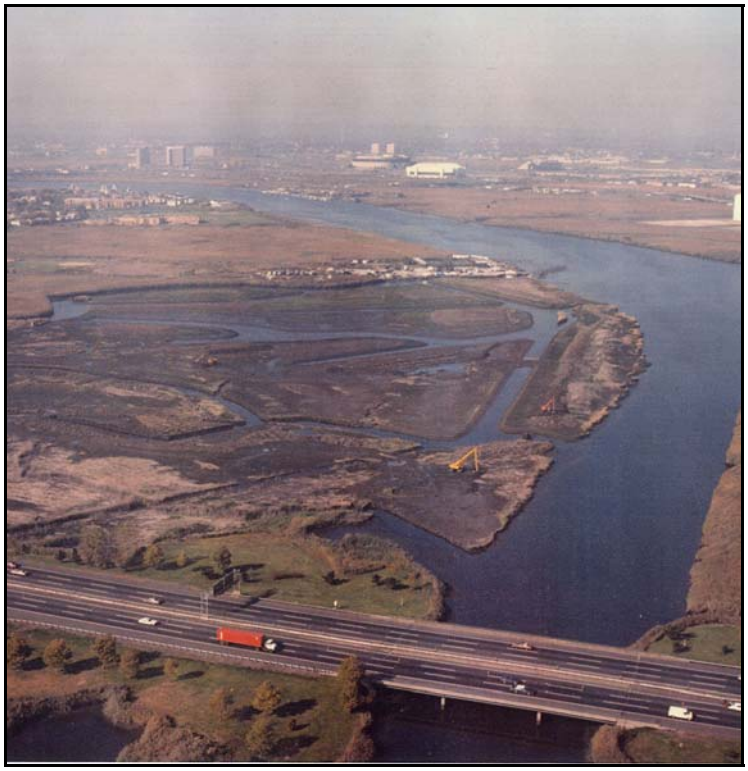
HUDSON-RARITAN ESTUARY
ENVIRONMENTAL RESTORATION FEASIBILITY STUDY

NEWARK BAY/HACKENSACK RIVER/PASSAIC RIVER

STUDY AREA REPORT



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U.S. Army Corps
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New York District

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NEWARK BAY/HACKENSACK RIVER/PASSAIC RIVER

STUDY AREA REPORT

I. INTRODUCTION

Background

1. The New York District of the Corps of Engineers (the District) is conducting a feasibility study for ecosystem restoration in the Hudson-Raritan Estuary (the Estuary) – the Hudson-Raritan Estuary Ecosystem Restoration Study, herein referred to as "HRE". The study area is delineated as the Port District, an area surrounding greater metropolitan New York City within an approximate 25-mile radius of the Statue of Liberty (Figure 1). However, for purposes of ecological continuity the actual study area may include additional portions of this system beyond the man-made Port District boundary.

2. The overall goal of the HRE is to restore ecological function and diversity that have been lost or degraded as a result of human activities. The HRE will rely on both existing and newly obtained natural resource data to identify areas to be restored or conditions that must be addressed to assure successful ecosystem restoration. The two primary components of the study are the preparation of a Comprehensive Restoration Implementation Plan (CRIP) and the implementation of restorations/enhancements at various locations in the Estuary.

3. The purpose of the CRIP is to serve as a master plan that lays out a comprehensive and coordinated strategy that, when implemented, will guide the ecological restoration of the Estuary. The CRIP will establish a framework within which the actions needed for successful restorations can be holistically evaluated and planned. The plan will address actions to enhance, expand, recreate, and diversify natural habitats, and actions to eliminate constraints to ecological functions, such as sediment contamination. The CRIP will describe the strategy for restoration efforts that will include immediate, mid-term, and long-range options. It will also provide a central focus for public input, data collection, restoration efforts, and management actions and policies, regardless of who might have authority, desire and/or funds to undertake any action.

Study Area Delineation of the Estuary

4. To get a more manageable and understandable picture of the Estuary, its history of degradation, local needs and desires, potential restoration opportunities, and current restoration efforts will be documented in eight Study Area Reports (SARs). The study area boundaries are typically delineated by major watersheds and/or major physical features, such as highways or waterways. By and large, each study area can be characterized by its ecological functions, history of degradation, and resulting needs and opportunities. For example, Jamaica Bay, a historically expansive wetlands complex, has been subject to extensive fill and loss of wetlands; the Hudson River system, to hardened shorelines and contaminated sediment; and the Lower Bay contains coastal and offshore environments, experiencing loss of dunes and benthic habitat. Separating the project area into smaller study areas will enable the study team and potential stakeholders to address study area-specific restoration needs as well as individual restoration opportunities within each study area, and to collect and characterize data in a more usable and understandable way, all under the ultimate umbrella of the CRIP, which links the study areas into one major plan.

