergent Habitat Enhancement*

LONG ISLAND SOUND WATERSHED

LI1	South Brother Island (*)	Heron Rookery
LI2	City Island Wetlands (*)	Wetland Fringe, Woodland Buffer
LI3	Udall's Cove Ravine (*) (7)	Mixed Woodland, Headwaters of Udall's Cove
LI4	Powell's Cove (*) (7)	Salt Marsh, Upland Buffer
LI5	Huckleberry Island (*)	Colonial Wading Bird Rookery

HACKENSACK RIVER WATERSHED

HR1	*"Hudson County Mall"*	*Marsh Preservation & Possible Restoration*
HR2A	*Hackensack Meadowlands / Bellman's Creek*	*Waterfowl & Northern Harrier Foraging Areas; Tidal Marsh Preservation / Permanent Protection & Restoration*
HR2B	*Hackensack Meadowlands / Penhorn Creek*	*Wetland & Tidal Creek Preservation & Possible Restoration*
HR2C	*Hackensack Meadowlands / Empire Tract / Moonachie Creek (*) (c)*	*Wetland Acquisition; Northern Harrier & Yellow Crowned Night Heron Foraging Area*
HR2D	*Hackensack Meadowlands / Berry's Creek*	*Permanent Protection of Wetlands & Stream Corridor*
HR2E	*Hackensack Meadowlands / Kearny Marsh*	*Permanent Open Space Designations*
HR3	*Overpeck Creek*	*County Park Habitat Management; Possible Restoration*
HR4	*Haworth (*) (1)*	*Reservoir Buffer, Forest Protection*
HR5	*Old Tappan (*) (2)*	*Upland Buffer Protection*
HR6	*Emerson (*) (c) (1)*	*Reservoir Buffer, Forest Protection*
HR7	*River Vale (*) (3)*	*Reservoir Buffer, Upland Protection*

RARITAN BAY WATERSHED

RB1	Pawpaw Hybrid Oak Coastal Woods (*) (5,6)	Mixed / Hybrid Oak Coastal Woods, abuts Raritan Bay
RB2	*Leonardo (4)*	*Wetland, Upland, & Dune Acquisition & Restoration*
RB3	*Ware Creek*	*Permanent Protection of Stream Corridor*
RB4	*Compton's Creek*	*Permanent Protection of Stream Corridor*
RB5	*Natco Lake / Thorn's Creek*	*Permanent Protection & Possible Stream / Lake Enhancement*
RB6	*East Creek*	*Permanent Protection of Stream Corridor*
RB7	*Flat Creek*	*Permanent Protection of Stream Corridor*
RB8	*Conaskonk Point (*)*	*Permanent Protection; Wetland & Upland Restoration*
RB9	*Matawan Creek*	*Permanent Protection of Stream Corridor*
RB10	*Treasure Lake*	*Permanent Protection; Freshwater Lake Enhancement*
RB11	*Whale Creek / Long Neck Creek*	*Permanent Protection of Stream Corridor*
RB12	*Marquis Creek (*)*	*Permanent Protection; Wetland & Upland Restoration*
RB13	*Cheesequake Marsh (*)*	*Permanent Protection*
RB14	*South Amboy*	*Permanent Protection; Wetland, Forest & Upland Restoration*
RB15	*Old Morgan Landfill / Raritan County Park*	*Upland Habitat Preservation*

RARITAN RIVER WATERSHED

RR1	*Raritan River Site, Multiple Sites (a,c)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1A	*Raritan River / Disch Disposal Site (a,b,c)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1B	*Raritan River / Raritan Arsenal (a,b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1C	*Raritan River / Kent's Neck (a.b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1D	*Raritan River / Raritan River Waterfront (a,b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1E	*Raritan River / Mill Brook Center (a,b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1F	*Raritan River / Akzo Chemical (a,b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*
RR1G	*Raritan River / Silver Lake (a,b)*	*Tidal Wetland Acquisition, Enhancement, & Restoration*

Table 1.2

HEP Restoration Priorities

(New Jersey sites italicized)

* – Highest Priority Site, as selected by HEP Habitat Workgroup
a – Does not appear on map
1 – Funded by NYS Clean Water/Clean Air Bond Act & City of New York/NYS DEC
2 – Partial funding by NYS Clean Water Bond Act & City of New York
3 – Funded by Jamaica Bay Damages Account (NYS DEC)
4 – US ACOE feasibility study site
5 – US ACOE proposed reconnaissance site
6 – US ACOE 1135 proposed stream restoration site
7 – Funded by the NY/NJ Harbor Oil Spill Trustees (design in progress)
8 – Funded by Section 319 Funds & City of New York
9 – Partial funding by EPF grant (NYS DOS)
10 – Partial funding by the NY/NJ Oil Spill Trustees
11 – Partial funding by the National Fish and Wildlife Foundation
12 – Public works mitigation

HACKENSACK RIVER WATERSHED

HR1	*Lincoln Park West (*)*	*Marsh, Tidal Pond, Tributary Enhancement*
HR2A	*Hackensack Meadowlands / NJ Turnpike, Western Spur*	*Fencing to Protect Diamondback Terrapins*
HR2B	*Hackensack Meadowlands / Mill Creek*	*Wetland & Tidal Enhancement*
HR3	*Van Buskirk Island*	*Freshwater Wetland Restoration: Riparian Buffer*
HR4	*Oradell Dam*	*Fish Ladder Installation*

HUDSON RIVER WATERSHED

HUR1A	Hudson River / Riverdale Park (*) (2)	Non-Point Source Reduction / Restoration
HUR1B	Hudson River / Inwood Park (*) (1,8,11)	Non-Point Source Reduction / Restoration
HUR1C	Hudson River / Fort Washington Park (*) (1)	Non-Point Source Reduction / Restoration
HUR1D	Hudson River / Fort Tryon Park (*) (1,11)	Non-Point Source Reduction / Restoration
HUR1E	Hudson River / Riverside Park (*) (2)	Non-Point Source Reduction / Restoration
HUR2	Spuyten Duyvil	Salt Marsh Restoration
HUR 3	*Liberty State Park*	*Oyster Bed Restoration*

RARITAN RIVER WATERSHED

RR1	*Raritan River*	*Oyster Bed Restoration*

ARTHUR KILL WATERSHED

AK1	*Arthur Kill, Multiple Sites (a)*	*Salt Marsh Restoration*
AK2	*Elizabeth River (a)*	*Riparian Corridor Restoration / Enhancement*
AK3A	*Rahway River / Dri-Print Foil Printing Co.*	*Forested Floodplain Preservation*
AK3B	*Rahway River / Central Avenue, Rahway*	*Stormwater Impact Reduction; Riparian Habitat Restoration*
AK3C	*Rahway River / Central Avenue, Rahway*	*Stormwater Impact Reduction; Riparian Habitat Enhancement*
AK3D	*Rahway River / Madison / Maple Avenues, Rahway*	*Stormwater Impact Reduction; Streambank Stabilization; Riparian Habitat Restoration*
AK3E	*Rahway River / Milton Lake*	*Shoreline Restoration; Possible Freshwater Habitat Creation*
AK3F	*Rahway River / Potter's Island*	*Habitat Enhancement for Heron / Egret Rookery*
AK3G	*Rahway River / Joseph Medwick Park (5,7)*	*Wetland Enhancement*
AK3H	*Rahway River / Essex Street, Rahway (6)*	*Shoreline Stabilization; Riparian Buffer / Upland Enhancement*
AK3I	*Rahway River / West Grand Avenue, Rahway*	*Streambank Restoration*
AK3J	*Rahway River / Union / Allen Streets, Rahway*	*Floodplain Restoration; Possible Freshwater Wetland Creation*
AK3K	*Rahway River / Rahway River Parkway Lake*	*Shoreline Stabilization; Shallow Water Habitat Enhancement*
AK3L	*Rahway River / Rahway River Parkway "The Lagoon"*	*Shoreline Restoration; Stormwater Impact Reduction; Possible Wetland Creation*
AK3M	*Rahway River / Cranford*	*Bank Stabilization & Riparian Habitat Restoration*
AK3N	*Rahway River / Vauxhall Creek (a)*	*Invasive Plant Management; Streambank Replanting; Aquatic Habitat Enhancement*
AK3O	*Rahway River / Orange Reservoir (a)*	*Lacustrine Shoreline Enhancement*
AK4	*Woodbridge River Restoration (*) (5,7,10)*	*Wetland Enhancement & Wildlife Sanctuary*
AK5	Arthur Kill / Kill van Kull, Staten Island (*) (2,7,10)	Salt Marsh Restoration / Non-Point Source Reduction
AK6	Arthur Kill / Kill van Kull A (a)	Clean Fill Marsh Restoration
AK7	Arthur Kill / Kill van Kull B (a)	Dredge Material Beneficial Reuse / Salt Marsh Restoration
AK8	Prall's Island (*) (1)	Heron Rookery Enhancement

Priority Sites Map

RARITAN BAY WATERSHED

RB1	Lemon Creek	Anadromous Fish Passage Ladder
RB2	Richmond Creek	Anadromous Fish Passage Ladder
RB3	*Matawan Creek / Keyport Harbor Mouth*	*Oyster Bed Restoration*
RB4	*Cheesequake State Park*	*Hook Lake Creek Restoration*
RB5	*Cheesequake State Park*	*White Cedar Forest & Stream Restoration*
RB6	Arden Heights Woods (*)	Perimeter Protection / Restoration / Non-Point Source Reduction
RB7	Long Pond Park (*)	Non-Point Source Protection and Sediment Reduction / Wetland Restoration / Perimeter Protection

JAMAICA BAY WATERSHED

JB1	Bayswater Park (4)	Salt Marsh Restoration
JB2	Bergen Basin (2,4)	Salt Marsh Restoration
JB3	Brant Point (*) (4)	Marsh & Meadow Enhancement
JB4	Breezy Point	Dune Enhancement
JB5	Canarsie Beach	Salt Marsh Restoration
JB6	Conch Basin	Salt Marsh Restoration
JB7	Dubos Point (4)	Salt Marsh Restoration
JB8	Four Sparrow Marsh (*) (1)	Salt Marsh Restoration / Wading Bird Restoration
JB9	Gerritsen Inlet (*) (2,4)	Salt Marsh Restoration
JB10	Hawtree Basin (4)	Salt Marsh Restoration
JB11	Healy Avenue (3)	Salt Marsh Restoration
JB12	JFK Shoreline	Salt Marsh Restoration
JB13	Marine Park (*)	Salt Marsh Restoration
JB14	Mill Basin	Salt Marsh Restoration
JB15	Mott Basin (*)	Salt Marsh Restoration
JB16	Rockaway Reef	Fisheries Enhancement / Wave Dissipation
JB17	Shellbank Basin	Salt Marsh Restoration
JB18	Somerville Basin	Salt Marsh Restoration
JB19	Spring Creek (*) (2,4)	Salt Marsh Restoration
JB20	Vernam Barbadoes A (*)	Maritime Heathland Restoration
JB21	Vernam Barbadoes B (*) (2)	Salt Marsh Restoration
JB22	White Island (*) (12)	Coastal Grassland Restoration

LONG ISLAND SOUND WATERSHED

LI1	Aurora Pond	Freshwater Pond & Watershed Restoration
LI2	Bowery Bay (*)	Salt Marsh Restoration
LI3	Flushing Creek (*)	Salt Marsh Restoration
LI4A	LI Sound / Alley Pond Park (*) (2,12)	Non-Point Source Reduction / Salt Marsh Restoration
LI4B	LI Sound / Seton Falls Park (*) (1)	Non-Point Source Reduction / Restoration
LI4C	LI Sound / Bronx Park (*) (2)	Non-Point Source Reduction / Restoration
LI5	Palmer Inlet	Salt Marsh / Riparian Restoration
LI6	Pelham Bay Lagoon (*) (2)	Salt Marsh Restoration
LI7	Powell's Cove	Salt Marsh Restoration
LI8	Pugsley Creek	Salt Marsh Restoration
LI9	Seton Falls (*) (1)	Freshwater Wetland Restoration
LI10	Soundview Park (*) (5)	Salt Marsh Restoration & Scrub Buffer
LI11	Turtle Cove (3)	Salt Marsh Restoration
LI12	Twin Ballfields, Forest Park (*) (1)	Shrub / Swamp Restoration
LI13	Wrack Removal, Alley Pond Park (*)	Marsh Restoration
LI14	Meadow Lake (*) (2,4)	Nutrient Reduction / Restoration
LI15	Little Hell Gate Wetlands (Randall's and Ward's Islands) (*) (9)	Salt Marsh / Coastal Scrub Restoration

NAVESINK-SHREWSBURY WATERSHED

NS1	*Shadow Lake Dam*	*Fish Ladder Installation*
NS2	*Shrewsbury River Watershed (Multiple Sites)*	*Stormwater Impact Reduction; Riparian Habitat Enhancement*

NEW YORK HARBOR WATERSHED

NYH1	Bush Terminal	Salt Marsh Restoration
NYH2	Coney Island Creek / Dreier-Offerman Park (*) (2,8)	Salt Marsh Restoration
NYH3	Lower Bay Reef	Artificial Reef

PASSAIC RIVER WATERSHED

PR1	*Dundee Dam (c)*	*Fish Ladder Installation*
PR2	*Third River (c)*	*Fish Ladder Installation & Streambank Restoration*

Addenda to the Harbor Estuary Program Priority Acquisition and Restoration Sites List

(Attached for NRG Map No. 200007-04AV)

I. United States Environmental Protection Agency, Region II

The United States Environmental Protection Agency supports the Harbor Estuary Program Proposed Acquisition and Restoration Priority Sites List with the addition of the following language to the tables associated with the map:

A. The Empire Tract

The proposed site is currently the subject of two ongoing major Federal actions to which EPA is party. EPA therefore cannot approve or disapprove any motion to either accept or reject the Workgroup's recommendations with respect to this site until all agency actions have been made final. In addition, EPA is aware that the owners have expressed, by letter from their attorneys dated January 23, 1998, that they have no intention of selling this site.

B. The Alfieri Tract

The proposed site is currently the subject of an ongoing major Federal action, for which the state of New Jersey is lead under the assumed 404 program. EPA is a party to this action and the Corps may be potentially involved. EPA therefore cannot approve or disapprove any motion to either accept or reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

C. Raritan Center

The proposed site is currently the subject of an ongoing Federal action for which EPA is lead and the Corps may potentially be involved. EPA therefore cannot approve or disapprove any motion to either accept or reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

D. Passaic Watershed Fish Ladder Installations

EPA will support these projects only if it is demonstrated that placement of fish ladders will not increase exposure of humans to contaminated fish.

II. United States Army Corps of Engineers, New York District

In response to the request of the Habitat Workgroup of the Harbor Estuary Program (HEP) asking for comment upon the Workgroup's recommendations for acquisition of priority sites, the New York District Corps of Engineers (US ACOE) must take a position like that of US EPA Region II with respect to land acquisitions. We believe it inappropriate to approve or disapprove the list of sites submitted by the Habitat Workgroup for property acquisition, because the disposition of many of the locations is the subject of ongoing federal project studies and/or Department of Army regulatory reviews.

US ACOE supports the concept of acquisition of highly sensitive ecological sites for providing habitat, flood control, recreation, and a number of other important public interest functions. However, the US ACOE must abstain from specifically recommending such acquisition for any particular site because of implications to Federal projects or permit applications, which might be pending.

III. New Jersey Department of Environmental Protection

Due to ongoing regulatory or remedial activities, NJ DEP is unable to take a position on the sites listed below. NJ DEP has completed its review and will approve the list with the following language being added to the record. While these areas are merely recommendations, there are outstanding permit requests or potential liability risks that NJ DEP felt should be brought to the attention of the HEP Policy Committee. The following is a list of the sites with which NJ DEP has reservations.

A. The Empire Tract

The proposed site is currently the subject of permit applications. NJ DEP is holding a permit application for this site pending a formal Environmental Impact Statement (EIS) by the Army Corps of Engineers and a formal review by the Hackensack Meadowlands Development Commission. NJ DEP can therefore neither accept nor reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

B. The Alfieri Tract

The proposed site was recently denied a permit by NJ DEP, and Alfieri has again applied for a permit. NJ DEP can therefore neither accept nor reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

C. The Raritan River Disch Site

A permit was recently denied on this site. Potential liability problems due to possible groundwater contamination should be considered before approval of this site.

D. The Compton's Creek Site

Upland permits have been issued for a ferry terminal at the site, and there is presently a water-ward permit being reviewed. Therefore, NJ DEP can neither accept nor reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

E. Emerson Woods

Several permits have been issued on this site and several more are still outstanding. Therefore, NJ DEP can neither accept nor reject the Workgroup's recommendations with respect to this site until all agency actions have been made final.

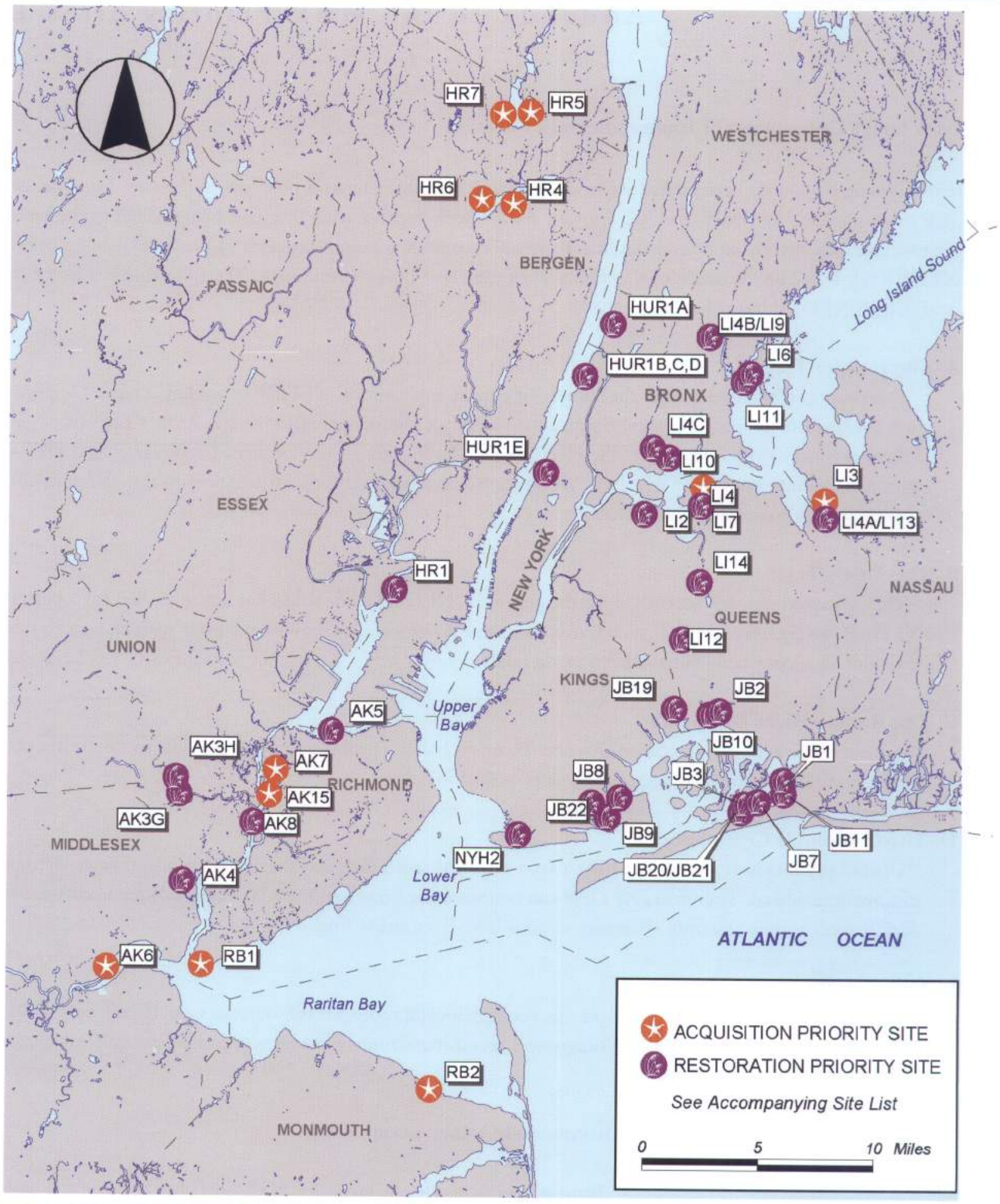
IV. New York State Department of Environmental Conservation

While it is understood that the priorities identified in this report are advisory, NYS DEC believes the following statements of clarification are necessary:

1. The State of New York is not solely bound to the priorities identified in this report, and may pursue acquisition or restoration on non-priority projects.
2. The priority list can be amended in the future to include or delete projects.

V. New York City Department of Environmental Protection

New York City is currently considering several proposals for development of the Charleston/Kreisher Hill Woods and Northern Sea View sites and cannot commit to including these sites on the HEP Habitat Map at this time.



NEW YORK - NEW JERSEY HARBOR ESTUARY PROGRAM

Habitat Workgroup

FUNDED PRIORITY ACQUISITION & RESTORATION SITES

City of New York
Parks & Recreation
Natural Resources Group
Mapping & Design Lab

1234 Fifth Avenue, New York, NY 10029

Rudolph W. Giuliani, Mayor
Henry J. Stern, Commissioner
Marc A. Matsil, Chief
Paul W. Katzer, GIS Manager

MAY 2000
NRG Map No.: 200005-43AV

Table 2.1

HEP Acquisition Priorities:
Land Transfers and Funding Received

* – High Priority Site, as selected by the HEP Habitat Workgroup

Approximate acreages provided.

The Garden State Preserve Trust (in progress)

HR4	Haworth (*)	14.5 acres
HR6	Emerson (*)	19.8 acres

NJ Green Acres Bond Act Award

HR5	Old Tappan (*)	7.5 acres
AK6	"Greenways to Arthur Kill"	25.5 acres

NJ Blue Acres Bond Act Award

RB2	Leonardo	75 acres

FY 1998-1999 NJ DEP Funds (in progress)

HR7	River Vale (*)	14 acres

NY/NJ Harbor Oil Spill Trustees

AK7	Graniteville Swamp Woods and vicinity (*)	
	Wilpon Pond, Old Place Creek headwaters/NYS DEC	50 acres
	Garcon property, Old Place Creek watershed	2.5 acres
	Teleport Magnolia Forest / NYC EDC	300 acres

City of New York/Parks & Recreation

AK15	Neck Creek (*)	26 acres
LI3	Udall's Cove Ravine (*)	0.5 acres
LI4	Powell's Cove (*)	21 acres

Trust for Public Land

RB1	Pawpaw Hybrid Oak Coastal Woods (*)	6 acres

Table 2.2

HEP Restoration Priorities:
Funding Received

* – High Priority Site, as selected by the HEP Habitat Workgroup

SMR – Salt marsh restoration
KPR – Kettle pond restoration
FWR – Freshwater wetland restoration
FOR – Forest restoration
WOR – Woodland restoration
RIR – Riparian restoration
GRR – Grassland restoration

Approximate acreages provided.

1996 NYS Clean Water/Clean Air Bond Act Awards and City of New York

LI6	Pelham Bay Lagoon (*) (partial funding) SMR	4.3 acres	$600,000
LI12	Twin Ballfields, Forest Park (*) KPR	6 acres	$550,000

1997 NYS Clean Water/Clean Air Bond Act Awards and City of New York

HUR1A	Hudson River / Riverdale Park (*) (partial funding) FOR, FWR	1 acre	$600,000
HUR1B	Hudson River / Inwood Park (*) (partial funding) FOR	15 acres	$380,000
HUR1C	Hudson River / Fort Washington Park (*) (partial funding) FOR	3 acres	portion of $700,000
HUR1D	Hudson River / Fort Tryon Park (*) (partial funding) FOR	2 acres	portion of $700,000
HUR1E	Hudson River / Riverside Park (*) (partial funding) FOR	1.8 acres	portion of $700,000
JB8	Four Sparrow Marsh (*) SMR,WOR	4.5 acres	$800,000
LI4A	LI Sound / Alley Pond Park (*) (partial funding) FOR	6 acres	$550,000
LI4C	LI Sound / Bronx Park (*) (partial funding) RIR	6.5 acres	$1,700,000
LI9	Seton Falls (*) FWR	1.5 acres	$550,000

1998 NYS Clean Water/Clean Air Bond Act Awards and City of New York

AK5	Arthur Kill / Kill van Kull, Staten Island: Saw Mill Creek (*) (partial funding) SMR	12 acres	$536,000
JB9	Gerritsen Inlet (*) (partial funding) SMR, GRR	5 acres	$1,300,000
JB19	Spring Creek (*) (partial funding) SMR	5 acres	$2,000,000

1999 NYS Clean Water/Clean Air Bond Act Awards and City of New York

AK5	Arthur Kill / Kill van Kull, Staten Island: Wilpon Pond (*) (partial funding) SMR	22 acres	$618,277
AK8	Prall's Island (*) WOR	5 acres	$410,000
JB2	Bergen Basin (partial funding) SMR	2 acres	$507,150
JB21	Vernam Barbadoes B (*) (partial funding) SMR	5 acres	$500,000
LI14	Meadow Lake (*) (partial funding) FWR	4 acres	$1,083,346
NYH2	Coney Island Creek / Dreier-Offerman Park (*) SMR	3 acres	$1,122,100

City of New York

LI7	Powell's Cove (*) SMR	4 acres	
	NYC DEP		$200,000
	NYC Parks / Capital Projects		$4,700,000

Jamaica Bay Damages Account (NYS DEC)

JB11	Healy Avenue SMR	2.25 acres	$350,000
LI11	Turtle Cove SMR	4 acres	$600,000

Section 319 (Non-Point Source Pollution) Funds and City of New York

HUR1B	Hudson River / Inwood Park (*) FOR	4 acres	$380,000
NYH2	Coney Island Creek / Dreier-Offerman Park (*) SMR	0.25 acres	$120,000

NY/NJ Harbor Oil Spill Trustees

AK3G	Rahway River / Joseph Medwick Park SMR	16 acres	$100,000
AK4	Woodbridge River Restoration (*) RIR	25 acres	$330,000
AK5	Arthur Kill / Kill van Kull, Staten Island (*) SMR		
	Saw Mill Creek, Old Place Marsh, Gulfport Marsh, Prall's Island, Arlington Marsh (1992-1996)	6 acres	$1,000,000
	Saw Mill Creek (1997-1999)	5.5 acres	$690,000
	Wilpon Pond, Rahway River, Saw Mill Creek, Prall's Island, Mariner's Marsh (2000-2001)	26.5 acres	$184,000
HR1	Lincoln Park West (*) (partial funding) SMR	N/A	$110,000
	Soil Characterization		
NYH2	Coney Island Creek / Dreier-Offerman Park (*) (1997-2001) SMR	1.6 acres	$336,000

US ACOE and NYC DEP Flushing Bay, NY Feasibility Study Sites

LI13	Flushing Creek (*) SMR	to be determined
LI14	Meadow Lake (*) FWR	to be determined

Priority Acquisition & Restoration Funding

US ACOE and NYC DEP Jamaica Bay Feasibility Study Sites

JB1	Bayswater Park SMR	to be determined
JB2	Bergen Basin SMR	to be determined
JB3	Brant Point (*) SMR	to be determined
JB7	Dubos Point SMR	to be determined
JB9	Gerritsen Inlet (*) SMR *1135 Program Request Match*	to be determined
JB10	Hawtree Basin SMR	to be determined
JB19	Spring Creek (*) SMR	to be determined

US ACOE Bronx River, NY Proposed Reconnaissance Sites (multiple sponsors)

LI10	Soundview Park (*) SMR	to be determined

US ACOE and NJ DEP Rahway/Woodbridge, NJ Proposed Reconnaissance Sites

AK3G	Rahway River / Joseph Medwick Park SMR	to be determined
AK4	Woodbridge River Restoration (*) RIR	to be determined

US ACOE and NJ DEP Rahway River 1135 PRP Proposed Stream Restoration Sites

AK3H	Rahway River / Essex Street, Rahway RIR	to be determined

US ACOE and NJ DEP Lincoln Park 1135 Tidal Salt Marsh Restoration EER

HR1	Lincoln Park West (*) SMR	to be determined

National Fish and Wildlife Foundation Royal Caribbean Cruiseline Settlement

HUR1B	Hudson River / Inwood Park (*) (partial funding) FOR	10 - 12 acres	portion of $200,000
HUR1D	Hudson River / Fort Tryon Park (*) (partial funding) FOR	1 acre	portion of $200,000

Public Works Mitigations

–	Pacrdegat Park Preserve GRR, SMR *CSO Abatement (NYC DEP and NYC Parks)*	41 acres	$8,000,000
JB22	White Island, Gerritson Creek (*) GRR *NYC Housing, Preservation, and Development*	60 acres	$5,000,000
LI4A	LI Sound / Alley Pond Park (*): FWR *Long Island Expressway HOV / Constructed Wetlands* *NYC DEP Flood Abatement / Constructed Wetlands* *Port Authority of NY&NJ La Guardia Airport Mitigation*	 10 acres 5 acres 18 acres	 $14,000,000 $3,000,000 $2,340,000

Swamp rose mallow and Tripsacum *on Hunter Island at Pelham Bay Park, Bronx*

CCMP Action H-9.5

Provide copies of the US F&WS report on aquatic and coastal habitat values to libraries and other interested parties in the Harbor/ Bight area.

CCMP Objective H-11

Identify significant coastal habitats warranting enhanced protection and restoration.

CCMP Action H-11.1

Prepare a report of regionally significant coastal habitats warranting special protection.

III. Significant Habitats and Habitat Complexes of the New York Bight Watershed

The U.S. Fish & Wildlife Service's Southern New England Coastal Ecosystems Program, working with the HEP Habitat Workgroup (HWG) and the natural resource agencies of New York and New Jersey, produced the report *Significant Habitats and Habitat Complexes of the New York Bight Watershed* in 1996. This document identifies regionally significant habitats and species populations and habitat threats in the New York/New Jersey Harbor and the Hudson River/New York Bight watershed. Emphasis is on large, interrelated, or interdependent habitats and species populations.

The report provides planning agencies, conservation organizations, the public, and local, state, and federal resource agencies with the information essential to making land use decisions that fully consider and value living resources and their environment, preserve regional biodiversity, and restore and maintain the health of the New York Bight ecosystem. Also included are recommended protection and restoration strategies for each region.

The report promotes the protection and maintenance, in their en-tirety, of ecologically integrated habi-tat complexes that often contain few to many smaller local populations and habitat units. The significant habitats identified provide the baseline criteria for the selection of HEP priority acquisition and restoration sites.

The US F&WS has produced a CD-ROM of the report. To request a CD,

- e-mail: rses_snenybcep@fws.gov
- call: (401) 364-9124
- write: US F&WS, CD Request
  P.O. Box 307
  Charlestown, RI 02813
- or visit:
  www.fws.gov/r5snep/snep5.htm

A paper copy of the report is available from the Harbor Estuary Program.

Ribbed mussel (Geukensia demissa) *colonies prevent erosion of salt marsh edge at the mouth of Mill Creek, New Jersey.*

IV. Acquisitions by Watershed

The acquisition program advocated by the HEP Habitat Workgroup requires more than the purchase of a property by a municipality, resource agency, or conservation organization. The site must be permanently preserved as a natural area. Outright purchase of property in the New York/New Jersey Harbor is an expensive and difficult process. Land is a limited resource, and there are competing plans for the remaining open spaces. Conservation easments and regulation of development in mapped wetlands can serve as alternatives, but often the greatest protection is afforded by inclusion of the property in federal, state, or municipal parks systems.

Notable NYC Parks acquisitions and dedications within HEP priority watersheds since 1997 include Four Sparrow Marsh Preserve (58 acres) in Brooklyn, and the coastal scrub grassland and shrub complex of Vernam Barbadoes Terra-Peninsula Preserve (20 acres) in Rockaway, Queens. Mariners Marsh Preserve (107 acres) and Arden Heights Woods (183 acres) are two recent NYC Parks acquisitions in Staten Island. Givans Creek Woods Preserve (11 acres) in the Bronx was acquired and dedicated in 1997. Healy Avenue, Queens (11 acres), a NYS DEC parkland acquisition, is described in further detail in the *Restorations by Watershed* section of this report.

Descriptions of current HEP acquisition projects are provided below.

West Branch, Elizabeth River, New Jersey – this Harbor Herons Corridor feeding site is also breeding habitat for Virginia rail, green-backed heron, and least bittern.

A. Arthur Kill

Woodland Avenue, Edison, NJ

In May 1998, NJ DEP's Office of Natural Resource Damages (ONRD) and Green Acres Program purchased the 25.5-acre Woodland Avenue site, at the headwaters of Robinson's Branch of the Rahway River, with natural resources damages funds from the 1990 Exxon oil spill. Woodland Avenue (AK6) is one of many sites in the Arthur Kill watershed identified by HEP for acquisition and preservation.

One of the last pieces of open space in Edison, the wetland and dense vegetative understory provide valuable flood storage and filtration for the Rahway River, a tributary of the Arthur Kill that was damaged by the spill. Once slated for development, the property is now permanently preserved as public open space. In addition to maintaining the water quality of the Rahway River, the site's mature hardwood forest, shrub wetlands, and rolling

Swamp cottonwoods in New York City Parks'
Teleport Magnolia Forest Preserve, Staten Island

meadow are extremely valuable habitat for resident and migratory wildlife.

Teleport Magnolia Forest Preserve, Staten Island, NY

This 300-acre mixed oak, red maple, and rare swamp cottonwood magnolia woodland complex was transferred from the NYC Economic Development Corporation to NYC Parks in 1997 and 1998, with the support of the Sweetbay Magnolia Conservancy & NYS DEC.

Teleport Magnolia Forest Preserve, at the headwaters of Saw Mill and Old Place Creeks in the Staten Island/Arthur Kill watershed, supports valuable habitat dominated by swamp white oak (*Quercus bicolor*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and pin oak (*Quercus palustris*). Its swamp forest understory includes fetterbush (*Eubotrys racemosa*), maleberry (*Lyonia ligustrina*), swamp azalea (*Rhododendron viscosum*), and highbush blueberry (*Vaccinium corymbosum*).

It is also habitat for several New York State rare plants, including swamp magnolia (*Magnolia virginiana*; NYS S1, critically imperiled), persimmon (*Diospyros virginiana*; NYS S2, imperiled), possum-haw (*Viburnum nudum*; NYS S1, critically imperiled), and a rare violet (*Viola primulifolia*; NYS S2, imperiled). The herb layer is rich in several species characteristic of undisturbed native forests, including sensitive ferns such as Virginia chain and cinnamon, as well as uncommon wildflowers such as cardinal flower and turtlehead. This watershed is also of critical importance as forage area for the region's largest heron rookery.

In addition to protecting the site's biological diversity, acquisition and protection of the site as a nature preserve will promote the filtration and bioregulation of stormwater and non-point source runoff from the developed watershed.

B. Jamaica Bay

Paerdegat Park Preserve, Brooklyn, NY

This 160-acre mixed coastal scrub grassland complex was transferred to NYC Parks from NYC Department of Environmental Protection (DEP) in 1997. A comprehensive Paerdegat Preserve restoration program has begun. NYC Parks/Natural Resources Group (NRG), in cooperation with NYC DEP, is designing a 6-acre ecology park, enhancement of a 35-acre grassland, coastal dune, and wildflower area, and installation of sidewalks, lights, and street trees. Eight million dollars has been earmarked for the project, supported by NYC DEP allocations from a combined sewer overflow (CSO) retention facility. Restoration is scheduled to begin in 2001.

C. Raritan Bay

Raritan and Sandy Hook Bays form the southeastern portion of the New York/New Jersey Harbor between the southern shoreline of Staten Island, New York, and the northern shoreline of Monmouth County, New Jersey. The shoreline wetlands and uplands are important as fish nurseries, foraging grounds for shorebirds and waterbirds, nesting and foraging habitat for terrapins, migratory and wintering stopover habitat for songbirds and raptors, and refugia for rare plant communities. Raritan and Sandy Hook Bays measure 109 square miles with a surface area of about 28,000 hectares (69,188 acres). The bays receive direct inflow from the Raritan, Shrewsbury, and Navesink Rivers and numerous smaller tributaries along the shorelines of Staten Island and New Jersey, and drain a watershed of approximately 3,630 square kilometers (1,400 square miles).

In 1998, fifteen sites within the Raritan Bay Watershed were placed on the Priority Acquisition Sites List, four of which were ranked as high priorities: Pawpaw Hybrid Oak Woods, Conaskonk Point, Marquis Creek, and Cheesequake Marsh. Stream mouth protection is a key objective. Nine of the sites listed share this objective. Some progress has been made in their protection; the mouth of Ware Creek is now protected by a conservation easement held by Monmouth County. However, portions of Compton's Creek face an advancing plan to build condominiums and a new ferry complex.

More detailed information is needed about current preservation efforts and ecological threats to Natco Lake/Thorn's Creek, East Creek, Flat Creek, Matawan Creek, and Whale Creek/Long Neck Creek. Marquis Creek, a high priority acquisition, may be preserved for flood control purposes, but is also included in speculative development plans for the area.

Aerial view of the Arthur Kill, looking north from the Isle of Meadows. Shooter's and Prall's Islands, important East Coast heron rookeries, are visible.

Pawpaw Hybrid Oak Coastal Woods, Staten Island, NY

The Pawpaw Hybrid Oak Coastal Woods (RB1), in Tottenville, are one of the HWG's highest acquisition priorities. Thirty acres are threatened by imminent plans for development. The site varies from swamp forest to moist forest to dry, sandy oak barrens, and contains NYS DEC and federally mapped wetlands. Its most outstanding attribute, however, is its high concentration of rare trees.

The Woods contain the highest concentration of NYS rare native trees in New York City. A total of 44 willow oaks (*Quercus phellos*; NYS S1, critically imperiled, endangered) and 19 blackjack oaks (*Quercus marilandica*; NYS S3, rare) have been mapped on this parcel. The site also contains several rare hybrids. The northeastern part of the site contains a dense stand of pawpaw (*Asimina triloba*; NYS S2, rare, imperiled). This is the northernmost stand of pawpaw on the Atlantic Coast and has been the subject of botanical study since 1888. There is also a large stand of persimmon (*Diospyros virginiana*; NYS S2, rare, imperiled), with 37 stems up to 14 inches in diameter.

The Woods present a unique opportunity for botanical, genetic, and horticultural research, which will be lost if the site is not protected from current development threats. In addition to the rare tree

populations, the forest supports many species of native plants characteristic of the undisturbed communities rapidly vanishing from New York City. The Woods are vital for maintaining healthy populations of native plants that are being extirpated by development.

The Pawpaw Hybrid Oak Woods are also important to southern Staten Island wildlife. Several forest breeding birds threatened by habitat loss are found here, including wood thrush, red-eyed vireo, and hairy woodpecker. The area is also home to an eastern screech owl and the yellow-billed cuckoo, a relatively rare breeding bird in New York City. The sandy soil in the northeastern portion of the site provides important nest sites for local populations of turtles. Both box and snapping turtles have been observed here, the snapping turtle while laying eggs. The ponds in the eastern part of the site support populations of spring peeper, green frog, and the locally rare pickerel frog.

Compton's Creek, Port Monmouth, NJ

The Compton marshes (RB4) are dominated by *Spartina spp.*, black grass, high tide bush, and marsh elder. They are viable high marsh habitats, though some areas have experienced significant invasion of *Phragmites* into former *Spartina patens*-dominated areas, while others have been degraded by ditching. The salt marsh and the adjacent upland are currently unprotected.

Summer residents on the marsh include great blue heron (Threatened – T), tricolor heron, black-crowned night heron, snowy egret, osprey (T), northern bobwhite, willet, marsh wren, and swamp, seaside, and sharp-tailed sparrows. American black duck and clapper rail breed in the marsh, and habitat remains suitable for black rail (T). Least terns (Endangered – E) forage in the creek. Horned grebe, greater scaup, common goldeneye, bufflehead, and oldsquaw are regular visitors to the waterfront during migration and winter. Virginia rail, greater yellowlegs, dunlin, spotted and least sandpipers, common nighthawk, and several species of swallow appear during migration.

The Belford Fishing Fleet, Fish Factory, and Seafood Co-Op are long-standing fixtures at the mouth of Compton's Creek. Proposals for 200 town houses and a ferry/parking lot complex threaten the existing fish nursery, waterfowl feeding areas, and intact high marsh community. Existing preservation and restoration plans recommend the continuance of the fish factory, the preservation of existing salt marshes, and the reforestation of vacant back dune areas.

Conaskonk Point, NJ

Conaskonk Point (RB8) is a Raritan Bay promontory at the mouth of Chingarora Creek, with nearly 200 acres of high and low marsh, sandy beach, and woody fringes. Much of the marshland has been ditched, but it remains significant habitat for resident clapper rail, green-backed heron, fish crow, sharp-tailed sparrow, willet, and marsh wren. Migrants seen regularly include many species of tern, Bonaparte's gull, waterfowl (especially scaup), raptors, horned larks, snow buntings, and shorebirds, including the rare Baird's sandpiper, curlew sandpiper, marbled and Hudsonian godwit, and rare gulls, among them black-headed and little gulls. Additional residents found on the site include American oystercatcher, American black duck, and mallard. Feeding herons and least terns (E) are common in summer. Brant, greater scaup, common goldeneye, bufflehead, and oldsquaw are commonly sighted offshore in the winter. Diamond-backed terrapins are also common. Fishing, particularly for striped bass, is popular at Conaskonk Point.

The acquisition and protection of Conaskonk Point has long been supported by Monmouth County Parks, Monmouth County Planning, Monmouth County Environmental Commission, Monmouth Conservation Foundation, US F&WS, local conservationists, and NY/NJ Baykeeper.

Marquis Creek, NJ

The 50-acre Marquis Creek (RB12) site includes beach, a narrow creek, marsh, filled marsh, and upland. The site contains one of the richest lists of bird species on the Raritan Bayshore.

The wetland area is heavily used by feeding herons, ducks, and shorebirds. The woodland portions are well used by migratory birds. Marquis Creek supports breeding waterfowl (mallard and American black duck), in addition to migrants, such as gadwall, and wintering bay ducks, such as greater scaup, common goldeneye, bufflehead, scoters, and red-breasted merganser.

The upland vegetation supports breeding songbirds such as brown thrasher, eastern kingbird, willow flycatcher, yellow warbler, common

Great egret (Ardea alba) *populations are increasing as New York/New Jersey Harbor water quality improves.*

yellowthroat, northern oriole, American goldfinch, and boat-tailed grackle, which recently began breeding on the Bayshore.

Migrant shorebirds include semipalmated plover, yellowlegs, spotted sandpiper, least sandpiper, and solitary sandpiper on the marsh; and ruddy turnstone, red knot, sanderling, and black-bellied plover on the beach. Also nesting here are green-backed heron, belted kingfisher, and killdeer. Other common migrants to the site are horned grebe, Bonaparte's and ring-billed gulls, hooded merganser, golden-crowned kinglet, yellow-rumped warbler, and savannah sparrow (T). Least tern (E) also use the site for feeding and roosting.

NY/NJ Baykeeper is working closely with the township of Old-bridge, which owns most of the property, to develop a concept plan for the site that includes passive recreation and restoration of the fill portions.

Cheesequake Marsh, NJ

Cheesequake Marsh (RB13) is the largest contiguous salt marsh on Raritan Bay, covering 1,285 acres and including four streams. Most of this marsh is owned and managed by Cheesequake State Park and Cheesequake Natural Area. One hundred and twenty-five acres of marsh and upland buffer in the northwestern edge are privately owned. This site includes a colony

A freshwater marsh at South Amboy, New Jersey - a HEP Acquisition Priority on Raritan Bay

of at least 60 pairs of bank swallows that nest on a cliff behind the Old Morgan Landfill.

New Jersey Breeding Birds Atlas visits to Cheesequake State Park, in May and June 1993, revealed an outstanding forest bird community dominated by wood thrush (about 50 pairs), vireos, warblers, flycatchers, scarlet tanager, and expected permanent residents such as downy and hairy woodpeckers, Carolina chickadee, white-breasted nuthatch, and tufted titmouse. The marsh community hosts breeding green-backed heron, feeding great and snowy egrets, black-crowned night heron, nesting American black duck, osprey (T), "kling" rail (hybrid king/clapper rail), numerous marsh wrens, and swamp sparrow.

Cheesequake Marsh is threatened along all its borders. Unprotected portions of the marsh and upland buffer are being developed, resulting in runoff of sediment and pollutants into the protected portions of the property. Long-range goals include acquiring portions of these unprotected buffer properties through easement or outright acquisition for addition to Cheesequake Park.

