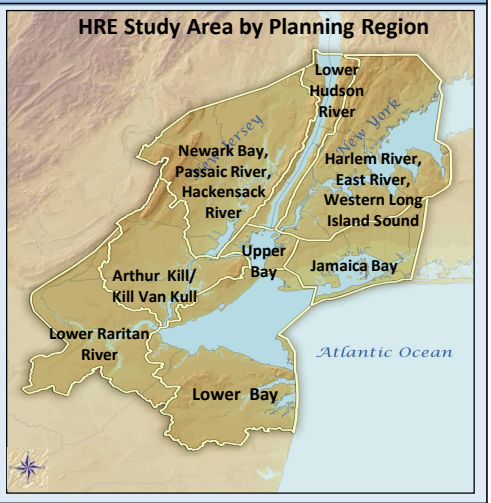
# Hudson Raritan Estuary (HRE) Ecosystem Restoration Project, New York and New Jersey

**Integration of six feasibility studies (four authorizations) with ten sponsors/partners:**

- HRE (8 Planning Regions)
- HRE - Lower Passaic River
- HRE – Hackensack Meadowlands
- Flushing Creek and Bay
- Bronx River Basin
- Jamaica Bay Marine Park, and Plumb Beach

**Purpose:** The purpose of the study was to ***restore significant ecological function, structure, and dynamic process*** that have been degraded throughout the Hudson Raritan Estuary. Restoration is needed due to the long-term historic habitat degradation and loss via urbanization and industrialization.

## 1




## Nationally Significant Estuary 2

**Institutional Significance:**
- Estuary of National Importance- National Estuary Program
- Ecosystems of National Significance
- One of the largest estuaries in the U.S
- Second largest Port in the U.S.
- HRE Comprehensive Restoration Plan (Regional Goals)
- Regionally Significant Coastal Habitat
- Migratory Bird Treaty Act
- Urban Waters Federal Partnership (Passaic & Bronx Rivers)
- National Estuarine Research Reserve System

**Technical Significance:**
- Wetland habitat is extremely scarce and actively declining nationally (99% freshwater >85% of estuarine wetlands)
- Provides habitat for 27 Federally-listed species of special status, 2 candidate species, 400 plant and animal species of special emphasis
- Atlantic Flyway - stop-over point for >500 avian species

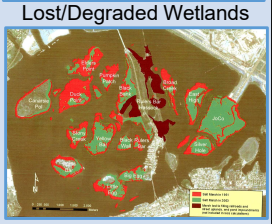
**Public Significance:**
- Home to over 13 million people
- Collaboration with over 120 federal and state agencies, academic institutions, nonprofit and community organizations to restore the HRE

## Objectives 4

1. Restore the structure, function, and connectivity, and increase the extent of ***estuarine habitat.***
2. Restore the structure and function, and increase the extent of ***freshwater riverine habitat.***
3. Restore the structure and function, and increase the extent of ***marsh island habitat*** in Jamaica Bay.
4. Increase the extent of ***oyster reefs***.

## Key Problems 3


Lost/Degraded Wetlands


Disappearing Marsh Islands


Hardened Shorelines


Fish Passage Barriers

- Significant habitat loss within study area:
  >85% estuarine wetlands lost
  > 99% freshwater wetlands lost
  ~2,000 acres of marsh islands in Jamaica Bay lost
- Filled, eroded, and hardened shorelines
- Loss of ~100% of oyster reefs
- Barriers to fish passage impede spawning and access to habitat
- Scarce habitat and lack of connectivity
- Bed and bank erosion
- Decrease in habitat diversity
- Increase in invasive species
- Poor benthic habitat
- Altered hydrology degrades habitat
- Straightened and deepened channels degrade habitat
- Loss of >95% of eelgrass beds
- Poor sediment and water quality