5. The eight study areas to be included in the CRIP are as follows (see Figure 1):

1) Jamaica Bay,
2) Lower Bay,
3) Lower Raritan River,
4) Arthur Kill/Kill van Kull,
5) Newark Bay/Hackensack River/Passaic River,
6) Lower Hudson River,
7) Harlem River/East River/Western Long Island Sound,
8) Upper Bay.

Purpose of the Study Area Reports

6. The identification of potential restoration opportunities in each study area will be a two-fold process. First, the District will identify potential restoration sites based upon a preliminary needs and opportunities survey of various interested groups/agencies conducted by the Regional Planning

Association (RPA) and presented in their Needs and Opportunities Report. This information will be supplemented by additional analyses of restoration needs and opportunities on a more local level. Study area needs will be determined based upon the causes of ecosystem degradation and the condition of existing natural resources in each study area. This effort is already underway (but far from completed) and potential restoration sites in the Newark Bay/Hackensack River/Passaic River have been identified.

7. Second, the District will hold stakeholder meetings in each study area. The purpose of these meetings will be to incorporate additional comments from environmental organizations, community groups, and other individuals and stakeholders in each study area. This process will ensure the needs and opinions of as wide and diverse a group as possible is incorporated into the CRIP.

Format of the Report

8. This SAR addresses the Newark Bay/Hackensack River/Passaic River study area (Figure 2). The **Study Area Description** section describes the setting, history of degradation, existing land/water usage, and existing natural resources in the study area. Restoration needs and existing restoration efforts are summarized in the **Ecosystem Restoration** section.

II. STUDY AREA DESCRIPTION

Setting

9. This study area report encompasses the Passaic River and Hackensack River drainage basins, including Newark Bay, in Bergen, Essex, Hudson, and Passaic Counties, New Jersey (Figure 2). The Passaic and Hackensack River basins are highly urbanized, with significant development in the natural floodplains.

10. The New Jersey Department of Environmental Protection (NJDEP) has designated watershed management areas throughout the state. The Newark Bay/Hackensack River/Passaic River study area, as defined by this Study Area Report, is located within Watershed Management Areas (WMA) 3, 4, 5, 6, and 7.

Study Area History

11. Major changes to the natural landscape within the study area began with European settlement. Although the early European settlers relied heavily on the study area through the late 1700s, the study area's natural character was not greatly impacted. However, over the next two centuries the Passaic River watershed would become a center for commerce and manufacturing with dramatic effects. The Great Falls, currently located in the City of Paterson, was an early focus of human interest. The Dundee Dam was constructed in 1858 to divert water from the Great Falls to numerous factories, which began the cascade of industrial growth throughout the study area. Between 1880 and 1890, urbanization, industrialization, and pollution began to limit recreational opportunities on the Passaic River and became a barrier to the upstream spawning of American shad (*Alosa sapidissima*) and sturgeon (*Accipenser* spp.). By 1900, sewage and pollution had eliminated all recreational activities on the Passaic River (Iannuzzi *et al.* 2002).

12. The process of degradation to the Hackensack River mirrors that of the Passaic River. However, in addition to urbanization, industrialization, and pollution, numerous hydrological alterations, e.g., the Dundee Dam and Oradell Reservoir Dam, were performed throughout the 19th and 20th centuries. Various mosquito extermination organizations, created by the New Jersey General Health Act, excavated extensive ditches and draining activities beginning in 1904. By 1924, the Bergen County Mosquito Commission alone had one-million feet of drainage ditches through salt marshes and over

500,000 feet of upland ditches. Beginning in 1906, the New Jersey Agricultural Experiment Station installed numerous salt marsh drainage systems. By 1945, most of the salt marsh along the Hackensack River and Newark Bay, estimated at 26,000 acres, had been ditched and diked. In the 1930's large tracts of these drained salt marshes were overrun by invasive species such as common reed (*Phragmites communis*). In addition to the draining and diking, vast expanses of land were used as dumping grounds for municipal and industrial waste (legal and otherwise) as well as for the disposal of dredge material. Although the dumping was halted in the 1970's, as much as 2,500 acres of refuse-filled marsh (freshwater and saltwater) remains (Iannuzzi *et al.* 2002).