Treasure Lake, NJ

Treasure Lake (RB10) is a small freshwater lake and marsh fringe found behind the dune cliffs in Aberdeen Township. The lake is a

freshwater oasis, serving as an important waterfowl feeding area. Forested upland, privately owned by local residents, surrounds the lake. Acquisition will protect the existing dune and forested buffer.

NJ Audubon monitors the site for long-term waterfowl/waterbird use. Resident lake species include green-backed heron, great blue heron (T), hooded merganser, and least tern (E). Cormorants, horned grebe, brant, greater scaup, common goldeneye, American black duck, bufflehead, and red-breasted merganser are on the waterfront during migration and winter. Sanderling and ruddy turnstone forage on the beach during autumn. Painted turtles are also common.

South Amboy, NJ

The South Amboy (RB14) site represents one of Raritan Bay's most important habitat preservation opportunities. This large area includes sandy beach, fill, salt marsh, forested uplands, and freshwater marsh. Situated between NJ Transit railroad tracks and an access road, the freshwater marsh is threatened by contaminated runoff. Portions of the site have recently been developed as a waterfront park, but a large undeveloped tract remains.

NY/NJ Baykeeper is researching preservation opportunities for this site.

Old Morgan Landfill, NJ

The Old Morgan Landfill (RB15) presents a great opportunity for returning vacant land to viable wildlife habitat. The environmental benefits of acquisition include storm protection, water quality improvement, habitat potential, and recreational use. This site requires further study.

D. Raritan River

The Raritan River is the second-largest source of freshwater for the estuary and an important migration corridor and foraging area for many species of fish and birds. In 1999, NJ DEP initiated the Raritan Basin Watershed Management Project to create a watershed-based management plan for the river. Characterization of the watershed is now complete, and the development of a management plan has begun.

The estuarine portion of the river, from the Fieldville Dam to Raritan Bay, has been incorporated into NJ DEP's watershed management effort and is also the focus of the Raritan River Project, a coalition of public and private entities created by the Edison Wetlands Association in September 1998. The project aims to monitor and remediate sites that are sources of contaminants to the river, and to preserve and restore habitat along the lower portion of the river and its tributaries.

Further site assessments and monitoring will be carried out for HEP Priority Acquisition sites (RR1A-1G) in order to develop preservation plans and examine potential restoration opportunities. Other potential acquisition or restoration sites will be nominated as they are identified and surveyed. Project members plan to produce an issues map for the estuarine portion of the river, similar to those produced by HEP for the Jamaica Bay and Arthur Kill Watersheds. Improving access to the river and public outreach and education are also major components of the Raritan River Project.

Seven sites were designated HEP priorities for tidal wetland acquisition, enhancement, and restoration in the estuarine portion of the Raritan River Watershed: Disch Disposal, Raritan Arsenal, Kent's Neck, the Raritan River Waterfront, Mill Brook Center, Akzo Chemical, and Silver Lake.

E. Long Island Sound

Approximately 110 miles long, with a drainage basin of 16,000 square miles, the Long Island Sound sustains a unique and highly productive ecosystem with a diverse assemblage of living resources, ranging from microscopic plants and animals to seaweeds and economically important finfish, shellfish, and crustaceans. Many other types of wildlife, such as birds, sea turtles, and marine mammals, spend all or part of their lives in the Sound, on its shores or in its watershed.

Long Island Sound provides a great economic benefit to the region. Commercial and recreational fishing in Long Island Sound contributed more than $1.2 billion to the regional economy in 1990. The Connecticut, Housatonic, and Thames Rivers are the major sources of the Sound's freshwater supply.

Principal negative influences on the Sound's living resources are water pollution, destruction and degradation of habitat, and overharvesting from fishing and hunting. By altering land surfaces, increasing runoff, and reducing natural filtra-

tion, development has greatly intensified the rate at which pollutants reach the Sound, and resulted in habitat loss and degradation. Over one-third of the Sound's tidal wetlands have been destroyed during the last century by filling, dredging, and development. These wetlands are critical breeding areas and help filter pollutants from land runoff. Fortunately, the rapid loss of wetlands has slowed because of wetland protection legislation and coastal management plans, but habitats continue to be degraded by pollution and invasion by non-native species. Unless this trend is altered by preserving significant habitats and restoring degraded habitats, the Long Island Sound ecosystem cannot be sustained. All five of the Long Island Sound Watershed sites placed on the Priority Acquisition Sites List received highest priority ratings from the HWG.

South Brother Island, Bronx, NY

This 7-acre island (LI1) in the East River north of Hell Gate supports one of the most productive colonial waterbird rookeries in the Harbor Herons complex. An average of 150 breeding pairs each of black-crowned night heron, great and snowy egret, and double-crested cormorant have nested here every year for the past decade. Significant but lesser numbers of cattle egret, yellow-crowned night heron, and glossy ibis also nest here. The island is privately owned.

Udall's Cove Ravine, Queens, NY

Udall's Cove Ravine (LI3) includes the forested upper watershed, stream corridor, and remnant floodplain forest tributary of Gabblers Creek. This tidal creek floods and drains the extensive salt marshes in Udall's Park Preserve on Little Neck Bay. Urban stormwater runoff and suppression of forest groundcover by invasive, non-native canopy trees (predominantly Norway maple) cause erosion and sediment loading into Little Neck Bay and the Sound. The ravine is mostly privately owned. Acquisition and restoration of the site would help reduce non-point source pollution.

A pair of black-crowned night heron chicks, South Brother Island, Bronx

Saw Mill Creek Preserve, Arthur Kill Watershed: dike removal and salt marsh restoration by NYC Parks/Natural Resources Group.

Before restoration (June 25,1998): Excavation of 2,000 cubic meters of fill restored tidal flushing to six acres of marsh. The team in the foreground prepares the site for planting.

V. Restorations by Watershed

A. Arthur Kill

Salt Marsh Restoration Initiative

In 1990, Old Place and Gulfport Marshes (AK5) were ground zero of a series of oil spills (Exxon, BT Nautilus, Cibro Savannah) exceeding one million gallons. An already disturbed and fragile ecosystem was devestated. Hardest hit were the heron rookeries and the fringe marshes of northwestern Staten Island, with the deaths of 684 birds and the destruction of 8 hectares of low marsh.

Damages claims recovered from the responsible parties finance the $1.75 million Staten Island Salt Marsh Restoration Initiative. These funds have enabled a series of salt marsh restorations in the Arthur Kill watershed, including the restoration of one mile of shoreline by NYC Parks/Natural Resources Group (NRG) and the NY/NJ Harbor Oil Spill Trustees (City of New York, NYS DEC, NJ DEP, National Oceanic and Atmospheric Administration (NOAA), and the Department of the Interior) from 1996 to 1999.

The project garnered national acclaim for its innovative restoration and monitoring protocols, including a study of bacteria that are capable of biodegrading oil and are naturally associated with the root systems of marsh grasses. These applictions and restoration successes were presented at national damages recovery and policy forums in Washington, D.C., sponsored by NOAA and the U.S. Department of Justice, during

After restoration (August 18, 1998): 12,000 Spartina alterniflora *seedlings are protected by goose fencing.*

Oil Pollution and Clean Water Act reauthorization hearings in 1997.

In June 2000, NYC Parks/NRG published the technical paper "Restoration of a *Spartina alterniflora* salt marsh following a fuel oil spill, New York City, NY" (*Wetlands Ecology and Management*) reporting the results of restoration at three degraded marshes. After a decade, unrestored control quadrats in heavily oiled zones remain denuded and continue to erode. Restored portions of the marsh are slowly recovering, but will take decades to return to full ecological function.

Urban wetland systems do not recover as efficiently as pristine systems and restorations and recoveries in urban watersheds take significantly longer to recover biological and structural function. Perturbations, including non-point source pollution, runoff, degraded water quality, and air pollution, impede biological recovery. Future damage recoveries must incorporate the realities of these cumulative impacts and the scarcity of urban natural resources.

Saw Mill Creek/Arthur Kill, Staten Island, NY

This HEP High Priority Restoration project aims to protect, enhance, and restore salt marsh within the 111-acre Saw Mill Creek Preserve (AK5). The preserve is an important feeding ground for seven species of wading birds that nest on the three crucial rookery islands within the Arthur Kill/Kill van Kull. A 2,500-foot long earthen dike from an abandoned land-reclamation project has restricted tidal flow to a remnant 12-acre section of marsh. As a result, the area has been aggressively colonized by *Phragmites*. The loss of salt marsh grasses has

impaired the system's function and compromised the health of the managed species of wading birds, rails, and salt sparrows for which the land was acquired.

NYC Parks removed a 750-foot section of the dike during Phase I, with funding from an Environmental Protection Fund grant, administered by the NYS Department of State Division of Coastal Resources. NYC Parks propagated 12,000 *Spartina alterniflora* seedlings for the project from seeds collected by a team of volunteers. Construction of Phase I began in June 1998 and was finished in July of that year. Funding for additional fill removal was awarded from the NYS Clean Water/Clean Air Bond Act and the City of New York in 1998. The total project cost is $740,000.

Site monitoring follows the Salt Marsh Restoration Protocol outlined in Section 3 of this report. Vegetation growth is being assessed in randomly selected m^2 quadrants over a three-year period. Five experimental treatments are being assessed and compared for their effects on *Spartina* and *Phragmites* growth.

Remnant *Phragmites* root mats are present and occur at varying depths throughout the site. The *Phragmites* root mat provides an organic matrix that may help support young seedlings of other species by providing drainage and aeration pathways not found in the underlying subsoil (mud horizon). However, there is a possibility that *Phragmites* may regenerate from the remnant stock and overtake the planting; higher elevation plots have shown some *Phragmites* regrowth. Monitoring will determine whether an optimum elevation zone exists that favors growth of planted *Spartina* and discourages regrowth of *Phragmites*, helping standardize the required depth of excavation in similar settings.

Old Place and Gulfport Marshes, Staten Island, NY

A series of NYC Parks/NRG Salt Marsh Restoration Team projects at Old Place and Gulfport Marshes (AK5) demonstrates the difficulties of restoring fringe marshes when site conditions are poor and considerable regulatory and economic constraints exist. Arthur Kill fringe marshes are highly disturbed due to the large amount of shipping traffic on the Kill. Restorations are subject to episodes of high wave energy, deposition of large marine timbers and floatable post-consumer waste, unstable shoreline morphology, and grazing by Canada geese. All these factors contribute to the failure of salt marsh cordgrass plantings.

NYC Parks/NRG is evaluating a potential solution – a geosynthetic fence. Funds to construct a fence at two Arthur Kill sites were received from the NYS DOS through its Environmental Protection Fund – Local Waterfront Revitalization Program. Careful attention was given to the manufacture and design specifications of the posts, piles, and fencing products selected. The Uniaxial Geogrid "Dunegard" has been used successfully in reducing erosion at barrier island sites in New Jersey by reducing wave energy by half.

Fencing was completed at two sites, Old Place Marsh and Gulfport Marsh, in September 1998; 1.5 acres were planted with *Spartina alterniflora* seedlings. Four of the six criteria for restoration success that are measurable within the first year of site monitoring were met at both sites: the fence/post system retained structural integrity; medium to large debris was withheld from the site; the wave fence prevented damage to the goose fence and thereby excluded geese from the site; and the plants remained anchored in the substrate.

A fifth criterion was met at Old Place but not at Gulfport Marsh: the crop achieved a survival of greater than 10% by the conclusion of the first year's assessment.

The last criterion, used by NYS DEC as a measure of successful project completion, was not met at either site: 85% of the crop did not survive beyond the second year's assessment.

Two other criteria will be measured over the long term. The first is the ability of the restoration to maintain or increase the basal area of existing stands of *Spartina alterniflora*. The second is shoreline stability. The shoreline morphologies of the two sites are highly unstable; sediment loss was measured in all plots. One permanent plot at Gulfport lost 30 cm in elevation between 1995 and 1999. The severity of shoreline degradation, from oil spills and tugboat waking, is the likely reason the plantings fared so poorly. Fencing, however, provided some tangible benefit when compared with earlier trials without fencing. A planned trial at a third and final test site will determine whether the fence system can pass all of the above criteria when the shoreline is moderately stable but goose predation, marine debris, and boat-generated waking remain high.

Chelsea Bridge, Staten Island, NY

Work is complete at the one-third-acre site on Saw Mill Creek at the Chelsea Road Bridge (AK5). The marsh and the adjacent upland were planted in October 1998. NYC Parks' Greenbelt Native Plant Center supplied 5,550 *Spartina alterniflora* and 2,350 *Spartina patens* plugs for the project. The original plan called for plants to be placed in the excavated subgrade, but once the area was excavated, an extensive debris field was revealed and at least two-thirds of the site was unacceptable for planting. A sand base of six inches was placed across the site to create a suitable planting substrate.

Monitoring for the Saw Mill Creek Park Chelsea Bridge site is being performed as outlined by protocols established by HEP (see Section 3).

Vegetation growth will be assessed at 16 randomly selected m^2 quadrats along two transects, one in the sand base and the other in peat. Growth will be assessed and compared with growth at existing marsh. Monitoring will continue over a three-year period. Initial planting success was determined in fall 1999, and the site is likely to achieve 85% coverage by the end of its second year.

Prall's Island Park Preserve, Arthur Kill, NY

Five New York Harbor islands are critical to the regional survival of seven species of heron, egret, and ibis. However, while the number of nesting pairs of colonial wading birds on several of the islands within the region has increased, the number on Prall's Island (AK8) has plummeted.

Researchers at NYC Audubon and NYC Parks/NRG have noted a correlating decline of gray birch, one of two dominant canopy tree species, due to pest, disease, and high soil pH. Gray birch is important to nesting wading birds because its complex multibranching architecture supports their nests. The birch is being displaced by invasive *Ailanthus* trees, which lack suitable branch structure. Two nearby rookery islands have canopies that are stable or improving, and heron populations there are stable and growing.

In 1996, NYC Audubon began a study in which native tree species were planted and growth and survival rates measured. NYC Parks will continue this campaign as a full-scale canopy enhancement through a combination of invasive plant control and native species plantings.

The total cost of this project is $410,000. This project received funding in 1999 from the New York State Clean Water/Clean Air Bond Act and the City of New York.

Woodbridge River, NJ

The NJ DEP Office of Natural Resource Damages (ONRD) is planning the restoration of 25 acres of degraded salt marsh along the Woodbridge River (AK4), a tributary of the Arthur Kill. The project is supported by damages claims recovered from a 1990 Exxon oil spill. The design for the project calls for reconnecting the site to the larger estuary, re-establishing daily tidal flushing, and building an education facility with a classroom and nature trails into the restored marsh.

Woodbridge Township has agreed to procure funding for construction. Design and specifications for the wetland restoration project are being reviewed by ONRD and the National Oceanic and Atmospheric Administration (NOAA).

Rahway River/Dri-Print Foil Printing Co., Rahway, NJ

The terms of a conservation easement for 12.5 acres of undisturbed riparian/palustrine wetlands on the South Branch of the Rahway River (AK3A) are being discussed by the City of Rahway and Dri-Print Foil.

City of Rahway, NJ

NY/NJ Baykeeper has facilitated a project between the ACOE and the City of Rahway to stabilize and restore approximately 500 feet of shoreline on the east bank of the Rahway River in downtown Rahway using bioengineering techniques.

Rahway River/Union-Allen Streets, Rahway, NJ

This site (AK3J), on the North Branch of the Rahway River, is contiguous with Union County's Rahway River Parkway. It is subject to frequent and repeated storm events and is the site of major rescue operations by the City of Rahway to evacuate families stranded in their homes.

The city has nearly completed its project to purchase these floodplain properties. A total of thirteen properties have been purchased, and the structures on them demolished. The city is in the final stages of purchasing the two remaining properties.

NY/NJ Baykeeper and the Rahway River Association are working with the City of Rahway and Union County Parks to develop and fund a 4.5-acre riparian floodplain habitat

Cleanup of the 1990 Exxon Bayway oil spill on Prall's Island.

restoration project. That project will include the construction of 1.6 acres of retention ponds and freshwater wetlands, as well as the restoration of floodplain forest and upland areas. Also included is the construction of an elevated walkway and an interpretative center. Supported by Federal Emergency Management Agency (FEMA) funds provided by the City of Rahway, Omni Environmental Corporation has completed detailed site studies and developed a conceptual plan for the project. Funding to complete a full project plan is currently being sought.

Construction costs are estimated at $350,000 to $500,000. Funding for construction is being sought from a number of public and private sources. When completed, the site will become part of the Rahway River Parkway.

Rahway River/Cranford, NJ

Planning for a Cranford (AK3M) stream bank enhancement project and volunteer restoration workshop began in December 1998. The project, on a Union County Park site adjacent to Drescher's Mill, began in March 1999 and will be extended to other sites in Cranford. Approximately 3,000 feet of shoreline was replanted with native species in 1999. The creation of in-stream structure to improve fish habitat is also being considered. NY/NJ Baykeeper conducted the workshop, and volunteers trained at previous restoration workshops have helped supervise work at the site. Project partners include the Cranford League of Women Voters, Union County Parks, and the Rahway River Association.

Rahway River/Robinson's Branch, Rahway, NJ

In partnership with Omni Environmental Corporation, NY/NJ Baykeeper has developed a stormwater management and habitat restoration and enhancement project for Robinson's Branch of the Rahway River. The project is supported by in-kind services donated by the

City of Rahway and Union County Parks. It will mitigate the impact of stormwater inputs and improve aquatic and riparian corridor conditions. Robinson's Branch is the potential site for an anadromous fish run restoration, and there have been recent anecdotal reports of shad and herring in the river. Funding for the project has been obtained from NJ DEP under Section 319 of the Clean Water Act.

Rahway River/Joseph Medwick Park, Carteret, NJ

NJ DEP's Office of Natural Resource Damages (ONRD) has entered into an agreement with Middlesex County to design and construct a 16-acre wetland restoration project at the Joseph Medwick County Park (AK3G) in Carteret. ONRD is working with NYC Parks/NRG to design the project. The project area was surveyed in May 2000, and project design will be completed in February 2001. The design phase for this project is being funded through the 1990 Exxon Bayway oil spill settlement.

B. Hackensack River

Lincoln Park, Jersey City, NJ

A restoration project is being planned for Lincoln Park (HR1) in Jersey City, adjacent to the Hackensack River. The area considered for restoration was predominantly tidal wetland, but filling and construction activities have altered natural tidal influence and site elevations. This area is still undeveloped, with approximately 80 acres of degraded wetlands, culverted and diked tidal creeks, and filled areas supporting upland shrub/scrub vegetation. NJ DEP/ONRD is working with the ACOE, NOAA, the Department of the Interior, Hudson County Parks, NY/NJ Baykeeper, and other groups to develop a restoration plan for this site. In March 1998, 230 volunteers participated in a site cleanup. Over 400 tons of trash was removed. Soil sampling of the potential restora-

Diamondback terrapin (Malaclemys terrapin), *at Healy Avenue, Queens*

After construction at the NYS DEC Healy Avenue Restoration Site in the Jamaica Bay Watershed, June 1998

tion project area was completed in early April 2000. The project is being funded by NJ DEP with damage claims from the Exxon Bayway oil spill settlement and the ACOE.

Hackensack Meadowlands Development Commission Wetlands Mitigation Projects

The Hackensack Meadowlands Development Commission (HMDC) attempts to balance preservation with development. Currently, seven sites within the district are in various phases of development. Wetland restoration activities begun in the spring of 1998 include: Skeetkill Creek Marsh, Ridgefield, Bergen County (16.3 acres); Harrier Meadow, North Arlington, Bergen County (77.5 acres); and Mill Creek (HR2B), Secaucus, Hudson County (142 acres). Restoration included *Phragmites* control, re-establishment of tidal flow, and creation of open water areas with native plants along the margins. This created low marsh habitats that are flushed daily by tides; lowland scrub/shrub passerine habitats along the marsh and upland ecotone; breeding, wintering, and migratory habitats for dabbling duck, shorebirds, and wading birds; greater fishery access; and some degree of mosquito control.

Restoration activities at Skeetkill Creek Marsh were completed in August 1998. The Harrier Meadow site was completed the following month. Activities at Mill Creek are ongoing, with upland habitat restoration begun in spring 2000. Four additional restoration sites are in the conceptual design and baseline study phase.

C. Jamaica Bay

Four Sparrow Marsh Preserve, Brooklyn, NY

Four Sparrow Marsh (JB8), acquired by NYC Parks in 1997, supports 35 acres of healthy low

marsh, high marsh, and maritime shrubland. These native plant communities are threatened by invasives, primarily mugwort (*Artemisia vulgaris*) and common reed (*Phragmites australis*), which are flourishing on the fill portion of the site and beginning to encroach on the high marsh. Loss of native habitat threatens the four sparrows that breed here: the seaside sparrow (*Ammodramus maritimus*), which nests exclusively in low marsh; the sharp-tailed sparrow (*A. caudacutus*), which prefers high marsh; the swamp sparrow (*Melospiza georgiana*), which inhabits the wetland-shrub edge; and the song sparrow (*M. melodia*), which is found in the upland.

This project aims to establish two acres of salt marsh and approximately one-third acre of maritime shrubland as native buffer along the west and south sides of a small tidal creek. The buffer will function as a biological and physical complement to the existing salt marsh community on the creek's east side, and create a visual and biological buffer between the creek and areas to its west and south slated for commercial development. The restoration will reduce non-point source pollution by trapping sediment and enhancing plant uptake of nutrients and products of bacterial decomposition. A combination of excavation, eradication of invasive plants, and introduction of native plants will be employed. The salt marsh will require over 80,000 plugs of *Spartina alterniflora*, which will be propagated from indigenous seed.

The maritime shrubland restoration will incorporate groundsel bush (*Baccharis halimifolia*), marsh elder (*Iva frutescens*), sumac (*Rhus sp.*), Eastern red cedar (*Juniperus virginiana*), elderberry (*Sambucus canadensis*), and bayberry (*Myrica pensylvanica*). Switchgrass (*Panicum virgatum*) and other herbaceous plants will also be planted.

A small deciduous grove, approximately 2.5 acres in area, will require supplemental plantings of red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), tuliptree (*Liriodendron tulipifera*), sassafras (*Sassafras albidum*), and hackberry (*Celtis occidentalis*). The herbaceous layer will include a mixture of ferns, forbs, and grasses, including arrowwood viburnum (*Viburnum dentatum*) and graystem dogwood (*Cornus racemosa*). These species will enhance aquatic and terrestrial biodiversity and habitat function of the adjacent salt marsh community.

The $800,000 project is funded by the NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks. Four Sparrow Marsh is a HEP High Priority Restoration Site. The expected completion date is October 15, 2002.

Healy Avenue, Queens, NY

In November 1995, NYS DEC purchased 11 acres of maritime shrubland and grassland habitat, with fringing intertidal wetlands, at Healy Avenue (JB11), with funds from the Jamaica Bay Damages Account. Funding included restoration of a 1.25-acre salt marsh and an acre of shrubland and grassland. The wetland restoration included the excavation of fill to appropriate elevations and placement of sand to support salt marsh vegetation. A combination of intertidal *Spartina alterniflora* and high marsh vegetation consisting of *Spartina patens* and spike grass (*Distichlis spicata*) was planted. The fill excavated from the newly created wetland was screened to remove concrete debris and placed upland of the site to create a low rolling dune habitat, which was planted with shrubs such as pitch pine (*Pinus rigida*), Virginia rose (*Rosa virginiana*), groundsel bush (*Baccharis halimifolia*), bayberry (*Myrica pensylvanica*), shadbush (*Amelanchier sp.*), and beach plum (*Prunus maritima*). Grasses and wildflowers planted include switchgrass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), seaside goldenrod (*Solidago sempervirens*), sand dropseed (*Sporobolus cryptandrus*), broom sedge (*Andropogon virginicus*), purple lovegrass (*Eragrostis spectabilis*), and side-oats grama (*Bouteloua curtipendula*). Additionally, an existing dune was regraded and planted with beach grass (*Ammophila breviligulata*). This project will be monitored qualitatively for plant densities and organic soil content.

Gerritsen Creek/Marine Park, Brooklyn, NY

This NYC Parks/NRG project at Gerritsen Creek (JB9) will restore areas of salt marsh currently dominated by invasive *Phragmites australis*. A $4 million nature center has already been constructed as a NYC Parks Capital Project. Existing marsh will be excavated to an elevation inhospitable to *Phragmites*, backfilled with clean sand, and planted with native wetland plants. Upland areas will be planted with maritime shrubland vegetation. These restorations will enhance aquatic and terrestrial biodiversity, as well as the habitat value of the area. The project will also reduce non-point

A view of lower Manhattan from the salt marsh at Liberty State Park, New Jersey

source pollution through sediment trapping, plant uptake of nutrients, and facilitation of bacterial decomposition and adsorption.

The total project cost is $1.3 million. This project was awarded funding from the NYS Clean Water/ Clean Air Bond Act in January 1999 and is a HEP High Priority Restoration Site. Additional funding may be available from the ACOE Jamaica Bay Restoration 1135 Program.

Spring Creek Preserve, Queens, NY

Restoration efforts in Spring Creek Preserve (JB19) will occur on the northern section of Spring Creek, which flows south into Jamaica Bay. There is no low salt marsh vegetation at the site. Due to construction debris dumping and sedimentation, former low marsh areas are now at elevations appropriate to high marsh or upland vegetation and support only a monoculture of *Phragmites.*

Five acres of fill completely dominated by *Phragmites australis* will be excavated to an elevation inhospitable to *Phragmites*, backfilled with clean sand, and planted with *Spartina alterniflora.* Aquatic and terrestrial biodiversity and habitat value are expected to improve dramatically. Non-point source pollution will decrease while sediment trapping, plant uptake of nutrients, bacterial decomposition, and adsorption all increase.

Lincoln Park West Priority Restoration Site, Jersey City, New Jersey

The $2 million project is scheduled to begin July 1, 2001 and will be completed in March 2003. This project was awarded funding from the New York State Clean Water/ Clean Air Bond Act in January 1999. The ACOE and NYC DEP have completed the reconnaissance phase for their Jamaica Bay Habitat Restoration Study and may provide additional funding through the 1135 program.

Spring Creek is a HEP High Priority Restoration Site.

Vernam Barbadoes, Terra-Peninsula Preserve, Queens, NY

This project will increase the area of intertidal salt marsh on the Vernam Barbadoes Peninsula (JB20) from its current 2.6 acres to 10 acres by removing the construction debris, trash, and fill material that now supports a depauperate buffer of non-native trees and shrubs. The removal of shoreline fill material will create links between native salt marsh, maritime heathland, and maritime grasslands found on this section of the Rockaway Barrier Peninsula. The maritime heathland and maritime grasslands have the NYS Heritage Program's highest ranking, S1: "especially vulnerable to extirpation in New York State."

The restoration of salt marsh will reduce shoreline erosion and the total acres of hardened shoreline. The marsh will act as a buffer in

times of flooding, protecting the rare upland plant communities and nearby roads. Expanding the acreage of salt marsh also offers a unique opportunity to significantly enhance water quality in Jamaica Bay using the proven denitrifying capacity of low and high salt marsh grasses.

The total project cost is over $1 million. Partial funding was received from the 1999 NYS Clean Water/ Clean Air Bond Act and the City of New York. Vernam Barbadoes is a HEP High Priority Restoration Site.

Idlewild Park, Queens, NY

Twenty-three acres of woodland, wetland, meadow, and dune-scrub communities were restored at Idlewild Park in spring 1999. The $1.5 million creative public works mitigation, which accompanied the construction of a sewer in southeastern Queens, was funded by NYC DEP and designed by DEP and NYC Parks/NRG. The project features the creation of a 5-acre freshwater wetland planted with 22,000 marsh plants representing 17 species. Thirteen acres of tidal salt marsh were planted with 80,000 *Spartina* marsh grasses. Three thousand native trees and shrubs and 160,000 coastal grasses and wildflowers were planted.

Following the restoration, muskrats, Fowler's toads, marsh hawks, tiger beetles, and more than 15 species of dragonfly and damselfly returned to the new wetland. Many of the plant species used in the restoration are rare or absent from the Jamaica Bay ecosystem. This site is now an important nucleus for dissemination of native species such as serviceberry, butterfly weed, swamp milkweed, New York ironweed, American holly, and turtlehead. NYC Parks, in cooperation with NYS DEC, is planning additional salt marsh restoration with monies recovered from a DEC consent order against the Port Authority of NY&NJ.

Idlewild is a proposed HEP High Priority Restoration Site.

D. Long Island Sound

La Guardia Airport Safety Overrun Mitigation, Alley Pond Park, Queens, NY

The Port Authority of NY&NJ, in cooperation with NYC Parks and NYS DEC, restored 18 acres of salt marsh at Alley Creek, Little Neck Bay (L14A), as mitigation for an acre of construction in marshland adjacent to La Guardia Airport.

The site has a uniform substrate of organic silt-clay. It had formerly supported a productive intertidal marsh, but was significantly degraded by indiscriminate dumping and ongoing siltation processes.

The $2.34 million Alley Pond Park mitigation restored tidal wetlands to a degraded shoreline and created opportunities for environmental education. The wetland restoration effort involved the excavation of 35,000 cubic yards of fill material, the creation of 3,500 square feet of tidal channels and a one-acre salt pond, and the planting of over 37,000 wetland plants. The new channel system is connected to Alley Creek and Little Neck Bay at three points, providing adequate tidal flow throughout the site for the growth of native plants and the re-establishment of productive wildlife habitat.

Excavation was completed in 1997 and *Spartina* seedlings were planted in spring 1998. Recent site inspections revealed excellent tidal flow over the site and a very low incidence of plant mortality. In cooperation with a local wildlife conservation group, an osprey-nesting platform was erected on the project site during grading operations. The platform was occupied by a pair of ospreys within weeks of its construction in 1997, and again in 1998. The latter event included nestlings, the first in Little Neck Bay in recent history.

In compliance with the maintenance and monitoring requirements of the involved agencies, the site will be monitored for a period of five years to assure a viable and self-sustaining wetland habitat. HEP salt marsh monitoring protocols have been implemented by the Port Authority to track recovery of ecosystem structure and function. The Port Authority monitoring program represents the most comprehensive protocols implemented to date by a non-government entity engaged in mitigation restoration.

Bronx Park, Bronx, NY

According to the EPA's Index of Watershed Indicators, about half of the Bronx River watershed is vulnerable to high stormwater flows and severe erosion. The goals of this project are to reduce sediment loads within the Bronx River and restore natural hydrologic, chemical, and biological processes both within and downstream of the project site. A variety of streambank stabilization techniques will be employed, and native riparian plants will be re-established within a half-mile reach

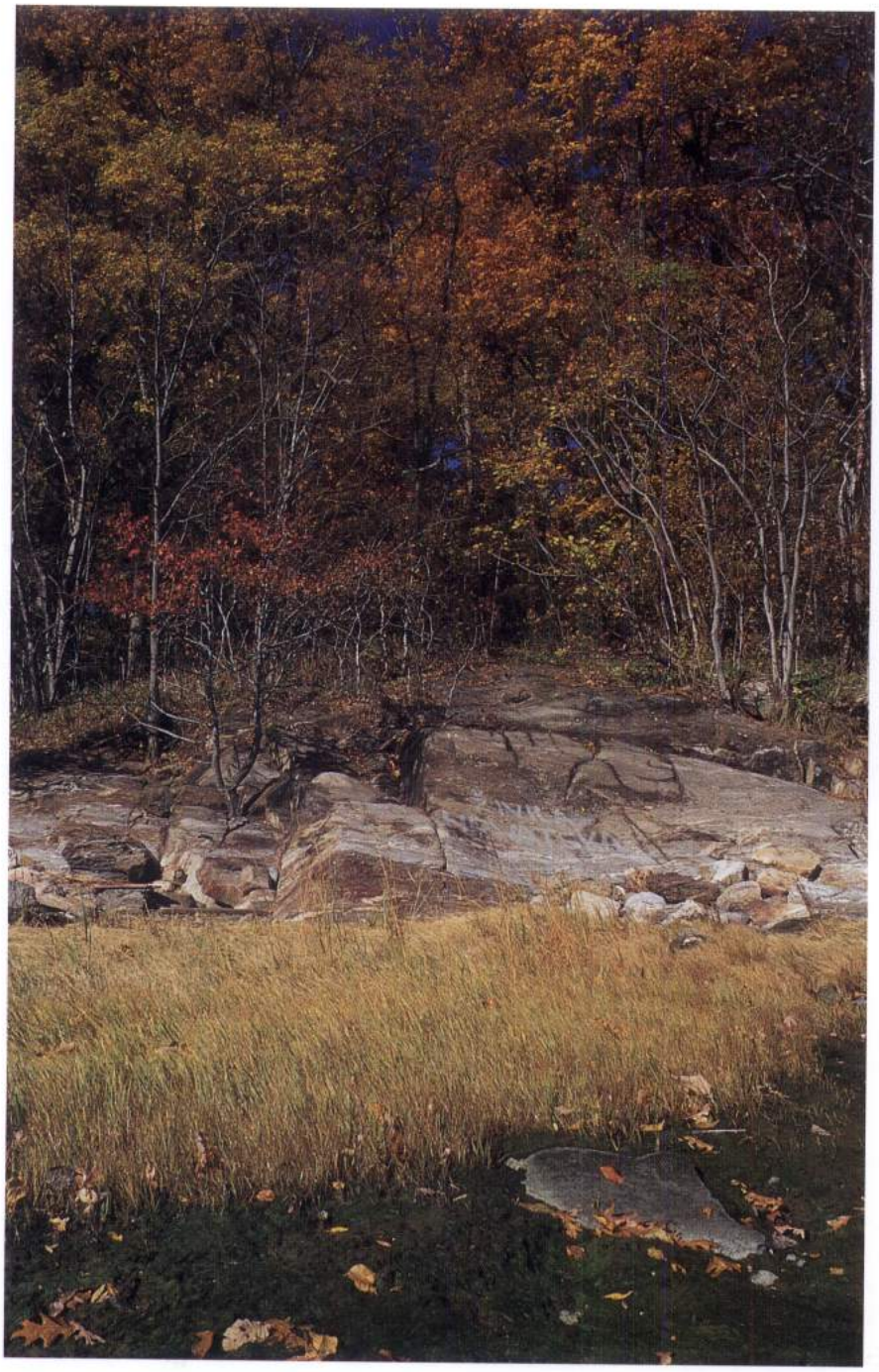
The Port Authority La Guardia runway extension mitigation site at Alley Creek in Alley Pond Park, Queens. An osprey nesting platform is visible.

of the river in northern Bronx Park (LI4C). This will not only enhance the river's ability to store floodwaters, but also improve overall water quality. An increase in the habitat value of the river and its adjacent riparian communities is expected, along with a parallel increase in aquatic and terrestrial biodiversity.

The total project cost is $1.7 million. This project was funded by NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks, and is a HEP High Priority Restoration Project. The expected completion date is July 2002, with monitoring continuing until October 2005.

Additionally, NYC Parks Partnerships for Parks, working with a consortium of environmental organizations, including the Bronx River Restoration Project, Department of the Interior, US EPA, NYS DEC, and NYC Soil and Water Conservation District, has been planning and implementing restoration projects along the river. These projects are funded in part by the Urban Resources Partnership.

Work already completed includes the stabilization of 3,000 square feet of upland slope with leaves, jute matting, and herbaceous and woody groundcover plantings. An additional 2,000 square feet of jute matting was installed during summer 2000 for fall planting. Twenty thousand square feet of adjacent riverbank was stabilized using bioengineering techniques, with funding from the EPA and NYC Environmental Fund. The site will be monitored monthly by NYC Parks/NRG for ecosystem structure and function, invertebrates, fish, and vandalism. Repairs and replanting will occur as needed.



Hunter Island in Pelham Bay Park, New York – part of the Long Island Sound Watershed

Pelham Bay Lagoon, Bronx, NY

This $900,000 project, completed in September 2000, restored tidal flow to 4.3 acres of filled marsh dominated by *Phragmites*. A fringe of low salt marsh and a small section of high marsh on the shoreline of Pelham Bay Lagoon (LI6), adjacent to the southern end of Hunter Island, have been expanded with the eradication of invasive plants and the re-establishment of native vegetation. The site is now being colonized by fiddler crabs (*Uca spp.*), ribbed mussel (*Geukensia demissa*), and mummichog (*Fundulus heteroclitus*). Excavation removed fill to a depth that allows daily tidal flow into the site. Because the salinity of tidally flushed areas is inhospitable to *Phragmites*, the *Spartina* marsh should be stable and resistant to regrowth of the invasive plants. Five-year HEP-endorsed monitoring protocols have been implemented.

The project was funded by NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks.

Turtle Cove, Pelham Bay Park, Bronx, NY

A 4-acre intertidal marsh restoration has been planned at Turtle Cove (LI11) in a cooperative effort between NYC Parks and NYS DEC. The project, to be funded by the Jamaica Bay Damages Account, will restore tidal flow to a diked, *Phragmites*-dominated area. The project will consist of berm and *Phragmites* removal and planting of *Spartina alterniflora*. A survey of existing site conditions has been completed by NYS DEC. The survey information gathered will determine tidal elevations, using vegetation bio-benchmarks, and guide development of a final project design. The restoration is slated to begin in 2001.

Alley Pond Park Kettle Ponds, Queens, NY

The forests of Alley Pond Park (LI4A) are among the oldest and

most ecologically complex in the region. This project will improve the soil mantle and forest structure of approximately 6 acres surrounding three hydrologically connected kettle ponds. In addition to their importance as unique freshwater wetlands, the kettle ponds recharge groundwater for the local watershed. The project seeks to reduce non-point source pollution in the groundwater, Alley Creek, and ultimately Long Island Sound, by restoring natural hydrologic, chemical, and biological processes in the project area.

Invasive, non-native woody shrubs and vines are being removed by hand-cutting and selective herbicide application. Geotextiles will be used to stabilize soil on steep slopes, and native plant communities will be re-established. Wetland edges will be enhanced with a variety of soil bioengineering materials and native wetland plants. The NYC Parks Forest Restoration Team began work on the 1.5-acre forest habitat restoration in October 1998. The site will be monitored and weeded as necessary for at least five years, preferably until the canopy closes. These actions will ensure that the site is not recolonized by invasive, exotic vegetation.

This $550,000 project was funded by NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks. The expected completion date is July 1, 2003. The Alley Pond Park Kettle Ponds restoration is a HEP High Priority Restoration Site.

Twin Ballfields, Forest Park, Queens, NY

In 1966, a glacial kettle, a natural bowl-shaped depression, in Forest

Alley Pond and Cunningham Parks, Queens, are the only known New York City breeding sites for the spotted salamander (Ambystoma maculatum).

Park, Queens (LI12), was filled to construct two ballfields. Over time, as hydrologic patterns re-established themselves, the fill settled, fine material from adjacent slopes clogged drains, and the ballfields became inundated and unusable. The project will reclaim the kettle pond and its associated plant community through excavation and planting of native trees, shrubs, and forbs, including common spicebush (*Lindera benzoin*), *Viburnum spp.*, *Cornus spp.*, sweet pepperbush (*Clethra alnifolia*), and sedges (*Carex spp*).

The project will restore 6 acres of freshwater wetland and upland habitat and re-establish natural drainage patterns. Severe erosion on surrounding slopes will be stabilized. Approximately 6,000 square feet of eroded uplands have already been stabilized with cribbing, leaves, jute matting, and herbaceous and woody groundcover plants. The site will be monitored every four months for at least three years to ensure that the plants survive. NYC Parks/NRG will perform additional plantings if needed.

This project is funded by the NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks. The total cost of the project is $550,000 and will be completed in May 2001. This site is a HEP High Priority Restoration Site.

Oakland Lake, Alley Pond Park, Queens, NY

This project will reduce nitrogen loading to Long Island Sound by stabilizing and replanting steep, eroded slopes and increasing the filtration capacity of Oakland Lake (L14A). Erosion control geotextiles and other bioengineering structures will be employed to stabilize soil in the drier upland embankments. Native trees, shrubs, and forbs will be planted to further anchor soil and increase wildlife habitat. Wetland edges will be enhanced with soil bioengineering materials and native wetland plantings designed to filter runoff entering the lake. In addition, invasive non-native vegetation, including *Phragmites australis*, will be removed. The overall increase in biodiversity and soil stabilization will improve ecological value, improve storm-water retention capacity, and reduce the input of nitrogen and other nutrients, sediments, and contaminants into Long Island Sound.

The project cost is $800,000. NYC DEP is funding an additional constructed wetland and flood abatement project in the Oakland Ravine targeted for the year 2001.

Powell's Cove, Queens, NY

Powell's Cove (LI7) is a crescent-shaped area of undeveloped shoreline on the north shore of Queens. The site is mostly tidal wetland with some low-lying uplands created on filled salt marsh. To date, 4 acres of wetland have been restored: two by NYC Parks and two by NYC DEP. Plans exist for an additional 4 acres. There is room for extensive expansion of the restoration, if additional property is transferred to NYC Parks. The Powell's Cove restoration represents an important opportunity to expand habitat in the eastern portion (Little Neck and Little Bays) of the Sound's Narrows Reach and reduce fill soils that support the breeding grounds of the West Nile-carrying *Culex pipiens* mosquito.

Seton Falls Park, Bronx, NY

The aim of this project (LI9) is to restore a freshwater marsh currently dominated by *Phragmites australis*. The marsh will be excavated, backfilled with clean sand, and planted with native wetland vegetation. Soil bioengineering techniques and materials will be used to stabilize the marsh edge and sections of a small stream. The project will improve wildlife habitat, increase stormwater retention, and improve water quality within the Hutchinson River/Long Island Sound Watershed.

The total project cost is $550,000. This project was funded by NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks, with the support of the Seton Falls Preservation Commission. The expected completion date is October 15, 2003. The Seton Falls restoration is a HEP High Priority Restoration Project.

The Pelham Project: Developing Wetlands for the Disposal and Treatment of Dredged Material

This project proposes coupling the dredging of sediments from Royal Marina on City Island with the creation of salt marsh around the Pelham Bay Landfill and the southern tier of Pelham Bay Park using dredged materials. The restoration of historic habitats that have been eliminated or reduced in this area and the re-establishment of creeks to channel stormwater runoff to Eastchester Bay will support a significantly broader base of ben-

thic, aquatic, and avian species, sequester pollutants, and enhance environmental quality.

This pilot study for broad-scale implementation of urban wetlands construction will be conducted under the guidance of scientists and engineers from Columbia University/Lamont Doherty Labs and the Gaia Institute. This research team will test hydrodynamic, geophysical, biological, and geochemical hypotheses with respect to environmental quality impacts and monitor pre- and post-construction conditions.

The proposed project seeks to renew an urban waterfront by dredging and increase the intensity of the water-based uses of this and nearby properties by improving access. To provide an example of how water-based economic activities can be strengthened while habitat diversity and ecological productivity are increased, this project aims to:

- Decrease contaminant discharge from sediments, non-point sources, and landfill leachate by reducing the surface area of the sediments and increasing biogeochemical activities which remove or sequester harmful contaminants;
- Increase habitat diversity in northwestern Eastchester Bay by restoring historically prevalent habitat types, including intertidal marsh, mudflat, rocky intertidal zones, rocky subtidal zones, and creeks, which were diminished, displaced, or destroyed by landfilling much of the surrounding area;
- Provide economically attractive dredge disposal options for western Long Island Sound coastal communities in Queens and the Bronx, and surrounding coastal counties in general; and
- Intercept and treat stormwater and combined sewer overflow (CSO) discharges from city streets and highway infrastructure, as well as flows of leachate from the Pelham Bay Landfill.

Each restored intertidal and subtidal ecosystem will provide foraging opportunities, habitat, and protection from predators for various fish, invertebrate, and avian species. The marsh and creek ecosystems also have capacities for water purification through removal of pollutants, toxins, excess nutrients, and chemicals of concern (COCs) from landfill leachate, stormwater runoff, combined sewer overflows (CSOs), and dredged sediments.

This full-scale beneficial use plan for dredged materials will restore about 30 acres of intertidal marsh and more than 10 acres of intertidal and subtidal rocky habitat using a 4,000-foot stone dike containment facility. Dredged material will be placed between the stone dike wave break and the shore and planted with *Spartina alterniflora*. The initial phase of this work, beginning with about 1.5 acres of marsh and a 400-foot rock armor wall, will create more than a half-acre of rocky intertidal and subtidal habitat. This will provide a prototype, at 1/20 scale of the entire project, for evaluating benthic macrophyte and faunal recruitment and development and biochemical, geochemical, and geophysical contributions to water quality.