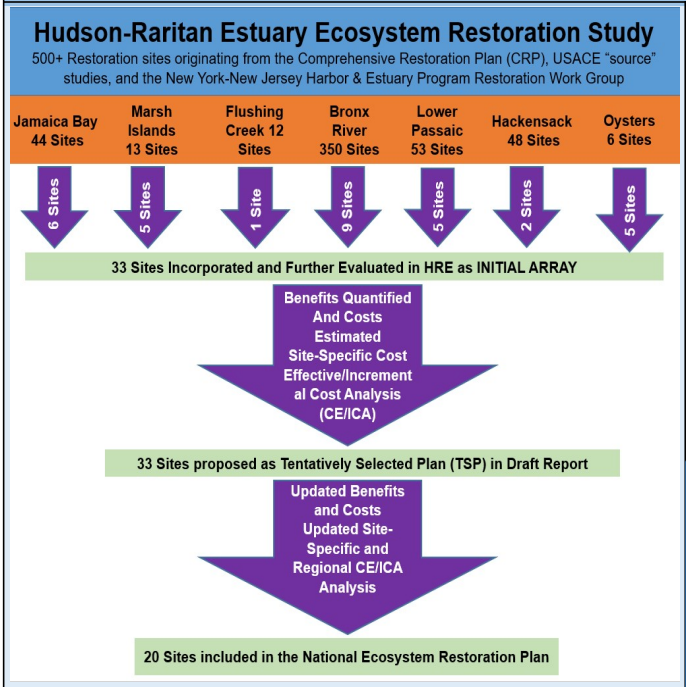

Degraded/Eroding Shorelines

## Comprehensive Restoration Strategy 5

| 1988 | 1996 | 1990-1999 | 1994-2001 | 2009/2016 |
|---|---|---|---|---|
| Estuary of National Importance<br>National Estuary Program | NY/NJ Harbor Estuary Program (HEP) Comprehensive Conservation Management Plan | HRE/Jamaica Bay/Bronx River/Flushing Creek Authorizations | HRE and Source Study Reconnaissance Reports | HRE Comprehensive Restoration Plan |

| 2013-2016 | ongoing | 2018 | 2015-2020 | 2020 |
|---|---|---|---|---|
| Integration of all Source Studies into HRE | Coordination with HEP Restoration Work Group & Sponsors | Harbor Estuary Program Action Agenda | Long Term Control Plans and Green Infrastructure | Authorized Recommended Plan Significant Contribution to meet Regional Goals |

## Plan Formulation 6




- Site Screening of 500+ Sites among the 6 "source" studies
- Criteria (including physical constraints, known upland contamination, real estate, sponsor readiness, habitat value, etc.)
- 99 Alternatives were developed at 33 sites
- Management Measures considered: excavation, invasives removal, regrading, native plantings, stream bed restoration, in-stream structures (j-hooks, cross vanes), streambank reestablishment, channel dredging, oyster reefs, fish ladders
- Cost estimated/benefits quantified with approved models including Evaluation of Planned Wetlands, Oyster Habitat Suitability Model and Watershed Scale Connectivity Toolkit
- Plan Evaluation and Comparison: Site and Regional (1,256 plans) Cost Effectiveness/Incremental Cost Analysis, planning objectives, secondary decision factors
- 20 Sites Recommended for construction

**Environmental Compliance**

- ✓ Environmental Assessment completed
- ✓ All coordination completed (Endangered Species Act, Fish and Wildlife Coordination Act Report, Essential Fish Habitat)
- ✓ Section 106, Programmatic Agreement
- ✓ Preliminary Water Quality Certificates and Coastal Zone Consistency
- ✓ Supported by State and Federal Resource Agencies

## The Recommended Plan 7

- The **National Ecosystem Restoration (NER) Plan** is the restoration of **20 restoration sites** within the HRE that address long-term and large-scale degradation of aquatic habitat.
- Restoration supports Comprehensive Restoration Plan's regional goal, "to develop a mosaic of habitats that provides society with renewed and increased benefits from the estuary environment".
- **NER Plan** provides restoration of approximately:
  - ✓ 381 acres of **estuarine wetlands** including 16 acres/30,650 linear feet of tidal channels;
  - ✓ 50 acres of **freshwater riverine wetlands**;
  - ✓ 27 acres of **maritime forest/uplands**;
  - ✓ 39 acres of **shallow water habitat**;
  - ✓ 52 acres of **oyster habitat**;
  - ✓ 1.6 miles of **streambank restoration**;
  - ✓ 72 acres of **bed and channel restoration**; and
  - ✓ **Two fishways** would be installed and three weirs would be modified to re-introduce or **expand fish passage (24 miles)** along the Bronx River.
- **Future spin-off feasibility studies** to be carried out under the existing HRE authority.