History of Degradation

13. The contamination of both marine sediments by chemical pollutants and heavy metals, and the resulting spread of those materials through aquatic and terrestrial food chains have been recognized as key environmental problems in the Estuary. Numerous studies of the problems have been undertaken by various organizations and agencies, including the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), the USACE, and the States of New York and New Jersey, which have focused on the relationship between sediment contaminant levels and benthic habitat quality. More detailed discussions and results of past and current studies of sediment contamination are described in the more detail in the *Summary of Sediment Characterization Studies* (USACE – under development).

14. The Hackensack River and Passaic River basins and Newark Bay have been a center of industrial activity since the Industrial Revolution. As a result, hundreds of chemical, paint and pigment manufacturing plants, petroleum refineries, and other large industrial facilities have been located along their banks. Effluent from these facilities has caused severe contamination of sediments in the rivers. Although the majority of the industrial facilities in the study area have been shut down, several petroleum refineries and chemical manufacturing plants continue to operate but their legacy of contaminants remain, and in the sediments. Primary contaminants of concern in the study area include dioxins (2,3,7,8-tetrachlordibenzo-p-dioxin [TCDD]), mercury, lead, polychlorinated dibenzofurans (PCDF), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and dichlorodiphenyltrichloroethane (DDT). Many of these contaminants pose risks to human and

ecological health and a 6-mile stretch of the Lower Passaic River has been deemed a Superfund site. Pathogenic microbial contamination, floatable debris, excessive levels of waterborne nutrients, and non-point source discharges further impair water quality in the study area.

15. In addition to the impacts outlined above, major industrial activity in the study area has caused extensive alteration of shoreline and riparian habitats, including a significant loss of tidal and freshwater wetland habitat through the construction of bulkheads and other anthropogenic structures. The few wetlands that remain have been degraded due to human disturbance and invasion by non-native species (e.g., common reed). There have been severe impacts to fish, shellfish, birds, and mammal populations. Prior to the industrial revolution, it is estimated that 200 species of fish were found in the Passaic River (USFWS 1997). Today, estimates suggest 27 species of fish remain (USFWS 1997). A number of historical tributaries have been filled or converted to storm sewer drains. Filling of these tributaries reduced the amount of spawning and nursery habitat available to fish. Human uses (e.g., fishing, rowing, boating, swimming, picnicking and wildlife observation) have also been severely limited or lost. It is estimated that almost 88 percent of all wetlands in the lower Passaic River and Newark Bay have been lost (Iannuzzi *et al.* 2002).

16. Several impediments to fish passage exist in the study area. In the Passaic River watershed, four dams prevent American shad and river herring (*Alosa* ssp.) from reaching the upper segments of the watershed. Three are located on the Passaic River (Paterson, Rutherford and Garfield). A forth dam is located on the Third River (Nutley). The Oradell Reservoir Dam, located on the Hackensack River, blocks passage of both American shad and river herring (NJDEP 2000). In addition several tide gates, many of which are inoperable, are present within the New Jersey Meadowlands and on the lower Hackensack River (American Littoral Society 1993). These structures have degraded the quality of habitat for anadromous species by preventing them from migrating from estuarine and marine environments to freshwater habitats to spawn.

Existing Land/Water Usage

17. Predominate land uses in the highly urbanized Newark Bay/Hackensack River/Passaic River study area include industry, commercial, and residential development. Surface waters are used primarily for commercial boat traffic. Water is also withdrawn from these rivers and used as cooling

water at the Kearny, Hudson, and Bergen power plants. Three sewage treatment plants (STPs) discharge treated wastewater into the study area. Secondary uses of the surface waters primarily include non-contact recreation such as boating and fishing. Parks, open space, and undeveloped land include Oradell Reservoir, Kearny Marsh, Overpeck Park, and Berry's Creek.

Natural Resources Conditions

18. This study area is located within a highly urbanized portion of northern New Jersey. The shorelines of Newark Bay, the Hackensack River, and the Passaic River are highly modified by bulkheads and riprap. The once forested floodplain of the Hackensack and Passaic Rivers has been replaced by expansive urban development. In some areas, the banks remain vegetated by species such as American Sycamore (*Platanus occidentalis*) and black cherry (*Prunis serotina*). However, these vegetated buffers are often very narrow and highly fragmented with little natural vegetation or shoreline features remain. In the most urbanized portions of the study area, it is highly unlikely that the remaining natural areas are able to provide ecological functions such as flood attenuation and filtering of runoff, let alone support the diversity and abundance of resources historically present. In the lower Passaic River basin, the majority of wetland areas have been filled and many streams have been converted to storm sewer drains.