The goals of project analyses are:

- To design a dredge containment facility comparible with salt marsh and estuarine habitat creation and restoration;
- To evaluate the comparative risk of no-dredge versus containment facility dredge treatment scenarios to ecological systems, and the potential impacts on human health from metals and other COCs;
- To initiate long-term hypothesis-driven monitoring of the effects of habitat creation and restoration in and around the Pelham Bay Landfill dredge containment facility, in terms of cordgrass planting survival, recruitment of invertebrates and macrophytes, mitigation of COCs from the dredged materials and surrounding waters, and habitat use as a finfish nursery.

E. New York Harbor

Dreier-Offerman Park/Coney Island Creek, Brooklyn, NY

In spring 1998, approximately 1,300 cubic yards of debris and illegally dumped fill material was excavated and removed from Dreier-Offerman Park (NYH2) and replaced with 360 cubic yards of clean sand. The sand created the substrate for planting *Spartina alterniflora*, *Spartina patens*, seaside goldenrod (*Solidago sempervirens*), and marsh elder (*Iva frutescens*) in the quarter-acre low marsh.

The upland area was also enhanced with native grasses and woody plants, including approximately 7,000 plants of 11 native species. This newly restored habitat will be used as a field station for outdoor education by three local school districts and the New York Aquarium.

NYC Parks Dreier-Offerman restoration near Coney Island in the New York Harbor Watershed

Before: Approximately 1,300 cubic yards of illegal fill was removed from a former sand flat to prepare for planting.

This restoration was funded by Section 319 funds through NYS DEC's Non-Point Source Pollution Abatement and Control Grant Program and NYC Parks. The total project cost was $120,000. An additional $1,122,100 was received in May 2000 from the NYS Clean Water/Clean Air Bond Act and the City of New York to expand the restoration an additional two acres, improving low marsh, sandy beach, and upland dune habitat. This expansion is currently in the design phase.

F. Passaic River

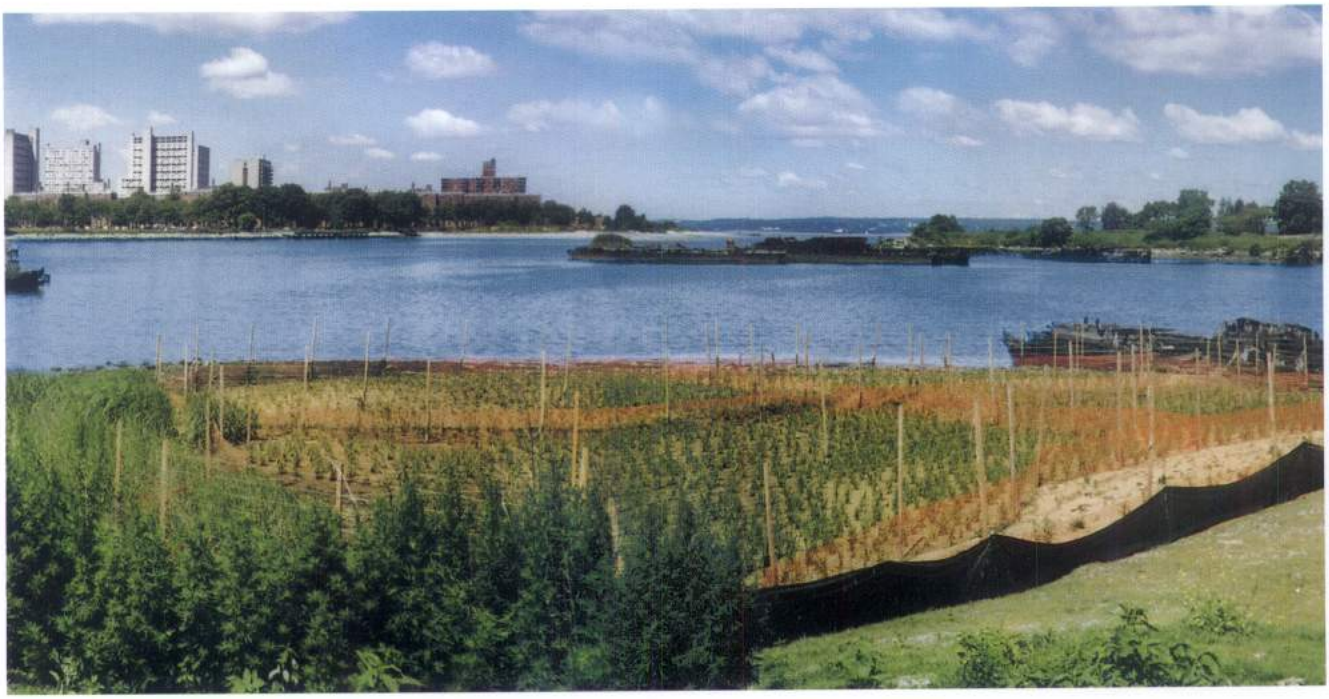
Frank Vincent Marina Salt Marsh, Kearny, NJ

This 1999 salt marsh restoration was the first completed by Friends of the Passaic River, Inc. Situated south of the Frank Vincent Marina, in the Town of Kearny, Hudson County, the site is 325 feet by 12 feet and lies 1.8 feet above sea level. At this height, tides submerge the area regularly, favoring the growth of *Spartina* grasses. Over one hundred *Spartina alterniflora* plants were rescued by NYC Parks/NRG from Saw Mill Creek and used for planting the Frank Vincent Marina salt marsh. The primary goal of the restoration is to educate local residents about the benefits of a clean river. The restoration will use NRG's protocols for planting, monitoring, and installing goose fencing and will survey adjacent restoration sites.

G. Raritan Bay

Leonardo Site, NJ

The Leonardo site (RB2), a 75-acre bay front tract between the Earle Naval Pier and the Leonardo State Marina, consists of beach, dunes, a filled salt marsh dominated by *Phragmites*, and a small creek mouth. The dunes at Leonardo Beach support wild cherry, *Rosa rugosa*, seaside goldenrod, sea bur-



After: Restoration of high marsh and adjacent upland was completed in summer 1998. The wooden barge bordering the north side was left as fish habitat.

dock, wormwood, and dune grasses. The beach is an extremely popular striped bass fishing area. Horseshoe crabs use the beach and creek mouth annually for mating and egg laying. Breeding birds that frequent the site include the green-backed heron, clapper rail, killdeer, and common songbirds. In winter, the waterfront hosts American black duck, greater scaup, oldsquaw, common goldeneye, and bufflehead, and during migration hosts sanderling, dunlin, and savannah sparrow.

Restoration opportunities at this site are varied and favorable and include threatened (T) and endangered (E) bird species habitat enhancement. Although *Phragmites* and Japanese knotweed dominate most of the site, there are bunchgrasses that could support savannah sparrow (T) breeding, especially if enhanced. The unused, western sandy portion of the site could be fenced as a colony for least tern (E), black skimmer (E), and American oystercatcher, which breed nearby. Other opportunities include revegetating the dunes, restoring tidal flow to the filled marsh by widening the creek mouth, and enhancing the upland portion of the site or allowing it to succeed to forest.

In 1996, local conservationists enlisted NY/NJ Baykeeper to initiate an acquisition and preservation campaign to thwart plans for construction of a condominium on the site. A cooperative effort between conservationists, the Township of Middletown, and the State of New Jersey resulted in Blue Acres Bond Act funding for the acquisition of privately owned lands within the site. Middletown holds the newly acquired property. Local, state, and federal entities own adjacent lands and support a comprehensive management plan for the site. Management would include habitat preservation and may provide for nature trails, fishing amenities (trash cans, cutting boards, storage bins), and an interpretative center in an existing building on the site's perimeter.

H. Hudson River

Liberty State Park, Jersey City, NJ

The Liberty State Park Conservancy, Friends of Liberty State Park, NY/NJ Baykeeper, and NJ Audubon are spearheading efforts to permanently preserve and restore the 225-acre emergent plant habitat in the interior of Liberty State Park and the 21-acre Caven Point natural area (HUR1). The State of New Jersey owns the site, though the area has not been designated as a natural area.

The original marshland was filled with rubble from the construction of the NYC subway system and highways through the Palisades. The site was a railroad terminal until the 1950s, when it was designated as a state park. Within the interior planning committee for Liberty State Park (which includes the State of New Jersey, NJ DEP, NJ Parks and Forestry, local elected officials, parks advocates, the Liberty Science Center, and the National Parks Service) there is consensus that a large section of the interior should be restored to functional habitat. The interior of the site has been largely isolated and some habitat has re-established, including several plant communities. There are open fields, moss mat communities, a small birch forest, and raptor and migratory songbird habitat.

Riverdale Park, Bronx, NY

A one-acre freshwater wetland, at the outlet of Alder Brook in Riverdale Park (HUR1A), will be restored in an attempt to reduce non-point source pollution into the Hudson River. A variety of soil bioengineering techniques will be used to repair eroded streambanks. Eroding upland slopes, currently contributing to the overabundance of sediment and nutrients in the river, will be stabilized with erosion-control geo-textiles and by re-establishing native vegetation. Japanese knotweed (*Polygonum cuspidatum*) and other invasive plants will be removed in wetland areas. Natural hydrology capable of supporting native wetland and floodplain vegetation will be restored. This project will improve the park's riparian habitat, provide stream habitat to a wide range of aquatic species, and improve water quality by reducing non-point source pollutants.

The cost of the project is $600,000. Funding was awarded to NYC Parks by the City of New York and the NYS Clean Water/Clean Air Bond Act. Riverdale Park is a HEP High Priority Restoration Site. The expected completion date is October 2004.

Northern Manhattan Parks, NY

This project will reduce non-point source pollution into the Hudson River by stabilizing and replanting steep, eroding slopes in Inwood Hill (HUR1B), Fort Washington (HUR1C), Fort Tryon (HUR1D), and Riverside Parks (HUR1E). Appropriate geotextiles and other bioengineering structures will be used to stabilize eroding slopes. Native trees, shrubs, and forbs have been planted by NRG's Forest Restoration Team to anchor the soil and increase the wildlife habitat value of these sites. Species include sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), hickories (*Carya spp.*), witch hazel (*Hamamelis virginiana*), sweetgum (*Liquidambar styraciflua*), tuliptree (*Liriodendron tulipifera*), oaks (*Quercus spp.*), and many others. Invasive, non-native vegetation (mainly satellite populations with colonizing potential) was removed by hand. These sites will be monitored by NYC Parks/NRG to ensure that recolonization does not occur. The overall increase in biodiversity and soil stability will improve the parks' ecological value, and reduce the input of sediments, nutrients, and contaminated urban runoff into the Hudson River and New York Harbor.

The cost of the project is $700,000. This project is funded by NYS Clean Water/Clean Air Bond Act and City of New York monies awarded to NYC Parks.

Highbridge Park, Manhattan, NY

The objectives of this $600,000 project are to protect, enhance, and restore riparian habitat in this underserved community through invasive plant control, soil stabilization, and native plantings. Invasive, non-native woody shrubs and vines will be removed by hand and with selective herbicide application. Geotextiles, in conjunction with backfilling where necessary, will be used to stabilize soil on steep slopes. Native trees, shrubs, forbs, and grasses will be planted to further anchor soil and increase wildlife habitat. Improving the overall biodiversity and ecological function of this area will reduce non-point source pollution by decreasing sediment loads entering the Harlem River and ultimately the New York Harbor.

I. Ongoing Army Corps of Engineers Studies

The U.S. Army Corps of Engineers is conducting five reconnaissance feasibility studies in the NY/NJ Harbor Estuary that incorporate sites from the HEP Priority Restoration List. As a member of HEP, the ACOE has worked with HEP and its participating agencies to identify and fund several large-scale restorations that merit federal interest. The projects range from flood control measures to habitat restorations.

Hudson-Raritan Estuary Habitat Restoration

The most recently authorized ACOE study is an ambitious investigation of the entire Port District of New York/New Jersey to assess potential sites for habitat restoration. The expedited reconnaissance report identified 87 restoration opportunities for the feasibility study through discussions with the HWG and other local environmental agencies and organizations. Eleven of the identified sites are endorsed by the HWG as Priority Restorations: Old Place Creek Watershed, Staten Island, NY; Rahway Riverfront Park, Rahway, NJ; Empire Tract and the FD&P site, Hackensack Meadowlands, NJ; Idlewild and Alley Pond Park, Queens, NY; Pelham Bay/Turtle Cove, Bronx, NY; Coney Island Creek/Dreier-Offerman Park, Brooklyn, NY; Marquis Creek, Oldbridge, NJ; and Leonardo, Middletown, NJ. These projects, affecting over 1,000 acres, are mostly large-scale salt marsh restorations involving the removal of fill and invasive vegetation and restoration of tidal flow. These 11 sites were among the top 15 projects recommended for the feasibility phase of the study.

A cost-sharing agreement between the ACOE and its nonfederal partners will be negotiated after the finalization of the recommended reconnaissance plan. The feasibility study is anticipated to begin in January 2001.

Jamaica Bay Environmental Initiatives

This ongoing study targets restoration opportunities in Jamaica Bay, Marine Park, and Plumb Beach. The reconnaissance report was authorized in 1990 and completed in January 1994; ACOE and NYC DEP signed a cost-sharing agreement two years later. A portion of NYC DEP's contribution has been supplied as in-kind services for the development of the Jamaica Eutrophication Model (JEM). This model has allowed DEP and ACOE to predict how the water quality and hydrodynamics of the bay and its tributaries would respond to various proposed management actions (*e.g.*, dredging).

The $2.7 million feasibility study is currently in the design phase for 12 potential restoration sites. This includes three HEP High Priority Restoration Sites – Brant Point, Gerritsen Inlet, and Spring Creek – and four Priority Restorations – Bayswater Park, Bergen Basin, Dubos Point, and Hawtree Basin. NYC Parks has requested that two sites, Gerritsen Inlet and Spring Creek, be fast-tracked as part of the ACOE 1135 program, potentially tripling the restoration funding available.

Only those sites with the highest probability of long-term restoration success and community support will be selected for the construction phase of the project. The feasibility study is scheduled to be completed in 2003.

Flushing Bay and Creek Ecosystem Restoration

The Flushing Bay watershed, on Long Island Sound, has been heavily degraded over the past century by filling, bulkheading, dredging, sewage, and CSO runoff. At the southwest corner of the bay, near La Guardia Airport, water quality is particularly poor, and odor is a serious public concern. The Flushing Bay Task Force initially identified an earthen dike as the cause of restricted tidal circulation and siltation along the College Point shoreline. The $2.7 million feasibility study, cost-shared with the Port Authority and NYC DEP, investigates solutions to this and other water quality problems in the bay. The study identifies ten potential sites for the construction phase of the project, including Meadow Lake and Flushing Creek, two HEP Priority Restorations.

Bronx River Flood Control and Environmental Restoration

Authorized in March 1998, this study targets 56.4 square miles in Bronx and Westchester Counties, NY. Because of intensive development on the river floodplain, storms lead to flooding, riverbank erosion, and habitat loss.

The expedited reconnaissance report was completed in September 1999, and Project Study Plans are currently under negotiation with

Aerial view of the Raritan Bay coast. Leonardo – a recently acquired HEP Priority Site – is visible in the upper right, between the marina and the pier.

potential sponsors (NYC DEP, NYC Parks, NYS DEC, and Westchester County). Included among the potential project sites are the HEP High Priority Restorations at Soundview and Bronx Parks.

Woodbridge and Rahway River Basins Flood Control and Ecosystem Restoration

Rapid development has increased storm runoff in the 10-square-mile Woodbridge River Basin and the adjacent 82-square-mile Rahway River Basin and left both areas prone to flooding. The reconnaissance phase of the study, initiated in January 1999, has identified five potential restoration sites. Included are Joseph Medwick Park, a HEP Priority Restoration, and Woodbridge River, a High Priority Restoration.

Rahway River 1135 ERR

Under the ACOE's Continuing Authorities Program (CAP), the agency has the authority to undertake smaller, site-specific restoration actions in areas affected by past or ongoing Corps projects (Section 1135 of the Water Resources Development Act, 1986). One such project is along the Rahway River in the City of Rahway, where a flood control project has damaged the shoreline and adjacent areas. The Preliminary Restoration Plan included a proposal to investigate options to restore some of the natural shoreline and freshwater wetlands. The next phase, currently under review by the potential sponsor (City of Rahway), will produce an Environmental Restoration Report (ERR) that will include designing site-spe-

cific recommendations and obtaining all permits. Included in this study is Essex Street, a shoreline stabilization project that is a HEP Priority Restoration.

Lincoln Park 1135 ERR

Initiated under the same CAP program, this 1135 study will investigate options for restoring a former tidal marsh along the Hackensack River in Jersey City. This area was filled partly with dredged material to maintain the nearby Federal channel. The completed Preliminary Restoration Plan was approved by the local sponsor, NJ DEP, and work on the ERR has begun with a site characterization. Lincoln Park is a HEP High Priority Restoration.

J. NY/NJ Baykeeper Hudson-Raritan Oyster Restoration Project

Oysters were once a major element of the Hudson-Raritan Estuary ecosystem. Roughly 35 square miles of oyster beds were scattered throughout the estuary. Today, there are no large populations of oysters. Researchers report that overharvesting, municipal and industrial pollution, and heavy siltation have caused the oyster population decline.

When the Hudson-Raritan lost its oyster beds, it lost a keystone species. In addition to providing protective structural habitat for several saltwater animals, oysters are an important

Benjamin Longstreth tends to an oyster net for the NY/NJ Baykeeper Oyster Restoration Project.

food source for many resident species. This trophic link extends from species like the naked goby, which lives in association with oyster beds, to important recreational and commercial species, like striped bass. Oysters also play an important role in maintaining water quality because they filter sediments, toxins, and excess algae.

NY/NJ Baykeeper anticipates that the recent water quality improvements will make the return of oysters feasible. Water quality is the best it has been since monitoring began in 1909, and the load of silt entering the Hudson is half of what it was at the turn of the last century. In fall 1997, Baykeeper started a project designed to restore oyster beds to the Hudson-Raritan. With the help of two dozen volunteers, Baykeeper completed two studies: surveys of seed oyster growth around the estuary, and a survey of oyster spat (settled oyster larvae) recruitment. The oysters grew well (on average 78% over 4 months), demonstrating that the estuary is clean enough to support adult oysters. However, there was almost no spat recruitment, a fact attributable to the estuary's low oyster population. In June 1999, Baykeeper established two demonstration-scale oyster beds. Future monitoring will include a second year of the oyster spat recruitment survey.

K. The Composting and Restoration Program (CARP)

NYC Department of Sanitation and NYC Parks/NRG implemented CARP in 1997. Composting operations were established in each borough near leaf collection points to avoid transporting leaf material from across the city to Staten Island's Fresh Kills Landfill. Composting sites were placed on already disturbed soils in City parks that had been filled during the 1940s, 50s, and 60s. These fill soils support monocultures of non-native, ruderal, tick-infested plants and breed freshwater mosquitoes.

The cost savings of eliminating leaf transport to Fresh Kills will support the purchase of thousands of trees and shrubs to be planted in the newly restored, composted soils. Azaleas, blueberry, viburnums, and trees, including red maple, eastern red cedar, oaks, and sweetgum, will be planted using this compost. The vegetation will be a boon to wildlife and community beautification.

CARP was first implemented in Ferry Point Park, Bronx, in 1997, and in Canarsie Park, Brooklyn, in 1998. Additional sites in Queens and the Bronx will follow.

L. NYC Parks/Greenbelt Native Plant Center and Rare Plant Propagation Program

Since 1998, the NYS Department of State and NYC Parks/NRG has funded the Rare Plant Propagation Program to grow 30 species of rare plants and *Spartina alterniflora* for reintroduction into HEP's critical watersheds. These plants include forest understory species such as Canada mayflower, Solomon's seal, wild sarsaparilla, and other species not propagated by commercial nurseries.

The program is based at NYC Parks/Greenbelt Native Plant Center, Staten Island, a plant propagation facility that raises local species. The Center provides an unparalleled opportunity to supply indigenous plants for large-scale restoration and mitigation projects.

The Rare Plant Propagation Program developed an inventory of New York City rare plants and located existing populations. Rare plants, including Nantucket juneberry and green milkweed, have been reintroduced at restoration sites identified by the program. All plants are propagated from locally collected seeds, woody cuttings, and plant tissue. Reintroduced plants are mapped and labeled separately in the New York City rare plant inventory to prevent confusion with naturally occurring populations. To date, rare plants have been reintroduced into Saw Mill Creek Park, the Butler Manor mitigation site, and Teleport Magnolia Preserve in Staten Island; Marine Park in Brooklyn; and Forest Park in Queens. Approximately 6,050 native rare plants and seedlings of 48 species and 100,000 plants of *Spartina alterniflora* have been propagated and planted thus far.

The use of native plants in restoration projects can be justified ecologically and economically. The NY/NJ Harbor is not only threatened with the loss of its remaining open space, but also, just as crucially, with the loss of native populations of flora and fauna that define regional biodiversity. The use of plants propagated from collected seed of local wild genotypes helps preserve

NY/NJ Harbor Oil Spill Trustees admire recently propagated Spartina alterniflora *at the NYC Parks Native Plant Center. Left to right: Marc A. Matsil, NYC Parks; John Catena, NOAA Restoration Center; Bob Reid, NMFS; Andy Raddant, Dept. of the Interior; John Sacco, NJ DEP; Marjorie Fox, NYC Law; Stan Gorski, NMFS; Susan Moresca, NYS DEC; Steve Zahn, NYS DEC; Robbin Bergfors, NYC Parks; Andrew Bergen, NYC Parks; Carl Alderson, NYC Parks.*

local biodiversity. Nursery stock grown from indigenous seed sources also produces plant material with the greatest degree of adaptation to local environmental conditions, having evolved through attendant climatic changes and survived to the present day.

Native plants are of great economic value to restoration activities because they require the least care in terms of water and fertilization. Their genetic variability and superior vigor make them less susceptible to disease and pests, offering the greatest degree of successful establishment and long-term survival on restoration sites.

Previously completed NYC Parks projects at Prospect Park Ravine offer tangible proof. During a severe drought in 1998, shrubs propagated at the Native Plant Center survived, while plants purchased from commercial stock and commercial nurseries suffered high mortality.

VI. Funding Sources for Habitat Acquisition and Restoration

The U.S. Fish & Wildlife Service has compiled a report for the HEP HWG (see Appendix 1) detailing 38 programs that offer funding resources for habitat restoration and acquisition in New York and New Jersey. Funding sources include the US EPA, US F&WS, NY/NJ Oil Spill Trustee funds, the Army Corps of Engineers restoration program, the NYS Clean Water/Clean Air Bond Act, and the Garden State Preservation Trust.

A. New York State Clean Water/Clean Air Bond Act

The $1.75 billion Clean Water/Clean Air Bond Act was proposed

Funding Sources for Habitat Acquisition and Restoration

by Governor George Pataki and approved by the voters of New York State in 1996. It provides $790 million for water quality projects, $355 million for safe drinking water projects, $200 million to restore brownfields, $175 million for solid waste projects, $150 million for land acquisition, and $230 million for air quality projects. Of the $790 million earmarked for water quality projects, $25 million has been allocated to water quality improvement projects that implement the NY/NJ Harbor Estuary Program CCMP. Over $17 million has been awarded to HEP High Priority Restoration Sites to date, matched by the City of New York. In addition, $25 million has been allocated to the Hudson River Estuary Plan and $200 million to the Long Island Sound CCMP. The Bond Act is administered by NYS DEC, NYS DOS, the NYS Department of Agriculture and Markets, the Environmental Facilities Corporation, and the NYS Office of Parks, Recreation, and Historic Preservation.

B. Jamaica Bay Damages Account

The Jamaica Bay Damages Account is a fund administered by NYS DEC for the purpose of "restoring, replacing, or acquiring the equivalent of any natural resources determined to have been injured, destroyed, or lost as a result of the release of hazardous substances from the five municipal landfills" – Edgemere and Pennsylvania and Fountain Avenues in Jamaica Bay; Pelham Bay Landfill in the Bronx; and Brookfield and Fresh Kills Landfills in Staten Island. The monies were recovered by the City and State of New York.

C. Garden State Preservation Trust Act

On November 4, 1998, New Jersey voters approved the use of sales-tax revenues to acquire woodlands, farmlands, and parklands. The $1 billion act sets aside $98 million per year as a stable source of funding for open space, farmland, woodland, and historic sites preservation and recreation development. Local governments will formulate an Open Space and Recreation Plan detailing their land preservation and tax implementation strategy. Two agencies, Green Acres and the Farmland Preservation Program (part of the NJ Department of Agriculture), will guide and coordinate the efforts of the individual municipalities.

D. Department of the Interior Funds

In December 1999, Senators Daniel Patrick Moynihan, Charles Schumer, Frank Lautenberg, and Robert Torricelli, of New York and New Jersey, wrote President Clinton in support of HEP's mission of habitat preservation and the Priority Acquisition and Restoration List (see Appendix 2). The senators requested that $30 million be allocated in the Department of the Interior's budget for fiscal year 2001 for habitat acquisition and restoration in the New York/New Jersey Harbor Estuary, with $15 million to be matched by each state over the next three years.

CCMP Action H-12.6

Establish a mechanism for public/private partnerships to preserve habitat.

Opposite:
A crab spider hides among the petals of the purple milkweed (Asclepias purpurascens), *a NYS-listed threatened plant (S3T).*

Development encroaching on wetlands at Pews Creek Marsh, Port Monmouth, New Jersey

Section 2

Watershed Planning and Protection of Critical Watersheds

I. National Wetlands Inventory: Northwest Staten Island

Freshwater wetlands serve several vital utilitarian functions. They store floodwaters, filter runoff, and recharge groundwater supplies. Flooding in many parts of New York City, including much of Staten Island and Queens, is a direct result of filling and building on freshwater and tidal wetlands.

Filling wetlands costs taxpayers in two ways: by causing flooding and flood damage and by requiring expensive flood control measures to substitute for lost wetlands. Developments built on filled wetlands will flood during storms because they generally have low elevation and high water tables. Asphalt, concrete, roofing, streets, and sidewalks have no absorption capacity and often cause massive flooding even after small storms. Hydric soils naturally function to store and filter runoff; artificial infrastructure for the same effect is expensive. Stormwater abatement facilities, which include retention and detention basins, treatment plants, storm sewers, and pipes, must be in place. Even with these facilities, flooding is still common and costs homeowners, businesses, and taxpayers millions of dollars annually in cleanup and repairs.

Filtration of runoff by freshwater wetlands helps prevent degradation of water quality in lakes, rivers, and estuaries around the New York/New Jersey Harbor. Eroded sediments settle out of runoff in wetlands, reducing non-point source pollution farther downstream.

CCMP Action H-1.2

Foster information transfer and tools to enhance and encourage watershed planning.

High wave-energy caused by uncontrolled boat traffic and violation of "No Wake" zones is a contributing factor to the decline of salt marshes.

National Wetlands Inventory

Toxins, heavy metals, pathogens, and nutrients also settle out of the water, and may be broken down by bacteria and absorbed by natural processes in the wetland. The retention capacity of wetlands also reduces excess surface water in developed areas prone to flooding. Runoff stored by wetlands north of New York City recharges groundwater supplies that are the City's source of drinking water.

Despite federal and state permit regulations, freshwater wetlands in and around the Harbor continue to be filled and degraded. In order to save some of New York City's remaining marshes, US EPA and F&WS have added Northwest Staten Island to the National Wetlands Inventory (NWI). Northwest Staten Island is an area of both great natural value and development potential, containing some of the last original tidal wetlands in New York City. Plans for expansion of the Harbor waterways threaten this habitat.

The NWI, created with advanced photography and mapping technology, was initiated to provide government agencies and the public with information on the current status of wetlands. This information is critical to responsible resource decision-making and planning. By identifying flood-prone areas and preventing development in them, the inventory will reduce tax dollars spent on flood relief. The maps can be overlaid with natural resources databases to demonstrate the health of the environment over time, show the extent of degradation of wetlands in the area, and provide baseline data for mitigations, while helping protect the economic interests of the region's neighborhoods and businesses.

A National Wetlands Inventory publication, *Wetlands of Staten Island, New York: Valuable Vanishing Urban Wildlands*, was released in May 2000. Copies can be obtained from EPA, Region II.

II. Watershed-Based Issues Maps

To focus greater attention on watershed management and watershed-based issues, the Habitat Workgroup (HWG) developed environmental issues maps for Jamaica Bay and Arthur Kill. Issues maps for the remaining watersheds of the New York/New Jersey Harbor Estuary are planned.

The maps illustrate general categories of habitat impairments including: oil spill threats, habitat loss and fragmentation, exotic and invasive species, brownfields, landfills, shoreline erosion and wetland destruction, stream channelization and flood control projects, and dredging and hydraulic alterations. These maps also highlight specific sites where habitat values are presently threatened or may be threatened in the future.

The maps are organized into four categories: endangered species protection/significant habitat; habitat loss; dredging & hydraulic alteration; and needs more information.

Like the priority sites maps, the issues maps will be revised as new information becomes available.

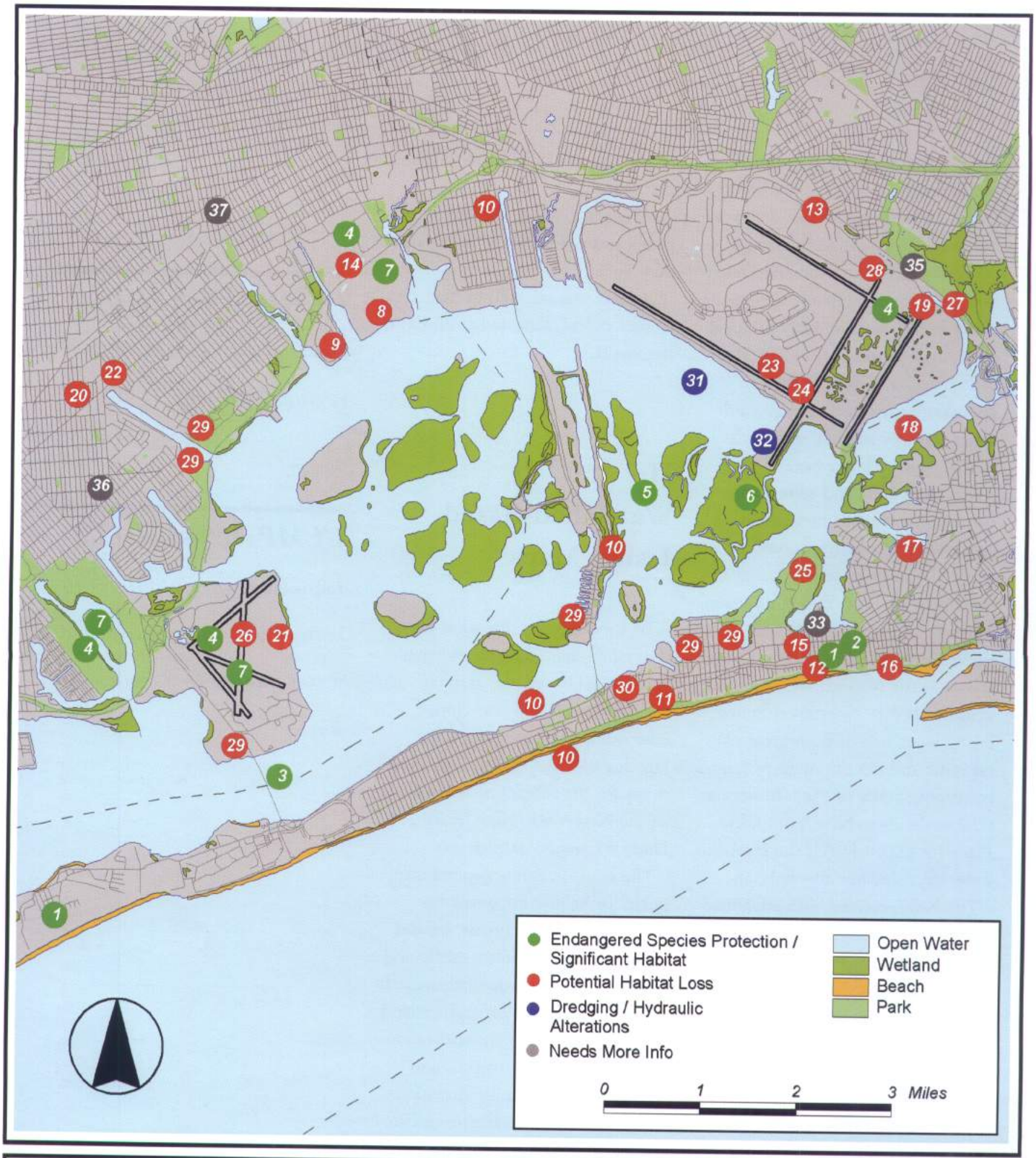
CCMP Action H-1.1

Develop a comprehensive regional strategy.

CCMP Action H-12.3

Implement special efforts to restore habitat and improve water quality in Jamaica Bay.

Opposite:
Salicornia, *or glasswort, in Marine Park, Brooklyn*



NEW YORK - NEW JERSEY
HARBOR ESTUARY PROGRAM
Habitat Workgroup

JAMAICA BAY ISSUES MAP

(See Attached List for Site Descriptions)

City of New York
Parks & Recreation
Natural Resources Group
Mapping & Design Lab
1234 Fifth Avenue, New York, NY 10029

Rudolph W. Giuliani, Mayor
Henry J. Stern, Commissioner
Marc A. Matsil, Chief
Paul W. Katzer, GIS Manager
Susannah B. Cox, GIS Technician

NRG Map No.: 200006-16AV
Revised June 2000

A. Jamaica Bay Issues Map

Endangered Species Protection/Significant Habitat

SITE ID	NAME	ISSUE	RECOMMENDED ACTION
1	Piping Plover Habitat	Endangered Bird Feeding / Nesting	Monitoring, Enforcement, and Protection
2	Sea Beach Amaranth	Significant Habitat	Monitoring, Enforcement, and Protection
3	Peregrine Falcon Nest	Endangered Bird Nesting	Monitoring, Enforcement, and Protection
4	Grassland Bird Nesting Habitat	Endangered Bird Nesting	Monitoring, Enforcement, and Protection
5	Osprey Nest	Endangered Bird Nesting	Monitoring, Enforcement, and Protection
6	Jocos Marsh Laughing Gull Colony	Endangered Bird Feeding / Nesting	Monitoring, Enforcement, and Protection
7	Checkered Butterfly	Endangered Insect Habitat	Monitoring, Enforcement, and Protection

Potential Habitat Loss

8	Fountain Avenue Landfill Closure	Landfill Closure	Habitat Restoration / Enhancement Potential
9	Pennsylvania Avenue Landfill Closure	Landfill Closure	Habitat Restoration / Enhancement Potential
10	Bulkheads and Other Hardening Structures	Erosion	Salt Marsh / Mudflat Restoration
11	Beach 80	Development	Monitoring, Inventory, and Habitat Protection
12	Arverne Urban Renewal Area	Development	Monitoring, Inventory, and Habitat Protection
13	Nassau Expressway	Development	Monitoring, Inventory, and Habitat Protection
14	Gateway Estates	Development	Monitoring, Habitat Protection
15	Rockaway	Lot Cleaning and Mosquito Control	Department of Health Management
16	Rockaway & Sprayview Promenade	Erosion Control	Non-Point Source Abatement, Plant Establishment

Jamaica Bay Issues Map

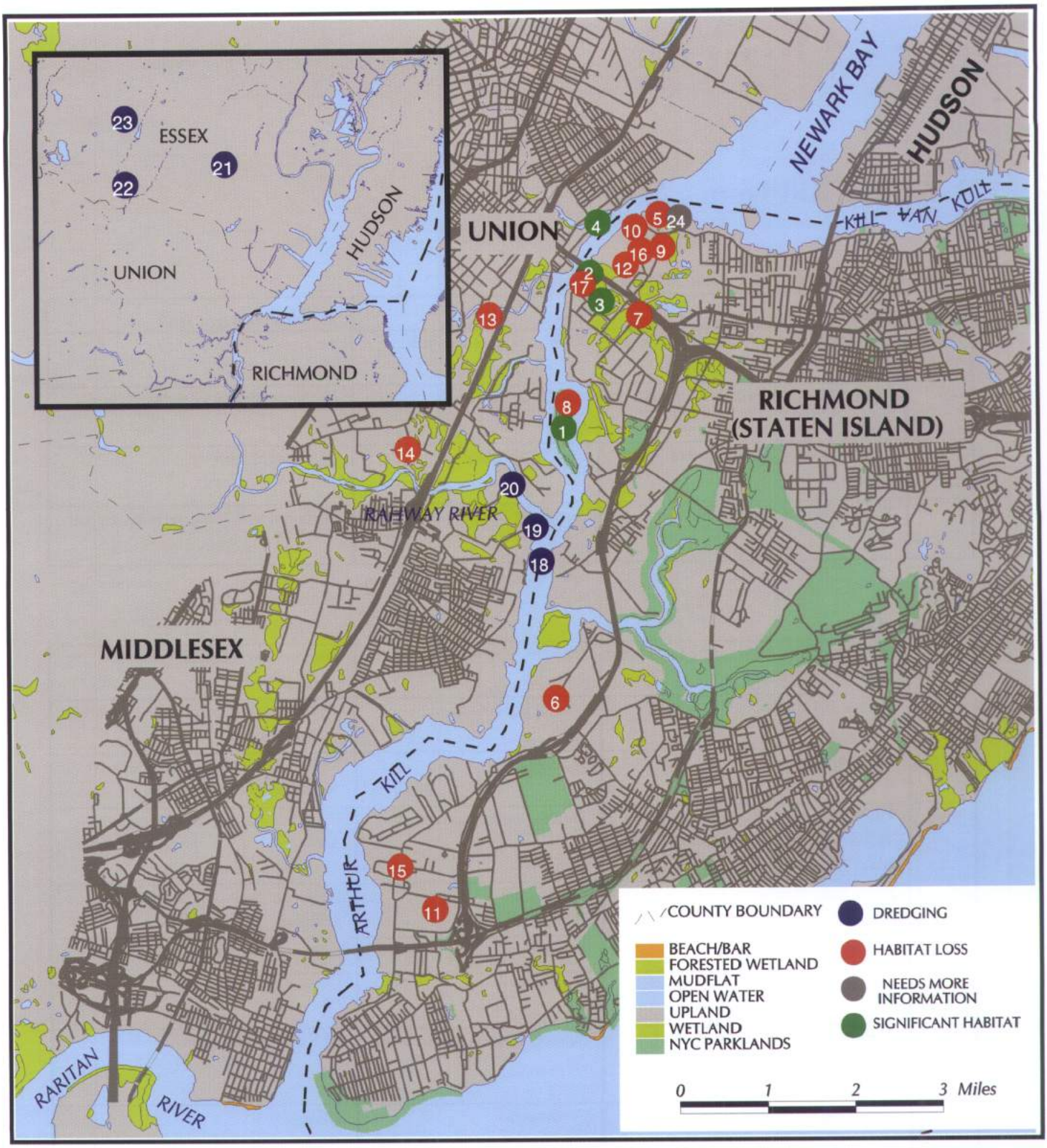
SITEID	NAME	ISSUE	RECOMMENDED ACTION
17	LILCO Plant	Contaminants	Monitoring, Analysis, and Enforcement
18	Mollusk Poaching	Enforcement	Enforcement
19	Proposed Stormwater Management Plan	Flooding	Planning and Zoning
20	Paerdegat 8 Acre Hold	Development	Monitoring
21	Active Recreational Activities	Development	Monitoring and Enforcement
22	DOT Maintenance Facility	Development	Restoration After Use
23	JFK / Port Authority	Oil Spill Contamination	Monitoring, Enforcement, and Compensation
24	JFK Underground Oil Storage Tasks	Groundwater Contamination	Monitoring, Enforcement, and Compensation
25	Edgemere Landfill	Landfill Closure	Habitat Restoration / Enhancement
26	Gateway Master Plan	Development	Monitoring and Habitat Protection
27	Idlewild Park	Storm Sewer Runoff	Monitoring
28	DOT Garage	Storm Sewer Runoff	Monitoring and Inventory
29	Marinas	Contamination	Monitoring and Enforcement
30	Beach 88 to 92	Development	Modeling and Habitat Protection

Dredging & Hydraulic Alteration

31	Grassy Bay	Dredging, Hydraulic and Water Quality Alteration	Modeling and Habitat Protection
32	JFK Runway	Improve Circulation	Modeling, Habitat Enhancement / Restoration

Need More Information (NMI)

33	Edgemere Urban Renewal Area	NMI	
34	Airport Plaza Mall	NMI	
35	Brookville Boulevard Realignment	NMI	
36	Bergen Beach Ballfields	NMI	
37	Habitat Restoration for Stormwater Management	NMI	



NEW YORK - NEW JERSEY
HARBOR ESTUARY PROGRAM
Habitat Workgroup

ARTHUR KILL ISSUES MAP

(See Attached List for Site Descriptions)

Prepared By:

City of New York
Parks & Recreation
Natural Resources Group
Mapping & Design Lab

1234 Fifth Avenue, New York, NY 10029

Rudolph W. Giuliani, Mayor
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Susannah B. Cox, GIS Assistant

FEBRUARY 1999
NRG Map No. 9902-6AV

B. Arthur Kill Issues Map

Endangered Species Protection/Significant Habitat

SITE ID	NAME	ISSUE	RECOMMENDED ACTION
1	Decline of Colonial Wading Bird Breeding at Prall's Island	Invasive Species and Predators	Restoration of Canopy
2	Peregrine Falcon Breeding at Goethals Bridge	Significant Habitat	Continued Monitoring and Management
3	Seaside Sparrow Breeding at Saw Mill & Old Place Creeks	Significant Habitat	Continued Monitoring
4	West Branch of Elizabeth River	Significant Habitat	Continued Monitoring and Management

Habitat Loss

5	Arlington Marsh: Future of the City-Owned Wetlands and Uplands	NYS DEC Enforcement	Inventory and Protection
6	Fresh Kills Landfill	Closure and Future Use	Terrestrial Woodland / Wetland Restoration and Enhancement
7	Graniteville Swamp	Development	NYS DEC and US ACOE Protection / Watershed Protection
8	Vanbro & Sarnelli Operations: NYS DEC Violations / Water Quality Impact on Prall's Island	Enforcement and Contamination	NYS DEC / US ACOE Enforcement Action
9	Future Redevelopment of Port Ivory / Bridge Creek	Development	Inventory, Monitoring, and Ecological Protection
10	Howland Hook Expansion	Development	Inventory of Existing Marsh Systems
11	Proposed Development of Charleston Site	Development	Inventory and Monitoring
12	Goethals Bridge Pond: Impacts of Trailer Park Sewage Discharge and Construction of Home Depot	Enforcement and Contamination	NYS DEC Enforcement
13	Linden Hazardous Waste Facility (GAF)	Contamination	Monitoring

SITE ID	NAME	NAME	RECOMMENDED ACTION
14	Linden Municipal Landfill	Closure and Future Use	Ecological Restoration Potential
15	Proposed Bellemead Residential Development	Development	Protection
16	Reopening and Use of the Staten Island Rail Yard and Travis Line	Habitat Loss	Inventory and Habitat Restoration
17	Second Span for the Goethals Bridge	Development / Wetland Destruction	NYS DEC and US ACOE Protection

Dredging & Hydraulic Alteration

18	Dredging and Deepening of the Arthur Kill	Salt Marsh and Coastal Erosion / Dredging	Habitat Protection; Acquisition / Mitigation and Restoration Based on Scarcity of Resources and Habitat / Watershed Analyses
19	Dredging of Pumpkin Patch Brook, Robinson's Branch of the Rahway River	Salt Marsh and Coastal Erosion / Dredging	Habitat Protection; Acquisition / Mitigation and Restoration Based on Scarcity of Resources and Habitat / Watershed Analyses
20	Dredging of South Branch of Rahway River to Increase Channel Capacity	Salt Marsh and Coastal Erosion / Dredging	Habitat Protection; Acquisition / Mitigation and Restoration Based on Scarcity of Resources and Habitat / Watershed Analyses
21	Proposed Flood Control (Levee) at Maplewood, North Branch of the Rahway River	Hydraulic Alteration	Modeling, Monitoring, and Analysis
22	Proposed Flood Control at Milburn, North Branch of the Rahway River	Hydraulic Alteration	Modeling and Analysis
23	Drying Up of the Rahway River at West Bridge	Water Usage	Modeling, Monitoring, and Analysis

Needs More Information

24	Mouth of Bridge Creek	NMI	

CCMP Action H-3.3

Encourage and support local comprehensive plans for habitat protection.