## Cost Summary (FY22 Price Levels) 8

| | |
|---|---|
| Project Total First Cost | $434,491,000 |
| Project Total Federal Share (65%) | $282,419,000 |
| Project Total Non-Federal Share (35%) | $152,072,000 |
| Lands and Damages | $7,328,000 |
| Cash Balance | $144,744,000 |
| Project Total Fully Funded Cost | $624,772,000 (escalated to the mid-point of construction for each site) |

## Average Annual Costs & Benefits 9

| | |
|---|---|
| Total Average Annual Cost | $14,950,000 |
| Average Annual OMRR&R Cost<br>Total OMRR&R Cost (100% Non-fed) | $156,000<br>$7,452,000 |
| Total Average Annual Benefits (AAFCUs)* | 341 |
| Costs/AAFCU* | $43,800 |
| * Average Annual Functional Capacity Units = Habitat Units | |

## Significance of Recommended Plan 10

**621 Total Acres of Nationally Significant Habitat Restored**

- Restoration of 431 acres of wetland habitat that is extremely scarce and actively declining nationally
- Habitat supports 27 Federally-listed species
- Key stop-over points for migratory birds (>500 species) along the Atlantic Flyway
- Estuarine marshes/wetlands serve as nursery, feeding, spawning sites and refuge to predators
- Reconnecting scarce and fragmented habitat
- Connectivity for migratory fish (anadromous and catadromous)
- Marsh island restoration of 175 acres of habitat in Jamaica Bay to counteract the loss of >2,000 acres providing ecosystem benefits and secondary coastal storm risk management benefits to coastal communities

# Authorized Recommended Plan Details

## Recommended Sites and Measures/Habitat Type at Each Site


### Restoration Measures/Habitat Types

1. Estuarine Wetlands
2. Tidal Channel Restoration
3. Maritime Forest
4. Oyster Reefs
5. Shallow Water Habitat
6. Freshwater Wetlands
7. Streambank Restoration
8. Bed Restoration
9. Fishway
10. Sediment Forebay

2022: Initiate Preconstruction Engineering and Design Phase of Stony Creek Marsh Island, Flushing Creek, Oysters at Naval Station Earle and Bronx Zoo & Dam/Stone Mill Dam Projects