19. The Passaic River is tidal from the mouth at Newark Bay to Dundee Dam, located in New Jersey between the towns of Clifton, Passaic County and Garfield, Bergen County. Anadromous fish runs have been eliminated from all reaches of the watershed above the Dundee Dam. The species that spawn in the river include American shad, blueback herring (*Alosa aestivalis*), and alewife (*Alosa pseudoharengus*).

20. Substrate of the Hackensack and Passaic Rivers vary from sand to mud to bare concrete bed. Some portions of the rivers have rocky substrate ranging from large rocks to small pebbles. In other portions of the rivers, contaminated bottom sediments reduce habitat quality for fish and other aquatic organisms. Man-made dams and debris block fish passage in portions of the rivers and their tributaries. Fish species found in both rivers include, largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), yellow perch (*Perca flavescens*), and carp (*Cyprinus carpio*).

21. The Hackensack River is of moderate salinity from the mouth upstream to Cromakill Creek. In this mesohaline reach, a combination of marine and estuarine invertebrates, fish, and turtles can be found. Upstream of Cromokill Creek, the Hackensack River is of low salinity and supports both estuarine and freshwater species.

22. A number of obstacles block or inhibit fish passage along the Hackensack River. These obstacles include four tide gates downstream of the Oradell Reservoir and the Oradell Reservoir Dam. The Oradell Reservoir Dam prevents most of the freshwater flow from the Hackensack River from reaching the New Jersey Meadowlands.

23. Intertidal wetlands characterized by an intermittent flooding regime and dominated by common reed are the most common type of wetland present in the New Jersey Meadowlands. Other wetland types still present in this habitat complex include tidal bays/mudflats, low salt marsh, high marsh, brackish impoundments, freshwater impoundments, and remnant palustrine forest. Grassland, shrubland, and early successional forest exist on undeveloped upland fill areas that are scattered throughout the study area.

III. ECOSYSTEM RESTORATION

Hudson-Raritan Estuary Ecosystem

24. The New York-New Jersey Harbor Estuary Program (HEP 1996) has identified five primary factors that have caused ecosystem impairments or otherwise degraded water or habitat quality in the Estuary. These factors are:

- Habitat Loss and Degradation: Recent wetland inventories estimate at least 80% of the Estuary's wetlands have been lost or significantly altered.

- Toxic Contamination: The presence of toxins in the Estuary's waters, sediments, and biota is the result of historic and residual contamination by industrial and non-point sources. Today, wastewater discharges, combined sewer overflows (CSOs), accidental releases, vehicle exhaust emissions, household chemicals, pesticides, atmospheric deposition, landfill leachate, urban runoff, and other non-point sources are continuing sources of toxic substances (HEP 1996).

- Pathogens: The primary sources of pathogens include CSOs, sewage treatment plant malfunctions, illegal connections to storm sewers, vessel sewage discharge, urban runoff, and other non-point sources.

- Floatable Debris: Floatable debris is made up of two primary components: trash or litter and harbor drift. Trash and litter enters the Estuary via runoff, storm sewer discharges, CSOs, beach and boat litter, and poor solid waste handling operations. Harbor drift composed primarily of material from dilapidated shoreline structures such as piers, bulkheads, and pilings, is a significant of floatable debris in the Estuary.

- Nutrient and Organic Enrichment: Eutrophication due to excessive discharges of nitrogen is a significant problem in the Estuary. Organic matter comprised primarily of carbon is decomposed as DO and used in the biochemical process. Nitrogen and carbon enter the Estuary through point and non-point sources such as sewage

treatment plants, runoff (primarily from over-fertilized lawns), rivers and tributaries and atmospheric deposition.

Primary Restoration Needs of the Hudson-Raritan Estuary

25. The overall goal of the HRE is to restore and enhance aquatic and nearshore terrestrial habitats that have been lost or degraded as a result of human activities. To achieve this goal, primary restoration needs of the Estuary have been established. These categories were identified in the document entitled *Restoration Opportunities in the Hudson-Raritan Estuary* (USACE 2001). These need are:

- Restore and create intertidal wetlands and mudflats,
- Restore benthic habitats and remediate "hot spots" of contaminated sediments,
- Restore and create freshwater/riparian wetlands,
- Restore fish habitat (remove impediments to fish passage; construct artificial reefs),
- Restore shellfish habitat,
- Restore and enhance shoreline/coastal fringe habitat (including upland areas),
- Create, restore, or enhance vegetated and non-vegetated shallow water habitat.