CCMP Action H-4.4

Ensure that actions impacting habitat in the Harbor core area, in the aggregate, result in a net increase in the acreage and quality of aquatic habitat, where feasible and appropriate.

III. Zoning Options for Enhanced Habitat Protection

The HWG has examined different zoning options for enhanced habitat protection used in the Harbor/Bight region as well as innovative uses of zoning in other communities across the country. Summaries of relevant legislation are provided below.

A. Significant Habitat Designations

1. U.S. Department of Interior, Fish & Wildlife Service, Significant Habitats and Habitat Complexes of the New York Bight Watershed

The *Significant Habitats and Habitat Complexes* program identified significant coastal habitats in the New York Bight by regional geographic distribution, population and habitat status, and number of threats to key marine, coastal, and terrestrial species. Thirty-five habitat complexes were identified in the New York Bight Watershed, including Jamaica Bay, Raritan Bay, Arthur Kill Complex, Hackensack Meadowlands, the Narrows (Western Long Island Sound), and the Lower Hudson River Estuary. Maps have been produced for each area, along with descriptions of ecological communities, habitat sub-units, ownership or protected status, ecological importance, threats to long-term integrity, and recommended restoration strategies. While these designations can be used to bolster cases concerning the protection of these areas, the program does not have an associated regulatory branch.

For additional information, refer to Section 1, Part III of this report.

2. State of New York Department of State, Significant Coastal Fish and Wildlife Habitats

Designed to preserve the viability of designated habitats, the Significant Coastal Fish and Wildlife Habitats Program rates habitats using a quantitative system to identify the degree to which they:

- Are essential to the survival of a large portion of a particular fish or wildlife population;
- Support species which are endangered, threatened, or of special concern;
- Support populations that have significant commercial, recreational, or educational value; and
- Exemplify a habitat type that is not commonly found in the state or coastal region.

Habitats receiving a score above a specific threshold are recommended for significant coastal fish and wildlife habitat status, and are designated following public review and NYS DOS/DEC approval.

The program provides habitat narratives, maps, and information regarding the fish and wildlife resources that depend on these areas. The protocols of this program contain no prior assumptions that development will harm a habitat and should therefore be prohibited. Proposed development is reviewed on a case by case basis

with respect to critical parameters of each potentially affected habitat. NYS DOS will recommend measures that would mitigate likely impacts, and only those actions with unavoidable adverse habitat impacts are not approved. In New York City, significant coastal habitats exist at Lemon Creek, Fresh Kills, Prall's Island, Saw Mill Creek Marshes, Goethals Bridge Pond, and Shooter's Island in Staten Island; the Lower Hudson Reach in the Bronx and Manhattan; North and South Brother Islands and Pelham Bay Park Wetlands in the Bronx; Jamaica Bay in Brooklyn and Queens; and Little Neck Bay, Alley Pond Park, Udall's Cove, Meadow and Willow Lakes, and Breezy Point in Queens.

B. Means of Protection Currently in Use in New York State

1. Land Use Controls/ Mapping/Zoning

a. New York City Zoning Resolution, Article X, Chapter 5, Natural Areas Districts

Special Natural Area Districts are designated to promote and protect public health, safety, and general welfare. The goals are to:

- Guide development in areas of outstanding natural beauty in order to protect, maintain, and enhance the natural features of such areas;
- Preserve land with exceptional recreational or educational value;
- Protect aquatic, biological, and topographic features having ecological and conservation values and functions;
- Limit erosion associated with development by conservation of vegetation and protection of natural terrain;
- Promote the most desirable use of land and direction of building development in accordance with a well-considered plan;
- Promote the stability of residential development;
- Promote the character of the district and its peculiar suitability for particular uses;
- Conserve the value of land and buildings; and
- Protect New York City's tax revenues.

Outstanding natural features might be of value due to special size, composition, function, structure, history, association, location, ecological value, or educational interest. They may also be preserved to avoid such adverse conditions as flooding, erosion, or hazards to private property. Persons desiring to develop or alter sites within the special districts must apply to the NYC Planning Commission. All new developments and site alterations on primarily vacant land are reviewed. No natural feature may be removed, destroyed, or altered unless permitted by certification, authorization, or special permit of the City Planning Commission pursuant to special review provisions. The effects of alterations of a natural feature on the total ecological processes of the surrounding environment, including effects on the existing topography, soil conditions, erosion, natural flow of water, drainage, water quality, and animal, plant, and marine life, are considered in the review process.

Natural features are protected by limiting modifications in topography and preserving natural water courses; by preserving tree, plant, and marine life; and by requiring setbacks, curb restrictions, and clustered development. These special provisions require that vegetation that cannot be saved upon development be replaced with alternate vegetation of specific girth and species. Landowners are permitted to transfer development rights from designated open space to the remaining balance of their property. Special Natural Area Districts have been mapped and designated in the Greenbelt and Von Briesen Park areas of Staten Island, Riverdale in the Bronx, and Fort Totten in Queens.

b. Zoning Options

Several zoning options can provide natural resources protection.

i. *Overlay Resource Protection Districts* identify sensitive areas for protection. Bylaws or ordinances prohibit various uses and require special permits or performance criteria. Enforcement through visual inspection and on-site investigations ensures that land use conforms to the provisions of the zone.

ii. *Transfers of Development Rights* designate areas from which and to which development rights may be transferred and allow a receiving parcel to develop at a higher density than permitted by the underlying zoning district. A landowner whose property includes a protected area where strict land-use standards are enforced is thereby compensated.

iii. *Cluster/ Planned Unit Development Design* allows for more development in an area than would otherwise be permitted. Buildings are clustered more densely on the portion of the site most suitable for development

by decreasing setback requirements and lot size. In exchange, the rest of the site is preserved.

iv. *Growth Controls/Timing* serve as delay tactics while other management controls are implemented. These tactics include moratoria, limitations on the number of building permits issued annually, building caps, and subdivision phasing.

v. *Performance Standards* ensure that a given resource is not overutilized, enforce pre-existing standards, identify critical areas, and define thresholds for use.

c. Mapping as Parkland

Land is better protected when it is mapped as parkland. Parks mapping affords the greatest protection from development. However, the system does not provide complete protection, as parkland has competing uses and what is preserved as natural space under one administration may be converted to recreational use in a following administration. Demapping parkland requires an act of the State Legislature and is very rare.

Designating parkland as natural area reserves through Memoranda of Understanding and Memoranda of Agreement can guarantee its management as a natural area. More permanent protection can also be afforded by adding a "Natural Areas Designation" to the City Park Rules and Regulations.

Stronger, more permanent protection for natural parkland can be attained through amending a local law that mandates the preservation of a particular natural site in the City Charter. Such local laws were enacted in 1968 to mandate the preservation of the Thomas Pell Wildlife Refuge and Sanctuary and the Hunter Island Marine Zoology and Geology Sanctuary. Once designated, a public conservation land site cannot be diverted to other uses except by the legislative process.

2. Designation of Significant Status and Review Processes

a. Sole Source Aquifers

Under Section 1424 E of the Safe Drinking Water Act, the EPA is permitted to determine, on its own initiative or upon petition, whether an area having an aquifer that is a population's sole or principal source of drinking water requires special protection and should be designated as a sole source aquifer. To be a sole source aquifer, the aquifer must be the sole or principal source of drinking water for the area and, if contaminated, would create a significant hazard to public health and safety. No economically feasible alternative drinking water sources can exist within the area.

The EPA has designated all of Brooklyn and Queens as sole source aquifers. Designation means that any federally assisted project, receiving more than 1% and less than 100% of federal funding, must be reviewed by the EPA to determine whether there will be adverse effects on public health. Projects typically affected are airports and highway construction. Several states (*e.g.,* Washington) have expanded their laws to include projects that are not federally assisted.

b. DEC Critical Environmental Areas

Pursuant to SEQRA (State Environmental Quality Review Act) Section 617.4:J, a state or local government may designate a specific geographical area within its boundaries as a Critical Environmental Area (CEA). These areas must be of exceptional or unique character. This could refer to a feature that is a benefit or threat to human health; is an exceptional or unique natural setting; has exceptional or unique social, historic, archaeological, recreational, or educational value; or has inherent ecological, geological, or hydrological sensitivity to change and may be adversely affected by any physical disturbance. CEA designation means that all future actions occurring wholly or partially within or substantially contiguous to the CEA, requiring approval or funding, or directly undertaken by any state, county, or city agency, and would otherwise be classified as unlisted actions under SEQRA, will be reviewed as Type I projects under SEQRA. Type I projects have more extensive filing procedures, so CEA designation ensures the fullest procedural assessment under SEQRA. The designation also alerts project sponsors to the agency's concern for the resources contained in the CEA. Jamaica Bay, its tributaries, tidal wetlands, and upland areas within 150 feet of the wetlands that are under DEC jurisdiction have CEA status. CEAs do not have regulatory power and are not a development control.

c. New York City Administrative Code, Title 25, Chapter 3, Landmarks Preservation and Historic Districts

Landmarks Preservation and Historic Districts call for the protection, enhancement, perpetuation, and use of improvements and landscape features of special character or special historical or aesthetic interest or value. Landscape features are defined as any grade, body of water, stream, rock, shrub, tree, path, walkway, road, plaza, fountain, sculpture, or other form of natural or artificial landscaping. The Landmarks Preservation Commission can create landmarks after a public hearing. Once an area has been designated a landmark, the commission can, after public hearing, specify the nature of any construction, reconstruction, alteration, or demolition that may be performed on the landmark. Central and Prospect Parks are protected as Historic Landmarks.

3. Legislation

a. Clean Water Act

The Clean Water Act, established in 1972 and amended in 1977, is designed to protect, restore, and improve the quality of the nation's water resources. Section 404 establishes a separate national permit program for construction that will result in the dredging or filling of wetlands. The EPA has established criteria for permit issuance, but the permit itself is issued by the ACOE. Releasing or placing dredged or fill material into the nation's waters requires the permit. Applications are reviewed by other federal agencies including the EPA and US F&WS.

b. Endangered Species Act

The act, adopted in 1973 and amended in 1982, is designed to conserve threatened and endangered species and the habitats on which they depend. US F&WS Critical Habitat designation refers to areas essential for the survival of a threatened or endangered species. Section 9 of the act prohibits anyone from "taking" any species listed as threatened or endangered. "Taking," under regulations promulgated by the US F&WS, includes acts that kill or injure wildlife. This includes modification or degradation of habitat that results in death or injury to wildlife by significantly damaging the resources needed for survival, *e.g.* breeding, foraging, feeding, and sheltering areas.

c. New York State Waterfront Revitalization and Coastal Resources Act of 1981 (WRCRA)

This act authorizes NYS DOS, as the Coastal Management Agency under the Coastal Management Program (CMP), to concur with or object to federal and state actions affecting the coast. The CMP addresses competing objectives within or affecting the state's coastal area through a total of 44 policies, which are applicable to development and use proposals. DOS uses the information provided for each designated significant coastal habitat in a consistency review process. DOS disapproves of proposed actions that would significantly alter or destroy a designated habitat. A habitat impairment test is used to define how the ecological function of the designated habitat will be considered under existing environmental or regulatory review procedures.

New York City is required under state law to protect designated significant habitats and is encouraged to establish local land use controls for habitat protection. New York City received approval under WRCRA for its Local Waterfront Revitalization Program (LWRP), which established a coastal zone boundary within which all discretionary waterfront actions must be reviewed for consistency with coastal zone policies. LWRP incorporates the 44 state policies and an additional 12 policies specific to New York City into a simplified set of 10 policies. One policy mandates: "Protect and restore the quality and function of ecological systems within the New York City coastal area."

d. State Environmental Conservation Law (ECL)

NYS DEC regulates, through permits, activities in and adjacent to habitats defined in the following three articles of the ECL.

Article 25: *Tidal Wetlands*

"It is declared to be the Public Policy of the State to preserve and protect tidal wetlands, and to prevent their despoliation and destruction, giving due consideration to the reasonable economic and social development of the State." After completion of the wetlands inventory required by the law, the NYS DEC Commissioner adopted, in 1973, land use regulations governing inventoried wetlands, considering the present and potential value of the particular wetlands for

marine food production, as wildlife habitat, as an element of flood and storm control, and as a source of recreation, education, and research. Activities that are regulated include draining, dredging, excavation, and removal, both directly and indirectly, of soil, mud, sand, shells, gravel; dumping, filling, or depositing of any soil, stones, sand, gravel, mud, rubbish, or fill of any kind; erection of any structures or roads; driving of any pilings, or placing of any other obstructions, whether or not they change the ebb and flow of the tide; and any other activity within or immediately adjacent to inventoried wetlands which may substantially impair or alter the natural condition of the tidal wetland area.

Article 24: *Freshwater Wetlands*

"It is declared to be the Public Policy of the State to preserve, protect, and conserve freshwater wetlands, and the benefits derived therefrom, to prevent the despoliation and destruction of freshwater wetlands, and to regulate use and development of such wetlands to secure the natural benefits of freshwater wetlands, consistent with the general welfare and beneficial economic, social, and agricultural development of the state." Where freshwater wetlands do not meet the state's 12.4-acre minimum, wetlands of "unusual local importance" may be protected and/or regulated if species of local significance are identified.

Article 34: *Coastal Erosion Hazard Areas Act*

The Coastal Erosion Hazard Areas Act protects shoreline features. Pursuant to this act, NYS DEC has mapped coastal erosion areas where storm damage is likely to occur. The act states that any activity, development, or other action in such erosion hazard areas should be undertaken in such a manner as to minimize damage to property and to prevent the exacerbation of erosion hazards. In addition, it states that publicly financed structures intended to minimize erosion damage should be utilized only where necessary to protect human life, existing investment in development, or new development which requires a location within the erosion hazard area or adjacent coastal waters to be able to function. Areas of concern are the Rockaways, Coney Island, and the south shore of Staten Island.

e. City Environmental Quality Review Act (CEQR) Executive Order No. 91, August 1977

This Act requires environmental analysis for decisions on physical activities, such as construction projects, that change the use or appearance of any natural resource or structure.

f. State Environmental Quality Review Act (SEQRA) New York State Environmental Conservation Law, Article 8

Like CEQR, SEQRA requires an environmental review process for construction projects.

g. Legislative Review Process: Uniform Land Use Review Procedure (ULURP), New York City Charter, Chapter 8

Proposals and applications by any person or agency respecting the use, development, or improvement of real property subject to city regulation shall be reviewed pursuant to a uniform review procedure. These include changes in the City Map, designations of zoning districts, selection of sites for capital projects, acquisitions by the city, landfills, and housing or urban renewal plans. Applications are submitted to the Department of City Planning. Community boards must review proposals and the community must be notified of them. Applications are also referred to the Borough President and City Council. Determination is made as to whether the action is subject to City or State Environmental Quality Review.

4. Acquisition/Agreements

a. Land Acquisition

Land can be acquired either at a fair market price, bargain price, in installments, with a reserved life estate in which transfer occurs upon the death of the original owner, or by eminent domain. In the case of eminent domain, the community demonstrates the value of a given parcel in terms of the public good and takes ownership of the parcel while compensating the former owner.

b. Conservation Easement

An easement is a legal agreement between a landowner and a conservation organization (land trust) or government organization that regulates uses of a parcel of land with a set of restrictions written into a deed description. Easements allow for a limited right to use or restrict land owned by someone else. Public education, monitoring, and enforcement are key components of the process.

c. Land Banking

Land banks are generally nonprofit organizations that are involved in acquiring and managing land. They receive a percentage of fees generated by real estate transfers and use the money to fund land acquisitions.

C. Progressive Environmental Programs of Other Municipalities

1. Lake Oswego, Oregon

Oregon has instituted State Planning Goals that are implemented locally. For example, Goal 5 states that local jurisdictions must inventory natural resources (open space, mineral resources, energy sources, fish and wildlife habitat, scenic sites, watersheds, wilderness, and other resources defined by the state), along with their location, quality, and quantity. Analysis of the inventory considers the consequences of full protection, no protection, and partial protection. In determining protection designation, an Economic, Social, Environmental, and Energy (ESEE) analysis of competing uses is conducted. The program is designed to protect open space, scenic areas, historic areas, and natural resources, and promote healthy and visually attractive environments in harmony with the natural landscape character.

Localities develop their own sets of objective rating standards. For instance, the City of Lake Oswego has developed a rating system based on habitat concerns and scenic and social values, including recreational use and proximity to education centers. Areas are judged by a private consultant and then mapped, designated with Resource Protection (RP) or Resource Conservation (RC) status, and placed on a Sensitive Lands Map. RP districts prohibit new development within the district. If development is permitted, the applicant must mitigate for damages to natural resources, including compensation for lost use. RPs require buffer districts, regulate the removal and replacement of vegetation, and limit the placement of public utilities and streets. RPs also require mitigation plans with native plants at a ratio of 1:1 for stream corridors and tree groves, and 2:1, 3:1, or 5:1 for wetlands, depending on the specific circumstances of each site. RC districts ensure that new development and alterations limit disturbance and maintain the functions and values of resources within the district. No development may occur within the portion designated an RC Protection Area, and development within the remaining areas must comply with specified criteria (setbacks, specific types of plants for revegetation, and limited locations and sizes of features such as roads).

Lake Oswego's local ordinance generally restricts all development within a buffer zone around significant stream corridors and wetlands. Buffer zones extend 25 to 30 feet from the edge of the stream corridor. Lake Oswego is also developing protection for tree groves, in which at least half of the trees in a mapped grove will receive full protection; the City designates which half. The regulations also specify types of activities that are not permissible and what mitigation must occur if a specific feature is disturbed. The objective criteria and regulations must be approved by the City Council and the State Land Conservation and Development Office, which ensures that the regulations are consistent with state goals.

2. Boulder, Colorado

a. Open Space Program

Boulder has instituted a program to acquire, preserve, protect, and manage open space. An Open Space Board of Trustees sets policies and priorities for acquisition and management of open space consisting of natural areas, water resources, scenic areas, wildlife habitat, passive recreation areas, and agricultural lands. Open space may not be improved after acquisition unless such improvements are necessary to protect or maintain the land. Since 1967, Boulder has imposed a 0.73% sales tax for the acquisition, management, and maintenance of open space. To date,

over 29,000 acres of land have been preserved and protected.

b. Environmental Assessment and Mitigation (EAM)

The City of Boulder adopted environmental objectives in 1994 as part of amendments to the land development review processes. The EAM process codifies the city's development standards as promoted through the development review process. Development site reviews aim to protect and preserve the natural and urban landscape, and avoid, minimize, and mitigate potential impacts on natural systems. Impacts on natural areas can result from vegetation removal, human encroachment, chemical pollutants, invasive growth of non-native species, hydraulic alteration, and increased sedimentation. Development site reviews also consider impacts on adjacent areas by construction activities, impacts on wetlands, and geology and soil assessments. In addition to natural areas, EAM focuses on water quality, air quality, noise pollution, light pollution, and resource conservation. Issues are specified in the identification step, and an applicant for a development project must address the issues in conceptual and site reviews.

c. Wetlands Protection Ordinance

Adopted in 1992, the Wetlands Protection Ordinance is a Boulder land use law that strengthens the Clean Water Act, Section 404. In an effort to ensure no net loss of wetland acreage or function, Boulder has established a local permitting program for certain activities in and around wetlands. Boulder negotiates agreements to protect wetlands owned by other governmental entities, purchases significant wetlands, provides technical assistance to property owners, and reviews new public projects. Buffers of 25 to 50 feet surrounding non-significant and significant wetlands, respectively, are also regulated. Avoidance and minimization of wetlands disturbance are encouraged, and, in the case of disturbance, mitigation is required.

d. Growth Management System

For non-residential development, an allotment of floor area is available each year in two categories: first-come, first-served and community priority projects. For 1997, 467,500 square feet of floor area was allotted. The rate of residential growth in Boulder is regulated to no more than one percent per year, with a total of 375 allocations in 1997.

3. Metro Portland (24 Cities and 3 Counties), Oregon

In the past five years, several steps have been taken by Metro (the regional government) to effectively plan for the growth of the Portland regional area. These steps include the adoption of Regional Urban Growth Goals and Objectives to provide a policy framework for guiding Metro's regional planning program and the Metro 2040 Growth Management Program to explore how the region can accommodate expected growth. The first step of the 2040 plan established a Growth Concept, which was adopted in 1995. A regional framework to implement these ideas was developed for adoption in 1997.

The Greenspaces program is a growth management strategy devised by Metro for protecting open spaces and scenic habitats. It is a planning document that will be incorporated into the regional framework as the strategy for implementing goals concerning natural areas. Following is a summary of each of these programs.

a. Regional Urban Growth Goals and Objectives

Metro is required by Oregon state law to develop a set of goals and objectives that provides a policy framework and process for guiding the regional planning program. The Regional Framework Plan to be developed must be consistent with the Regional Urban Growth Goals and Objectives. Goal 1, the Regional Planning Process, deals with coordinating issues in the region by providing a process to address areas of regional significance. Goal 2, Urban Form, focuses on the natural environment, stating that "preservation, use, and modification of the natural environment of the region should maintain and enhance environmental quality while striving for stewardship and preservation of a broad range of natural resources." The Regional Urban Growth Objectives include developing a long-term regional strategy for comprehensive water resources management; encouraging the use of techniques that rely on natural processes to address flood control, stormwater management, and non-point pol-

lution reduction; encouraging redevelopment and reuse of developed property for commercial or industrial purposes whenever economically viable and environmentally sound; and developing an urban growth boundary that separates developable land from rural land, based on 20-year projected need for urban land. Objectives also focus on air quality, water quality, and preservation of open spaces.

b. 2040 Growth Concept

The Metro 2040 Growth Concept describes the preferred form of regional development to guide growth for the next 40 years. It encourages compact development near existing or future transit to reduce rural land consumption and conversion of rural land to urban uses, promotes the preservation of existing neighborhoods, identifies "rural reserve areas" as areas not subject to urban growth boundary expansion, and sets goals for providing permanent open space areas inside the urban growth boundary. Urban growth boundaries were created as part of Oregon's statewide land-use planning program in the early 1970s. The boundaries mark the separation between rural and urban land.

c. 2040 Regional Framework

This plan, adopted December 31, 1997, specifies how the region and local communities will implement the Growth Concept and provides performance standards for local governments to meet. The 2040 Regional Framework protects rural reserves, designated for farms, forestry, natural areas, or rural residential use, from development pressures. Designating land as open space (parks, stream and trail corridors, wetlands, and floodplains) removes it from the category of urban land that is available for development. As such, the capacities of urban growth boundaries, as well as plans for housing and employment, have to be calculated without these areas. In addition, these designated areas receive high priority for purchase through the Greenspaces program. Regulations could be developed to protect designated critical natural areas that would not conflict with housing and economic goals. Preservation of designated areas could be achieved through purchase by public entities (Greenspaces), donations, or environmental zoning that allows very low-density residential development by clustering houses on portions of the land. Additional areas of focus are land use, transportation, and water.

d. Greenspaces Program

Greenspaces is the growth management strategy for protecting scenic open spaces and wildlife habitats. It is written as a planning document to implement goals relating to natural areas, specifically Objective 9 of the Regional Urban Growth Goals and Objectives: "[T]o establish an open space system capable of sustaining or enhancing native wildlife and plant populations." Greenspaces is recommended for voluntary consideration in the preparation, administration, and periodic review of comprehensive plans and the implementation of land use regulations and regional functional plans. As such, Greenspaces serves as the basis for improvement and operation of sites by local governments, special districts, non-profits, and Metro. It is the basis of the open spaces portion of the Regional Framework and, when incorporated into the framework, it will serve as a binding document.

Greenspaces offers a cooperative, regional approach among public and private organizations to establish an interconnected system of natural areas, open space, trails, and greenways. Greenspaces' Master Plan identifies natural areas within the urban parts of the region, evaluates their significance, and proposes a system of regional natural areas and connecting corridors to be designated for preservation and management. It calls for cooperative efforts to acquire and protect a system of greenspaces, prepares management plans and standards for the system to guide development, and operates and maintains the components. It offers policy and implementation recommendations for protecting natural areas, but does not offer specific regulations. Acceptable maintenance, types and levels of programmed use, and development standards are established for all portions of the Greenspaces system. A communications and education network and stewardship programs are also important facets of Greenspaces. In addition, it offers technical assistance and advice to landowners, developers, and public officials on environmentally sound land management practices and design concepts for sensitively integrating development with natural resources and the landscape.

Andrew Bergen, NYC Parks/NRG wetlands scientist, monitors a salt marsh restoration at Old Place Creek, Staten Island.

Section 3

Restoration and Monitoring Protocols

In 1998, the NYS DOS Division of Coastal Resources initiated proposals to standardize restoration monitoring protocols related to public works mitigations, natural resources damages claims, and grant awards. Concurrently, the HEP HWG drafted monitoring protocols to be incorporated into public works mitigations, habitat restoration contracts, and natural resource damage recovery plans. The HWG has examined objective monitoring criteria for wetland and forest ecosystems that extend beyond the usual measurements of planting success. HEP's effort was prompted by a national statistic that an overwhelming majority of restoration projects ultimately fail to restore ecosystem structure and function.

By requiring and standardizing monitoring, a great amount of data that can be used to design successful habitat restoration projects will be made available. For example, NYC Parks has been collaborating with the National Marine Fisheries Service (NMFS) to assess fish abundance and diversity, as well as the duration of feeding by wading birds, associated with restored marsh systems. NMFS and NYC Parks have extended this monitoring to include fish stomach content analyses, a faunal benthic community survey, tests for trace metals and hydrocarbon contaminants in ribbed mussels, multiple stable isotope ratio analysis of the salt marsh food web, and studies of sediment geochemistry.

The HWG recommends that a minimum of five years of monitoring be required of all habitat restoration projects. Parameters examined in a generalized salt marsh monitoring protocol include measurements of primary production, colonization by benthic invertebrates, and utilization by macrofauna. Parameters examined in a forested ecosystem monitoring program are more complex than those of a salt marsh monitoring program and include classification of the soil type, characterization of the humus and leaf litter, and evaluation of the species composition of ground-cover, shrub, seedling, and tree canopy layers.

The $1.2 million salt marsh and woodland buffer mitigation for the La Guardia Safety Overrun costruction, funded by the Port Authority of NY&NJ, showcases the coordination of a sound restoration with a thorough monitoring protocol. A five-year HEP-endorsed monitoring program has tracked the success of this 18-acre restoration, completed in 1998. NYC Parks/NRG has used similar protocols in restoration projects over the past decade in the Arthur Kill, Staten Island; Little Neck Bay, Queens; and Coney Island Creek, Brooklyn.

The following are sample monitoring protocols generated by the HWG. The salt marsh monitoring protocol was developed by NYC Parks/NRG in cooperation with NOAA's scientific peer review and US F&WS and has been adopted by NYS DOS & DEC. The forest monitoring protocol was developed by NYC Parks/NRG Forest Restoration Team. Upland planting specifications, from NYC DEP, are also included at the end of this section.

CCMP Objective H-10

Complete ongoing research and initiate special studies on habitat issues.

CCMP Action H-10.4

Assess the success of past habitat restoration efforts.

I. Salt Marsh Monitoring Protocol

Draft of the Tidal Wetlands Restoration Recommended Monitoring Protocol

These guidelines were developed by Andrew Bergen, NYC Parks/Natural Resources Group (NRG), and revised by the NYS DOS Division of Coastal Resources, with input from the HEP Habitat Workgroup.

1. Principal Parties Involved

A. Responsible Party (RP): The party responsible for carrying out all mandated restoration requirements will be referred to as the Responsible Party (RP). Restoration activities include the development and implementation of a monitoring protocol to assess the progress of the ongoing restoration and to evaluate the success or failure of the restoration at the conclusion of the monitoring period (a period ≥ 5 years is recommended).

B. Designer: The Designer in the employ of the RP designs the restoration and, in collaboration with the Ecologist, integrates into the site plan all monitoring specifications, including:
a. Location of transects
b. Location of quadrats
c. Location of permanent photo points
d. Code for identifying all transects, quadrats, and photo points

C. Ecologist: The Ecologist in the employ of the RP assists the Designer in planning and implementing a site-specific monitoring protocol. In collaboration with the Designer, the Ecologist carries out all phases of the monitoring from the design through completion of the project. Should the site be part of Superfund or other mandated remediation, the monitoring plan must include appropriate assays assessing the reduction of those priority pollutants of concern.

D. Contractor: The Contractor(s) in the employ of the RP construct(s) the restoration and is (are) responsible, along with the Designer and Ecologist, for maintaining transects, quadrats, and permanent photo points for monitoring efforts. When a Contractor is not required for restoration, all site manipulation and maintenance activities are generally the responsibility of the RP.

E. Regulator: The Regulator(s) in the employ of the city, state, or federal government is (are) responsible for approving restoration designs and monitoring protocols and for obtaining any required permits for restoration activities. The Regulator also determines when the restoration is complete by assessing all aspects of the project.

F. Volunteers: Volunteers may be involved in conducting monitoring activities. They may require training and are usually supervised by and/or report to the RP.

Note: The Designer and the Ecologist may be the same person, and this person may also be the RP. The RP is generally responsible for ensuring fulfillment of all monitoring requirements, including those of the

Designer, Ecologist, Contractor(s), and Volunteers as specified in the work plan, and is responsible for reporting as specified to the Regulator(s) when applicable.

2. Purpose of Monitoring

The purpose of monitoring is to assess the success or failure of the salt marsh restoration. Success is defined as the establishment of the desired salt marsh habitat.

A. Salt marsh habitat is defined by accepted standards of salt marsh function:

a. Primary productivity
b. Vegetation development
c. Soil properties
d. Colonization by benthic invertebrates
e. Utilization by macrofauna

B. Five years of monitoring is the minimum required to determine the above functional standards and maintain the site in case of damage by geese, wrack, ice, and debris.

3. Monitoring Protocol Design

It is recommended that all salt marsh restoration project transects, 1.0 m^2 quadrats, and fixed-point photo stations be planned and located according to the guidelines described below. A comprehensive work plan should always be written by the RP for any restoration project undertaken, including any site-specific modifications to the recommended monitoring protocol, where necessary and appropriate. All monitoring parameters and activities, whether the recommended protocol below or some other appropriate protocol, should be clearly articulated and documented in the comprehensive work plan in a manner similar to, and at a level of detail equal to, the guidelines below. All transects, 1.0 m^2 quadrats, and fixed-point photo stations should be assigned location codes, and this information should be documented on the official site map and in the work plan for the restoration project.

All monitoring, except where noted below, should be conducted at the restoration project site and at an appropriate reference site. This reference site will consist of, at a minimum, *a single control transect (including 3 quadrats)*, and must be located contiguous with or nearby the restoration site, and similar in morphology and vegetation zones (*i.e.*, compare restored high marsh with nearby unrestored "natural" high marsh; restored low marsh creek bank with nearby unrestored "natural" low marsh creek bank). An additional requirement of the reference site is that all major vegetation zones of the restoration site must be matched at the reference site. Therefore, additional transects at the reference site may be needed to provide control data for all applicable vegetation zones or morphological features.

The purpose of the reference site is to help discern background environmental effects from the effects attributable to the restoration project. For example, vegetation parameters at a restoration site must be compared with the same parameters at a nearby reference site to determine whether an observed loss of vegetation is a restoration failure or is the result of a natural event, such as a hurricane or winter storm that has similarly affected all the marshes in the area.

Salt Marsh Monitoring Protocol

A. Transects: *A minimum of 3 transects*, evenly spaced across the site, should be used for all restoration projects. For large sites, transects should be evenly spaced, and although an absolute minimum of three transects is required, a larger number of transects is recommended based on the acreage to be covered and the number and type of vegetation zones present. Transects should run perpendicular to the main channel and/or parallel with the elevation gradient, across the restoration site approximately from the seaward edge of the *Spartina alterniflora* zone (*i.e.*, encompassing traditional areas of occurrence for *Geukensia demissa* and/or *Fucus spp.*) to the mean high water mark. Transect locations should be permanently marked at the upland and seaward ends using stakes that are sturdy and will be easily located.

During monitoring visits, a tape measure should be used to mark the transect line, starting at the upland end. Hook the tape measure onto the upland stake and walk toward the seaward transect end. To minimize trampling of the site, do not walk directly to the seaward transect end. Rather, walk diagonally from the upland marker toward some point a short distance away from the actual seaward marker, but in line with the marker, to either the right or left. When you are in line with the seaward marker, walk to it and wrap the measuring tape around the stake, making sure it is taut. This forms a transect line between the upland and seaward stakes. This procedure should be repeated for all pairs of upland/seaward transect ends at the restoration site.

Noteworthy features occurring along each transect should be recorded relative to the distance marked on the tape measure. It is imperative that a notation be made stating that the upland marker is being used as zero distance, and that the same end be consistently used as zero distance for all transect monitoring at a restoration site.

B. Quadrats: Quadrats (1.0 m^2) should be placed along the transects at a *minimum of three different elevations* (*i.e.*, a minimum of three quadrats) between the seaward edge of the *Spartina alterniflora* zone and the mean high water mark, including, as applicable, all vegetation zones present. Within a single vegetation zone (*e.g.*, low marsh *Spartina alterniflora* zone), quadrats must be located *at least 3.0 meters apart* along the length of the transect. Quadrats will be placed randomly anywhere within an area 2.0 meters to either side of the measuring tape transect line. A stake, bar, length of PVC pipe, or other item 4.0 meters in length, carried or placed on the ground with 2.0 meters length extending on either side of the centerline, can be used to demarcate this area during monitoring visits. Placement of quadrats can be accomplished by walking in a zigzag pattern back and forth across the demarcated area along the entire length of the transect line, dropping quadrats randomly (with the exception of deliberate inclusion of all vegetation zones present and/or deliberate placement of quadrats >3.0 meters apart within a single vegetation zone). After placement, the location of quadrats in terms of the distance marked on the tape measure where they were placed should be recorded, *e.g.*, distance from zero of the upper corner and distance from zero of the lower corner of the quadrat (such as: 4.3m - 5.3m). This should be done for all quadrats along all transects at the restoration site.

C. Permanent Fixed-Point Photo Stations: The permanent transect marker stakes (seaward end and upland end) should also be used as permanent photo stations for photographic monitoring. Photographs should be taken facing the seaward transect marker from the upland transect marker and facing the upland transect marker from the seaward marker. This should be done for all pairs of transect ends at the restoration site. Also, a location that provides an overview photograph or photographs of the entire restoration site should be identified and consistently used for the duration of photomonitoring. All photographs should

be taken at low tide (avoiding spring tide and full moon periods) and should be labeled with the location code, direction of view, date, time, and tide, if ambiguous. All photographs should be in the form of prints no smaller than 4" x 6" and must be in color.

D. Video Monitoring: Use of video monitoring is encouraged to supplement photomonitoring and provide additional qualitative information that cannot be provided by standard photographs. This includes close-up images of vegetation, benthic epifauna, and substrates. Panoramic filming of the site is also encouraged. The restoration site should be walked by the video monitor, using the transect lines as guides. Cards may be filmed, or voice may be used, to give the required information, such as location code, date, time of day, direction of view, and tide. At each transect end, the location code and direction of view should be identified. Close-up views should be filmed of all vegetation zones occurring along the transects.

4. Pre-Restoration Monitoring Activities

On sites where *planting is planned*, a complete set of color photographs should be taken, including all permanent fixed-point stations (transect ends and elevated overview), upon completion of the design phase and prior to any construction activities. Photographs should also be taken at the reference site.

On sites where some marsh habitat already exists, (*e.g.*, formerly connected marshes, grid ditched marshes) and *no planting is planned*, all parameters described below under ***Post-Manipulation Monitoring: Annual for Five Years*** should be monitored once prior to the restoration at both the restoration site and the reference site. At a minimum, all parameters should be monitored once during the last week of August prior to the restoration. May and/or December parameters specified below can be included in the pre-restoration monitoring during the year prior to the restoration at the discretion of the RP or other overseeing entity.

5. Post-Manipulation Monitoring: Four to Five Weeks Post-Planting/Manipulation

A. The restoration site should be walked by the RP, the Ecologist, and/or the Regulator(s) four to five weeks post-planting/manipulation to assess compliance with submitted work plans.

B. Permanent fixed-point photo stations: A set of color photographs should be taken at this time at all permanent fixed-point photo stations articulated above, for the restoration site and the reference site. All photographs should be taken at low tide (avoiding spring tide and full moon periods) and should be labeled with the location code, direction of view, date, time, and tide, if ambiguous. All photographs should be in the form of prints no smaller than 4" x 6" and must be in color.

C. The Regulator(s), the RP, or some other overseeing entity should determine, based on the four to five week post-manipulation assessment, whether any additional work is required to achieve work plan compliance.

6. Post-Manipulation Monitoring: Annual for Five Years

A.Vegetation: The vegetation parameters found below should be monitored for the restored, reference, and existing vegetation at the site. Parameters should be monitored once annually in the last week of August or first three weeks of September. All quadrats should also be assessed once before planting. All results should be submitted to the Regulator.

a. Percent cover: Percent coverage of each m^2 quadrat is assessed annually. Each m^2 quadrat is scored from 0 - 1.0 by assessing visually the percentage of the m^2 quadrat covered by the basal and areal portions of vegetation.

b. Stem density/m^2 quadrats: Vigor of individual quadrats is measured at the various elevations monitored. All stems in each m^2 quadrat are counted annually. Stems identified as late summer cohorts and dead are not counted.

c. Flower density/m^2 quadrat: Vigor and potential of seed to act as a colonizer of marsh beyond the extent of the restoration site is measured. All flowers in each m^2 quadrat are counted annually.

d. Plant height: Heights of six plants are measured in cm within each m^2 quadrat. Plants from each corner of the quadrat and from two points in the center of each quadrat are randomly selected and measured annually.

e. Basal area of plants: Vigor of the individual plants in the first two years after planting is measured. The cross section of the base of six plants in each m^2 quadrat should be measured in cm annually.

f. Rhizome spread of plants: Lateral, rhizomonous spread of individual plants in the first two years after planting is measured. Emergent rhizomes are measured in cm from the parent plants in each m^2 quadrat annually.

g. Signs of disease or pests: Disease and pests, such as rust or goose or muskrat predation, should be assessed and recorded for each m^2 quadrat.

h. Vegetation Zones: Walk along the measuring tape that demarcates the transect line, starting at the seaward transect end, noting the distance marked on the tape at the transition between vegetation zones and the dominant species composition of these zones.

B. Fixed-Point Photo Stations: Color photographs should be taken from all designated locations once annually for 5 years at the time of vegetation monitoring, for both the restoration site and the reference site. The permanent transect marker stakes (seaward end and upland end) should be used as photo stations for the photographic monitoring. Photographs should be taken facing the seaward marker from the upland marker, and facing the upland marker from the seaward marker. This should be done for all pairs of transect ends at the restoration site. Also, an overview photograph or photographs of the entire restoration site should be consistently used in all photomonitoring. Photographs should be taken at low tide (avoid spring tide and full moon periods) and should be labeled with the location code, direction of view, date, time, and tide condition. All photographs should be in the form of prints no smaller than 4" x 6" and must be in color.

Video monitoring, if used, should also occur at the time of vegetation monitoring, annually for 5 years.

C. Soil Properties: The following parameters should be monitored once annually for 5 years, at the time of vegetation monitoring (during the last week of August or the first three weeks of September, at low tide, avoiding spring tide and full moon periods). All soil property parameters should be measured twice in all quadrats placed along the transect line.

a. **Soil organic matter:** Sediment cores (2 per quadrat) should be sampled to 10 cm depth using a cylindrical push corer ~5 cm in diameter. Soil organic matter from marsh substrates may be measured by loss on combustion. Samples for this procedure are dried, weighed, combusted at 500 degrees Celsius for ~8 hours, and weighed again.

b. **Soil salinity:** The salinity of the soil may be determined in the field using a refractometer. Pore water from a small soil sample is squeezed onto the lens of the refractometer, and the resulting salinity reading is recorded as "soil salinity." Pore waters with high concentrations of suspended solids may require rudimentary filtration in the field. In these cases, squeeze pore water through filter paper before testing.

D. Benthic Invertebrates: The parameters below should be monitored in all m^2 quadrats for 5 years annually for the restored, reference, and existing vegetation at the site. All quadrats should also be assessed once before planting. All results should be submitted to the Regulator(s).

a. **Ribbed mussels:** All live and dead ribbed mussels (*Geukensia demissa*) should be counted in each m^2 quadrat. Six mussels (or fewer, as appropriate) should be measured lengthwise in each m^2 quadrat. March is the best time of year to find and measure ribbed mussels.

b. **Fiddler crab burrows:** All fiddler crab (*Uca spp.*) burrows should be counted in each m^2 quadrat. The presence of live fiddler crabs should also be recorded, where applicable. March is the best time of year to assess fiddler crab burrows.

c. **Other benthic invertebrates:** The presence of additional species observed *(e.g., Melampus bidentata)* and the number of individuals (when practical) should be recorded both within quadrats and along the length of the transect line.

E. Macrofauna: The parameters below (except ***Other Macrofauna***) should be monitored for the restored sites *once monthly in May and August* for 5 years. *Monitoring of bird species will not generally be required for the reference site*, unless the specific goals of the restoration project target these parameters. In this case, at minimum, the monitoring protocol below should be conducted at both the reference site and the restored site. The RP or some other overseeing entity may design additional monitoring plans for bird species.

Birds should be observed from an obscured location on the upland side of the restoration site, unless site-specific characteristics require otherwise. Where this is the case, a location should be identified that will minimize disturbance to bird species at the site when the monitor approaches. In every case, the location must be documented, assigned a location code, and must be accessible in future monitors. During bird observation, the monitor should record sightings as described below for a 1-2 hour period between low and mid-tide. Time of day and tidal condition must be recorded on all observation sheets, as well as the location code and direction of view from the chosen viewing station.

a. **Saltwater-fish-feeding birds:** Presence, duration of stay, general location, and activity should be recorded for wading birds, *e.g.,* great egret (*Ardea alba*), snowy egret (*Egretta thula*), tricolor heron (*Egretta tricolor*), black-crowned night heron (*Nycticorax nycticorax*), and other appropriate species, if observed.

b. **Benthic-invertebrate-feeding birds:** Presence, general location, duration of stay, and activity should be recorded for wading birds, *e.g.,* little blue heron (*Egretta caerulea*), yellow-crowned night heron (*Nyctanassa violacea*), and other appropriate species, if observed.

c. **Winter waterfowl:** If resources are available and the goals of the restoration are compatible, waterfowl species can be monitored *once annually in December.* Species, abundance, general location, activities, and duration of stay should be recorded.

d. **Other bird species:** Sightings of additional birds should be recorded, including species, abundance, general activities, location, and duration of stay.

e. **Other macrofauna:** The presence of, or reasonable evidence of the presence of, any other macrofauna (small mammals, horseshoe crabs, terrapin) at the site, observed *during any site visit,* should be recorded.

7. Monitoring Report Requirements

Annual monitoring reports should be written and submitted to the Regulator(s), when applicable, and/or some other pre-designated central repository, beginning after the first post-planting or post-manipulation growing season. All data and photographs, labeled as described above, should be included, as well as a brief summary of the collected data. All length measurements should be reported using the metric system.

8. Recommended Monitoring After Five Years

It is recommended that photomonitoring for all restoration sites continue for an additional three to five years following the conclusion of the initial five-year monitoring period. Photomonitoring during years five to ten should occur at a minimum of once annually during the last week of August or the first three weeks of September, and consist of the same site overview and photographs as described above at all of the same permanent transect photo stations used during the initial monitoring period. The additional three to five years of photomonitoring records should be labeled, stored, and distributed in the same manner as during the initial five-year monitoring period.

II. Forest Monitoring Protocol

Draft of the Forest Restoration Recommended Monitoring Protocol

This document was drafted by Paul Kortebein, NYC Parks/Natural Resources Group Forest Restoration Team, and Dr. Margaret Gargiullo, NYC Parks/Natural Resources Group.

1. Purpose of Monitoring

The purpose of monitoring is to assess the efficacy of a restoration over time. It is a way to systematically monitor mortality of plants due to animal predation, fire, vandalism, and disease, as well as the establishment of desirable species.

A restoration is considered successful if it improves several key desired functions of the forest ecosystem.

A. Desired functions of the forest ecosystem include:

a. Varied plant structural and species composition
b. Adequate regeneration of desired species
c. Control of invasive exotic species
d. Stabilization of soil mantle
e. Adequate recolonization by micro- and macrofaunal populations

B. Forest regeneration is a slow process. The ultimate goal is to achieve canopy closure, but that cannot be expected for 25-30 years on most open sites. For deciduous forests in the northeast region, a minimum of 5 years is required to determine if the above functions have been established and maintained.

2. Monitoring Protocol

Forest restoration protocols will differ depending on the level of detail required. The protocols outlined below are intended to monitor seedling survival and forest and soil structure of northeastern deciduous forests. It is important to determine the goals of each monitoring regime prior to any on-site work. Once these goals have been established, it is critical to choose the correct method of monitoring, which will depend on site-specific parameters. A combination of methods may be required. For all monitoring, it is recommended that a comprehensive monitoring plan be developed, including monitoring parameters and any site-specific modifications to the monitoring protocol, before any on-site work is performed.

Forest restoration monitoring for seedling survival should be established immediately after a planting. Monitoring for regeneration and forest structure should begin prior to any on-site work to establish baseline data. Monitoring for both protocols should be performed once a year for a minimum of 5 years. Reference sites on which no restoration work is performed should be identified in ecologically similar areas and monitored identically. The number of plots and transects will depend on several variables, including overall restoration area, planting variability, variability in site conditions (*e.g.*, shade and aspect), and time and labor constraints.

A. Seedling Survival (*adapted from the NYC Parks Urban Forestry Education Program manual*)

This method follows the success or failure of tree plantings. It is important to install plots soon after the planting is finished so that planted specimens are easily distinguished from volunteers.

Equipment required

1. compass
2. tape measure (100 m)
3. diameter breast height (dbh) tape (metric)
4. clinometer (for obtaining % slope)
5. *Seedling Locator Form* (1 per plot); see Figure 1
6. *Tree Measurement Form* (1 per plot); see Figure 2

Plot placement

The number of plots should be based on the following formula:

Table 1

Planting Area [m^2 (acres)]	# of Plots
> 2400 (> 0.6)	3
< 1200 (< 0.3)	1
1200-2400 (0.3-0.6)	2

If the planting area is unknown, a rough estimate can be made by measuring the distances between several seedlings (given that the seedlings are spaced relatively uniformly). Take the mean of these distances, square it, and multiply by the number of seedlings planted.

Plot size should be 36 m^2 (6 m on a side). Each plot is to be randomly located within the planting. Start by locating a single point within the planted area. This will be the starting corner point of the plot. Identify at least one witness tree (a tree with a distinguishing feature, for example) and carefully record the distance and azimuth (degrees from north) from the starting point to the center of the witness tree. It is advisable to use magnetic north rather than setting the declination on the compass. Mark the base of this tree with a small dot of spray paint to facilitate relocation. This starting corner may also be marked, either with a metal survey shiner or a flagged stake. Metal shiners must be relocated using a metal detector, but will draw less attention to the plot.

Using the tape measure, lay out a line 6 m in length in a random direction, recording the azimuth on the *Seedling Locator Form*. Place a second survey shiner or flagged stake at this point. Set the compass at 90° from this line and measure another 6 m for the third corner. Repeat this step to get the fourth and final corner point. It is helpful to place grid lines at 1 m intervals through the plot, creating 36 1 m^2 sections.

Measurements

Note the slope and aspect (*e.g.,* northwest facing) of the plot using the clinometer and record on the *Tree Measurement Form.*

Using the *Seedling Locator Form,* start at one end and work through the plot, 1 m^2 section by 1 m^2 section, recording the location of every tree seedling. Record the corresponding information for each seedling on the *Tree Measurement Form.* Species name can be abbreviated using the 4-letter scientific abbreviation (the first two letters of the genus and species).

Tree height is to be measured from root collar (where the tree stem meets the ground) to the tip of the tallest branch, excluding foliage, to the nearest 0.5 cm. If the tree is leaning or drooping, stand it erect and measure to the tallest leader. Record these data on the *Tree Measurement Form.*

Diameter at breast height (dbh) can be substituted for trees that are too tall to measure. Measurements are taken at 1.37 m (4.5 ft.) above the ground using a metric diameter tape. Record dbh to the nearest 0.1 cm.

Note any animal browse, top dieback, death, vandalism, or other comments on the *Tree Measurement Form.*

These data will provide mean seedling height, mean annual growth increment, and survival and indicate problems with predation or vandalism.

B. Monitoring for Forest Structure/Regeneration *(adapted from Stewart, 1988 and Penn State REGEN Model)*

This method tracks trends in forest development, such as natural regeneration, the presence of groundcover vegetation, and vertical structure. Monitoring should be implemented prior to any on-site work to compile data on conditions prior to restoration of the site.

This protocol combines two sampling methods. The first is used to determine the regeneration state of desirable species on the site. The second is used to determine understory species composition and canopy cover. The combination of methods provides a comprehensive view of the overall health and vigor of the restoration area. As with the Seedling Survival protocol, reference sites should be identified in ecologically similar areas and monitored identically for each of the techniques outlined below.

Equipment required

1. compass
2. tape measure (100 m)
3. spherical densiometer
4. clinometer (for obtaining % slope)
5. *Forest Regeneration Data Sheet* (1 per plot); see Figure 3
6. *Understory Monitoring Data Sheet* (1 per plot); see Figure 4

a. Natural Regeneration Monitoring

This method is used to track natural regeneration of the major desirable tree species of the northeastern deciduous forest. "Desirable," defined as all commercial tree species native to the region, also includes all the ecologically desirable species of the northeast. Desirable species are divided into two categories as follows:

Table2

Fast Growth	Slow Growth
Red Maple	All Oak species
Yellow Poplar	Hemlock
Black Birch	White Pine
Aspen	Beech
Black Cherry	Sugar Maple
White and Green Ash	All Hickory species

Plot size should be 4 m^2. Randomly locate an initial point within the study area as the starting point for the first transect. Plots should be randomly spaced along this and each additional transect. Individual transects should be at least 10 m apart if possible. Using either a prefabricated frame (*e.g.* hinged 1 x 1 inch wood stakes) or a tape measure, lay out the 2 m x 2 m plot. Mark each of the four corners of the plot with either a metal survey shiner or a flagged stake. There should be no more than 50 such plots per restoration site.

Measurements

Note the slope and aspect (*e.g.,* northwest facing) of the plot using the clinometer and record on the *Forest Regeneration Data Sheet.*

Note all tree species within this plot on the *Forest Regeneration Data Sheet* using the 4-letter scientific name abbreviation. Tally the number of seedlings of each species falling into three distinct size classes: seedlings 2.5 - 30 cm (1-12 in.), seedlings 30 - 137 cm (1-4.5 ft.), and saplings 2.5 - 7.6 cm dbh (1-3 in. dbh). Heights should be taken from the root collar (where the tree stem meets the ground) to the tip of the tallest leader, excluding foliage (a pole graduated at 30 cm and 137 cm is often helpful). Diameter at breast height (dbh) is taken at 1.37 m (4.5 ft.) above the ground, to the nearest 0.1 cm. Also, note the presence and heights of any shrub species within the plot and record on *Forest Regeneration Data Sheet.* These data can be used to track forest structure through time.

An adequately stocked stand of trees will have a minimum of fast growth and slow growth saplings in each size class as outlined below:

Table3

SizeClass	Species	Stocking Required
2.5 - 30 cm (1-12 in.)	All species	20
30 - 137 cm (1-4.5 ft.)	Fast Growth species	5
30 - 137 cm (1-4.5 ft.)	Slow Growth species	10
Saplings 2.5 - 7.6 cm dbh (1-3 in. dbh)	All species	1

A stand is stocked for regeneration if 70% of the plots are considered adequately stocked.

b. Understory Monitoring

This method is typically employed with the ***Natural Regeneration Monitoring*** technique. It is useful in tracking understory development through each stage of forest maturation, from early succession to closed canopy. It also follows trends in herbaceous plantings through time. Plots should be established concurrently with the ***Natural Regeneration Monitoring*** protocol and prior to any on-site restoration work to compile baseline data of the site.

Measurements

Plot size is 1 m^2. Randomly choose one of the four 1 m x 1 m plots within each 4 m^2 plot of the ***Natural Regeneration*** model. Record which plot is used on the data sheet to facilitate relocation. A mean densiometer reading should be taken at each plot to estimate the light conditions of the site. Take four densiometer readings per plot, one in each of the four cardinal directions, using the center of the 4 m^2 plot as your pivot point. Record these readings on the data sheet.

Within each 1 m x 1 m plot, record the presence of each herbaceous species. It may be sufficient to record only vegetation families (*i.e.*, graminoids, aster species, solidago species, *etc.*). Visually estimate the total cover of each of these species and place them into percent cover classes of <1%, 1-5%, 5-25%, 26-50%, 51-75%, and 76-100%. Record this information on the *Understory Monitoring Data Sheet.*

These data will provide species diversity, overall ground cover, and species transition for the site.

C. Soil Measurements

a. Litter Layer and Worm Population Sampling (*adapted from Walther and Snider, 1984*)

Significant changes in leaf litter should occur as the canopy closes, but formation of a humus layer may take much longer, depending on soil chemistry and fauna. High populations of earthworms, usually found in urban areas, have been shown to greatly increase the rate of leaf decay. Rapid leaf decay would prevent build up of humus and other desirable microclimate conditions. It is advisable to sample for earthworms to determine if any amendments are required on the project site.

Equipment required

1. large flat container for hand sorting soil
2. 4-5 mm soil sieve
3. 1.5-2 mm soil sieve
4. 1 mm soil sieve
5. large soil screen (>10 mm)

Measurements

Initial measurements should be taken at the start of the restoration. Plot size should be 25 cm x 25 cm. A wooden frame should be constructed to aid in sampling. Cut along the inside of the frame, making sure to pass through the leaf litter and into the mineral soil. Remove and bag all of the litter, excluding humus. If a humus layer exists, remove and place into a separate plastic bag. Finally, excavate and separately bag two underlying 10 cm layers. Measure the depth of litter and humus (if any) separately.

The humus and soil samples are first hand sorted in the large flat container to remove any large debris and as many worms as possible. They are then passed through the largest sieve size twice, making sure to catch the soil in the large container each time. Remove all worms and large non-soil fragments (stones, sticks, glass, etc.) caught in the sieve. Crumble any large blocks of soil and force through the sieve. The remaining soil is then passed through the medium sieve size (1.5 or 2 mm) twice. Again, catch the sieved material in the large container each time and remove any worms, as well as non-soil fragments, caught in the sieve. Finally, this procedure is repeated with the finest sieve (1mm).

Extract worms from the litter samples by chemical means. Create a 0.025% formalin solution or a mustard solution (2 tablespoons mustard powder in 2 liters water). Wet the litter with one of these solutions and allow the litter to rest on a large mesh screen for 24 hrs. Allow worms to work their way through the mesh and into an underlying bucket. Remove the bucket and pass this material through the 1 mm sieve. Count all worms and record. This procedure should be performed at 5-10 locations within the project site, depending on overall project area.

b. Soil Physical Characteristics

As the result of a restoration, the chemical and physical structure of the soil can change. All of the following tests should be performed at 5-10 locations within the project site, depending on the size of the area. These data can be correlated with overall project and individual species success or failure. All tests may be performed in the field and on undisturbed soil.

Equipment Required

1. hand penetrometer
2. field soil pH kit
3. field sieve analysis kit, or lab soil texture kit
4. electronic field soil moisture meter, tensiometer, or irrometer

Measurements

Test soil for compaction with a hand penetrometer. Readings should be taken prior to any on-site work and once a year at the same locations for at least five years thereafter.

Take samples of mineral soil to test for pH and soil particle size distribution. Follow the instructions on the pH test kit, as not all kits are uniform in their application. Soil pH test kits are available from most environmental equipment suppliers. Soil particle size distribution can be performed in the field using a sieve analysis field kit, or in the lab using a soil texture classification kit. Note soil debris, if any, including concrete, garbage, glass, *etc.* These data are particularly helpful in choosing species to be planted on the site.

Soil water potential can be measured using a portable soil moisture meter, a tensiometer, or irrometer. Unlike the previous soil tests, soil moisture readings should be taken several times a year. It is advisable to have permanent test stations installed for this test. Again, readings should be taken prior to any work on the site and for at least five years thereafter. This test will provide valuable information on soil moisture conditions, and may be helpful in tailoring species composition to the site. Alternatively, weight differences in dry and wet soil mass can be measured in the lab.

c. Mycorrhizal Development

Improvement of the microbial soil structure is an intrinsic part of long-term improvement of a restoration site. Mycorrhizae, a mutualistic symbiosis between plants and fungi, are important to virtually all species of trees and shrubs, including those of temperate forests, *e.g., Quercus, Fagus, Salix, Betula, Populus,* and *Castanea.* Arbuscular mycorrhizae improve nutrient and water absorption by infected plants, thereby improving their stress tolerance. Ectomycorrhizae improve access of a plant to organic nitrogen and carbon and increase metal tolerance, pathogen resistance, and rooting strength. These mycorrhizae also connect the root systems of shade trees and saplings to dominant canopy trees, improving understory survival.

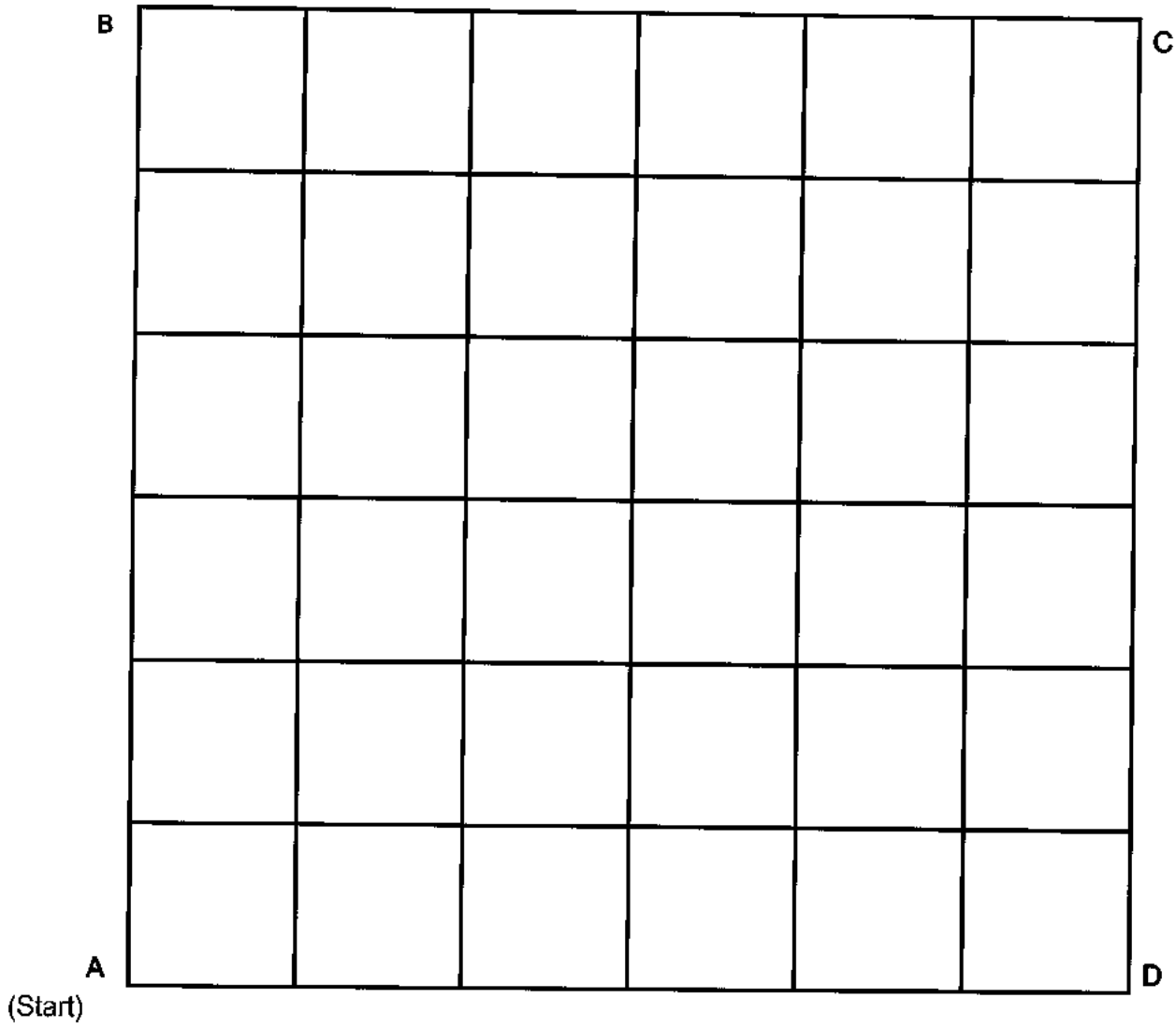
Mycorrhizal development is one of the most difficult components of restoration success to monitor; mycorrhizae are often microscopic and difficult to identify and quantify on a gross scale. Total and active fungal biomass and arbuscular mycorrhizal colonization, as well as bacterial biomass and protozoan and nematode numbers, provide quantifiable measures of changes in soil ecology. (A high fungal to bacteria ratio is desirable for most forested regions). Microbial biodiversity assays of soil samples are available at reasonable costs through commercial firms.

Species identifications of ectomycorrhizae are possible during spring and autumn mushroom flushes. Although these flushes vary due to moisture levels and temperature, weekly surveys after rainfall, particularly during October in New York/New Jersey, would provide a rough indication of ectomycorrhizal species changes. (Arbuscular mycorrhizae, however, fruit underground and would be visible only with careful examination in the event of a tree blow-down.)

Ectomycorrhizal species identifications and soil bioassays must be completed yearly for a minimum of five years. Given the irregular development of fruiting bodies, however, ectomycorrhizal identifications should be undertaken for a longer period, if possible.

Figure 1

Seedling Locator Form



Witness tree 1

Species _____

Distance from Point A to tree (m) _____

DBH (cm) _____

Azimuth from Point A to tree _____

Azimuth line AB _____

Azimuth line BC _____

Azimuth line CD = AB

Witness tree 2

Species _____

Distance from Point A to tree (m) _____

DBH (cm) _____

Azimuth from Point A to tree _____

Plot Number _____ of _____

Figure 2

Tree Measurement Form

Date: _____ Slope: _____

Plot Number _____ of _____ Aspect: _____

				1=yes, 0=no			
Number	*Species*	*Height (cm)*	*DBH (cm)*	*Browse*	*Vandalism*	*Dieback*	*Mortality*
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Comments:

Figure 3

Forest Regeneration Data Sheet

Date: _____

Slope: _____

Aspect: _____

Transect Location: _____

Plot Location on Transect: _____

Transect Number: _____

Plot Number on Transect: _____

Slow Growth

Species	Seedling size class / Sapling dbh 2.5 - 30cm	30 - 137cm	2.5 - 7.6cm	Notes

Fast Growth

Species	Seedling size class / Sapling dbh 2.5 - 30cm	30 - 137cm	2.5 - 7.6cm	Notes

Figure 4

Understory Monitoring Data Sheet

Date: _____

Transect Location: _____ Plot Location on Transect: _____

Transect Number: _____ Plot Number on Transect: _____

Subplot Number within Plot: _____

Densiometer	
Reading 1 (north)	
Reading 2 (east)	
Reading 3 (south)	
Reading 4 (west)	
Mean	

Species	*% cover*

III. Specifications for Plantings

The following planting specifications, developed by John McLaughlin, NYC DEP, are provided with the caveat that all restoration plantings must be site-specific, reflecting local species diversity and habitat conditions. These specifications were created as guidelines for contractors engaged in public works restoration projects on landfill covers.

Organic Fertilizer: Trees, Shrubs, Grasses, and Wildflowers

Description

Under this item the Contractor shall furnish, spread, and incorporate at the specified rates an approved organic **BioFertilizer** in planted areas, in accordance with the plans and specifications, as directed by the Engineer and approved by the on-site Ecologist. While these protocols may serve as a guide, it is essential that an experienced Ecologist versed in soil sciences, hydrology, and monitoring design and implementation be assigned to each project. Engineers and landscape architects generally lack the training required to execute a successful wetland or forest restoration project.

Materials

Natural Organic Fertilizer shall be Plant Health Care's "Healthy Start™" (3-4-3) Fertilizer or approved equal and have the following composition. **Fertilizer must not contain animal or poultry manure:**

Nutrient Analysis:

Total Nitrogen	3%	Calcium (Ca)	5%
Water Soluble Nitrogen	2%	Sulfur (S)	2.8%
Water Insoluble Nitrogen	1%	Magnesium (Mg)	0.5%
Available Phosphoric Acid (P_2O_5)	4%	Iron (Fe)	0.4%
Soluble Potash (K_2O)	3%		

Other Ingredients:

Humic Acids derived from Leonardite Humates	30%
Nitrogen Fixing *Bacillus*	Minimum 100 million CFUs per lb.
Phosphorus Solubilizing *Bacillus*	Minimum 100 million CFUs per lb.

Application Rate (Healthy Start or approved equivalent):

Trees and Shrubs

- 1 gallon container = 1/2 cup (1/4 lb.)
- 2 gallon container = 1/2 cup (1/4 lb.)
- 3 gallon container = 3/4 cup (1/3 lb.)
- 4' - 5' (trees) = 3/4 cup (1/3 lb.)
- 6' - 8' (trees) = 1 cup (1/2 lb.)
- 1" caliper (trees) = 2 cups (1 lb.)
- 1.5" caliper (trees) = 2 1/2 cups (1.25 lbs.)
- 2" caliper (trees) = 3 cups (1.5 lbs.)

Proportionate amounts of fertilizer should be added to in-between sizes.

Grasses and Wildflowers

- 175 pounds per acre

Submittals

A. The Contractor shall furnish a certified report from an approved testing laboratory, showing a **full** analysis of a representative sample of the organic fertilizer that s/he proposes to use.

B. Application equipment, method of operation, and schedule.

C. Coordinated and adjusted application rates with topsoil nutrient analysis necessary to achieve the required levels of nutrients in the soil.

D. The Contractor shall provide to the Engineer a 2-pound sample of the fertilizer 4 weeks prior to the application of the fertilizer.

Execution

Trees and Shrubs

Specified concentrations of BioFertilizer shall be uniformly spread around the base of each plant and thoroughly incorporated in the top ten (10) inches of the backfill of the planting hole.

Grasses and Wildflowers

Specified concentrations of BioFertilizer shall be uniformly and thoroughly incorporated to a 4" soil depth.

A. The BioFertilizer application concentrations may be decreased should the soil test results indicate an excess of any specific nutrient(s).

B. BioFertilizer shall arrive at the project site in original unopened bags, each fully labeled, conforming to the name or trademark and warranty of the producer.

C. An initial watering of planted areas immediately after placement is required to activate the BioFertilizer. This is separate from the ***Vegetation Watering*** item and is deemed included in the cost of planting. No additional compensation will be made for this watering operation.

D. BioFertilizers shall be packed in the manufacturer's standard containers weighing not more than 100 pounds each. The name of the material, net weight of contents, manufacturer's name, and guaranteed analysis shall appear on each container. The Ecologist reserves the right to reject any material that has become caked or otherwise damaged. If the material is not used immediately after delivery, it shall be stored in a dry place in such a manner that its effectiveness will not be impaired.

Mycorrhizal Inoculation

Description

Under this item the Contractor shall furnish and incorporate vegetation specific mycorrhizae inoculations to planted and seeded areas in accordance with the plans, and specifications, and/or as directed by the on-site Ecologist. This treatment provides a symbiotic relationship between the fungus and the roots that will give the plant improved drought resistance, better growth, and aid in acclimation to the site.

Submittals

A. The Contractor shall furnish a certified report from an approved testing laboratory showing a full analysis of a representative sample of the mycorrhizal inoculation that s/he proposes to use. All samples are to be taken under the supervision of the Ecologist and delivered to the laboratory. No mycorrhizae shall be delivered until the approval of samples by the Ecologist, but such approval does not constitute final acceptance. The Designer and Ecologist reserve the right to reject, on or after delivery, any material that does not meet these specifications.

B. Application equipment, method of operation, and schedule.

Materials

Trees, Shrubs, Grasses, and Wildflowers

A mycorrhizal (endo- and ectomycorrhizal) inoculation, Plant Health Care's, Mycor Tree Saver™ Transplant Inoculant (P.O. Box 355, Old Westbury, NY 11568-0355 Tel. 516-338-8786) or approved equivalent.

Execution

Trees and Shrubs

A. All trees and shrubs shall be inoculated with the vegetation specific mycorrhizal fungi. Inoculation shall be added after the trees and shrubs have been placed in their planting holes. Apply the specified rate of inoculation to each tree and shrub, thoroughly mixing into the upper 6 to 8 inches of the backfill mix, and then hydrate. The initial watering as specified under Plant Material item may be used for this purpose.

B. Mycorrhizal fungi shall be added to trees and shrubs according to size. The application rates for mycorrhizal inoculation shall be as follows:

Plant Size	Application Rates (oz.)
1 gallon	1
2 gallon	2
3 gallon	3
4' - 5' (trees)	3
6' - 8' (trees)	3
1" - 2" caliper	6
2" - 3" caliper	9

C. All operations are to be performed in the presence of, and as directed and approved by, the Ecologist or representative. All empty containers or packets shall be turned in at the end of each day for verification of use.

Grasses and Wildflowers

A. All seeded areas shall be inoculated with vegetation-specific mycorrhizal fungi. Inoculation shall be thoroughly incorporated into the soil **immediately prior** to seeding. The contractor is responsible for the following:

- Fifty (50) pounds of the specific endomycorrhizal fungi for the native warm-season grasses/wildflowers shall be applied per acre.
- The mycorrhizal inoculation shall be carried out only after the soil has been moistened to a depth of twelve (12) inches by natural rainfall or irrigation.
- Mycorrhizal inoculation shall be carried out before seeding or placement of straw mulch.
- Mycorrhizal inoculation shall be limited to conditions in which the temperature of the inoculum may be kept below 90° F and above 32° F at all times.
- Mycorrhizal inoculum shall be stored and transported out of direct sunlight and in all cases prevented from rising above 90° F.
- The contents of the endomycorrhizal fungi are to be broadcast uniformly on all seeded areas using a drop spreader prior to the placement of the seed. The fungi shall be mixed into the top four (4) inches of the soil, **and then hydrated** (if the fungi can be adequately applied through one of the drill seeder compartments, this step can be combined with seeding). This watering is deemed necessary to successfully complete this item as specified and no additional compensation will be made for this watering. The contract ***Vegetation Watering*** item cannot be used for the initial hydration of the fungi.
- A tractor (no low ground pressure equipment) pulling a rake shall immediately follow behind the inoculum broadcasting operation to cover the inoculum.
- The land surface shall not be recompacted or made smooth and level after the inoculation.

B. All operations are to be performed in the presence of, and as directed and approved by, the Ecologist. All empty containers of the fungi shall be turned in at the end of each day for verification of use.

C. There shall be no exceptions in the application of these materials.

D. The Contractor shall submit to the client (sponsoring agency) for review and approval the methods and types of equipment to be used to incorporate the mycorrhizal fungi.

Plant Material

Description

Information contained herein applies to all plant material used on a project. **Additional specific planting requirements for grassland/meadow seeding are included under that item.** This item includes the furnishing of all equipment, materials, labor, and services necessary for the proper execution of the planting of all shrubs and trees, and maintenance thereof for two years, as specified herein and as shown on the contract drawings, including all incidental and appurtenant work required for a complete job.

General Requirements

Reference Standards

- American Association of Nurserymen, Inc. (American National Standards Institute) Nursery Stock (ANSI Z60.1–latest edition)
- "Manual of Vascular Plants of the Northeast United States and Canada," Gleason and Cronquist, 1991
- "A Checklist of New York State Plants, Contributions to a Flora of New York State, Checklist III," Bull. # 458, Richard S. Mitchell, State Botanist, New York State Museum, 1986.

Note: There will be no approval of subcontractor without meeting the eligibility requirements established in this specification.

Preservation and Restoration of Vegetation

A. Contractor shall not be permitted to stockpile materials of any nature under the drip line of existing trees and shrubs. This is to minimize surface and subsurface root damage and soil compaction. This directive shall apply to all areas within or outside the contract limit line.

B. Contractor shall assume the responsibility for any remedial work such as root and branch pruning required and/or necessary to prevent loss of plant materials when this article is not complied with or when trees or shrubs are injured by construction equipment.

C. Pruning and fertilizing of existing trees and shrubs shall be performed to compensate for damage of roots incurred. Fertilize in areas around undamaged roots only and not adjacent to the trunk or main stem. Fertilizer shall be applied in the fall unless otherwise approved by the on-site Ecologist. Specifications for fertilizer shall be that as specified under the Item ***Biofertilizer, Soil Conditioner, and Mycorrhizal Treatment.***

D. Pruning shall be performed by a licensed New York State Arborist with the proper tools in a professional manner.

E. No separate payment will be made for fertilizing and pruning of existing trees and shrubs in stockpile areas or when trees or shrubs are injured by construction equipment.

F. No existing trees, shrubs, or meadows shall be removed, except as specifically required by this Contract or as specified on Contract Documents, or as specifically approved in writing by the Ecologist.

G. Any areas or items of existing landscape which are removed or damaged shall be replaced by Contractor at no additional cost to the City. The Contractor shall replant and replace soil as required in the damaged areas as directed by the Ecologist or representative.

H. All existing landscape features, including trees, shrubs, perennials, meadows, lawns, wetlands, paving, walls, stairs, *etc.* shall be protected as approved by the Engineer and the Ecologist prior to start of work.

Submittals

A. List of Materials/Suppliers: Submit a complete materials list (*e.g.,* fertilizer, mulch, cedar stakes, biostimulants, mycorrhizal treatment, *etc.*) of items to be provided under this section for review by the Ecologist before the purchase or use of any such material.

B. Method of Work: Submit a list of proposed methods of execution of work under this section for review by the Ecologist when proposed methods are different from, or supplementary to, those specified herein.

C. The Contractor must submit the following information to the Ecologist or representative for review and approval within sixty (60) days following the Notice to Proceed:

(a) Subcontractor(s): The subcontractor for all landscaping work (seeding and woody plant material) must be pre-approved by the Ecologist or representative **prior to selection by Contractor.** The subcontractor proposed will be evaluated on the following criteria, prioritized in descending order:

- Prior experience in the installation, restoration, and maintenance of similar *native habitats* and familiarity with the growing requirements of all vegetation used on this project. References and photocopied reproductions of photographs shall be submitted. The projects should be at least three years old.
- Demonstrated capacity to accomplish the work in the time allotted.
- Qualifications of key personnel that will be present **on the site** while work is in progress.
- Experience with planting material and seeds specified under this contract.
- Experience with other agencies, such as the NYC DEP, NYC Parks, NYS DEC, US EPA, US ACOE, HPD, and the Port Authority of NY&NJ. Provide references.
- Other references or experience deemed appropriate to obtaining approval.

(b) List of Growers/Nurseries

The following is required prior to the start of landscaping work:

- List of all materials and certificates specified within this item.
- Schedule/Methods of Operation/Three-Year Maintenance Plan (some projects have five-year maintenance plans).
- Equipment

Quality Assurance

Source Quality Control

A. All primary source nurseries must be within a **250-mile radius** of the planting site. All plants (including seeds) obtained from approved nurseries or seed suppliers must have been produced by plants with a provenance within the 250-mile radius requirement. That is, all plants grown and/or originating from outside the 250-mile radius will be rejected. In addition, all plants must have been grown in the same climatic zone as that of the planting site. No substitutions of specified plants will be accepted without the written permission of the Ecologist or representative.

B. Ship plant materials with certificates of inspection when required by governmental authorities. Comply with governing regulations applicable to landscape materials.

C. Trees, shrubs, and herbaceous material shall be as specified in the Contract Documents. The Contractor shall furnish the nurseries with a copy of the plant list. Due to the rarity of some species, specified plants may have to be contract grown. **The arrangement for contract growing of plants shall be initiated at the start of the project to give sufficient lead time to have the plants available for the specified planting dates and in coordination with the construction schedule.**

D. The Ecologist or representative will furnish a list of seed suppliers and specialty growers on request. Nurseries that collect plants from the wild will be **rejected.** No substitutions will be permitted, except as authorized in writing by the Ecologist or representative.

E. If specified landscape material is not obtainable, submit proof of non-availability, with proposal for use of equivalent material, to the Ecologist or representative. For NYS projects, plants specified are native to the State of New York according to the "Checklist of New York State" as referenced above. Species native to this region, but not listed on the New York State flora, may be accepted on a case by case basis. For other regions, native plants and landscaping materials will be specified by the Ecologist.

F. The Contractor shall provide trees, shrubs, and plants of the quantity, size, genus, and species shown and scheduled for planting in compliance with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock" as referenced above (*e.g.*, ball diameter, plant height, number of stems, *etc.*). The Contractor shall provide healthy, vigorous stock, grown by a professional nursery in accordance with good horticultural practices and free of diseases, insects, eggs, larvae, and defects, including but not limited to: malnourishment, knots, sun-scald, injuries, abrasions, or disfigurement.

G. All plants furnished under this item shall be true to name. Plant names shall agree with the nomenclature of *Manual of Vascular Plants of the Northeast United States and Canada* (Gleason and Cronquist, 1991). Size and grading shall conform to those of the American Association of Nurserymen.

Inspection of Plant Material at Nursery

A. The Ecologist shall inspect all plant material used on this project at the place of growth before planting for compliance with requirements for genus, species, variety, size, and quality. The Contractor shall be responsible for all inspection costs beyond a 50-mile radius from the planting site.

B. The Ecologist or representative retains the right to further inspect all plant material for size and condition of root system, insects, injuries, and latent defects and to reject unsatisfactory or defective material anytime during the progress of work. The Contractor shall remove rejected plant material from the project site immediately upon notification without compensation.

C. Tagged samples of plant material shall be delivered to the site and planted in locations approved by the Ecologist or representative. These tagged samples shall be maintained, protected, and used as standards for comparison with all other appropriate plants.

D. The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by Federal, State, or other authorities to accompany each shipment of plants, and on arrival the certificates shall be filed with the Ecologist or representative.

Plant Material and Execution

A. Before digging the pits, the Contractor shall submit for approval the proposed methods of soil preparation and planting to perform the work shown on the plans. Soil amendments shall be thoroughly mixed by approved methods. **The soil around each plant shall be thoroughly saturated with water upon planting.** Instructions for subsequent waterings are under ***Watering Vegetation***.

B. The Contractor is notified that existing field conditions are potentially harsh. Mulching of installed plant material within 24 hours of planting and watering requirements will be strictly adhered to.

C. Plant material shall be as specified under the subheading *Plant Schedule* and as further specified on the plans. The Contractor shall provide **freshly** dug plant material. Cold storage or previously dug plants will not be acceptable. The Contractor shall not prune prior to delivery unless otherwise directed and approved by the Ecologist or representative. Plants that are pruned without authorization from the Ecologist will be rejected. Plant material shall be delivered to the site in such a manner as not to damage the bark, break branches, or destroy the natural shape of the plant. **To protect plant material from desiccation, the Contractor shall apply an approved anti-desiccant 48 hours prior to digging and fully cover plant material during transportation to the planting site.** Plant material shall not be dropped or in any way mishandled during unloading. Plants damaged during transportation to the site will be immediately rejected. Unacceptable conditions shall include, but not be limited to, the following: loose burlap or rope, soil spilling from balled and burlapped (B&B) or containers, plants that move independently of root ball or container, soil missing from B&B or containers, and irregularly shaped root balls.

D. Root ball diameters and depths shall not be less than the following:

Tree Caliper (inches) (6" from ground)	Minimum Root Ball Diameter (inches)	Minimum Root Ball Depth (inches)
2.0	24	16
2.5	28	18.5
3.0	32	19
3.5	38	23
4.0	42	25
4.5	48	29
5.0	54	32

E. Wire baskets shall be removed from the top and sides of the root ball to a depth of at least twelve (12) inches. All rope is to be removed or loosened at the top of the ball where it meets the trunk. No backfilling of plants is permitted unless the removal of the wire basket and the removal or loosening of the rope has been verified by the Ecologist or a representative. Plants that have been backfilled and not verified by an Ecologist or representative will be rejected.

F. Plants shall be delivered **only** when preparations for planting have been completed and plants can immediately be installed. If planting is delayed for more than six hours after delivery, set plant material in shade, protect from mechanical damage, and keep roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture, watering as necessary.

G. For bare-root material, the Contractor shall provide for plants that have been puddled at the nursery immediately after digging by immersing the roots in a thick mixture of clay and water so as to completely coat the roots. Material shall be planted **immediately** after delivery to the site. Storage of bare-root plant material will not be permitted. Plants shall be covered with damp—not wet—leaf compost or straw while awaiting ground installation. Do not allow plants to dry out or freeze.

H. All plants shall be subject to inspection and approval by the Ecologist or approved representative. Plants required for the work will be inspected and tagged at the place of growth before being removed. The Contractor shall be responsible for all costs related to inspection of plant material by the Ecologist or representative beyond a radius of 50 miles from the restoration site. Selection and/or tagging of material shall cover the type and quality of the plant only, but shall not constitute final acceptance nor preclude the right of rejecting plants not fully meeting the requirements of the specifications. No plant material shall be accepted without prior **nomenclature labeling** at the nursery of origin. The nursery label must display the full botanical name of the plant.

I. Plant cultivars or varieties will be reviewed on a case by case basis. In general, cultivars or varieties are not acceptable. The Contractor should consider only straight species when ordering plant material.

J. Each shipment of plants must be declared and certified free of diseases and pests of any kind with such necessary inspection certificates accompanying each shipment.

K. All nursery stock furnished by the Contractor shall be subject to inspection within 48 hours of delivery of said stock. The plants shall also be subject to such inspection during the life of the contract, and infestations occurring on the stock as a result of conditions existing prior to the receipt of the plants shall be cause for rejection.

L. The time of planting is subject to the type and size of the material, method of planting, and approved planting schedule. The Contractor shall furnish a certification from the nursery regarding the date of digging for all applicable plant material.

M. Unless otherwise directed by the Ecologist in writing, **evergreen plant material shall be planted and transplanted from April 1 to May 15 and from September 1 to October 15. Deciduous plant material shall be planted and transplanted from March 1 to May 1 and from October 15 to December 1. Herbaceous plant material shall be planted and transplanted from April 15 to May 15 and from August 15 to September 15.** Actual planting shall be performed only when weather and soil conditions are suitable for optimal benefit to the plant. No plant material shall be planted when the ground is frozen or excessively moist. Notify the Ecologist or approved representative at least three days (excluding weekends) in advance before proceeding with any planting operations.

- No shipment of plant materials shall be unloaded or planted by the Contractor until such materials have been inspected and accepted by the Ecologist or approved representative, and inspection certificates, if any, have been delivered.
- The Contractor shall proceed with and complete landscape work as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.
- Determine location of underground utilities and perform work in a way that will avoid possible damage. Hand excavate, as required. The Contractor assumes responsibility for damage to underground utilities when excavating and is advised of "One Call" (800-272-4480), a service that

marks underground facilities on the surface, prior to excavation. Maintain grade stakes set by others until the Ecologist or representative approves their removal.

- When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Ecologist or representative before planting.
- The Contractor shall furnish a certification from the nursery regarding the date of digging. All appropriate plant material shall be sprayed in the nursery within 48 hours prior to digging with an approved anti-desiccant.

Wood Chip Mulch

All plant material shall receive 3" of wood chip mulch within 24 hours following planting. Do not place mulch within 3 inches of tree trunks or shrub stems. The Contractor shall submit a sample of the wood chip material to the Ecologist or representative for approval two (2) weeks prior to installation. Shredded wood chip mulch is not acceptable. Wood chips (*e.g.*, elm, black pine, Austrian pine, *etc.*) shall be aged at least one year prior to use and be free of insects, diseases, or any other material or chemical that would be detrimental to the plant material used on this project. The Contractor shall submit verification to the Ecologist or representative of the composition of wood chip, supply vendor, and age of material.

Watering

All plant material shall be thoroughly watered immediately after installation. Planting will not be permitted unless a water-truck is on site and made available whenever the contractor is installing plant material.

Anti-Desiccant

Unless otherwise directed, all trees shall be sprayed with an approved anti-desiccant (Wilt Pruf NFC or approved equivalent), using a power sprayer to apply adequate coverage, according to manufacturer's directions, over trunks, branches, twigs, and foliage as directed by and in the presence of the Ecologist. The Contractor is to read the product label carefully as some plant material can be injured by the application of an anti-transpirant. The material to be used shall be emulsions or other materials that will provide a protective film over plant surfaces, yet permeable enough to permit transpiration. The time of spraying shall be as follows, unless otherwise directed by the Engineer:

Evergreens: Apply within five (5) days of planting.
Deciduous: Spring planting – Apply when leaves have reached seventy-five percent (75%) of mature size.

Biofertilizer, Soil Conditioner, and Mycorrhizal Treatment

A. At the time of seeding, Contractor shall apply Plant Health Care's "Healthy Start™" (3-4-3) Organic BioFertilizer and Soil Conditioner (P.O. Box 355, Old Westbury, NY 11568-0355 Tel. 516-338-8786) or approved equivalent, at the following rates:

- 1 gallon to 3 gallon containers = 1/4 lb. (1/2 cup)
- For every inch of trunk diameter = 1/2 lb. (1 cup)

B. Fertilizer shall be uniformly spread around the base of the plant and incorporated in the top 10 (ten) inches of the backfill of the planting hole. The application rates may be increased should the soil test results indicate a deficiency in any specific nutrient(s). Fertilizer shall arrive at project site in original unopened bags. Each bag should be fully labeled, conforming to the name or trademark and warranty of the producer. An initial watering immediately after placement is required to activate the BioFertilizer. This is separate from the ***Vegetation Watering*** item and is deemed included in the cost of planting. No additional compensation will be made for this watering operation.

C. A mycorrhizal (ectomycorrhizal) treatment, Plant Health Care's Mycor Tree Saver™ Transplant Inoculant, shall be incorporated into the soil around the base of each plant material prior to backfilling the hole. This treatment provides a symbiotic relationship between the fungus and the roots that will provide the plant with improved drought resistance, better growth potential, and aid in acclimation to the site. The Contractor shall apply the following:

- (1) One Tree Saver™ Transplant packet (premeasured 3 oz.) per shrub
- (1) One Tree Saver™ Transplant packet (premeasured 3 oz.) per 1" of tree diameter measured at six (6) inches above the ground.

The contents of the appropriate number of Tree Saver™ Transplant packets are to be broadcast on the outside of the roots all the way around them, mixed into the top ten (10) inches of the backfill of the planting hole, and then hydrated. Initial watering may be used for this operation.

All operations are to be performed in the presence of, and as directed and approved by, the Designer or representative. All empty packets shall be turned in at the end of each day for verification of use.

D. There shall be no exceptions in the application of these materials.

Plant Staking

A. Stakes for supporting trees shall be white or red cedar, with a minimum diameter of three inches. Wire shall be new annealed galvanized steel wire. Wiring around tree trunk and stake shall be fastened in such a manner as to allow slight movement of trunk.

B. In natural area plantings, the Ecologist will determine if stakes are required. If it is determined that staking is required, a modified staking system shall be used. The modified stakes shall be shorter than conventional stakes. In either situation, the Contractor shall maintain stakes until the end of the maintenance period or as directed by the Ecologist. The Contractor shall remove all stakes, wires, and hoses at the end of the maintenance period as directed by the Ecologist.

C. Jute burlap shall be in six-inch wide strips and weigh eight ounces per square yard. Hose shall be good quality braided rubber or reinforced materials, at least 3/4 inches outside diameter. Twine for use in wrapping trees shall be jute twine not less than two plies. Paper for trees shall be 30-30-30 Krinklecraft or equivalent.

Landscape Guarantee and Replacements

Guarantee

A. All landscaping work shall have a maintenance and replacement guarantee for a minimum of three (3) years beginning at the date of acceptance of the landscaping work or the date of substantial completion, whichever is later. Contractor shall request in writing an inspection of all landscaping work when completed to **begin** the maintenance and guarantee period.

B. Plant material found to be unsatisfactory or in poor condition shall be removed and replaced at the appropriate planting season for that type of plant material. No payment will be made for plant material found to be unacceptable during this inspection.

C. The Contractor shall submit, in writing, any conditions or species which he feels may be questionable *prior to* ordering said plants. If s/he is agreeable, the Ecologist will substitute recommended species or address the conditions deemed unsuitable. However, upon ordering a plant and installing it, the Contractor accepts the responsibility for *guaranteeing* the plant's survival. There shall be no exception.

D. During the guarantee period, any plant material that is dead or not showing satisfactory growth, as determined by the Ecologist, shall be promptly removed and replaced by the Contractor during the appropriate planting season for that type of plant material as determined by these specifications. The replacement shall be of the same variety, size, and character as specified for the original planting and continue to be under the same maintenance and guarantee. That is, they will be subject to replacement again up to the end of the previously established guarantee period. The Ecologist or representative shall be the sole judge as to the condition of the plants (three years from date of final acceptance of the restoration work or the date of substantial completion, whichever is later). The guarantee and maintenance applies to all planted areas.