Restoration Needs of the Newark Bay/Hackensack River/Passaic River Study Area

26. The natural ecosystems of the Newark Bay/Hackensack River/Passaic River study area have been dramatically altered due to human activities. However, given current use and level of development, the goal of ecosystem restorations may not always be to restore a given area to previous, "historic" conditions. More realistic goals may involve restoring what is left through the establishment of native vegetation or clean-up of contaminated sediments and expanding when opportunities exist.

Protect/Restore Existing Wetlands and Create New Wetlands

27. Intertidal wetland and mudflat areas should be restored to remove invasive species. Filled wetland sites should be regraded to restore tidal flow, eliminate common reed and other invasives, and reestablish native salt marsh vegetation. Other blockages that restrict tidal flow should also be removed. Restoration of these habitats will improve foraging habitat for wading birds, waterfowl, raptors, and fish. Increasing the area of intertidal mudflats will improve habitat for benthic invertebrates and provide foraging habitat for shorebirds.

28. Like many of the tidal wetlands in the study area, freshwater and riparian wetlands have been degraded due to human disturbance and the placement of fill. Freshwater wetlands can be restored by removing fill, regrading, and planting native freshwater wetland vegetation. They can be expanded or created where they don't exist by excavation or upland areas. Managing stormwater runoff and restoring water flow connections between upland freshwater wetlands and the main river or tributaries can enhance habitat in riparian zones. Restoration of freshwater wetlands will improve habitat for reptiles and amphibians (herpetofauna) as well as waterbirds.

29. Opportunities may also to increase the amount of wetlands within the study area by constructing new wetlands. Locations where it may be feasible to construct new wetlands include remediated brownfield sites, closed landfills, or other vacant upland fill parcels.

Restore Stream/River Habitat

30. There is also a need to restore stream and river habitat in the study area. This could be achieved by removing debris and structures that hinder natural habitats , vegetation, or features and restrict tidal flow and fish movement. Fish ladders could be installed in areas where structures cannot be removed. Riparian habitat along many of the streams and rivers has been greatly reduced by development actions. Floodplain restoration efforts could be included in projects that involve restoration of stream and river habitat. Removal of fill and bulkheads could soften shorelines. Planting of native floodplain vegetation along newly softened shorelines could help improve water quality, reduce flooding, and provide wildlife habitat.

31. Tide gates and dams block fish passage in the Passaic and Hackensack River basins. Installation of fish passage structures and removal of tide gates and debris dams, together with efforts to improve water quality, could help restore historic fish runs to the Passaic River and Hackensack River basin.

Remediate Leachate Sources, Persistent Oil Spill "Hotspots"

32. Efforts should be made to identify and remediate leachate sources in the study area. Leachate typically originates from landfills and industrial sites where liquid material migrates off-site and through the soil. Groundwater contamination also contributes to water quality problems. Leachate recovery and treatment systems could be installed or wetlands could be constructed to treat contaminated leachate.

Contaminated Sediments

33. Contaminated bottom sediments are a significant problem in the study area, particularly in the Passaic River and Newark Bay. Some areas are "sources," which contribute to contamination of other areas when the sediments are transported by littoral currents. Other areas are "sinks" for contaminated sediments. These "sinks" accumulate contaminated sediments that are moved by the currents within the waters of the study area. These contaminated sediments affect not only the immediate area but also penetrate the system through re-suspension and natural dispersion. Several options exist for the remediation of contaminated sediments. One potential option is to cap areas of contaminated sediments using clean material. Another option is to remove the contaminated sediments by excavation or dredging and replacing the sediments that were removed with clean material. Contaminated sediments that are removed from waterbodies in the study area could be treated and then used in upland locations. These treated sediments could, for example, be used to cap landfills or brownfields. Because of the on-going deepening of many navigational channels in the area, there is an especially good opportunity to have available millions of cubic yards of good quality dredged material to accomplish this in an especially cost effective manner. However, this material will only be available over the next 10 years and so plans to take advantage of this limited opportunity must be expedited to maximize clean-up of this area-wide problem.