E. Unless a written waiver of this clause is issued under the terms of the guarantee, replacement plants shall be chosen only by the Ecologist.

Maintenance

A. The Contractor shall, for a period of three (3) years, thoroughly remove all weeds from planted areas, spray (with approved fungicide, insecticide, and herbicide) for diseases, insects, and weeds as directed, prune dead wood from all trees and shrubs as directed, and practice any other recognized beneficial horticultural activity, to the satisfaction of the Ecologist, and as is required to properly establish the newly planted material.

B. Regular removal of competing weeds will be required frequently and will be strictly enforced. Adjacent areas that contain a high weed content may also need to be sprayed or hand removed to prevent colonization of planted areas. The Contractor is advised to seriously consider this requirement when bidding.

C. The Contractor shall submit for review a landscape maintenance schedule covering this three (3) year period, prior to the start of work. Planting shall not proceed until this schedule has been approved by the Ecologist.

Topsoil

Description

The work to be performed under this item shall include furnishing, amending (if required), placing, and preparing topsoil for seeding and/or placement of plant material as shown on the Contract Drawings and/or as directed by the Engineer. All testing specified under this item is for vegetation compatibility only; additional testing for hazardous materials of topsoil is required under a separate item.

Materials

A. Topsoil is an integral part of the Final Cover System; as such, certification of its material properties is subject to the testing protocols of the Quality Assurance/Quality Control (QA/QC) Plan. The QC requirements of the QA/QC Plan relative to topsoil are detailed below; the complete QA/QC Plan is included in the Specific Provisions. The Contractor shall strictly comply with all requirements of the QA/QC Plan.

B. Topsoil shall be a sandy loam as classified by the U.S. Department of Agriculture. Topsoil shall be fertile and friable surface soil, of uniform quality, not exceeding an excavated depth of more than two and a half feet from the surface. Topsoil shall not contain subsoil materials. Topsoil shall be free of refuse, hard clods, woody vegetation, stiff clay, construction debris (of any kind), boulders, stones larger than two inches, chemicals, or other material toxic to any vegetation used on this project.

C. Topsoil shall have a minimum organic content of 4 percent and a maximum of 7 percent. The organic content shall be increased (if required) by adding leaf compost. All testing specified for topsoil shall also apply to the leaf compost used to amend the organic content of the soil. No soil mixing shall be permitted upon placement, but shall be permitted at designated stockpiles at the topsoil source. Amended soils shall be retested for compliance with contract specifications and resubmitted for approval at the Contractor's cost.

The organic content of soils shall be determined by a laboratory using the Loss On Ignition Method as described in *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*

D. The gradation of topsoil shall be determined by a laboratory using the Bookcase Hydrometer Analysis conforming to the methodology of the most current ASTM D-422. All reporting of particle sizes shown below shall be that as classified by the U.S. Department of Agriculture. The gradation of the topsoil shall be within the following ranges:

- Very Coarse Sand (2.0 mm to 1.0 mm)
- Coarse Sand (1.0 mm to 0.5 mm)
- Medium Sand (0.5 mm to 0.25 mm)
- Fine Sand (0.25 mm to 0.10 mm)
- Very Fine Sand (0.10 mm to 0.05 mm)
- Silt (0.05 mm to 0.002 mm)
- Clay (< 0.002 mm)

E. The pH value of topsoil shall be determined by an approved laboratory using the soil pH procedures (Water [1:1, V:V]) as described in *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.* Amendment of soil to lower pH to meet contract requirements is not permitted.

F. The soluble salt value of the topsoil shall be determined by an approved laboratory using the soluble salt procedures (1:1 [V:V]) as described in *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*

G. The tests for macro (N, P, K) and micronutrients (Mg, Ca, Mn, Zn, Cu, and B) shall be determined by an approved laboratory using the procedures as described in *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*

H. Tests for bulk density of the soil shall be taken after spreading but just prior to seeding or planting. A standard volume for testing shall be established between the Contractor and the municipality or sponsor prior to taking samples. The Contractor is to supply all materials and equipment required to complete this test. This test will measure soil compaction from construction equipment.

I. Topsoil shall not contain any traces of hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered to be toxic to any vegetation used on this project.

Submittals

A. The following submittals shall be required for every 1,500 cubic yards of topsoil borrowed from the source before the agency can accept the soil. This is an additional requirement to the initial testing and approval of the source. Prior to the procurement of topsoil and start of the delivery of topsoil, the following information and samples are required for review and approval:

- Proposed material source and vendor.
- A 5-pound sample of the proposed material, taken with a representative of the overseeing agency, indicating the method of sampling and location of the sample.
- A certificate of compliance prepared by the sponsoring agency that the proposed topsoil meets all the material specifications for topsoil.
- The Contractor shall submit the name and location of the borrow or stockpile sites(s) and the estimated quantity of material available. The Contractor shall provide a notarized letter from the owner(s) of the proposed borrow site and/or stockpile sites(s) indicating ownership of the proposed site(s) and a commitment to supply a specified minimum quantity of material for this project. At a minimum, 75 percent of the soil needed for this project shall be procured and secured by the Contractor no later than when 25 percent of the allotted calendar contract days (CCD) have expired.
- Results of the following required tests:
  - Organic content analyses conducted in accordance with the above referenced standard (*Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95*).
    Acceptable range is from 4% to 7%.
  - Gradation analyses conducted in accordance with the above referenced standard (ASTM D-422), with all reporting of particle sizes according to the U.S. Department of Agriculture soil classification system. Acceptable range is as follows:

Sand	50% - 80%
Silt	10% - 20%
Clay	10% - 20%

Note: Gravel content (particle sizes from 2 mm - No. 10 sieve to a maximum of a 2" sieve) shall not be greater than 12% of the total for each sample tested.

- pH tests conducted in accordance with the above referenced standard (*Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95*). Acceptable range is 5.0 to 7.0, inclusive.
- Soluble salts test conducted in accordance with the above referenced standard (*Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95*). Acceptable range is 0 to 1.2, inclusive, in the units used by the bulletin.
- Nutrient analyses tests conducted in accordance with the above referenced standard (*Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95*). Review of the test will indicate nutrient deficiencies. Acceptable range will be based on the results of the test. The Contractor shall apply an approved organic fertilizer containing the elements that are deficient, at the manufacturer's suggested rate. Type of fertilizer is dependent on the type of plant material used. See ***Plant Material and Warm-Season Grasses and Wildflower Drill Seeding*** specifications for appropriate fertilizer to use.

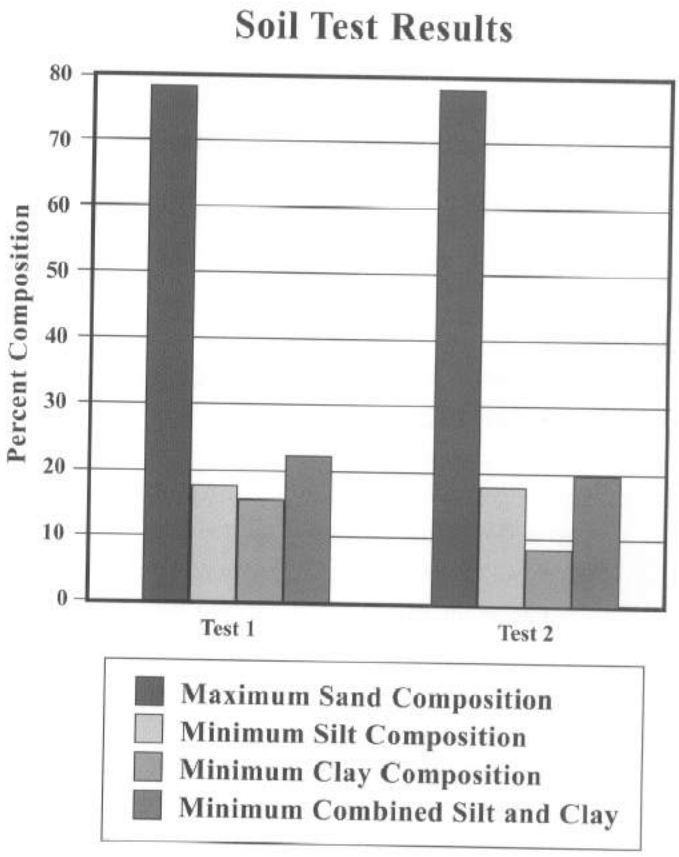


Figure 4.1 Soil Gradation Chart

- Bulk density test. Acceptable range is 1.0 g/cm^3 to 1.6 g/cm^3. Locations that have readings that are outside of this range shall be corrected in the following manner: the Contractor shall thoroughly disc areas to a minimum depth of 8 inches to reduce compaction.
- Chemical analyses conducted in accordance with EPA Method 8021.

Note: All soil testing must comply with the procedures and methods described in this specification. The Contractor is notified that the turnaround time for test results from the analysis lab chosen may exceed two weeks. Results for each soil sample must contain all the information requested herein. There shall be no exceptions.

B. As delivery of soil to the site progresses, the following additional soil testing shall be conducted by the Contractor on topsoil brought to the site. Frequency of testing for each category is given below. Results of tests shall be submitted to the sponsoring agency for review and approval.

- Organic content testing in accordance with *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*
- Chemical analysis in accordance with EPA Method 8021.
- pH testing in accordance with *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*
- Soluble salts testing in accordance with *Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeast Regional Publication, Agricultural Experiment Station, University of Delaware, Bulletin # 493, 12/95.*

C. The Contractor shall submit all thickness measurements, after such measurements have been verified by the QC Site Manager, to the agency.

D. The Contractor shall submit to the sponsoring agency the materials and procedures for amending soil, if appropriate. Amendment of soil is permitted only to meet the organic requirement of the specifications.

E. The Contractor shall submit quantity records on a weekly basis to the sponsoring agency.

Execution

A. Prior to procurement of topsoil and start of delivery of soil, all approvals for those items required in the section entitled *Submittals* must have been given in writing to and approved by the sponsoring agency.

B. Prior to the placement of topsoil, the QA and QC Site Managers must approve the subgrade (barrier protection layer). Maximum allowable pH for barrier protection layer is 7.3.

C. The Contractor shall complete all grading within the area to be covered with topsoil in order to bring the surface of the subsoil to the required grades. Topsoil shall be evenly placed to a minimum thickness of six (6) inches except in special landscaping projects where depth and configuration of the topsoil shall be as directed by the Engineer. The spreading shall be performed in such a manner that seeding or planting can proceed with little additional soil preparation or tillage. Irregularities in the soil surface resulting from spreading or other operations shall be corrected so as to prevent the formation of depressions where water will stand. Topsoil shall not be placed when the subgrade or topsoil is frozen, excessively wet, extremely dry (as determined by the bulk density tests), or in a condition otherwise detrimental to the proposed seeding or planting.

D. As construction progresses, the following QC testing shall be conducted on all topsoil:

Organic Content Testing

- Test Method and Procedures: *Soil Testing Procedures for the NE U.S., 12/95*
- Frequency: One test per 2,000 cubic yards brought to site
- Sampler: Sponsoring agency representative
- Sample Description/Location: Take samples from on-site stockpile
- Testing Lab: Approved State lab
- Test Results to: Sponsoring agency and other designated agencies

Chemical analysis in accordance with EPA Method 8021

- Test Method and Procedures: EPA Method 8021
- Frequency: One test per 5,000 cubic yards brought to site
- Sampler: Sponsoring agency representative

- Sample Description/Location: Grab samples from on-site stockpile
- Testing Lab: Approved State laboratory
- Test Results to: Sponsoring agency and other designated agencies

pH Testing

- Test Method and Procedures: *Soil Testing Procedures for the NE U.S., 12/95*
- Frequency: One test per 2,000 cubic yards brought to site
- Sampler: Sponsoring agency representative
- Sample Description/Location: Take samples from on-site stockpile
- Testing Lab: Approved State lab
- Test Results to: Sponsoring agency and other designated agencies

Soluble Salts Testing

- Test Method and Procedures: *Soil Testing Procedures for the NE U.S., 12/95*
- Frequency: One test per 2,000 cubic yards brought to site
- Sampler: Sponsoring agency representative
- Sample Description/Location: Take samples from on-site stock pile
- Testing Lab: Approved NYC DEP lab

E. The material delivered to the site shall be visually and continuously inspected by sponsoring agency representatives during construction to ensure that it is consistently the same material previously approved and delivered to the site. If changes in material occur, soil delivery shall cease immediately and the sponsoring agency shall reject any work performed by the Contractor using the rejected material, until all applicable specification requirements are executed and verified by the sponsoring agency, at the expense of the Contractor. If the rejected soil does not meet specifications, Contractor shall immediately remove the material off the project site at no additional cost to the City.

F. The thickness of the in-place topsoil will be checked after the completion of the work on a 50' by 50' grid pattern by digging, by hand with a shovel, test holes which do not exceed 1' in diameter. The Contractor will be responsible for digging holes in the topsoil to allow for the measurements to be taken. After measurements have been made, the Contractor shall backfill the holes with topsoil.

G. Placement of topsoil shall be performed only when it can be followed within five (5) days by planting or seeding. After topsoil placement and final grading, no heavy equipment, pickup trucks, or other construction vehicles (other than low ground pressure equipment) shall be permitted to travel on these completed areas. The Contractor shall, through mechanical raking and hand grading with rakes and shovels, grade all areas around fences, pipes, and other structures in preparation for seeding or planting.

The Contractor shall, as part of the topsoil spreading operation, mechanically rake and clean all undesirable materials from the topsoil prior to seeding or planting operations. The method for this work shall be approved by the Ecologist.

The Contractor shall dispose of all undesirable materials raked from the topsoil, in accordance with the Specific Provisions.

The Contractor shall pay all costs, fees, *etc.*, to rectify any deficiencies in placement of the topsoil layer, until deemed acceptable by the Ecologist.

Measurement

Topsoil quantities shall be measured to the nearest cubic yard of in-place material, computed from pavement lines shown on the contract drawings, except where revised pavement lines have been approved by the Engineer.

The measurement to determine the thickness of the topsoil will be made perpendicular to the slope and shall be the distance from the surface of the cover fill material to the finished grade of the topsoil. No other measurements will be made to determine the thickness. A deficiency of 1/2 inch will be permitted at any particular measurement. However, the arithmetical average of the sum of measurements made over an acre of topsoiled area will not be less than the thickness specified herein. The Engineer or his representative will make measurements and the Contractor will be responsible for providing the necessary labor and equipment.

Warm-Season Grasses and Wildflower Drill Seeding

Description

This work shall consist of furnishing and installing seed, straw mulch, and mulch binder in a way that obtains optimal germination and long-term success according to the Contract Plans and Specifications and as directed by the Engineer.

Submittals

A. List of Materials: Submit a complete list of materials (*e.g.*, seeding equipment, seed, straw mulch, straw binder, *etc.*) proposed to be provided under this section for review by the Engineer before the purchase or use of any such material.

B. Method of Work: Submit a list of proposed methods of execution of work under this section for review by the Engineer when proposed methods are different from, or supplementary to, those specified herein.

C. A separate germination test on the complete actual seed mix to be used on this project is required prior to approving the seed mix and supplier. The Contractor is advised that these tests can run six months or more and should be prepared to do these tests ahead of the seeding season. Seed shall conform to all applicable state and federal regulations and to test provisions of the Association of Official Seed Analysts. There shall be no exceptions.

Materials

Delivery and Storage of Materials

Seed shall be clean, fresh, and delivered to the site in the original, unopened bags showing the net weight, composition of mix, supplier's name, and guarantee of analysis. Soil amendments and seed shall be delivered and stored in original unopened packages, kept dry, and not opened until needed for use. Damaged or faulty packages shall not be used and will be rejected.

Table 4.1 Seed Mixture Analysis

Description	Minimum Percent Purity	Minimum Percent Germination	Pure Live Seed Rate per Acre *
Commercially Available Mixes			
Schizachyrium scoparium "Aldous" or "Camper"	70	75	6 lbs.
Andropogon gerardii "Niagra"	70	75	3 lbs.
Panicum virgatum "Blackwell"	95	75	2 lbs.
Sorghastrum nutans "Cheyenne"	70	75	3 lbs.
Eragrostis spectabilis	70	75	1/4 lbs.
Bouteloua curtipendula	70	75	1 lb.
Elymus canadensis	80	75	5 lbs.
Avena sativa	95	90	64 lbs. - Spring 128 lbs. - Fall
Wildflowers			**Rate for Every 3 Acres**
Lolium multiflorum	95	90	5 lbs.
Aquilegia canadensis	60	60	1 oz.
Asclepias syriaca	60	60	1 oz.
Asclepias tuberosa	98	80	1/4 oz.
Cassia fasciculata	60	60	1 oz.
Heliopsis helianthoides	60	60	1 oz.
Lespedeza capitata	60	60	1/2 oz.
Lupinus perennis	60	60	2 oz.
Monarda punctata	60	60	1/4 oz.
Rudbeckia hirta	97	75	1/8 oz.
Solidago speciosa	60	60	1/8 oz.
Solidago rigida	60	60	1/4 oz.
Solidago sempervirens	60	60	1/8 oz.
Eupatorium byssopifolium	60	60	1/4 oz.
Aster azureus	60	60	1/4 oz.
Aster ericoides	60	60	1/8 oz.
Aster laevis	60	60	1/4 oz.
Aster linariifolius	60	60	1/4 oz.
Chrysopsis (Pityopsis) falcata	60	60	1/4 oz.
Helianthemum dumosum	60	60	1/4 oz.
Helianthemum propinquum	60	60	1/4 oz.
Euthamia graminifolia	60	60	1/4 oz.
Aster patemus	60	60	1/4 oz.

* Addition of wildflowers into drill seeder hopper shall be done approximately every 3 acres to place wildflowers in random drifts.

Straw Mulch

A. The material for mulch shall be straw or other acceptable native grasses, well cured to less than 20% moisture by weight. Hay is **NOT** acceptable, due to its high weed content. Straw shall be stalks of oat or wheat, free from noxious weeds and other material.

B. All seeded areas must be adequately covered according to specifications contained herein within two (2) days of seeding. Seeding is not permitted when straw mulch cannot be applied within two (2) days.

C. Mulch shall be applied at the rate of 1.5 tons per acre using a mulch blower mounted on a tractor (no low ground pressure equipment). In extremely windy or harsh locations, additional mulch up to a 1/2 ton per acre may be required. A mulch binder shall be applied immediately (same day) after placement of straw mulch. Binder shall be a cellulose or non-asphaltic emulsion, natural gum binder blended with gelling or hardening agents such as Terra-Tack, as manufactured by Grass Growers, or approved equivalent. Application of binder shall be heavier at all edges where the wind may catch the mulch. Mixing and application rates shall be in accordance with the manufacturer's instructions and as directed by the sponsoring agency. A wood fiber mulch shall also be added to the tackifier for improved stability. No omission or substitution for this step will be permitted.

Execution

A. Inspection: Examine the areas and conditions under which work is to be done and notify Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner, as approved by the Engineer.

B. Seedbed Preparation: As approved by the sponsoring agency, **prepare all placed topsoil prior to seeding** by York raking, loosening soil surface to a minimum two-inch depth, and removing stones larger than 1.5 inches in size, trash, debris, twigs, stems, root mat, and other matter detrimental to warm-season grass/wildflower development. Smooth the topsoil only enough to insure uniform seeding by mechanical seeder. If the placement of topsoil has just been completed (within seven days) and soil is loose and friable, not eroded or crusted, the tilling step may be omitted, if so approved by the sponsoring agency.

C. Soil Tests: The same tests as those specified for imported topsoil shall be made on existing soil areas **not** topsoiled under the contract prior to seeding. The contractor shall submit test results to the sponsoring agency for review. Soil test recommendations will determine additional soil amendments as reviewed by the Ecologist.

D. Grass/Wildflower Seeding: Seeding shall be done within two days of fertilizing, weather permitting. All areas to be seeded shall be reviewed and approved by the Ecologist prior to seeding. Entering onto any seeded areas with heavy equipment is prohibited. The contractor shall enter upon seeded areas only with small tractor equipment to apply the straw mulch. There shall be no exceptions.

E. Unless otherwise directed by the Ecologist, seeding dates (weather permitting) shall be as follows:

Spring Season: April 15 to June 1
Fall Season: August 15 to September 1

Seed only during favorable weather conditions. The Ecologist reserves the right to limit seeding seasons when s/he feels that weather conditions would reduce the overall efficacy of the seeding.

F. If final contract seeding (*i.e.*, warm-season grasses/wildflowers) cannot occur within the specified times, an interim seeding will be required to stabilize the slopes until the appropriate seeding season occurs again. The contractor shall apply *Avena sativa* (oats) at a rate of 130 pounds per acre, or *Lolium multiflorum* (annual rye) at a rate of 50 pounds per acre. The Contractor shall thoroughly till the oats or rye under when ready for final seeding. Areas shall be inspected and approved by the Ecologist and sponsoring agency prior to final seeding. Straw mulch and binder shall also be applied at the same rates as that specified for the final seeding. This work shall be considered included in the Contractor's approved Erosion Control Plan and no additional compensation will be made for this work. Seeding outside of the contract specified windows is strictly prohibited.

G. Do not seed if soil is excessively dry or saturated as determined by bulk density tests.

H. Sowing shall be by the following method for all grass and wildflower seeds **except oats, annual rye and Canada wild rye:** Mechanical power drawn "Brillion Seeder," "Truax Drill Seeder," or approved equivalent. Seed should be planted 1/4" to 1/2" deep. Seeding operation shall be kept as close as possible to the contours and not up and down slopes.

I. Oats, annual rye, and Canada wild rye shall be broadcast seeded by a Hopper Type Cyclone seeder or through a double paddle agitator Hydroseeder. If using the Hopper Type seeder, the seed shall be uniformly distributed by sowing half the seed in one application and the remainder in a second application.

J. When an area has been seeded with the final warm-season grasses/wildflowers, oats, and Canada wild rye, straw mulch and mulch binder shall be applied as per the directions and rates specified above.

Vegetation Watering

Description

Under this section, the Contractor shall provide water to all trees and shrubs planted as part of this project throughout the maintenance period and as directed by the Ecologist. This item does not cover the required initial watering as specified under the item *Plant Material.*

Materials

At a minimum, the water shall meet the requirements of the New York State Department of Transportation Specification, Subsection 712-01, Water.

Execution

A. Watering shall take place at one-week intervals from May 1 through October 31, for a total of twenty-seven (27) waterings. Each week, the individual plants shall receive the following volume of water:

Plant Size	Volume of Water
1 gallon	2 gallons
2 gallon	2.5 gallons
3 gallon	3 gallons
4' - 5' (trees)	6 gallons
6' - 8' (trees)	9 gallons
1' - 2' caliper	18 gallons
2' - 3' caliper	30 gallons

B. This is the maximum amount of water to be applied each week. The Ecologist may order less watering based on weather and soil conditions.

C. Watering shall not be done for any given week if soil is saturated from recent rains or snowmelt. During extended dry periods, the Ecologist may order more frequent watering than scheduled or during non-scheduled periods.

D. Watering shall be applied in such a manner as not to damage plants or remove wood chip mulch and stakes. Watering shall not cause the uprooting or the exposure of plant roots.

E. Damage resulting from improper watering shall be immediately repaired at the Contractor's expense.

F. The watering method to be used shall be approved by the Ecologist.

Scheduling

A. The units of water applied to trees and shrubs requires monitoring by the Ecologist or an approved representative. The Contractor is responsible for setting up a regular schedule for weekly watering and is responsible for notifying the Ecologist of any deviation from that schedule at least two (2) working days before the regularly scheduled watering date.

B. If the Ecologist or approved representative cannot verify the watering application and rates, the Contractor shall not be paid for that watering, and it shall be counted as a missed watering.

Monitoring

Pre- and post-monitoring protocols must be established for a minimum of five (5) years following the restoration.

IV. Evaluation of Mitigation Sites Success Rates

In addition to examining restoration monitoring criteria, the Habitat Workgroup (HWG) is attempting to collect data on the success rate of mitigation projects in the Harbor/Bight region. Results from this investigation may be used to address policy questions concerning mitigation project accountability. Can restoration compensate for lost ecological use from previously healthy natural systems? The HWG has explored criteria for "replacement" of naturally functioning systems. Decades of regrowth may be necessary to restore the ecological value of an area, and some structural and functional uses of an ecosystem may be permanently impaired. Parkland acquisition more readily addresses lost use due to development or natural resources damages.

Black-billed plover, found at Lemon Creek Park, Staten Island

Section 4

Wetland Permitting Coordination and Protection

I. NYS Wetland Permitting Agreement of Coordination

The HEP Comprehensive Conservation and Management Plan (CCMP) identifies the need to manage shoreline and aquatic habitat modifications. A powerful mechanism for regulating changes to coastal habitat is the existing wetland permit-issuing process, which reviews proposed actions for their impact on the environment and establishes limits on development. Permitting regulations exist at the local, state, and federal levels. One critical challenge to wetland protection is coordinating these regulations.

To protect watershed integrity and strengthen New York State's Coastal Management Program and New York City's Waterfront Revitalization Program, the HWG Regulatory and Enforcement Subgroup drafted an Agreement of Coordination (AOC) on Wetland Permitting. Workgroup participants from agencies with overlapping regulatory functions in the coastal area of New York City – the Army Corps of Engineers (ACOE), U.S. Environmental Protection Agency (US EPA), NYS Department of Environmental Conservation (NYS DEC), NYS Department of State (NYS DOS), and NYC Department of City Planning (NYC DCP) – have closely evaluated and revised the document.

The AOC outlines existing regulations related to the permit-issuing process in New York State among federal, state, and local agencies. Existing statutes require that the ACOE and NYS DEC determine whether an action would be consistent with the policies and purposes of the State Coastal Management Program and the City's Local Waterfront Revitalization Program when local, state, and federal jurisdiction overlap. In addition, the AOC includes agreement to attempt diligent interagency communication, including forwarding copies of joint permit applications and supporting documentation among NYS DEC, NYS DOS, and ACOE, and forwarding NYS DEC permit applications for actions in the New York City coastal area to NYC DCP. It also includes agreement that the ACOE and NYS DEC will inform applicants of other governmental authorization that may be required.

Final approval from participating agencies and the HEP Management Committee was received March 2000. The AOC was ratified by the Policy Committee in November 2000.

The challenge of implementation is now the responsibility of each permit-issuing agency, and enforcement is under the jurisdiction of NYS DOS. The HWG, however, recognizes that implementation and enforcement of existing wetland permitting procedures still fail to adequately regulate small freshwater wetlands outside of the New York City coastal area. The HWG is committed to freshwater wetland protection and will address the issue as a future goal.

CCMP Action H-3.4

Identify projects and issues requiring regional cooperation; facilitate cooperation.

CCMP Action H-4.4

Ensure that actions impacting habitat in the Harbor core area, in the aggregate, result in a net increase in the acreage and quality of aquatic habitat, where feasible and appropriate.

CCMP Action H-3.2

Ensure that significant coastal habitats are afforded protection through the consistency review process of the Coastal Zone Management Program.

AGREEMENT OF COORDINATION AMONG THE ARMY CORPS OF ENGINEERS, NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NYS DEPARTMENT OF STATE, AND NYC DEPARTMENT OF CITY PLANNING

Whereas, the New York/New Jersey Harbor Estuary Program (HEP) was created pursuant to the National Estuary Program, which was established to promote the development of comprehensive management plans for estuaries of national significance threatened by pollution, development, or overuse;

Whereas, the HEP Comprehensive Conservation and Management Plan (CCMP) identifies habitat loss and degredation as one of the five primary causes of human use and ecosystem impairments in the New York/New Jersey Harbor. Among the causes of loss and degradation of natural habitat identified in the CCMP are the filling of wetlands, alteration of shorelines, and coastal development;

Whereas, the HEP CCMP recognizes the importance of wetlands in providing habitat and food for fish and wildlife, filtering the aquatic ecosystem, and controlling stormwater;

Whereas, the HEP CCMP identifies actions to address habitat loss and degradation, including Action H-4.1, which provides that "the responsible state and federal agencies will, as legally permissible and appropriate, develop Memoranda of Agreement to coordinate surveillance, inspection, permitting, and enforcement activities in wetlands and adjacent upland areas";

Whereas, the adoption and approval of the HEP CCMP was determined to be consistent with the State's Coastal Management Program and the City's Waterfront Revitalization Program;

Whereas, the Army Corps of Engineers, New York State Department of Environmental Conservation, New York State Department of State, and New York City Department of City Planning (the governments) recognize the importance of developing and executing an Agreement of Coordination to coordinate activities, including direct funding and approval activities, in coastal areas — including wetlands and adjacent uplands — within the coastal areas of New York City;

Whereas, the responsibilities of the signatory governments in regulating and managing activities in the wetlands and coastal areas of the State of New York overlap in many instances;

Whereas, the Army Corps of Engineers (ACOE) is charged with regulating the disposal of dredged or fill materials into navigable waters pursuant to § 404 of the Clean Water Act and the construction or placement of structures in or over navigable waters pursuant to §10 of the Rivers and Harbors Act;

Whereas, the New York State Department of Environmental Conservation (DEC) is charged with the protection and regulation of natural resources, including tidal and freshwater wetlands, streams, streambeds, and coastal erosion hazard areas pursuant to Articles 15, 24, 25, and 34 of the State Environmental Conservation Law;

Whereas, the New York State Department of State (DOS) is responsible for administering the state's federally approved Coastal Management Program and ensuring that certain federal and state activities are

consistent with state coastal policies and approved local waterfront revitalization programs;

Whereas, the Department of City Planning (DCP), as an agency responsible for land use within the coastal zone, acting on behalf of the City Coastal Commission, is charged with the administration of the City's approved Waterfront Revitalization Program;

Whereas, the ACOE and state agencies involved in authorizing activities in wetlands and waters of the state have developed a joint permit application process which requires permit applicants to submit a single permit application to DEC and requires DEC to forward a copy of that permit application to DOS and the ACOE;

Whereas, the ACOE, DEC, and DOS recognize the importance of the joint permit application process in coordinating their respective regulatory activities;

Whereas, the Federal Coastal Zone Management Act of 1972 encourages the states to prepare and implement coastal management programs to, among other things, "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone" and requires that federally authorized, direct, and funding actions be consistent with approved coastal management programs;

Whereas, pursuant to the Federal Coastal Zone Management Act, New York State's Coastal Management Program was approved by the federal government;

Whereas, federal approval of the Coastal Management Program has conferred upon DOS the authority to determine whether federal direct, authorized, or funded activities are consistent with the State's Coastal Management Program, as expressed in the City's Waterfront Revitalization Program;

Whereas, Article 42 of the State's Executive Law (known as the Waterfront Revitalization and Coastal Resource Act), adopted by the State to implement the Coastal Zone Management Act and Coastal Management Program at the state level, requires actions undertaken by State agencies within the coastal area to be consistent with the coastal area policies set forth in Article 42 of the New York State Executive Law and 19 NYCRR §600.5, or approved local waterfront revitalization programs;

CCMP Action H-4.1

Develop memoranda of agreement, as legally permissible and appropriate, to coordinate surveillance, inspection, permitting, and enforcement activities in wetlands and adjacent uplands.

CCMP Action H-1.3

Seek establishment of memoranda of understanding or other formal mechanisms among agencies to implement recommendations, to the extent legally permissible and reasonable.

Whereas, upon approval by the New York Secretary of State and concurrence with that approval by the United States Department of Commerce's Office of Ocean and Coastal Resource Management, local government waterfront revitalization programs are incorporated into and amend the State's Coastal Management Program;

Whereas, the City of New York has adopted a Waterfront Revitalization Program, the New York Secretary of State has approved the City's Waterfront Revitalization Program, and the federal government has concurred with that approval as an amendment to and formal component of New York's Coastal Management Program in accordance with § 915 of the New York State Executive Law and the Federal Coastal Zone Management Act;

Whereas, before DEC or ACOE authorizes or undertakes certain activities in the coastal area, the proposed activities must be determined to be consistent with the enforceable policies of the State Coastal Management Program or the policies and purposes of the City's Local Waterfront Revitalization Program;

Whereas, coordination of regulatory, funding, and direct activities by the governments is essential to the protection and management of the coastal resources and land and water uses in the State's coastal area;

Whereas, education of the public concerning the ACOE and State regulatory and other decision-making requirements is an important part of ensuring compliance with those regulatory and other decision making standards;

NOW THEREFORE the government agencies agree as follows:

1. DEC, DOS, ACOE, and DCP shall make diligent efforts to communicate with one another through email, fax, mail, and telephone about proposed projects and regulatory activities. As part of this effort, DEC shall promptly forward copies of all joint permit applications and supporting documentation that they receive to the ACOE and DOS. Joint permit applications and supporting documentation for projects in New York City shall be forwarded to DCP. In its correspondence with permit applicants, ACOE shall continue to inform applicants that local and State authorization(s) may be required. DEC shall include in its correspondence with permit applicants a statement that an ACOE permit may be required.

2. In its correspondence with permit applicants, ACOE shall continue to inform applicants that local and State authorization(s) may be required. DEC shall include in its correspondence with permit applicants a statement that an ACOE permit may be required.

3. DEC shall send to the ACOE copies of all letters seeking information from DEC about wetlands delineations on properties that may be under consideration for purchase or development and, whenever possible, DEC shall inform project sponsors/developers, in writing, that an ACOE permit may also be required for a proposed project.

4. For the issuance of permits under Clean Water Act § 404 or § 10 of the Rivers and Harbors Act, the ACOE shall inform each applicant that the applicant must complete a federal consistency assessment

form and consistency certification and that the applicant must submit a copy of the permit application, federal consistency assessment form, and all necessary supporting documentation to DOS at the same time it is submitted to the ACOE. For projects seeking an individual permit from ACOE, DOS shall forward to the Department of City Planning (DCP) for comment a copy of the applicant's consistency certification and permit application. For direct activities proposed by the ACOE, DOS shall forward a copy of the ACOE's proposed activity and consistency determination to DCP for comment. DCP shall provide comments, if any, or identify any conflicts between any proposed activity and the City's Waterfront Revitalization Program, within 45 days of the date of DOS's transmittal letter. In such instances, DOS shall not issue its decision to concur with or object to a consistency certification, or agree or disagree with an ACOE consistency determination before DCP has had the opportunity to provide comments to DOS within that 45-day period.

5. As set forth in 19 NYCRR § 600.4, DEC shall complete the Coastal Assessment Form (CAF) in its consideration of an action in the coastal area upon receipt of an application for work in the coastal area, and forward a copy of the CAF to DOS. If an action is located within New York City, a copy of the CAF shall also be forwarded to DCP.

6. As set forth in 19 NYCRR § 600.4(c), for those actions where a determination has been made that an action will not have a significant effect on the environment pursuant to the State Environmental Quality Review Act (SEQRA), 6 NYCRR Part 617, prior to the issuance of a DEC permit in the coastal area where there will be review, funding, or approval activities by a federal agency, DEC must make a determination regarding the consistency of its action with state coastal policies in 19 NYCRR Part 600.5 or the City's Waterfront Revitalization Program, and file a certification with DOS that the action will not substantially hinder the achievement of any of the policies and purposes of the City's Waterfront Revitalization Program. Pursuant to guidelines developed by DOS, DEC, and other state agencies, before making the consistency determination, as soon as possible DEC must submit the permit application, or other material describing the proposed action, to DCP for comment. If DCP and DEC disagree as to whether a proposed action is consistent with the Waterfront Revitalization Program, either party may request that DOS mediate the disagreement.

7. As set forth in 19 NYCRR § 600.4(a), for those actions where a determination has been made that an action may have a significant effect on the environment pursuant to SEQRA, compliance with SEQRA, 6 NYCRR 617.9(b)(5)(vi) and 6 NYCCR Part 617.11(c), shall satisfy the requirements set forth in paragraph 6 above.

8. If an action would not be consistent with one or more of the policies and purposes of the City's Waterfront Revitalization Program, the action shall not be undertaken by DEC unless it meets the following three requirements set forth in 19 NYCRR Part 600.4(c)(1), (2), and (3):

   (1) "No reasonable alternatives exist which would permit the action to be taken in a manner which would not substantially hinder the achievement of such policy or purpose";
   (2) "The action taken will minimize all adverse effects on the local policy or purpose to the maximum extent practicable"; and
   (3) "The action will result in an overriding regional or statewide public benefit."

NYC Parks/NRG Salt Marsh Restoration Team planting Spartina *along the high-tide line at Saw Mill Creek, Staten Island*

Section 5

Habitat Restoration and Stewardship Training

I. Landfill Restoration Symposium

The imminence of landfill closures in the Harbor/Bight region presents an unparalleled opportunity to restore natural areas that have been traditionally regarded as wasteland. In order to explore the range of landfill restoration options, the HWG, in cooperation with NYC Parks and NYC Sanitation, convened an International Landfill Restoration Symposium on April 22-23, 1998 at the American Museum of Natural History. The symposium, attended by 260 participants, fostered the exchange of ideas between academics, policy-makers, government ecologists, and regulators involved in determining restoration policy and implementing landfill closures.

Presenters at the symposium included landfill restoration ecologists from the University of East London, UK Forestry Authority, and Pitsea Landfill (the UK's largest landfill); and New York, New Jersey, and federal landfill restoration experts and regulatory officials. Representatives from the US EPA, US F&WS, ACOE, the Interstate Sanitation Commission, NYS DEC, NYS DOS, NJ DEP, NYC Parks, NYC Sanitation, and NYC DEP, among others, participated. Options for wetlands treatment and bioremediation were also addressed. The second day of the symposium featured a tour of Fresh Kills Landfill, the world's largest landfill, and afternoon sessions at Snug Harbor Cultural Center in Staten Island. Meeting abstracts are provided in Appendix 3.

The conference was sponsored by the HEP HWG, NYC Parks, NYC Sanitation, the Hudson River Foundation, British Airways, the American Museum of Natural History, and Snug Harbor Cultural Center.

II. New York/New Jersey Baykeeper Urban Stream Restoration Training Workshop

The Baykeeper Urban Stream Restoration workshops aim to provide information on stormwater management, hydraulics, hydrology, and the bioengineering restoration techniques needed to help plan and implement community-based restoration and riparian corridor enhancement projects. The workshops use a successful model developed by members of the Coalition to Restore Urban Waters (CRUW), sponsored by the Natural Resources Conservation Service and are geared towards training citizen volunteers and city, county, and federal employees.

On May 24-25, 1997, Baykeeper conducted the first of a series of restoration workshops with both classroom and on-site/in-ground activities. Three sections of eroding streambank, totaling approximately eighty linear feet, were stabilized using a combination of live stake cuttings on the lower bank and

CCMP Action H-1.2

Foster information transfer and tools to enhance and encourage watershed planning.

CCMP Action H-6.1

Sponsor workshops to encourage federal, state, and local management agencies, other appropriate agencies, and other landowners to protect habitat values.

CCMP Action H-9.2

Educate the public on the impacts of lifestyle on habitat and living resources.

brush matting and fascines on the upper bank. The upper bank and a 15-foot-wide buffer along the entire site were replanted and heavily mulched. A variety of floodplain species were planted.

Although good streamside upper-story canopy cover existed at the site, several tree species were planted to enhance the canopy. They included river birch (*Betula nigra*), red maple (*Acer rubrum*), and black willow (*Salix nigra*). Other species planted at the site included red osier dogwood (*Cornus sericea*), silky dogwood (*Cornus amomum*), soft rush (*Juncus effusus*), and arrowhead (*Sagittaria latifolia*). Black willow and dogwood were used for the stake cuttings, brush matting, and fascines.

III. Bronx River Bioengineering Workshop

Over forty participants representing various federal, state, and local agencies, divisions of NYC Parks, and community groups participated in a three-day bioengineering workshop in March 2000. The workshop was sponsored by NYC Parks/NRG and Robbin B. Sotir & Associates, a worldwide leader in bioengineering, with funding from US EPA and the New York City Environmental Fund.

Bioengineering installations were demonstrated on 60 linear feet of channel bank in the Shoelace Park section of the Bronx River near East 216th Street. The nearly vertical bank was regraded with machinery and hand labor and different bioengineering restoration methods were employed on three 20-foot sections of riverbank.

The workshop sought to educate interested community volunteers and to expand the ranks of volunteers who regularly assist NYC Parks and Partnerships for Parks with river restoration and stewardship projects. Workshop participants were introduced to the vocabulary and technology needed to participate in small-scale restorations. Concepts discussed included live facines, live stakes, brushlayering, brushmatting, live gabons, and live siltation fencing. Participants developed sample restoration strategies before enthusiastically picking up their shovels and deadblow hammers to complete the demonstration installation.

The workshop brought representatives from Bronx River Restoration, AmeriCorp, New York Restoration Project, the Point Community Development Corporation, and the Gaia Institute together in a forum where they could share ideas, inform each other about upcoming projects, and gain a new set of skills and techniques, all of which will make for a more unified Bronx River restoration effort.

IV. Project WET

Project WET facilitates and promotes awareness, appreciation, knowledge, and stewardship of water resources through the development and dissemination of classroom-ready teaching aids and the establishment of state-sponsored Project WET programs. In New Jersey, Project WET is sponsored by the Wetlands Institute and supported by NJ DEP.

HEP sponsored ten Project WET workshops in New Jersey that gave educators information on the Harbor's ecology. The workshops provided books for a total of 250 teachers, a facilitator, promotional materials, and copies of the guide "Exploring New Jersey's Watersheds." These six-hour workshops also included the Project Learning Tree program, providing a full perspective on the connection between land and water.

V. Watershed Stewards Program

The Watershed Stewards Program is a partnership effort between NJ DEP and the Youth Environmental Society (YES), which began in 1997. The project provides leadership training for teachers and high school students through community service learning and environmental stewardship projects. HEP funded teachers from the Harbor area, who participated in the Watershed Stewards Weekend Workshop and led a group of high school students in a stewardship action project (*i.e.*, stream restoration, tree planting, *etc.*). NJ DEP is working closely with Baykeeper to identify projects and partnerships with local environmental groups, county and local governments, and corporations.

Spartina patens *and* Spartina alterniflora,
Udall's Park Preserve, Queens

The Raritan Bayshore,
Compton's Creek, Port Monmouth,
New Jersey

Section 6

For Further Information

Harbor Estuary Program

- New York/New Jersey Harbor Estuary Program

Robert Nyman
US EPA
290 Broadway, 24th Floor
New York, NY 10007-1860
(212) 637-3809

- New York/New Jersey Harbor Estuary Program
  Habitat Workgroup, Chair
- City of New York/Parks & Recreation
  Natural Resources Group, Chief

Marc A. Matsil
Natural Resources Group
City of New York/Parks & Recreation
1234 Fifth Avenue
New York, NY 10029
(212) 360-1417
(212) 360-1463

- New York/New Jersey Harbor Estuary Program
  Citizens' Advisory Committee, Chair
- New York City Soil & Water Conservation District
- Coalition for the Bight

Eugenia Flatow
121 Avenue of the Americas, Suite 501
New York, NY 10013
(212) 431-9676

- New York/New Jersey Harbor Estuary Program
  Public Outreach

Laura Bartovics/Zoe Kelman
US EPA
290 Broadway, 24th Floor
New York, NY 10007-1860
(212) 637-3816
(212) 637-3792

Federal Government

- U.S. Fish & Wildlife Service
- *Significant Habitats and Habitat Complexes of the New York Bight Watershed*
- Funding Opportunities for Habitat Restoration

Andrew Milliken/Don Henne/
Andrew MacLachlan
US F&WS
P.O. Box 307
Charlestown, RI 02813
(401) 364-9124

- U.S. Environmental Protection Agency – Region 2

Kevin Bricke/Dan Montella
US EPA
290 Broadway, 25th Floor
New York, NY 10007-1860
(212) 637-3737
(212) 637-3801

- U.S. Army Corps of Engineers
- Ongoing ACOE Studies
- New York State Wetland Permitting Coordination

Jim Haggerty/Leonard Houston
US ACOE, New York District
26 Federal Plaza
New York, NY 10278
(212) 264-3912
(212) 264-2122

- U.S. National Park Service

Dr. John T. Tanacredi
Gateway National Recreation Area
210 New York Avenue
Staten Island, NY 10305
(718) 354-4520

Don Riepe
Jamaica Bay Refuge
Gateway National Recreation Area
Floyd Bennett Field
Brooklyn, NY 11234
(718) 318-4348

State of New York

- New York State Department of State Coastal Program
- Environmental Protection Fund
- New York State Clean Water/Clean Air Bond Act
- New York State Wetland Permitting Coordination

Greg Capobianco/Steve Resler
NYS DOS
Division of Coastal Resources
41 State Street, 8th Floor
Albany, NY 12231
(518) 474-8811
(518) 473-2470

- New York State Department of Environmental Conservation
- New York State Clean Water/Clean Air Bond Act

Karen Chytalo
NYS DEC
205-S North Bellemead Road
East Setauket, NY 11733
(516) 444-0468

Melissa Alvarez/Jim Gilmore
NYS DEC
47-40 21st Street
Long Island City, NY 11101
(718) 482-6605
(718) 482-4875

- New York State Office of the Attorney General

Peter Lehner/Andrew Gershon
Environmental Protection Bureau
120 Broadway, 26th Floor
New York, NY 10271
(212) 416-8450

State of New Jersey

- New Jersey Department of Environmental Protection

Jennifer A. DiLorenzo/John Sacco
NJ DEP
401 East State Street
Trenton, NJ 08625
(609) 633-7242
(609) 292-2938

- Hackensack Meadowlands Development Commission

Don Smith
HMDC Consultant
261 Pinnacle Road
Gloversville, NJ 12078
(201) 460-4680
(518) 725-2095

City of New York

- City of New York/Department of Environmental Protection
- Specifications for Plantings Protocols
- Jamaica Bay Feasibility Study

John McLaughlin
NYC DEP
Office of Environmental Assessment
LeFrak Building, 11th Floor
Corona, NY 11368
(718) 595-4458

James Mueller
NYC DEP
Bureau of Environmental Engineering
96-05 Horace Harding Expressway, 5th Floor
Corona, NY 11368
(718) 595-5973

- New York State Wetland Permitting Coordination

Inga Van Eysden
Environmental Law Division
NYC Law Department
100 Church Street, Room 3-125
New York, NY 10007
(212) 788-0864

- City of New York/Department of Sanitation
- New York City Landfill Issues

Phil Gleason
Director, Landfill Engineering
NYC DOS
44 Beaver Street
New York, NY 10004
(212) 837-8370

- City of New York/Department of City Planning

Bill Woods/Omie Ryan
NYC Planning
Waterfront and Open Space Division
22 Reade Street, 6th Floor
New York, NY 10007
(212) 720-3623

- New York City Soil & Water Conservation District

Dr. Paul Mankiewicz
Gaia Institute
99 Bay Street
City Island, NY 10464
(718) 885-1906

Non-Governmental Organizations

- Environmental Defense
- HEP Dredged Material Management Integration Workgroup (DMMIWG)

Jim Tripp
Environmental Defense
257 Park Avenue South
New York, NY 10010
(212) 505-2100

- Hudson River Foundation

Nancy Steinberg
Hudson River Foundation
40 West 20th Street, 9th Floor
New York, NY 10011
(212) 924-8290

- Natural Resources Defense Council

Carolyn Summers
Natural Resources Defense Council
40 West 20th Street, 11th Floor
New York, NY 10011
(212) 727-4496

- New York/New Jersey Baykeeper

Steve Barnes/Greg Remaud
NY/NJ Baykeeper
Sandy Hook, Building 18
Highlands, NJ 07732
(732) 246-2038
(732) 291-0176

- New Jersey Audubon

Richard Kane
NJ Audubon
P.O. Box 693
Bernardsville, NJ 07924
(908) 766-5787

- Bergen Save the Watershed Action Network

Mark Becker
Bergen SWAN
368 Center Avenue
Westwood, NJ 07675
(201) 666-1877

- New Jersey Concern

Beatrice Bernzott
President
New Jersey Concern
508 West Elizabeth Avenue
Linden, NJ 07036
(908) 862-2056

- New York City Audubon

Sean Andrews
Executive Director
New York City Audubon
71 West 23rd Street, Suite 1529
New York, NY 10010
(212) 691-7483

- Trust for Public Land

Peter Blanchard
Trust for Public Land
Mid-Atlantic Regional Office
666 Broadway
New York, NY 10012-2317
(212) 677-7171

- NY League of Conservation Voters

Marcia Bystryn
League of Conservation Voters
130 William Street, Suite 801
New York, NY 10038
(212) 766-0014

- Friends of Rockaway, Inc.

Bernard Blum
67-11 Beach Channel Drive
Arverne, NY 11692
(718) 474-4193

- Sweetbay Magnolia Bioreserve

Richard Lynch
Sweetbay Magnolia Bioreserve
17 Monroe Avenue
Staten Island, NY 10301
(718) 273-3740

- Sierra Club

Susan Holmes
Sierra Club
116 John Street, Suite 3100
New York, NY 10038
(212) 791-9293

- Save the Sound
- *Long Island Sound Conservation Blueprint: Building the Case for Habitat Restoration in and around the Sound*

Bill Shadel
185 Magee Avenue
Stamford, CT 06903
(888) 728-3547
www.savethesound.org
savethesound@snet.net

Appendix 1
Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Partners for Wildlife Program	US F&WS	Primarily private landowners; also municipalities, states, nonprofit organizations. Cannot fund projects on federal lands.	Approximately $1.2 million in Region 5 for FY 96. Funds split into a 30%-70% operational/project ratio. At least a 50% non-program cost share on each project. Can be matched by Federal funds.
National Wetlands Conservation Grant Program	US F&WS	Coastal and Great Lake State agencies responsible for land acquisition or wetland restoration	Approximately $7-8 million/year nationwide, 25% non-federal match
North American Wetland Conservation Act	US F&WS, North American Waterfowl and Wetlands Office	Federal, state and local government agencies, conservation groups, and private industry (also Canada and Mexico)	Annual appropriations; penalties for violation of the Migratory Bird Treaty Act; and funds from the Coastal Wetlands Action of 1992. Approximately $26 million available in FY96.
North American Wetland Management Plan		Anyone	Approximately $100,000/year in Region 5
Challenge Grant Cost Share Program	USDI, US F&WS	Anyone can apply through a Service Project Leader (station must sponsor project). Non-federal public and private organizations and individuals.	Annual appropriations to FWS for federal share. Must include 50% non-federal funding. Grant requests should be less than $25,000. Approximately $400,000 (1261 funds) in Region 5 in FY 96. Requires 50% non-federal match.

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
	Voluntary program that provides cost-share assistance to landowners who want to restore trust species habitat.	Michael Horton, Ecological Services, USFWS, Hadley, MA (413) 253-8614 or State Ecological Services Field Office	Wetland and Upland Habitats
September 1	Funds the acquisition, restoration, or management of coastal wetlands.	Flip Nevers, Federal Aid, USFWS (413) 253-8507 Mike Horton, Ecological Services (413) 253-8614	Coastal Wetlands
April and August	Fosters partnerships to protect, restore, and enhance wetlands. Provides matching grants for wetland conservation projects, including those that support joint venture initiatives under the North American Waterfowl Management Plan.	Joe McCauley, Refuges (413) 253-8269 Robert Streeter, Executive Director North American Waterfowl and Wetlands Office USFWS 4401 North Fairfax Drive Arlington, VA 22203 (703) 358-1784 (703) 358-2282 fax	North American continent joint venture
IPW Process	Startup or operational projects that support the NAWMP.	Joe McCauley, Refuges (413) 253-8269	
Generally solicited in July. Deadline October 1.	Uses federal and non-federal matching funds to manage, restore and enhance natural and cultural resources. Highest priorities are endangered species and wetlands. Prior to FY 98, 35% of funds could be used for off-refuge projects. In FY 98, all funds went to projects on or directly benefiting refuges.	Tom Goettel, Refuges (413) 253-8517 Allison Rowell, Division of National Wildlife Refuges FWS, USDI (670 ARLSQ) 18th and C Street, NW Washington, DC 20240 (703) 358-1744 (703) 358-2240 fax	FWS National Wildlife Refuges or benefiting refuges. May be available for other off-refuge projects.

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Federal Aid in Wildlife Restoration (Pittman-Robertson Act)	US F&WS	States	Annual state apportionment 75% federal/25% state
Federal Aid in Sport Fish Restoration (Dingle-Johnson Act)	US F&WS	States	Annual state apportionment 75% federal/25% state
Partnerships for Wildlife	US F&WS	States	$214,000/year (FY96) match - 1/3 state, 1/3 private, 1/3 federal
Endangered Species - Section 6 Grants	US F&WS	States	Varies
Endangered Species - Recovery Funds	US F&WS	States, organizations	Varies
Endangered Species - Prelisting Funds	US F&WS	States, organizations	Varies
Fisheries Across America	US F&WS, NFWF	Anyone	$225,000 year nationwide from the NFWF. Requires 50% non-federal match.
Natural Resources Damage Assessment Program	Federal and State Trustees	NA	Varies by project. Funding for restoration is site specific.

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
	States decide how funding is spent to restore wildlife habitat on state or private lands under agreement; also includes technical assistance.	Herb Conley, Federal Aid (413) 253-8671	
	States decide how funding is spent to restore fish habitat, manage fisheries, and provide technical assistance.	Paul O'Neil, Federal Aid (413) 253-8681	
September 15	Habitat restoration projects to conserve nongame native fish and wildlife diversity. Projects selected by Washington Office.	Alison Haskell, Federal Aid (413) 253-8505	
October 1	Surveys, research, habitat protection, enhancement, and creation for listed species and state species of concern.	Alison Haskell, Federal Aid (413) 253-8505 Paul Nickerson, Endangered Species (413) 253-8615	
Proposals generally requested in October/ November but accepted anytime	Surveys, research, habitat protection, enhancement, and creation for listed species.	Paul Nickerson, Endangered Species (413) 253-8615	
Proposals generally requested in October/November but accepted anytime	Surveys, research, habitat protection, enhancement, and creation for species proposed for listing.	Paul Nickerson, Endangered Species (413) 253-8615	
August for projects to be completed within a year. Projects announced in March and must be complete by September.	Riparian and in-stream restoration, fisheries management, exotic species eradication, monitoring, habitat protection.	Rick Bennett, Fisheries (413) 253-8400	Fish habitat
	Funds assessed from damages to trust resources during oil and chemical spills and at superfund sites. Service and other trustees then use funds to restore damages to trust resources.	Tim Fannin Ecological Services Contaminants Coordinator (413) 253-8646	

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Ducks Unlimited		Anyone	Varies by state
Wetlands Reserve Program (WRP)	US Department of Agriculture (USDA), Agricultural Stabilization and Conservation Service (ASCS)	Owners of farmed wetlands and cropland converted from wetlands prior to December 23, 1985	Annual appropriations to ASCS, match by private landowner
Agricultural Conservation Program (ACP)	USDA, ASCS	Owners or operators of productive agricultural land (farming and ranching) that will have control over the land during the life of the conservation practice	Annual appropriations to ASCS
Water Bank Program	USDA, ASCS	Any person with an interest in eligible land, including privately owned wetlands and adjacent lands essential for migratory waterfowl nesting, breeding, or feeding areas	Annual appropriations to ASCS
Forest Stewardship Program (FSP) / Stewardship Incentive Program	USDA, Forest Service (FS)	Private owners of nonindustrial forest land	Annual appropriations to FS

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
None	Habitat management projects that benefit waterfowl.	Ducks Unlimited regional directors Craig Kessler, SE NY (516) 751-5850 Joe McCauley, Refuges (413) 253-8269	
	Purchases easements and provides cost-share funds and technical assistance for wetlands restoration on private lands. Authorized by the 1990 Farm bill, this program focuses on restoration of farmed or converted wetlands.	Lois Hubbard, Conservation and Environmental Protection ASCS, USDA PO Box 2415 Washington, DC 20013 (202) 720-9563 (202) 720-4619 fax	Enrollment currently authorized for nine states
	Provides cost-share funds and technical assistance for a variety of conservation practices on agricultural lands that provide long-term and community-wide benefits, one of which is development or rehabilitation of shallow water areas to support wildlife habitat.	Grady Bilberry, Conservation and Environmental Protection ASCS, USDA PO Box 2415 Washington, DC 20013 (202) 720-7333 (202) 720-4619 fax	Available for participation by all farmers and ranchers who establish the need for cost-share assistance
	Provides annual payments to participants for entering 10-year agreements for wetland preservation. Provides cost-share funds for conservation practices to preserve and improve major wetlands as habitat for migratory waterfowl and other wildlife.	James McMullen Director Conservation and Environmental Protection ASCS, USDA South Building Washington, DC 20013 (202) 720-6221 (202) 720-4619 fax	Enrollment authorized in states with State Forestry Management Plan (all states but one)
	FSP provides matching funds to state foresters to develop Landowner Forest Stewardship Plans. SIP provides cost-share funds to private landowners to implement technical practices identified by the Landowner Forest Stewardship Plans.	Bruce Baldwin (FSP) Mary Carol Koester (SIP) Cooperative Forestry FS, USDA Auditors Building 201 14th Street, NW Washington, DC 20250 (202) 205-1375 (202) 205-1271 fax	Enrollment authorized in states with State Forestry Management Plan (all states but one)

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Clean Water Act /319(h) Wetland and Riparian Projects	States	Counties, municipalities, soil and water conservation districts, and others	Annual appropriations to EPA for /319 Grants
American Greenways Program	The Conservation Fund	Preference for local, regional, or statewide nonprofit organizations	Contributions from DuPont, the Conservation Fund, and the National Geographic Society
Fish America Foundation	Fish America Foundation	Nonprofit organizations with 501(c)(3) status, and government agencies	Contributions from fishing tackle and boating manufacturers and major retailers; public and private grants
MARSH (Matching Aid to Restore States Habitat) Program	Ducks Unlimited (DU)	Public and private agencies and organizations	7.5 percent of DU grassroots fund-raising revenues in each state; individual donor contributions; state agency contributions
Habitat USA	Ducks Unlimited (DU)	Primarily public agencies	Grassroots fund-raising

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
	Awards grants to develop and implement projects that incorporate a watershed approach to addressing non-point source pollution problems, some of which have a wetlands or riparian area component. Projects vary among states, with some directly protecting or restoring wetlands or riparian areas, some focusing on public education, and others dealing with the use of constructed wetlands for water quality improvement.	*Connecticut* Stan Zaremba CT DEP Bureau of Water 79 Elm Street Hartford, CT 06106 (860) 424-3730 *New York* Robin Warrender NYS DEC 50 Wolf Road Albany, NY 12233 (518) 457-0635	Nationwide
	Provides grants up to $2,500 for activities associated with planning of greenways, which may include wetland activities.	Linda McLelvey The Conservation Fund 1800 North Kent Street Suite 1120 Arlington, VA 22209 (703) 525-6300 (703) 525-6410 fax	Nationwide
	Funds action-oriented projects aimed at improving fish habitat and/or water quality.	Andrew Loftus Fish America Foundation 1010 Massachusetts Avenue, NW Suite 320 Washington, DC 20001 (202) 898-0869 (202) 371-2085 fax	Nationwide
	Provides matching funds to develop, restore, preserve, and maintain waterfowl/wetland habitat in the United States.	Dr. Robert Hoffman, Director of Habitat Development Ducks Unlimited 1 Waterfowl Way Memphis, TN 38120-2351 (901) 758-3888 (901) 758-3850 fax	Lands under control of a public agency in all states, unless otherwise approved by DU's Conservation Programs Committee
	DU provides technical assistance or performs activities on behalf of public agencies related to waterfowl enhancement.	Dr. Robert Hoffman, Director of Habitat Development Ducks Unlimited 1 Waterfowl Way Memphis, TN 38120-2351 (901) 758-3888 (901) 758-3850 fax	North America

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Private Lands Program	Ducks Unlimited (DU)	Private landowners	Grassroots fund-raising; North American Wetlands Conservation Act Grants
Save Our Streams Program	Izaak Walton League of America	Pilot projects ar selected on a case-by-case basis. Voluntary monitoring and restoration activities.	Government and private foundation grants; corporate contributions
Izaak Walton League of America Grants and Loans	Izaak Walton League of America	Unspecified	Izaak Walton League of America Endowment (interest)
National Fish and Wildlife Foundation Grants	National Fish and Wildlife Foundation	Public and private entities	Annual federal appropriations
Pheasants Forever Projects	Pheasants Forever	Public and private entities	Grassroots fund-raising; National Fish and Wildlife Foundation Grants; corporate sponsors

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
	Works with private landowners to encourage and facilitate waterfowl habitat improvement projects.	Dr. Robert Hoffman, Director of Habitat Development Ducks Unlimited 1 Waterfowl Way Memphis, TN 38120-2351 (901) 758-3888 (901) 758-3850 fax	
	Performs pilot habitat restoration projects in coordination with development of restoration manuals and workshops that are available to the public to facilitate voluntary monitoring and restoration activities. Maintains a database of US water protection projects.	Karen Firehock Izaak Walton League of America 1401 Wilson Boulevard Level B Arlington, VA 22209 (703) 528-1818 (703) 528-1836 fax	
	In addition to funding efforts of Izaak Walton League state and local chapters, grants and loans from Endowment interest are awarded to other entities for projects that support the interests of the League.	Wendie P. Haley President Izaak Walton League of America Endowment 1840 NE 92nd Avenue Portland, OR 97220 (503) 253-9749	
	Provides matching funds for projects that protect and enhance fish and wildlife resources.	Whitney Tilt Director of Conservation Programs National Fish and Wildlife Foundation 1120 Connecticut Avenue, NW Suite 900 Washington, DC 20036 (202) 857-0166 (202) 857-0162 fax	National Fish and Wildlife Foundation
	Provides funding for restoration and preservation of pheasant and other wildlife habitat. Also provides technical assistance through staff biologists in nine regional offices.	Russ Sewell Director of Program Development Pheasants Forever PO Box 75473 St Paul, MN 55175 (612) 481-7142 (612) 481-0715 fax	415 local chapters in 27 states and three Canadian provinces

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
Waterfowl USA projects	Waterfowl USA	Within 36 states where local chapters exist, any project that will benefit the wetland and/or waterfowl habitat in a public area	Grassroots fund-raising
Waterways for Wildlife Program	Wildlife Habitat Enhancement Council	All entities, but corporation are primary participants	Membership donations
Wildlife Habitat Incentives Program (WHIP)	USDA's Natural Resources Conservation Service (NRCS)	Individuals must own or have control of the land. Not eligible if currently enrolled in similar program.	Up to 75% of the cost of installing the wildlife habitat practices. Cost-share payments may be used to establish, maintain, or replace practices.
NY City Environmental Funds (Con-Ed Settlement)	NYS Department of Environmental Conservation (DEC)	NPO's government agencies, schools in NYC and part of Westchester County	$5,000 - $15,000 awards annually
Section 22 Planning Studies	Corps of Engineers	States and local governments	50% match requirement
NY Environmental Protection Fund - Local Waterfront Revitalization Program	NYS Department of State (DOS)	Municipalities located on the State's coastal waters or designated inland waterway which meets criteria for economic distress	Approximately $1-2 million annually 50% local match. Planning costs eligible

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
	Conducts wetlands acquisition, preservation, and enhancement activities, which vary by local chapter. Holds some land in the name of chapters and conveys land to public natural resource agencies. Chapters also assist state or local agencies in purchasing equipment to support a project.	Scott Murphy Waterfowl USA PO Box 50 Edgefield, CT 29824 (803) 637-5767 (803) 637-0037 fax	Nationwide
	Assists in managing wildlands (including wetlands) through collection and analysis of data, identification of enhancement projects, development of habitat plans, and technical direction in implementation and monitoring efforts.	Robert Ferris, Director of Field Programs Wildlife Habitat Enhancement Council 1010 Wayne Avenue Suite 1240 Silver Spring, MD 20910 (301) 588-8994 (301) 588-4629 fax	Nationwide
	Participants work with USDA's NRCS to prepare a wildlife habitat development plan in consultation with local conservation district.	NRCS, Farm Service Agency (FSA), Cooperative Extension Service, or local conservation district	Nationwide. Wildlife habitation of private lands.
	Habitat restoration, education, youth programs for cleanup, access improvement and info programs, high school and college projects to increase understanding of estuary systems.	Jim Gilmore, NYS DEC Region 2 1 Hunters Point Plaza 47-20 21st Street Long Island City, NY 11101-5407 (718) 482-4900	Acquisition and management of marshes and other unique shoreline features.
	Identifies opportunities to restore habitats affected by Corps activities.	Stu Pikens US Army Corps of Engineers, NY District (212) 264-0023	Tidal wetlands
March, annually	Funds waterfront revitalization, natural resource restoration, reduction of non-point source pollution affecting significant natural resources. Support of appropriate water dependent industries. Improvement and expansion of public access.	GeorgeStafford NYS DOS 162 Washington Avenue Albany, NY 12231 (518) 474-6000	All coastal habitats

Funding Resources for Habitat Restoration

Program	Lead Agency	Eligible Applicants	Funding
NY Environmental Protection Fund - Non-Point Source Reduction Program 319	NYS Department of Environmental Conservation (DEC)	Municipalities	Approximately $2 million annually and 50% local match
Clean Air/Clean Water Bond Act	NYS Department of Environmental Conservation (DEC)	Municipal governments and state agencies, soil and water conservation districts	$25 million for NY Harbor, HEP; $200 million for Long Island Sound (requires local match); $25 million for Hudson River Management Plan; $150 million state-wide acquisitions and allocations
Water Resources Development Act (WRDA)	Army Corps of Engineers	Non-federal agencies	Project dependent
TEA-21 (Transportation Equity Act for the 21st Century) Transportation Enhancements Program	NYS Department of Transportation (DOT)	Incorporated groups, municipalities, state agencies of authority	$50,000 - $2,000,000 per project with at least 20% match by local project sponsor

Deadlines	Program Description	Primary Contact	Type of Habitat/ Location
Not fixed	Funds planning and implementation of non-agricultural non-point source abatement and control projects.	Robin Warrender NYS DEC Department of Water 50 Wolf Road Albany, NY 12233 (518) 457-0635	
Call for projects due out May 1997 for first round of funding	•Wastewater treatment improvement projects •Non-point sources abatement •Aquatic habitat restoration •Pollution prevention	Phil DeGaetano/John Mckeon NYSDEC 50 Wolf Road Albany, NY 12233 (518) 457-0635	NY - Aquatic habitat restoration
	Section 704 makes funds available for the conduct of fish and wildlife restoration and creation projects unrelated to Corps projects. Required match is 25% non-federal. Section 906(b) makes funds available to mitigate damages to fish and wildlife resulting from Corps water resources projects at any stage of completion. Section 1135 makes funds available for modification in constructed Corps structures or operations to improve fish and wildlife resources.	Stu Pikens US Army Corps NY District (212) 264-0023	See Program Description
	Projects that "enhance the cultural, aesthetic, historic, and environ-mental aspects of intermodal transportation networks" including Mitigation of Water Pollution Due to Highway Runoff *(e.g.,* wetlands restoration and stormwater runoff control) and Landscaping and Other Scenic Beautification *(e.g.,* native plantings)	Peter Dunleavy NYS DOT 47-40 21st Street Long Island City, NY 11101 (718) 482-4642	Those affected by transportation projects (roads, rails, terminals)

United States Senate

WASHINGTON, DC 20510

December 3, 1999

Honorable William Jefferson Clinton
The White House
1600 Pennsylvania Avenue
Washington, D.C. 20500

Dear Mr. President:

The Comprehensive Conservation and Management Plan (CCMP) of the New York-New Jersey Harbor Estuary Program (HEP), adopted by the Environmental Protection Agency and its partners, features habitat preservation as its primary objective. We are writing to let you know of our strong support for the funding of the priority habitat acquisition and restoration sites that have been initially identified under this program.

The Harbor Estuary Program's Habitat Work Group has identified a number of sites in both states for acquisition and restoration. The group identified four specific geographical watersheds in need of special protection because of their high ecological value: Jamaica Bay in New York; the Arthur Kill and the Raritan/Lower New York Bay, areas shared by both states; and the Hackensack Meadowlands in New Jersey. These watersheds contain some of the last remaining parcels of open space in the most densely populated region of the country and are home to important species of waterfowl, wading birds, shorebirds, raptors, anadromous fish, and estuarine fish.

The work group selected acquisition projects in wetland, nearshore, and coastal habitats that are under immediate threat from development. The overwhelming majority of these sites have been ratified by the New York-New Jersey Harbor Estuary Program Policy Committee, including the governors of both states and the Regional Administrator of EPA. Proposed restoration projects selected by the work group include saltmarsh, oyster, riparian buffer/freshwater wetlands, and rare, threatened, and endangered species habitats.

The acquisition and restoration plan has the strong support of a number of bi-state non-governmental organizations which have worked cooperatively with the estuary program. Moreover, it is consistent with the Administration's "no net loss" policy for wetlands and conforms to the Administration's Livability Agenda.

The comprehensive plan requires approximately $60 million over the next three years to acquire and restore the first critical elements of the estuary's ecological base. We expect that the States of New York and New Jersey would cost share approximately $30 million of this funding and that the federal government would finance the remaining costs. We, therefore, urge you to include $30 million in your Fiscal Year 2001 budget for high priority acquisition from willing sellers and restoration activities.

We look forward to working with you on this important initiative.

Sincerely,

Sen. Daniel Patrick Moynihan

Sen. Frank R. Lautenberg

Sen. Charles E. Schumer

Sen. Robert G. Torricelli

Appendix 3
Harbor Estuary Program International Landfill Restoration Symposium Program

April 22 and 23, 1998
Landfill Restoration Symposium
Restoring Native Ecosystems: An End-Use Debate

New York/New Jersey Harbor Estuary Program Habitat Workgroup
City of New York/Parks & Recreation
City of New York/Department of Sanitation
Trans-Atlantic Urban Ecology Initiative
University of East London

Introductory remarks:

Henry J. Stern, Commissioner, City of New York/Parks & Recreation

Jeanne M. Fox, Region II Administrator, U.S. Environmental Protection Agency

Abstracts: *In Order of Appearance*

Overview — Landfills, Habitat Restoration, and the "New Paradigm"

Marc A. Matsil, Chief, Natural Resources Group, City of New York/Parks & Recreation
Chair, NY/NJ Harbor Estuary Program Habitat Workgroup

Regional landfill closings represent an enormous opportunity for large-scale landscape restoration. Jamaica Bay's Fountain Avenue, Pennsylvania Avenue, and Edgemere Landfills, Staten Island's Fresh Kills Landfill, and the Hackensack Meadowlands occupy thousands of acres within critical estuarine ecosystems, where they compromise ecological functions and habitat values. Prescriptive regulations concerning final closure plans for landfills include a final vegetation cover of grasses, such as non-native fescues, perennial rye, and other sod formers. The chemistry and physical nature of soil cover, the community ecology of these grasses, the regional seed rain, and other factors create conditions in which colonization and ultimate dominance of invasive weeds is inevitable.

The current model approaches landfill closures as an engineering problem: vegetation is a kind of construction material used for erosion control, severely limiting the potential of closed landfills to contribute to the function of regional ecosystems and scenic values. This closure regime fails to create landscapes that function in the regional vegetation mosaic, and not surprisingly, they appear as landscape anomalies. Scientists in the UK employ a more ecologically sound model, creating native oak woodlands in which attention is paid to essential soil processes and community and landscape ecology. These systems function as, and look like, integrated parts of the regional ecoscape.

Tough questions must be asked about the traditional engineering models applied in the United States. Government regulators, always concerned with potential cap breaches, may restrict the use of woody vegetation. Ecologists often disagree with the standard engineering practices. While landfill gas emissions, methane, CO_2, ammonia, leachate, and excessive temperatures compromise plant growth performance, many argue that a clay cap — anaerobic, hardpan, and infertile, with low permeability — should provide effective barrier to root penetration. If 90%+ of all tree roots are found in the upper 0.6m of soil and are further stressed by landfill perturbations — methane oxidating bacteria and phytotoxic gas exchanges — are tree root breaches the major concern? Municipalities may wish to cut costs on soil covers, throwing fescue and grass seed to the wind, and cap their landfills with anthropogenic-based soil mixes that may ultimately support a full complement of invasive, ruderal weeds. Who pays in the end?

Recreating a healthy forest cover type with native plants that have adapted to regional conditions, evolved defenses against native insects, fungi, and other pests, and grow best under regional temperatures and moisture regimes enhances ecosystems, as native plants and animals have co-evolved and are mutually dependent. The other argument involves cost-savings. Establishing a native forest mosaic through active planting will provide shade, absorb nutrients, and limit competition, resisting dominance by successional, often monotypic, non-native invasives.

Salt marsh edges at our landfills should be established. *Spartina* grasses can induce naturally occurring aerobic microbial communities associated with the plants' rhizosphere, capable of assisting with the biodegradation of leaching PAHs and ammonia. *Spartina* also enhances habitat values.

We must re-evaluate basic assumptions about the best end use for closed landfills. This conference will be a forum in which we can achieve a fertile cross-pollination of ideas. Presenters will examine goals for landfill end use, physical and biological opportunities and constraints, and the regulatory environment concerning closure methodologies. Landfills usually become parkland. As managers and stewards, researchers and park users, we have a responsibility to re-create sound, ecologically sustaining, low maintenance, cost-effective ecoscapes. A healthy forest canopy will encourage a self-supporting leaf litter cycle, soils, root growth, and mycorrhizal associations. It will contribute to the biodiversity of our urban estuarine ecosystems.

Potential for Woodland Restoration on Landfills in Urban Areas

Steven N. Handel, Rutgers University

There is increased interest in improving the natural habitat and diversity of lands damaged by humans. Our long-term research has been in plant reproduction and population biology. Restoration ecology represents an arena to apply ecological principles about the forces that control and mold plant communities to urgent public needs. We have developed a series of experimental studies to test the role of various ecological processes (such as migration and dispersal, the role of mutualist, and soil structure) in limiting the development of natural vegetation on urban landfill sites. We have two goals: first, to understand what population processes control species presence and abundance under conditions where the habitat has been highly modified; and second, to make design and management recommendations to public agencies so that future habitat restorations on landfills and other degraded areas can start with a solid base of ecological understanding. These studies all include collaboration among vari-

ous types of ecologists and soil scientists and constant interplay with public officials charged with developing environmental policy and protocols.

At Fresh Kills in Staten Island and in the New Jersey Meadowlands, we have studied above-ground and below-ground processes over the past seven years. Studies have shown that roots of woody plants are repelled by the landfill cap, and remain in the overburden above the cap. The soil quality typically is not ideal for proper root growth and mycorrhizal development, and future closure specifications should be improved to reflect this need. Site conditions are rather windy and dry, favoring plants adapted to more xeric conditions. Plants are spreading by colonial growth and fruiting abundantly. Many mutualists such as native bee pollinators and fruit-eating, seed-dispersing birds visit the site. Both large and small patches of plants have done well in attracting these mutualists. Even in this highly modified urban environment, dozens of new native plant species arrive by seed dispersal from surrounding woodlots. However, seedling recruitment is sparse, limited by the dense perennial grass cover, dry conditions, and herbivory by small mammals. Attention to these issues could provide a system for native vegetation to spread across these large sites in an efficient and cost-effective manner. A comprehensive systems approach to vegetation development is needed to ensure that this large site and other area landfills reach their ecological potential, and become fully functioning as parts of the natural resources of the region and as public amenities.

Landfill Restoration: Soils and Surroundings

Dr. Jim A. Harris, Reader, Restoration Ecologist, University of East London
Co-Director, Trans-Atlantic Urban Ecology Initiative

Landfill sites are usually viewed as a necessary evil, and by some as an unnecessary one. There are, however, ways in which the opportunities offered by these sites to provide areas of biological interest may be taken advantage of.

Final soil covers are the first element in the provision of conditions that enable the development of a vegetated system that has at least some elements of ecological integrity. Soil is of central importance. It is where the lithosphere, hydrosphere, atmosphere, and biosphere all meet and interact. It is in the "pedosphere" that integration of biotic and abiotic components needs to occur if the cover is to act as an effective environmental and ecological buffer. The microbiological community mediates many of the nutrient transformations within soils systems and is a significant contributor to the development of structural stability. Therefore, selection of appropriate cover material is an essential first step.

Beyond this, the microbiological community has a further role to play in transformation of the methane emissions, by microbiological oxidation, in situations where covering systems allow this to occur. Here, adequate provision for the supply of nutrients to the microbial community is essential, along with consideration of appropriate textural conditions to allow oxygen penetration to occur within the soils, permitting the oxidation to proceed.

In systems where trees are being established, the use of appropriate symbiont inocula may be appropriate, particularly with respect to mycorrhizae, as their presence can be shown to improve rates of tree survival. The microbiological community may also be brought to bear in the long-term control of liquid arising from the site, and their potential as treatment systems in artificially constructed wetlands will be explored.

Do Trees Have a Place on Containment Landfills at All?

Dr. Andrew J. Moffat, UK Forestry Authority

Tree planting on containment landfill sites involving a capping layer beneath a soil cover has been quite a controversial subject in the United Kingdom. Governmental guidelines in the 1980s were wholly against it for three main reasons:

- The perception that tree roots could penetrate through an engineered cap and compromise control of water ingress into waste;
- The possibility that shallow rooting in trees on landfill sites could increase the risk of trees blowing over, thus disrupting pollution control measures; and
- The observation that conditions on landfill sites could adversely affect tree survival.

However, there is a statutory need in the UK for reclamation of landfill sites to a beneficial after-use. Further evaluation of the placement of trees on landfills was called for. Detailed research commenced in 1991. This has included an in-depth review of relevant literature, plus field, nursery, and laboratory experimentation.

The literature review covered issues of tree growth in the landfill environment, the rooting habit of trees, windthrow, and landfill hydrology. In the experimental research phase, several field silvicultural experiments have been established using best practice on modern landfills, and tree growth (above and below ground) has been examined at older sites. In addition, studies of water use by mature woodland on a clay soil (analogous to a clay cap) have been conducted, and the ability of trees (of several species) to root into landfill caps (of several simulated systems) has been studied.

The research has provided the basis for revised guidance, which acknowledges that if landfill engineering is adequate to meet current landfill cap permeability specifications ($1x10^{-7}$ cm^3/s), trees of most species can be planted. However, it has been recognised that a greater soil thickness is required to reduce the risk of cap penetration by tree roots. In addition, woodland planting must be conducted sensitively, accepting the needs of the landfill engineer who must be able to maintain and monitor pollution control measures.

If Not Trees Then What?
Sustaining Tree Growth in Landfill Reinstatement Programmes

Philip J. Shaw, Chief Ecologist, Cleanaways Ltd.

Trees may be specified as part of a landfill site reinstatement programme for a number of reasons, including:

- Aesthetic consideration and landscape improvement;
- Enhancement of public amenity in the absence of other beneficial land use; and
- Ecological habitat creation.

In the past, UK governmental guidance has not been favorably disposed towards tree planting as a reinstatement option on landfill sites. As a consequence, there is little experience about the performance of trees on landfill sites over meaningful time scales.

Trees have been planted at Pitsea Landfill Site in the UK since 1978, including early trials performed in conjunction with the (then) UK Forestry Commission. These trials were used to investigate depth and type of soil materials, together with the establishment and subsequent growth of different native and forestry tree species. Drawing upon this experience, together with a continuing campaign of extensive woodland planting at Pitsea, this presentation addresses some of the practical aspects of using trees in landfill reinstatement programmes.

What About Wetlands?

Richard A. Lindsay, Wetlands Specialist, University of East London

The first thing to recognise is that there is no such thing as a dryland restoration scheme; even capped systems may crack.

The problem for wetlands in particular is that they don't so much lie at the bottom of the food chain as the bottom of the catchment, where events at several sites, whether nearby or distant, tend to accumulate, perhaps producing small-scale incremental changes that are detectable only over considerable periods of time, but that are nevertheless inexorable (cumulative), and sometimes fatal.

A key element in any reclamation programme must therefore be a clear understanding of the surrounding catchment and its functional relationship with the reclamation scheme in both space and time.

Landfill can be wetland-negative, in that it may remove wetlands from the catchment, or it can be wetland-positive, inasmuch as it adds new wetlands to the catchment. These are relatively simple audit assessments, but what of the impacts that are far less easy to feed into the balance sheet? What of those occasions — far more common than is generally recognised and far more significant than developers care to admit — where the issue is not simple gain or loss, but a steady change in quality?

In practice, many reclamation schemes have elements of all three impacts. However, the last impact is present in all cases, because, long term, it is reasonable to assume that any scheme, no matter how well-engineered, will eventually have some impact on catchment behaviour, either in terms of water movement or, more likely, water quality. The difficult part is in anticipating in what way, and to what degree, this impact will be felt.

Wetland-Negative Impacts

It is unfortunately the case that wetlands continue to be regarded as wastelands, and therefore prime targets for mining, garbage disposal, and a host of other destructive activities which subsequently end with reclamation programmes. Throughout Europe, North America, and Asia it is possible to point to the destruction of wetlands, which are then sometimes claimed to have been "restored." Such activities rarely lead to sustainable end points and are increasingly being recognised as undesirable and unacceptable, even under schemes such as "no net loss."

Wetland-Positive Impacts

There are occasions where reclamation schemes may involve the creation and management of wetland systems where originally there were none. Aggregate extraction followed by sensitive reclamation schemes is a prime example in lowland England. On other occasions, perhaps an area of derelict land that was, in former times, a type of wetland has the opportunity, through a reclamation scheme, to re-establish the original type or a new wetland sys-

tem. These new wetlands may be part of the clean-up process, whereby wetland functions and services operate hand-in-hand with engineered systems to reduce nutrient or particulate loading in downstream waters.

Cumulative Wetland Impacts

As discussed above, these are the most universal, but also the most insidious and most difficult to deal with. Like coastal management processes, an action in one place can have far-reaching consequences for an area several kilometers away from the managed site. The dangers from this type of impact include: simply not recognising and linking such impacts to the source site, either because of the time scales or distances involved; accumulation of nutrients in a collection basin within the catchment through infiltration (how to stop such diffuse inputs?); and alteration of water flows, perhaps apparent only during extreme events, but nevertheless sufficient to bring about change within the catchment.

Reclamation schemes that claim to be environmentally sound should include within their environmental audit and working practices landfill development and completion, in order to improve local environments.

A Regulatory Perspective Roundtable

John A. Castner, Assistant Director, Permitting & Technical Problems,
Solid and Hazardous Division, New Jersey Department of Environmental Protection

New Jersey's regulatory program governing solid waste disposal has changed significantly over the past 30 years. This progression has led us from disposal in dumps to a reliance on highly sophisticated sanitary landfills and other high-tech management systems for waste disposal. Stringent rules and environmental performance criteria have been developed to ensure protection of public health and the environment.

New Jersey began to develop its statewide program with the legislative adoption of the Solid Waste Management Act in 1970. Implementing regulations were also adopted in 1970 and have subsequently been modified numerous times. A significant change to the Solid Waste Management Act occurred in 1981 with the imposition of long-term maintenance and monitoring requirements on the owners or operators of sanitary landfills.

Prior to the 1970s there were no requirements for liners, leachate collection systems, and decomposition gas control systems; final cover systems were at best simply two feet of soil. With the development of liner systems, it became evident that leachate must be managed for many years. This typically involves pumping or trucking to a publicly owned treatment works. Considering that regulations dictate at least 30 years of post-closure care, such management of leachate can become very costly. In order to address this concern, state and federal regulatory agencies have imposed requirements to impede the infiltration of rainwater into landfilled solid waste, thereby reducing the volume that must be disposed of. This generally includes the construction of an impervious final capping system. The systems typically include layers of impermeable soil or a synthetic membrane and, in some cases, may include both materials. On the impermeable layer will be a sand drainage layer overlain by the growth medium. The final surfaces must be stabilized to guard against erosion. Commonly, grass is used for this purpose to avoid compromising the impermeable barrier by deep root penetration.

A variety of end uses of closed landfills have been authorized by the New Jersey Department of Environmental Protection. These range from continued use for solid waste and recycling facilities to open space

or recreational use on up to commercial or light industry construction. The design professionals must address many technical concerns in selecting an end use such as foundation integrity, proper venting of decomposition gases, stormwater management, and compatibility with final capping systems. Selection of vegetation that will enhance development is an important consideration. Soil, water, maintenance demands, and depth of root zone must be matched to the required final capping system dictated by environmental needs or regulatory standards.

Support for Habitat Restoration at Closed Landfills

Carl Johnson, Deputy Commissioner, Office of Air and Waste Management,
New York State Department of Environmental Conservation

NYS DEC's Part 360 closure regulations were developed as a "how to" guide that would allow municipalities to ensure that they were constructing landfill closures that would be sufficiently protective of the environment without having to evaluate competing proposals from consultants and engineers. Essentially, if a cap met the standards set forth in the regulations, it would be accepted by DEC. However, these regulations should not be viewed as a stumbling block to creating habitat at closed landfills. Variance procedures are available and are often used for closures where there are special local considerations or when new technologies are available. If the circumstances warrant, we will revisit the regulations. Only recently has the issue of closed landfills as habitat arisen, particularly as we look at closure of Fresh Kills. Governor Pataki and Commissioner Cahill see habitat restoration at landfills as a splendid opportunity to return these degraded sites to an environmentally beneficial purpose. DEC will do everything it can to maximize this opportunity, at Fresh Kills and elsewhere.

A Regulatory Perspective Roundtable

Andrew Bellina, RCRA Senior Policy Advisor,
U.S. Environmental Protection Agency

US EPA supports actions to restore landfills for wildlife habitat and other beneficial uses. Consideration of these values can provide opportunities to implement the goals of our estuary management plans, such as the New York/New Jersey Harbor Estuary Program (HEP) Comprehensive Conservation and Management Plan and our other community-based programs and initiatives.

In considering landfill restoration from a RCRA Subtitle D perspective, it is important to consider the intent of EPA's Criteria for Municipal Solid Waste (MSW) Landfills as presented in the Code of Federal Regulations (40 CFR 258). The criteria include various provisions to protect surface water, ground water, and to prevent the accumulation and migration of dangerous gases. Additionally, the criteria call for ground water monitoring and corrective action to mitigate any migration of groundwater contaminants that may occur for 30 years after landfill closure. EPA-approved state programs include similar provisions. Accordingly, in reclaiming and restoring landfills, these remain important considerations.

EPA's RCRA program has also supported landfill reclamation projects under its MSW Innovative Technology Evaluation (MITE) program. In terms of RCRA, landfill reclamation has been pursued from several perspectives, including:

- Reusing landfill capacity (extend landfill life);
- Recovering soil for use as cover elsewhere at the landfill;
- Providing fuel for MSW combustors;
- Recovering recyclable materials;
- Reducing liability for long-term management of waste; and
- Reducing landfill footprint so land can be freed for other uses.

Landfill reclamation has proven it can have benefits in each of these areas. However, there are also potential drawbacks, including:

- Managing hazardous materials encountered during reclamation;
- Controlling gases and odors;
- Subsidence of areas near excavation; and
- Public concern about exposing waste.

These issues would need to be considered in designing a landfill restoration program for habitat development.

In addition to specific RCRA concerns, which are related to the operation, maintenance, and management of the landfill itself, there are also broader regulatory concerns relating to other environmental issues. It was a common practice years ago to site landfills in wetlands; historically, wetlands were often viewed as having little value to society. We know today that wetlands perform a vast array of ecological functions that benefit society, from water purification to flood control to providing fish and wildlife habitat. Because it was more costly to prepare a wetland site for construction, the only open space left in urbanizing areas tended to be wetlands. The federal government regulates the placement of fill into wetlands under Section 404 of the Clean Water Act, which has been in place since 1972. This may become an issue in landfill closure; if there are wetlands adjacent to the landfill, activities such as the placement of slurry walls would require a 404 permit.

While it is not possible in landfill closure to restore wetland habitat that was lost from landfilling, closure of landfills presents an opportunity to establish habitats that may benefit wildlife in areas where wildlife habitats have been lost. This has been accomplished successfully in the Hackensack Meadowlands, where there were 27 active landfills in 1969. Of these landfills, only one is currently active. The regulatory body responsible for solid waste management in the District, the Hackensack Meadowlands Development Commission (HMDC), is responsible for the closure of five of these landfills; two have been successfully closed, and all will eventually have habitat restoration performed on them.

The HMDC is currently working in partnership with the federal government to develop a Special Area Management Plan (SAMP) in the District. Part of this plan contains provisions for funding and implementing the closure of the remaining abandoned landfills in the District and using the closed landfills for wildlife habitat establishment. One habitat establishment project has occurred in the District. In this case, the area has been converted to a park in connection with an adjacent wildlife management area and an environmental education center. The remediated upland habitat landscaped with native vegetation provides habitat that is regionally scarce. This habitat is even more ecologically valuable due to its context within a large wetland system. It supports a large variety of wildlife, particularly the numerous species of hawks that overwinter in the District, and for which such habitat has long been scarce in the region. It also provides enormous opportunities for education and recreation, which are not values society usually associates with landfills.

EPA looks forward to working with symposium participants and other stakeholders to advance landfill restoration and restore natural ecosystems.