Restore/Remediate Brownfield Sites

34. Many abandoned industrial and commercial facilities (brownfield sites) adversely affect adjacent habitats as well as the habitats within sites themselves. Contamination at existing brownfield sites could be remediated reducing their off-site effects and restoring each to more ecologically viable conditions. Abandoned, man-made structures could be removed and native vegetation could be re-established perhaps by connecting to or adjacent rivers or tributaries. In addition, depending upon their position in the landscape, brownfield sites could be used to establish buffers between existing industrial uses and natural communities and, in many cases, serve as parks and open space as well.

35. Superfund sites and Hazardous, Toxic, and Radioactive Waste (HTRW) sites are located within the study area. The remediation of these sites could incorporate a wide variety of remedial activities, ranging from relatively simple "cut and scrape" cleanups to highly complex long-term remediation activities, depending on the nature/level of the contamination and clean-up required.

Restore Upland Habitats

36. Upland habitats are severely fragmented and degraded. Enhancement of shoreline habitat along the Passaic and Hackensack Rivers will benefit nesting waterbirds, reduce habitat fragmentation, help shade and provide cover to stream systems, and provide additional upland habitat for reptiles and amphibians, mammals, and migratory and resident landbirds, while also improving the adjacent river habitats as well.

37. The study area contains pockets of undeveloped land across a highly developed landscape. In addition, many abandoned industrial sites exist. Opportunities may exist to restore these abandoned properties to a natural state and link sites that are currently isolated from other natural areas. Connections between isolated natural areas have the potential to provide important corridors for fish and wildlife. These corridors could also serve as parks, trails, or other public open space areas that would provide passive and active recreational opportunities, as appropriate.

Existing Restoration Efforts

38. Habitat restoration projects have been undertaken in the study area and various organizations, most notably, the Harbor Estuary Program (HEP) Habitat Workgroup, have identified additional

potential sites and sought to promote restoration efforts. The following habitat restoration initiatives have been completed or are proceeding in the study area.

Lower Passaic River

39. A separate feasibility study for the tidally influenced area of the Lower Passaic River (below the Dundee Dam) was recommended as part of the HRE Reconnaissance Study. The EPA has designated a 6-mile reach of the river as an operable unit under the Superfund Program; thus, to address the problem area the District has formed a government partnership with the EPA, Region 2 and the NJ Department of Transportation/Office of Maritime Resources (OMR), which is acting as the non-Federal sponsor), to address all of the Superfund remediation and potential environmental restoration opportunities for the basin.

USACE – New Jersey Meadowlands Ecosystem Restoration Study

40. The Corps is currently conducting a feasibility study of ecosystem restoration within the Hackensack Meadowlands. The $5.2 million study is an outcome of early HRE coordination to target this special and unique habitat, which is one of only two areas identified by HEP (the other is Jamaica Bay) as focus areas subject to a separate feasibility study. The study will produce a plan for New Jersey Meadowlands that is fully coordinated with CRIP and HRE goals and priorities. Opportunities that will be considered for habitat restoration, including the selected and careful removal of undesirable fill and *Phragmites* dominated areas on former high-value tidal wetlands, and the restoration of tidal flow to enhance fish and wildlife value habitat value and water quality function. Opportunities may also exist for the careful removal of impairments to fish migration on tributaries and the covering of contaminated sediment hot spots with clean sediments will also be targeted for implementation. Identification and implementation of beneficial use of dredged material for habitat enhancement and restoration from the NY/NJ Harbor channel deepening project is an additional goal of the study.

41. The District completed the Project Management Plan (PMP) for the separate Hackensack Meadowlands Restoration Study, which details the full scope, cost and schedule of the ecosystem restoration study of the Hackensack Meadowlands, in April 2003. Also in April 2003, the District

executed the Feasibility Cost-Sharing Agreement with the study's non-Federal sponsor, the New Jersey Meadowlands Commission.

Passaic River Basin

42. Several communities located in the Passaic River Basin requested a program of improvements to the degraded shoreline and habitats along highly urbanized portion of the lower Passaic River. In January 2000, the District initiated a reconnaissance study and is currently working on a Project Management Plan (PMP) for the feasibility study. The PMP will outline the tasks and costs to be associated with the feasibility study. The PMP will also identify potential non-Federal partners for cost sharing.

Lincoln Park West

43. The District, under the Continuing Authorities Program, is completing an Environmental Restoration Report for restoration activities at the Lincoln Park West site. The site, located in Jersey City, New Jersey, is managed by the Hudson County Division of Parks and Recreation, is 150 acres, and is adjacent to the Hackensack River.