Idlewild Park Landfill Restoration — Grassland, Coastal Scrub, Salt and Freshwater Mosaic

Michael J. Feller, Deputy Chief, Natural Resources Group,
City of New York/Parks & Recreation
John McLaughlin, Director of Landscape Management,
City of New York/Department of Environmental Protection

In spite of the obvious conflicts, select urban infrastructure improvement projects that occur on undeveloped open spaces can sometimes be used to an ecological advantage. Thousands of acres of New York City's wetlands were used as unregulated landfill sites between the 1920s and 1960s. Vegetation cover existing on these sites is the result of volunteer recruitment and natural succession. Many of these existing lands are unfortunately often degraded with extremely low plant and wildlife diversity. The mitigation required to produce an appreciable difference in these areas can easily exceed $500,000. Including large-scale restorations as part of these infrastructure improvements provides the mechanism to fund substantial and effective restoration efforts.

The distribution of vegetation communities, relative to fill-derived soils, can illuminate opportunities and constraints for establishing particular plant communities and habitats on landfills. While the initial ecological improvements are limited to the defined boundaries of the infrastructure project, the planting of dozens of new woody and herbaceous species provides a "new" seed source that can disseminate to adjacent areas. Besides the restoration of tidal wetlands and the creation of freshwater wetlands, our project restored nearly 16 acres of a coastal dune plant community in an area of former landfill. Species selected for planting were chosen for specific functional contributions to the site's ecology, but also for providing new, or augmenting existing, under-represented seed sources that would benefit the region.

Trees as Landfill Cover — Opportunities and Constraints — Case Studies

Deborah Marton, Landscape Designer, Natural Resources Group,
City of New York/Parks & Recreation

Landfill restoration is a relatively new phenomenon in the United States, where land has historically been plentiful and inexpensive, and landfills first established in the nineteenth and early twentieth century are only now reaching capacity. Early efforts to revegetate former landfills achieved limited success, in large part due to anaerobic soil conditions and extremely narrow plant palettes. In recent years, technological developments have significantly decreased gaseous emissions and leachate breakout, the causes of anaerobic soil conditions.

Cost constraints and legislation designed to protect sealing cap integrity combined to encourage certain design solutions in early restorations, primarily recreational grasslands, such as golf courses. Breaking with this trend, some municipalities have opted for more creative uses, incorporating shrubs and trees. Examples of this type of post-closure treatment can be found at Danehy Park, Cambridge, Massachusetts; Dyer Landfill, Palm Beach County, Florida; Spectacle Island, Boston, Massachusetts; Byxbee Park, Palo Alto, California; and Jyvaskyla Sanitary Landfill, Jyvaskyla, Finland. These projects will be examined and evaluated for the lessons they offer regarding use of a diverse plant palette and the level of maintenance necessary to protect public health.

While it may be appropriate to restrict vegetative types where the maintenance budget is low and/or soil cover is thin, the ecological and recreational benefits of a broad plant palette may outweigh the risk of cap penetration. In fact, developing research suggests that closed landfills can support a wide variety of species without cap penetration. With adequate soil cover, these sites can sustain complex natural systems or even woodlands, helping to link remnants of natural forests and wetlands in urban areas with the little existing natural habitat.

Landfill Edge Restoration: A Salt Marsh Primer

Carl Alderson & Andrew Bergen, Natural Resources Group,
City of New York/Parks & Recreation

The landscape architects and designers of the Salt Marsh Restoration Team (SMRT) of NYC Parks/Natural Resources Group (NRG) tested and modified restoration techniques that demonstrated success in order to restore 2.43 hectares of heavily oil-impacted low salt marsh along the Arthur Kill, NY/NJ. Parks employed techniques of planting, wave-energy dissipation, debris barrier fence design, and predator exclusion fencing. Many of these techniques were adopted successfully by the NYC Department of Sanitation (DOS) during a recently completed low salt marsh project at the Fresh Kills Landfill.

Because planting in such a heavily oiled substrate had never been attempted, SMRT designed each project with two goals: to test methodologies and to achieve restoration success. Both indigenous and non-indigenous seedlings and local transplants were utilized. Other variables included plant spacing and depth, fertilizer regimes, time of year planted, and site factors such as location, fetch, current speed, wave energy, drainage, slope, and elevation. Wave energy and debris barrier design were handled as one. Literature provided a model for permanent barriers, which we then modified to create a temporary barrier design, constructed of an extruded plastic fence and discarded Christmas trees. Predator exclusionary devices were primarily directed at resident Canada goose populations. Techniques that were employed included fencing, scare away devices such as mylar flags, time-set inflatable human replicas, pistols, screaming or banging rockets, and chasing.

Planting success was best between April and June, in well-drained, gently sloped soils within a strict elevation range. Plants given a time release fertilizer outperformed those that received no fertilization. This assessment held true regardless of seedling source (in-house or out-sources) and type (transplant/indigenous/non-indigenous) and wave barrier employed. Predation was unpredictable. Losses due to foraging by geese were so extensive at some sites as to necessitate the redesign of the fence and to require it at all subsequent sites.

Further bioengineering technologies were required for the successful creation of 1.1 hectares of marsh at the landfill edge at Fresh Kills Landfill, Staten Island, NY. The tidal creeks surrounding and penetrating the landfill are under continuous use by barges and tugboats for off-loading solid waste. This requires the maintenance of a deep-

water channel adjacent to the marsh creation site. The existing shoreline contained some remnant peat mats and patches of *Spartina alterniflora* but the marsh was severely sloped and eroded, and contained solid waste embedded in its surface. The proximity of the two incompatible uses (restoration and usage by boats) required construction of a soil retaining structure, which then could support and protect the created substrate.

DOS utilized a stacked wall of rock gabion mattresses, which was backfilled with clean sand and gradually sloped to create a large surface area within the upper half of the intertidal zone. Where necessary, the existing sediments were excavated and replaced by sand because of their solid waste content. The techniques employed in planting *Spartina alterniflora* and the design of predator exclusion fences follow SMRT's model employed at heavily oiled restorations just to the north along the Arthur Kill. The landfill marsh creation differs significantly from the oiled/restored marsh in one regard: the plants were fertilized with a granular quick-release fertilizer placed on the substrate surface, rather than in plant holes with a time-release fertilizer. Due to the abundance of nutrients delivered to sediments and surface waters via landfill leachate, this did not cause any reduction in primary plant productivity. An area of concern under observation by DOS is the gabion wall, which is subject to surcharge into the soft, unconsolidated sediments it was placed on. In the few months after construction, the gabion wall dropped as much as a foot from its intended elevation. It remains to be seen how much further it will continue to sink, and how this will ultimately affect the success of the planted areas.

SMRT is in the process of designing improved methods of debris deflection, wave energy dissipation, and sediment capture for use at the Old Place Creek Restorations completed in 1993-94. SMRT is working on conceptual designs for marsh creation projects, which include a design solution to replace the use of gabion walls or sediment filled geo-textile tubes. These designs feature a vinyl coated/recycled plastic sheet pile wall which is not subject to surcharge but retains the strength found in these other solutions. A system patented as "bulk and tiering" utilizes this product to create terraced marsh surfaces. The technologies employed by Parks at oil-impacted sites and the structural solutions employed at Fresh Kills Landfill offer useful examples of appropriate technologies for creation and restoration of marshes in narrow, heavily trafficked waterways and landfill edges.

Minimum Requirements for Monitoring Low Salt Marsh Restorations and Results from Salt Marsh Restoration Team Projects

To assess the success or failure of restorations and the long term viability of a given restoration in terms of ecological function, the Salt Marsh Restoration Team of NYC Parks/Natural Resources Group has designed and implemented monitoring protocols for *Spartina alterniflora* (salt marsh cordgrass), *Geukensia demissa* (ribbed mussel), and total petroleum hydrocarbons (TPH). Success or failure is defined as the successful establishment of the desired salt marsh habitat, and salt marsh habitat is defined by accepted standards of salt marsh function. These include primary productivity of *Spartina alterniflora*, colonization by benthic invertebrates (*Geukensia demissa*), and utilization by macrofauna, in this case colonial wading birds and fish. The nature of the initial SMRT contract with the government trustees guaranteed a minimum three-year monitoring proposal, although SMRT would have preferred to assess the restoration sites for a minimum of five years. Given this preference, five years of monitoring is the minimum required to determine the above functional standards and to maintain the site in case of damage by geese, wrack, ice, and debris. It is assumed that the site will be assessed prior to restoration in terms of fetch, sediment characteristics, salinity, and elevation.

At the time of this assessment transects should be set through the restoration site along which permanent m^2 quadrats are placed. The transects at the channelward and landward ends, as well as each quadrat, become permanent photo points. Photo points must be chosen to represent both the specific nature of an individual transect and the overall site. At the time that these preliminary monitoring requirements are being met, a "pristine" reference marsh should be selected, within which transects and m^2 quadrats are set, for purposes of comparision with

the results obtained from the restored site. SMRT also included unplanted oil-impacted reference quadrats in all its work, although obviously not all restorations need include such a comparision. Landfill edge projects would be well served to assess the proposed restoration sites in terms of priority pollutants and nutrients before and after restoration. The transects, m^2 quadrats, and photo points should all be incorporated into the landscape architect's plan for the restoration site.

Results from the monitoring of the above parameters will be presented for the Old Place Creek Restoration Site 1, oil-impacted reference sites, and "pristine" reference sites. These results are found below.

Table A2.1 Old Place Creek Restoration Sites Monitored in m^2 Quadrats 1992-1996

	1992	1993	1994	1995	1996
TPH (ppm)	31950	29322	10200	8350	8752
Ribbed Mussels	0	3	6	11	13
Biomass (g)	0	555	895	688	1900
Stems	0	143	143	152	181
Height (m)	0	0.87	1.14	1.47	1.54
Flowering Stems	0	9	20	24	31

Table A2.2 Oil-Impacted Reference Sites Monitored in m^2 Quadrats 1992-1996

	1992	1993	1994	1995	1996
TPH (ppm)	7538	5526	4628	9510	9269
Ribbed Mussels	0	0	0	0	2
Biomass (g)	0	0	10	20	15
Stems	0	0	5	9	7
Height (m)	0	0	0.4	0.34	0.46
Flowering Stems	0	0	0.5	2	1

Table A2.3 Unimpacted "Pristine" Marsh Monitored in m^2 Quadrats 1993-1996

	1993	1994	1995	1996
TPH (ppm)	583	330	10	nc
Ribbed Mussels	nc	nc	0	2
Biomass (g)	1908	1433	806	nc
Stems	165	128	90	99
Height (m)	1.61	1.82	1.74	1.56
Flowering Stems	29	45	27	13

Fish Abundance and Diversity

Ten baited killi-traps were set 15 m apart, elevation 2.5 ft Mean Low Water, at the oiled/restored Old Place and the oiled/unrestored Con Ed sites at slack high tide in August-October 1995 and March-October 1996 for a total of 20 trapping days. Traps were collected when exposed by the falling tide. A 4.3 m x 1.2 m straight seine (0.64 cm mesh) was also used 25 minutes after slack high tide. Seining was always performed at the same location and tide height. Fish caught in the traps and seine were sorted, counted, and measured. Mummichogs were also collected for food habit analyses at all sites in fall 1996 and spring 1997 with several baited killi-traps. These particular traps were deployed about one hour before high tide, when the fish would be feeding, and retrieved about one hour after high tide. The stomach contents from at least 30 fish of mixed sexes were identified.

Table A2.4 Fish Data Summary 1995-1996. Arthur Kill Sites, Staten Island, New York. Comparison between Oil-Impacted/Restored Salt Marsh and Oil-Impacted/Unrestored Salt Marsh. Straight seine and bi-conical traps treated separately.

		Mummichog *Fundulus heteroclitus*			Striped Killifish *Fundulus majalis*			Atlantic Silverside *Menidia menidia*		
Date/Gear	*Site*	*Abundance*	*% of Catch*	*Length (cm)*	*Abundance*	*% of Catch*	*Length (cm)*	*Abundance*	*% of Catch*	*Length (cm)*
1995-96 (Trap)	Restored	2279	78.4	5.0±0.6	135	4.6	5.1±1.25	493	17	7.7±0.52
	Unrestored	476	65.2	4.8±0.8	28	3.8	6.1±1.3	226	31	7.8±0.6
1995-96 (Seine)	Restored	0	0		0	0		376	100	7.4±1.5
	Unrestored	7	0.3	4.1±0.0	5	0.2	5.8+1.8	2063	99.4	6.8±1.6

Wading Bird Foraging Success

Snowy and great egrets (*Egretta thula, Ardea alba*) at the oiled/restored Old Place and the oiled/unrestored Con Ed sites were observed during three-hour periods in the mornings, on flood tides from June to October 1995 and April to October 1996. The number of visits where foraging was observed, total duration of foraging visits, and number of successful strikes were recorded.

Table A2.5 Avian Data Summary for 1995-1996. Arthur Kill Sites, Staten Island, New York. (Comparison of Snowy and Great Egret Foraging Success in Oiled/Restored and Oiled/Unrestored Sites.)

Date/Site	*Species*	*Foraging Visits*	*Strikes*	*% Successful Strikes*	*Duration of Stay (min)*	*Capture Rate (fish/min)*	*Hour Landing (1st-3rd)*
1995-96 Restored	Great Egret	26	121	43	392	0.13	1.78
	Snowy Egret	29	131	24	375	0.08	1.24
1995-96 Unrestored	Great Egret	10	19	37	65	0.11	1.67
	Snowy Egret	9	12	25	44	0.07	1.33

Fresh Kills Pilot Project: Planting Possibilities— Landfill Restoration and the Native Palette

Richard T. Lynch, Sweetbay Magnolia Bioreserve, Inc.

The 3,000-acre Fresh Kills Landfill, considered the largest unlined landfill in the world, comprises former freshwater and tidal wetlands and upland native plant communities. While no formal restoration plan currently exists, the community is working to create the political will to restore as much of Fresh Kills to as natural a condition as possible. To this end, pilot restoration projects have been undertaken, including the restoration of Eastern Prairie grasslands, coastal emergent shrublands, oak and pine barrens, and additional plant communities considered well adapted to the environmental conditions likely to exist at Fresh Kills upon final closure.

This presentation will consider the engineering and regulatory constraints to the establishment of native woody plant communities on final cover sites at Fresh Kills. A review of existing pilot projects will help guide a resolution of the difficulties encountered in successful planting projects and reveal delimitations that must be addressed by further experimental planting projects.

Finally, the presentation will consider the need to select plant communities native to the vicinity of the landfill in order to optimize the chances for success, and not rely on current models from other states or horticultural planting zones. Special consideration will be given to selecting native plant communities that are imperiled locally (such as the Eastern Prairie) and that may not persist in the vicinity without human intervention. There will follow a discussion of techniques that one might employ to determine the effectiveness of the plantings, as well as to monitor project effectiveness over the long term.

Garbage Dumps to Public Parks: Case Histories in Landfill Reclamation

Katherine Weidel, Hackensack Meadowlands Development Commission

As landfills are being closed throughout the country, the question arises "What to do with them now?" The Hackensack Meadowlands Development Commission, in the midst of highly urbanized northern New Jersey, likes to view closed sanitary landfill as opportunities rather than eyesores. For the past decade, the Commission has undertaken the task of reclaiming these visually offensive and environmentally damaging landfills as self-sustaining habitats for plants, people, and animals. The Kingsland Overlook and the Lyndhurst Nature Reserve are two examples which illustrate the dynamic potential for the creative end use of landfills. These pilot projects serve as testing grounds for innovative reclamation techniques for both upland and wetland habitats. They serve as models for the remaining 1,700 acres of inactive landfills within the district as well as future projects nationwide. Their primary goals are to provide passive recreational amenities, opportunities for environmental education, and increased biodiversity and wildlife utilization for the entire Meadowlands area. Both projects represent the recycling of entire landscapes, using the ecological process of natural plant succession to produce sensitive and economic solutions for total site recovery.

Salt Marsh Bioremediation — Beneficial Reuse of Dredge Material

Dr. Paul S. Mankiewicz, Gaia Institute

Ecosystem Services of Salt Marsh Communities

Salt marshes carry out a large number of ecosystem services, reducing pollutants and toxins in the environment, while contributing to food web productivity and diversity. A significant opportunity exists in and around the New York Harbor Estuary for restoring marshes near or adjacent to landfilled marsh and mudflat environments on dredged materials. While costs and benefits of restoring marshes on dredged sediments need to be carefully analyzed, it may be of greater benefit than the no-action alternative. Benefit is likely since the vast majority of tidal marshes (>90%) in and around New York City have been filled, between Dutch settlement and the present, with an estimated 45,000 acres of intertidal marsh landfilled in New York City alone. It is hypothesized that such marshes would have been major centers of ecological productivity and biogeochemical activity in the estuary, and such functions may be restored in proportion to the scale of marsh restoration efforts.

Biogeochemical Mechanisms of Toxin and Pollutant Removal from Landfill Leachate

Mechanisms of pollutant removal from landfill leachate by salt marshes are well-documented features central to nitrogen, carbon, and sulfur cycles. The heterotrophic loop in the upper aerobic and facultative sediments in marshes and flats involves high rates of biomass production and consumption of low molecular weight carbon molecules. In this zone, mineralization (breakdown) rates are relatively high for less complex hydrocarbons and many of the simpler forms of dissolved organic carbon (a large fraction of what is characterized as the biochemical oxygen demands fraction). While there are complexities under certain loading conditions (*i.e.*, marshes have been shown to store hydrocarbons in anaerobic peat environments below the upper zones of steep redox gradients), it is probably fair to say that, except for dioxins and PCBs, salt marshes and mudflat sediments have documented abilities to break down or sequester major classes of hydrocarbon-based pollutants and chemicals of concern.

Specific steps in the nitrogen cycle critical to the enhancement of environmental quality around landfills include the nitrification of ammonia, a product from the breakdown of the organic fraction of garbage, and the denitrification of nitrate, which, through a number of steps, removes fixed nitrogen from aquatic and estuarine habitat and moves it as nitrogen gas (N_2) into the atmosphere. A basic step in the sulfur cycle, the reduction of sulfate to sulfide, is also critical to the mitigation of landfill leachate containing specific metal ions. In sedimentary environments, the molar concentration of acid volatile sulfide has been shown to be a predictor of the bioavailability and toxicity of cadmium and other metals, with sulfide concentration inversely proportional to metal availability.

This broad range of biogeochemical activity itself enhances environmental quality and protects human health. While published results in the research literature of the past three decades indicate relatively robust and well-corroborated removal capacities, it is important to note areas where this documentation is incomplete. Diagenesis, or the development over time of the subsystem structure and function in environmental quality enhancement, has not yet been well characterized. Nor have the structural features and parameters of marsh and mudflat habitats which determine and/or constrain function been fully described to date.

While many of the complexities of the carbon cycle are involved in processing leachate chemicals of concern (COCs), the activities of heterotrophic bacteria are primary regulators of the more labile fractions of dissolved organic carbon. The high density of aerobic and facultative bacteria in surface sediments, > 109/cc, provides a sink for relatively simple dissolved organic carbon (DOC) molecules. This sink extends to hydrocarbons from simple to complex, where microbially mediated breakdown mechanisms operate under higher oxygen tensions. At

lower oxygen tensions and higher Eh (the standard measurement of oxidation/reduction potential), electron addition and a number of other mechanisms come into play, which are capable of destabilizing certain carbon ring compounds under specific pH, Eh, and nutrient availability conditions. Across the redox range available in marshes, mechanisms from direct enzymatic catalysis to co-metabolism are involved in mineralization of hydrocarbons. Some of the recent research at the scale of microbial community activity *vis-á-vis* specific COC loadings is indicative of the relative fit between microscopic mechanism and the macroscopic input/output behavior of marshes. This research provides a firm basis from which to approach the problem at hand.

Sedimentary Processes and the Dredging Crisis in the Port of New York

The present dredging crisis in the Port of New York and New Jersey may be characterized statically in terms of several million cubic yards of sediments in berths and channels which interfere with shipping. Dynamically, the problem is much more complicated. Erosion tends to be maximized in the channels where water moves fastest and minimized in still water berths. Major channels are often maintained by the federal government; berths are often owned or operated by private companies. Because smaller size class materials are more likely to be contaminated than larger grain sands, still water berths will have an increased likelihood of contamination than the better scoured channels. This creates an ongoing conflict between sedimentary processes and private companies which constitute the water-based economy of New York City.

Silts, clays, and organic materials are the predominant sediments deposited in still water docking areas. These same sediment size classes, in presettlement times, were deposited in quiescent, depositional environments. These were frequently sites of salt marsh and mudflat habitat development, and such enhanced depositional environments fringed the majority of the land masses of the Hudson Estuary in precolonial times.

In the relatively deep water (2 to 10+ meters) around docking facility infrastructure, the combination of slow moving water and fine grained sediment deposition with high oxygen demand can lead to the establishment of habitat with relatively low frequency and diversity indices for benthic invertebrates or macrophytes. Low water velocities, small sediment size classes, and high oxygen demand may create much more widespread anoxic or hypoxic environments within the estuary than in earlier times. In presettlement times, sediments in these size classes were incorporated into salt marshes and mudflats that bordered presettlement land masses in the Hudson River Estuary. The steep redox gradients in these intertidal environments enhanced the breakdown of carbon compounds, the incorporation of nutrients into macrophytes, the establishment of major biogeochemical cycles, and biomass transfer from intertidal wetlands into food webs of the estuary.

Soil Disturbances and Requirements for Landfill Restoration

J. Eric Scherer, Resource Conservationist, Natural Resources Conservation Service

Surface protection of landfill slopes, whether they are in their final or interim form, is often given little or no consideration by landfill operations. With the availability of large earth moving equipment, reshaping and regrading eroded surfaces poses little concern for most operations. The economic costs of time and resources spent in "chasing earth" on a site need to be coupled with the costs of eroded slopes exposing underlying refuse and the cost of allowing surface water to enter underlying landfill cells, which creates a leachate problem. These unaccounted-for costs can be easily corrected with the proper application of sound soil and water management practices that include the preparation and application of an appropriate protective vegetative surface cover.

Angler with a striped bass (Morone saxatalis) *in Liberty State Park, New Jersey. Many species of fish, including striped bass, weakfish, and bluefish, have returned to these waters in the past five years after long absences.*

Additionally, long-term use of the landfill and the selection of a final vegetative cover may not have been given any consideration in the development of closure plans.

A proper soil and water management plan for a landfill site should specify those practices that will, if properly designed and installed, reduce and/or eliminate the need for the regrading and reshaping of slopes, while allowing for long-term stabilization of the site. Additionally, stabilization of these slopes with the appropriate vegetation will reduce both short- and long-term maintenance costs and offer a more diverse use of the site.

Speaker Biographies: *In Order of Appearance*

April 22, 1998, American Museum of Natural History

Henry J. Stern
Commissioner, City of New York/Parks & Recreation

Henry J. Stern is the only nonconsecutive, two-term Parks Commissioner to be appointed by two different mayors (Koch and Giuliani). Commissioner Stern coined the term arborcide ("the act of killing a tree"), and shepherded into legislation, under Mayor Giuliani, the nation's toughest law against it. A New Yorker to the core, Commissioner Stern attended Bronx High School of Science, City College, and Harvard Law School, where he was president of the *Harvard Law Record.*

Commissioner Stern's political career began early. Following law school, he served for four years as law clerk to Justice Matthew M. Levy, in the Supreme Court of the State of New York. Stern joined Parks as Executive Director in 1966 under Commissioner Thomas Hoving. Between February 1967 and Koch's appointment of Stern as Parks Commissioner in April 1983, he was Assistant City Administrator and First Deputy Commissioner of Consumer Affairs. He was twice elected New York City Council Member at Large, serving for nine years. Between his first and second terms as Parks Commissioner, Stern served as President of the Citizens' Union of the City of New York, working with Chair, Robert F. Wagner, Jr.

In 1984, Commissioner Stern created the Natural Resources Group (NRG), which serves as a watchdog for New York City's environment. During the past 14 years, NRG has restored, acquired, and protected thousands of acres of parkland.

Commissioner Stern is the recipient of the Renew America National Award for Environmental Sustainability, the National Audubon Society Lifetime Achievement Award, and the City Club Earthling Award for Environmental Excellence.

Jeanne M. Fox
Region II Administrator, U.S. Environmental Protection Agency
Chair, NY/NJ Harbor Estuary Program Policy Committee

As Regional Administrator, Jeanne Fox is responsible for the planning, programming, policy implementation, and direction of all US EPA activities in New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands. She manages a staff of nearly 1,000 with an operating budget of $60 million and a current total annual regional budget of approximately $900 million.

Prior to EPA, Ms. Fox served seven months as Commissioner of the New Jersey Department of Environmental Protection (NJ DEP), where she had previously served for two and a half years as the Deputy Commissioner. Before NJ DEP, Ms. Fox served nine years with the New Jersey Board of Public Utilities.

Ms. Fox is a graduate of Douglass College at Rutgers, The State University of New Jersey (1975) and Rutgers Law School at Camden (1979), and is a member of the Rutgers Board of Trustees. She is Chair of the NY/NJ Harbor Estuary Program's Policy Committee.

Marc A. Matsil
Chief, Natural Resources Group, City of New York/Parks & Recreation
Chair, NY/NJ Harbor Estuary Program Habitat Workgroup

Marc A. Matsil is Chief of New York City Parks/Natural Resources Group (NRG). He develops and implements conservation, restoration, and management programs for the City's natural resources. NRG publishes ecological assessments and technical management plans that serve as guidance for the protection of 28,000 acres of parkland. He has obtained grants, natural resources damages claims, and public works mitigations exceeding $60 million that support NRG's wetland and woodland acquisition and restoration programs.

Before joining Parks in 1987, Mr. Matsil was Natural Resources Specialist with the U.S. National Park Service, conducting wetland and meadow restorations, as well as wildlife and vegetation surveys for the Alaska National Parks, Mount Rainier, and Mesa Verde. He has presented numerous papers at international meetings and conferences.

Mr. Matsil is the recipient of several awards including the Society for Ecological Restoration International Sperry Award, the Nature Conservancy Oak Leaf Award, the National Wetlands Award, and the Chevron-Times Mirror North America Conservation Prize.

Phil Gleason
Director, Landfill Engineering, City of New York/Department of Sanitation

Dr. Steven N. Handel
Rutgers University

Steven N. Handel is a Professor in the Department of Ecology, Evolution, and Natural Resources at Rutgers University. His research and teaching focus on plant ecology and the restoration of natural habitats. He received a B.A. from Columbia College and his M.S. and Ph.D. from Cornell University. He has been Chair of the Ecological Society of America's Plant Population Ecology Section, President of the Torrey Botanical Society, and Board Member and Co-Chair of the Society for Ecological Restoration's 1996 Annual Meeting, held at Rutgers. Dr. Handel has also been an editor of *Evolution and Restoration Ecology*. He has contributed to restoration plans and projects throughout the tri-state area.

Eugenia M. Flatow
Chair, NYC Soil & Water Conservation District
Chair, NY/NJ Harbor Estuary Program Citizens' Advisory Committee

Eugenia M. Flatow is an industrial engineer with over forty years experience as a management consultant, business proprietor, and citizen advocate, and ten years of public service as an executive administrator with the City and State of New York. She has led many civic and government efforts to yoke local initiatives with public resources and private support in order to create effective working partnerships. Ms. Flatow has particular expertise in negotiating consensus and believes that commitment to a project is a necessary condition to its success.

Ms. Flatow served in the Lindsay cabinet for six years as Acting Coordinator of Housing & Development and supervised the consolidation of housing agencies into the Housing Development Administration. She was Administrator of the Model Cities Program, and currently serves as Chair of the NYC Soil & Water Conservation District and Executive Director of Coalition for the Bight. Ms. Flatow has taught at Columbia University, New York University, and the American Society of Mechanical Engineers.

Margaret Vodopia
Communications Manager, British Airways

Margaret Vodopia is responsible for planning and implementation of British Airways' U.S. media campaign, as well as sponsorship of community relations and environmental projects, including the Trans-Atlantic Urban Ecology Initiative. Ms. Vodopia and British Airways Executive Vice President Dale Moss were instrumental in the establishment of the Trans-Atlantic Urban Ecology Initiative.

Dr. Jim A. Harris
Reader, Restoration Ecologist, University of East London

Dr. Jim Harris is Reader in Environmental Sciences in the Department of Environmental Sciences and Mathematics at the University of East London. His career in land restoration issues began as a result of his doctoral studies into the effects of the storage of topsoil on strip mine sites on microbial communities. Since then his interests have broadened into many areas of land restoration and the fundamental principles underlying them, leading to prescriptions for changes in restoration management approaches.

Dr. Harris has presented keynote talks at a number of international meetings and published over thirty papers in the scientific press. He is the lead author of the internationally acclaimed textbook *Land Reclamation and Restoration: Principles and Practice*. Dr. Harris is a contributing author to the latest Intergovernmental Panel on Climate Change Report, 1995, and is a member of the International Standards Organization Soil Quality Committee EOC48. He is co-founder, with Marc A. Matsil, of the Trans-Atlantic Urban Ecology Initiative.

Dr. Andrew J. Moffat
Head, Environmental Research Branch, UK Forestry Authority

Dr. Andrew Moffat is Head of the Environmental Research Branch of the Forestry Authority Research Division, based at Alice Holt in Surrey, England. He is a member of many expert international panels, including the Editorial Board of Soil Use and Management. Dr. Moffat has worked on woodland establishment on landfill sites since 1985, and has published 90 scientific and general papers on soil and forestry issues, in addition to *The Potential for Woodland Establishment of Landfill Sites* (Her Majesty's Stationary Office) and *Reclaiming Disturbed Land for Forestry* (HMSO).

Dr. Moffat is the UK representative to the European Union Scientific Advisory Group, the UK member of the ICP Forest Soil Expert Panel, and of the Forests Foliar Expert Panel. He advises the Forestry Commission on a wide range of reclamation issues. He is a frequent lecturer on reclamation techniques at training meetings and conferences.

Philip J. Shaw
Chief Ecologist, Cleanaways Ltd.

Philip J. Shaw is an environmental consultant employed as Chief Ecologist of Cleanaway Ltd. Waste Management Services, responsible for landfill restoration and development, environmental monitoring, and environmental impact assessment. His interests cover the field of landfill reclamation, but he has particular expertise in restoration of cover materials and their ecological function, and in the use of constructed wetlands to control off-site pollution.

Mr. Shaw has produced over 30 reports and publications related to landfill restoration and management. He is responsible for long term planning in the restoration and management of Cleanaway sites in South-East Essex, particularly at the Pitsea co-disposal site, where many innovations in site management and restoration implementation have been carried out. He is Visiting Researcher and Special Lecturer at the University of East London.

Richard A. Lindsay
Wetlands Specialist, University of East London

Richard Lindsay is Principal Lecturer in Wildlife Conservation in the Department of Environmental Sciences and Mathematics at the University of East London (UEL). Prior to UEL, he worked as a UK Government Scientist in the Nature Conservancy Council, providing advice and guidance to Ministers on a range of nature conservation and restoration issues. He is the Chair of the International Mire Conservation Group. Mr. Lindsay has produced numerous reports and publications and contributed to the development of international protocols for wetlands management including the Ramsar Convention.

Mr. Lindsay has worked with Wetlands International on many projects, including mire conservation, restoration program for Eastern Europe, and establishment of a workshop program for the conservation of mires in China. He has worked on the International Workshop on Peatland and Mire Conservation for the Canadian Environment Ministry and discovered "patterned" fens on Fraser Island, Queensland, Australia. He acts as liaison with the European Union DGXI Secretariat on behalf of the European Habitats Forum.

John A. Castner
Assistant Director, Permitting & Technical Problems, Solid and Hazardous Division
NJ Department of Environmental Protection

John Castner is a graduate of Lehigh University and holds a B.S. in Civil Engineering. He is licensed in the State of New Jersey as a Professional Engineer and a Professional Planner. He has also worked with the New Jersey Department of Environmental Protection in the field of solid waste management starting with landfill permitting and design in 1976. Mr. Castner presently manages the Department's engineering, scientific evaluation, and permitting for the construction, operation, closure, and post-closure maintenance and monitoring of all solid and hazardous waste facilities. These include: sanitary landfills, transfer stations, materials recovery facilities, composting facilities, recycling facilities, and hazardous waste treatment, processing, and disposal facilities.

Carl Johnson
Deputy Commissioner, Office of Air and Waste Management
NYS Department of Environmental Conservation

Carl Johnson is Deputy Commissioner of the New York State Department of Environmental Conservation Divisions of Air Resources and Solid and Hazardous Materials. Prior to his appointment in 1997, Mr. Johnson was the Region 4 Director of NYS DEC. He was responsible for the day-to-day operation of programs in environmental quality and natural resources management for a nine-county region. Mr. Johnson was previously Director of Special Projects, NYS Department of Environmental Conservation. He worked on a number of initiatives, including the 1996 Clean Water/Clean Air Bond Act, the Fresh Kills Landfill Closure Task Force, and the DEC Dredging Work Group. For five years, he served as Legislative Assistant with the New York State Senate Environmental Conservation Committee, Senator Owen H. Johnson, Chairman. Mr. Johnson graduated from the Maxwell School of Citizenship and Public Affairs at Syracuse University with a Masters of Public Administration and received a B.S. from the S.U. Newhouse School of Public Communications.

Andrew Bellina
Senior Policy Advisor, Division of Environmental Planning & Protection
U.S. Environmental Protection Agency

James W. Haggerty
Regulatory Branch, U.S. Army Corps of Engineers

James W. Haggerty is Chief of the Eastern Permits Section with the New York District, U.S. Army Corps of Engineers. He has held that position for nine years. Prior to 1990, he worked for four years as a project manager in the Corps Regulatory Program. Previous professional experience includes a stint as a meteorologist/oceanographer for a small ship routing and port forecasting company based in New Rochelle, New York. He received a B.S. degree in Meteorology & Oceanography from Polytechnic University in 1979.

Glenn Milstrey
Section Supervisor, NYC Bureau of Solid Waste and Land Management
NYS Department of Environmental Conservation

Jim Gilmore
Natural Resources Supervisor, NYS Department of Environmental Conservation

HEP International Landfill Restoration Symposium Program

April 23, 1998, Snug Harbor Cultural Center, Staten Island

Michael J. Feller
Deputy Chief, Natural Resources Group, City of New York/Parks & Recreation

Michael J. Feller is Deputy Chief of NYC Parks/Natural Resources Group. He grew up on the landfilled marshes of southern Brooklyn and smelled of mugwort most of his youth, the result of frequent forays into the weedy wilds along Jamaica Bay's north shore that served as his backyard. He has a degree in Anthropology from SUNY-Albany and has done extensive graduate study in Archaeology, Ethnobotany, and Cultural Ecology. Mr. Feller is the recipient of the Municipal Art Society's Stubbs Davis Award and the EPA Region 2 Environmental Quality Award.

John K. McLaughlin
Director of Landscape Management, City of New York/Department of Environmental Protection

John McLaughlin is responsible for design, review, and implementation of many landscape restorations associated with DEP's capital infrastructure program. Mr. McLaughlin has collaborated with NYC Parks on several projects, producing complex designs and ecological restoration models at Idlewild and Flushing Meadows Corona Parks. He has consulted on and implemented several successful landscape restorations using trees and shrubs as landfill cover at Fresh Kills.

Deborah Marton
Landscape Designer, Natural Resources Group, City of New York/Parks & Recreation

Deborah Marton is a Project Manager/Landscape Designer for NYC Parks/Natural Resources Group and currently manages several NRG grants. Prior to 1997, Ms. Marton was principal of Marton Landscape Consulting, specializing in landscape restoration design and legal compliance. Before consulting, she worked as a corporate litigator. She has published articles on environmental design and landfill restoration and was a moderator at the "Manufactured Sites" Conference held at the Harvard University Graduate School of Design, where she earned an M.L.A. Ms. Marton earned a J.D. from New York University School of Law.

Carl Alderson
Wetland Specialist/Project Manager, Natural Resources Group, City of New York/Parks & Recreation

Carl Alderson is a wetland specialist and project manager with the NYC Parks/Natural Resources Group. With colleague Robbin Bergfors, CLA, he designs and prepares construction drawings for the restoration of oil impacted salt marshes in the Arthur Kill, Staten Island. He has a B.S. in Landscape Architecture from Rutgers University.

Mr. Alderson is the recipient of the American Rivers National Science & Technology Award, the Renew America National Award for Environmental Sustainability, and the City Club of New York Earthling Award for Environmental Excellence. He joined Parks in 1989 as a forest restoration ecologist and has been project manager of NRG's Salt Marsh Restoration Team since 1991.

Andrew Bergen
Wetland Specialist, Natural Resources Group, City of New York/Parks & Recreation

Andrew Bergen is NRG's Salt Marsh Restoration Team's wetland specialist. He received a B.A. from City University of New York/Lehman College in natural sciences and is currently a Ph.D. candidate in CUNY's Earth and Environmental Sciences Program. He has experience in monitoring a wide range of parameters in the salt marsh ecosystem. Mr. Bergen has designed and implemented surveys of vegetation, Total Petroleum Hydrocarbon, invertebrates and bacteria, and rates of shoreline erosion and sediment accretion.

Mr. Bergen is the recipient of the American Rivers National Science & Technology Award, the Renew America National Award for Environmental Sustainability, and the City Club of New York Earthling Award for Environmental Excellence.

Richard T. Lynch
Sweetbay Magnolia Bioreserve, Inc.

Richard Lynch received formal training in botanical genetics and evolutionary biology at the University of California at Berkeley. At NYC Parks, Mr. Lynch established the Greenbelt Native Plant Center, conducting research into the field biology and propagation of over 430 native plant species. Mr. Lynch has located or relocated dozens of endangered native plants on Staten Island and has dedicated much of his current work to the protection of rare plants in the wild. He consulted the Department of Sanitation on the ecoscape design of Fresh Kills woodland and shrub pilot. In 1997, he established the Sweetbay Magnolia Bioreserve Conservancy, a not-for-profit corporation working to protect and restore native plant communities in Staten Island.

Katherine Weidel
Senior Landscape Architect, Hackensack Meadowlands Development Commission

Katherine Weidel oversees the reclamation of degraded landscapes, wetlands, and sanitary landfills in the Hackensack Meadowlands, converting these into productive and diverse habitats.

Dr. Paul S. Mankiewicz
Executive Director, Gaia Institute

Dr. Paul S. Mankiewicz earned his Ph.D. from the City University of New York/New York Botanical Garden Joint Program in Plant Sciences. His research focused on the physical and surface chemistry of plant structures, peats, soils, and impacts of hydrostatic and fluid dynamic forces on plant water-holding strategies. Dr. Mankiewicz has hands-on experience with the enhancement, restoration, and construction of wetland and terrestrial ecosystems. He has more than twenty years of teaching and research experience at City University, the New York Botanical Garden, Pratt Institute, and Columbia University.

Dr. Mankiewicz has developed a number of fluid purification and measurement technologies. A past president of the Torrey Botanical Society, Dr. Mankiewicz is now Chair of the Solid Waste Advisory Board of the Bronx and Treasurer of the NYC Soil and Water Conservation District.

J. Eric Scherer

Resource Conservationist, USDA, Natural Resources Conservation Service

Currently serving on the Community Team of the Natural Resources Conservation Service in Connecticut, Mr. Scherer provides assistance to communities on resource concerns including wetland protection, streambank and shoreline protection, and erosion and sedimentation control.

Mr. Scherer has worked with NRCS in Virginia, Vermont, Rhode Island, Maryland, and Connecticut, holding positions of soil, resource, district conservationist, and manager of the NRCS National Plant Materials Center.

Mr. Scherer earned a B.S. in Agronomy from Virginia Polytechnic Institute and State University and a Master's in Public Administration from the University of Hartford. He is a Certified Professional Erosion and Sediment Control Specialist and a registered Soil Scientist with the Soil Science Society of Southern New England.

Cristina Rumbaitis-del Rio

Special Projects, Natural Resources Group, City of New York/Parks & Recreation

Cristina Rumbaitis-del Rio is the former Special Projects Manager for NYC Parks/Natural Resources Group. As project coordinator for the NY/NJ Harbor Estuary Program's Habitat Workgroup, Ms. Rumbaitis-del Rio organized many activities related to habitat protection and restoration. She also conducted water quality monitoring in Parks water bodies. Ms. Rumbaitis-del Rio graduated summa cum laude from Columbia College and has worked for the National Oceanic and Atmospheric Administration, the National Biological Service, and the U.S. Department of State. She is a 1996 National Harry S. Truman Scholar and is currently enrolled in the University of Colorado at Boulder as a Ph.D. candidate.

Conference Sponsors:

NY/NJ Harbor Estuary Program Habitat Workgroup is a part of the National Estuary Program, which was established under Section 320 of the Clean Water Act of 1987. HEP is a partnership of federal, state, interstate, and local agencies, citizens, and scientists working together to protect and restore the natural resources of the estuary, its tributaries, and the New York Bight. The HEP Habitat Workgroup was created with the goals of fostering public awareness, increasing appreciation of the natural environment, and restoring and maintaining a sustainable and diverse ecosystem.

City of New York/Parks & Recreation/Natural Resources Group (NRG) is responsible for the conservation and restoration of the City's natural areas. Founded by Commissioner Henry J. Stern in 1984, NRG is an international leader in innovations in restoration ecology, research, and parks management. NRG has received numerous awards for its groundbreaking work in urban ecology and conservation management. As one of the City's ecological watchdogs, NRG has designed natural resources restorations, park acquisition projects, and public works mitigations exceeding $60 million.

Trans-Atlantic Urban Ecology Initiative is the world's first international academic and government technology transfer focusing on restoration of our urban ecosystems. Through scientific and educational exchanges by students, academics, and government officials, the joint program explores protection and restoration of our critical watersheds and urban ecosystems. Global warming trends, relative sea level rise, fragmented natural systems, contaminated landfills, and non-native invasive species are common problems that compromise the economic values and quality of life in our cities.

University of East London (UEL), co-founder of the initiative with NRG, is renowned world wide for its ventures in restoration ecology. Its Department of Environmental Sciences offers the world's first degree program in restoration ecology, under the direction of internationally renowned microbiologist Dr. Jim Harris.

City of New York/Department of Sanitation, Bureau of Solid Waste Management and Engineering performs long-range solid waste management planning, facilities development, permitting, regulatory compliance activities, and maintenance of the marine infrastructure critical to disposal activities. The plan for the Fresh Kills Landfill, scheduled to close in 2001, includes post-closure monitoring, maintenance, and end-use restoration implementation.

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US EPA - National Estuary Programs

To learn about other National Estuary Programs, visit their websites online:

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New Hampshire Estuaries (no website available)
New York-New Jersey Harbor
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SARASOTA BAY
CORPUS CHRISTI
CHARLOTTE HARBOR
SAN JUAN BAY
Prepared by: NYC Parks / Natural Resources Group, January 2001

Acronyms

ACOE	United States Army Corps of Engineers
AOC	Agreement of Coordination
cc	Cubic centimeters
CCD	Calendar Contract Days
CCMP	Comprehensive Conservation and Management Plan
CEA	Critical Environmental Area
CEQR	City Environmental Quality Review Act
COC	Chemicals of Concern
CSO	Combined Sewer Overflow
DCP	Department of City Planning
E	Endangered
EAM	Environmental Assessment and Mitigation
EIS	Environmental Impact Statement
GIS	Global Information System
GPS	Global Positioning System
HEP	Harbor Estuary Program
HMDC	Hackensack Meadowlands Development Commission
HWG	Habitat Workgroup
JEM	Jamaica Eutrophication Model
NJ DEP	New Jersey Department of Environmental Protection
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRDC	Natural Resources Defense Council
NRG	NYC Parks/Natural Resources Group

NYC DEP	New York City Department of Environmental Protection
NYC DOS	New York City Department of Sanitation
NYC Parks	City of New York/Parks & Recreation
NYS DEC	New York State Department of Environmental Conservation
NYS DOS	New York State Department of State
OEM	Office of Emergency Management
ONRD	NJ DEP Office of Natural Resource Damages
PAH	Polyaromatic hydrocarbons
PCB	Polychlorinated biphenyl
ppm	Parts per million
PRP	Potentially Responsible Parties
QA	Quality Assurance
QC	Quality Control
RC	Resource Conservation
RP	Responsible Party; Resource Protection
SEQRA	State Environmental Quality Review Act
SMRT	NYC Parks/NRG Salt Marsh Restoration Team
SWCD	Soil and Water Conservation District
sp.	Species (singular)
spp.	Species (plural)
T	Threatened
TPH	Total petroleum hydrocarbons
US EPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service

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