44. The site was once a tidal wetland that was filled and altered to the extent that tidally influenced has been disrupted. This wetland was well known for its historically diverse and productive fish and wildlife populations; however, these populations are now suffering from habitat loss and degradation that is the result of decades of intense disturbance to the site. The goal of restoration is to return the site to its historic condition: a fully functioning tidal marsh. Portions of the site would be used as an upland transition zone to provide added diversity. Besides benefiting many species of fish and wildlife, the restored site will provide enhanced recreational and educational opportunities (including an interpretive center and trails) for the many users.

45. Restoration of the site to its historical condition would likely include fill removal, regrading, dike and berm removal/modification, daylighting culverts, excavation of tidal creeks and open water areas and replanting native vegetation species. This restoration is considered a high priority by the Habitat Workgroup of the HEP and is endorsed as a major site by the Natural Resources Restoration Plan for oil and chemical releases in the Estuary.

Cole's Brook

46. The Hackensack Riverkeeper has received a grant from the New Jersey Department of Environmental Protection to restore a 750-foot section of Cole's Brook, located in Staib Park, Hackensack, Bergen County, New Jersey. Funding for the grant is provided under Section 319(h) of the Clean Water Act to mitigate non-point sources of pollution.

47. Currently, asphalt parallels Cole's Brook for much of its length and lies within 20 to 25 feet of the water's edge. Over the years, illegal dumping of household garbage, shopping carts, waste from landscapers, and other trash has substantially degraded the waterway. Historically, vehicles could easily access the water's edge to deposit garbage directly into the stream and riparian zone. Runoff from the adjacent paved and turf areas flows directly into the stream carrying oil, gas, fertilizer, animal waste, and other non-point source pollutants. Invasive species have taken root and now dominate the riparian zone.

48. Goals set forth by the Hackensack Riverkeeper include restoring Cole's Brook to historic conditions, which will assist in improving the water quality of the Hackensack River overall, and creating a sense of stewardship and community in the surrounding urbanized area.

Marsh Resources, Inc. Wetland Mitigation Bank

49. Marsh Resources, Inc. (MRI) is a wetland mitigation banking company that was established in 1995, after the Army Corps of Engineers, U.S. Environmental Protection Agency, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration issued the document entitled *Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks*. The release of this document allowed the concept of wetland mitigation banking to become reality.

50. MRI developed the Marsh Resources Meadowlands Mitigation Bank, which is a 206-acre site located in Carlstadt, Bergen County, New Jersey. Restoration activities at the site are on-going. The site became a degraded, common reed-dominated wetland as result of historic development and mosquito ditching. MRI is converting the site to a more natural inter-tidal, island/channel/mudflat ecosystem that supports native estuarine salt marsh species (e.g., *Spartina* spp.). Construction and

planting of a 120-acre portion of the marsh was completed in 1999. After the completion of this initial phase, shorebirds and other migratory species began to use the restored marsh. In 2000, northern harriers and osprey (*Pandion haliaetus*) began foraging at this site.

General Efforts by the New Jersey Meadowlands Commission

51. The New Jersey Meadowlands Commission (NJMC), formerly known as the Hackensack Meadowlands Development Commission (HMDC), began restoration activities at selected sites in 1998. Specific restoration efforts include control of common reed, re-establishment of tidal flow, and creation of open water areas with native plants along the margins. The habitat types created as a result of these restoration efforts include low marsh habitats that are flushed daily by tides, lowland scrub/shrub habitat along the marsh, and an upland ecotone. These habitat types provide breeding, wintering and migratory habitats for dabbling ducks, shorebirds, and wading birds, allow for greater fishing access, and provide some mosquito control.

Potential Restoration Sites

52. In addition to the existing and on-going restoration efforts, 16 potential restoration sites have been identified in the Newark Bay/Hackensack River/Passaic River study area and are listed in Table 1. Each site not currently under study or construction will be evaluated to determine which of the proposed restoration activities, if any, are feasible from an engineering, ecological, and economic perspective, and what level of information is needed to complete the designs of those that are.

Table 1 - Potential Restoration Sites in the NHP

HRE Site ID	Name	Restoration Opportunities[(1)]
1NHP	Oradell Reservoir Dam	4
2NHP	Van Buskirk Island	3,10
3NHP	Dundee Dam	8,11
4NHP	Overpeck Creek	1,6
5NHP	Moonachie Creek	*
6NHP	Passaic River	2
7NHP	Lincoln Park West	1,8
8NHP	Hudson County Mall	*
9NHP	Newark Bay (Shoreline Restoration)	*
10NHP	Newark Bay (Hotspot Remediation)	2
11NHP	Newark Bay/Bayonne Park	1,6

HRE Site ID	Name	Restoration Opportunities[(1)]
12NHP	Berrys Creek	1
13NHP	Losen Slote	*
14NHP	Bellmans Creek	1
15NHP	Kearny Marsh/Hackensack Meadowlands	1
16NHP	Mill Creek/Hackensack Meadowlands	2,8
17NHP	NJ Turnpike Fringes/Western Spur	8
18NHP	Penhorn Creek	1
19NHP	Hackensack River	1,2
20NHP	Third River	*
21NHP	Anderson Creek Marsh**	*
22NHP	Empire Tract**	*
23NHP	Laurel Hill Park Wetland**	*
24NHP	Lyndhurst Riverside Marsh**	*
25NHP	Meadowlark Marsh**	*
26NHP	Mehrhof Pond**	*
27NHP	Metro Media Tract**	*
28NHP	Mori Tract**	*
29NHP	Oritani Marsh**	*
30NHP	Petrillo Tract**	*
31NHP	Riverbend Wetlands Preserve**	*
32NHP	Secaucus High School**	*
33NHP	Secaucus Tract**	*
34NHP	Steiners Marsh**	*
35NHP	Teterboro Woods**	*

(1) Restoration Opportunities:
1 – Restoration/Creation of Intertidal Wetlands/Mudflats
2 – Benthic Habitat Restoration (Hotspot Removal)
3 – Restoration/Creation of Freshwater/Riparian Wetlands
4 – Restoration of Fishery Habitats (Anadramous Fish Migration, Artificial Reefs)
5 – Shellfish Habitat Restoration
6 – Restoration/Enhancement of Shoreline/Coastal Fringe Habitat (Dunes, Bird Habitat)
7 – Creation/Restoration/Enhancement of Shallow Water Habitat (including Eelgrass)
8 – Shoreline Enhancement/Bank Stabilization
9 – Water Quality Improvement
10 – Riparian Habitat Restoration
11 – Environmental Interpretation
* To be determined
** Potential restoration sites are recent additions, therefore, are not discussed at any length in this report. Sites obtained from the Hackensack Meadowlands Environmental Site Information Compilation (MESIC), May 2004.

IV. CONCLUSIONS

53. The study area, encompassing the Newark Bay, the Hackensack River, and the Passaic River, is an important component of the Estuary, providing the largest proportion of unfragmented wetland habitat. However, the majority of the wetland habitat in the study area has been degraded and many areas contain contaminated soils and sediments. In addition, riparian areas upstream of the New Jersey Meadowlands have been highly disturbed and degraded further impacting the Meadowlands complex. Few natural areas exist upstream of the New Jersey Meadowlands, especially on the Passaic River. Fish passage is blocked by a number of tide gates and dams. Restoration efforts in the New Jersey Meadowlands can improve habitat for wildlife species and have the potential to contribute to recreational opportunities. Restoration efforts upriver, especially those that include remediating contaminated areas, have the potential to improve fisheries.

54. The Newark Bay/Hackensack River/Passaic River study area has a unique combination of problems that have led to the current degraded state of the natural resources. However, the presence of still extensive marsh complexes make this an excellent restoration target, as much value can be added by size alone. Hardened shorelines, heavy industry, contaminated sites, and wetland loss have degraded water quality and habitat conditions. The primary restoration needs in the study area should focus on the addressing conditions that are common throughout the study area such as contamination, hardened shorelines and fill. Opportunities for the beneficial use of material from the Historic Area Remediation Site (HARS) and expanded use of clean dredged material exist in the study area. This material could be used to cap contaminated sediments or landfills. Abandoned brownfield sites also offer unique opportunities for ecosystem restoration. Restoration could return abandoned sites to viable habitat for fish and wildlife, and provide opportunities for public access to the waterfront for recreational activities such as wildlife viewing.

55. Restoration can be accomplished through partnerships between Federal, State, and local governments and agencies. For example, the District and other local sponsors may cap contaminated sediments or restore wetland areas in the study area. Where degradation or contamination is related to issues such as Superfund sites, CSOs, or brownfields, the responsible parties, facility operators, or other private entities may lead restoration or remediation efforts.

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FIGURES