| HUDSON RARITAN ESTUARY ECOSYSTEM RESTORATION RECOMMENDED PLAN (FY2022 Price Levels) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Proposed Habitat Types and Actions (Acres/Linear Feet/Miles) | Net Ecological Output (AAFCU/AAHU) | First Costs ($) | Fully Funded Cost ($) | | | Annual OMRR&R Cost ($) | Sponsor |
| | | | | Total ($) | Federal | Non-Federal | | |
| **Jamaica Bay Planning Region – Perimeter Sites** | | | | | | | | |
| Dead Horse Bay | Low Marsh (19 acres); High Marsh (5.4 acres); Scrub/Shrub (6.2 acres); Upland (8 acres) Tidal Channels (2.31 acres) [Total Habitat: 40.91 acres] | 30.3 | $43,399,000 | $73,065,000 | $47,492,250 | $25,572,750 | $4,432 | NYCDEP NYSDEC |
| Fresh Creek | Low Marsh (16.1 acres); High Marsh (4.4 acres); Scrub/Shrub (3.6 acres); Maritime Forest (10.7 acres); Bed/Channel Restoration (45.08 acres) [Total Habitat: 79.88 acres] | 36.9 | $36,118,000 | $47,183,000 | $30,668,950 | $16,514,050 | $4,964 | NYCDEP |
| **Total:** | | **67.2** | **$79,517,000** | **$120,248,000** | **$78,161,200** | **$42,086,800** | **$9,627** | |
| **Jamaica Bay Planning Region – Marsh Islands** | | | | | | | | |
| Stony Creek | Low Marsh (26 acres); High Marsh (22.5 acres); Scrub/Shrub (3.49 acres); Tidal Channels (1.43 acres); Shallows (8.67 acres) [Total Habitat 62.09 acres using 151,360 CYD of dredge material] | 37.3 | $24,714,000 | $29,727,000 | $19,322,550 | $10,404,450 | $5,138 | NYCDEP |
| Duck Point | Low Marsh (24.9 acres); High Marsh (5.6 acres); Scrub/Shrub (8.1 acres); Tidal Channels (1.03 acres); Shallows (7.57 acres) [Total Habitat: 47.2 acres using 213,776 CYD of dredge material] | 28.4 | $22,784,000 | $28,999,000 | $18,849,350 | $10,149,650 | $4,620 | NYCDEP |
| Pumpkin Patch West | Low Marsh (13.7 acres); High Marsh (8.61 acres); Scrub/Shrub (.9 acres); Tidal Channels (0.74 acres); Shallows (3.88 acres) [Total Habitat: 27.83 acres using 327,686 CYD of dredge material] | 18.4 | $21,434,000 | $33,968,000 | $22,079,200 | $11,888,800 | $4,222 | NYCDEP |
| Pumpkin Patch East | Low Marsh (15.6 acres); High Marsh (10.1 acres); Scrub/Shrub (3.1 acres); Tidal Channels (0.58 acres); Shallows (5.22 acres) [Total Habitat: 34.6 acres using 351,952 CYD of dredge material] | 22.1 | $22,982,000 | $41,397,000 | $26,908,050 | $14,488,950 | $4,277 | NYCDEP |
| Elders Center | Low Marsh (15.2 acres); High Marsh (10.9 acres); Scrub/Shrub (1.4 acres); Tidal Channels (0.95 acres); Shallows (5.49 acres) [Total Habitat: 33.94 acres using 284,891 CY of dredge material] | 21.6 | $20,853,000 | $30,137,000 | $19,589,050 | $10,547,950 | $4,264 | NYCDEP |
| **Total:** | | **127.8** | **$112,767,000** | **$164,228,000** | **$106,748,200** | **$57,479,800** | **$23,075** | |

| HUDSON RARITAN ESTUARY ECOSYSTEM RESTORATION RECOMMENDED PLAN (FY2022 Price Levels) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Proposed Habitat Types and Actions (Acres/Linear Feet/Miles) | Net Ecological Output (AAFCU/AAHU) | First Costs ($) | Fully Funded Cost ($) | | | Annual OMRR&R Cost ($) | Sponsor |
| | | | | Total ($) | Federal | Non-Federal | | |
| **East River, Harlem River and Western Long Island Sound Planning Region** | | | | | | | | |
| Flushing Creek | Low Marsh (9.76 acres); High Marsh (2.47 acres); Scrub/Shrub (1.8 acres); Maritime Forest (3.89 acres); Shallows (1.37 acres)[Total Habitat = 19.29 acres] | 8.3 | $17,226,000 | $21,032,000 | $13,670,800 | $7,361,200 | $4,639 | NYCDEP |
| Bronx Zoo and Dam | Emergent Wetlands (1.16 acres); Forested Scrub/Shrub Wetland (0.48 acres); Invasives Removal/Native Plantings (0.42 acres); Streambank (750 linear feet); Fish Passage Opening (0.8 river miles opened) [Total Habitat: 2.06 acres] | 1.9 | $11,736,000 | $13,879,000 | $9,021,350 | $4,857,650 | $15,653 | NYC Parks |
| Stone Mill Dam | Invasive Removal/Native Planting (.03 acres); Bed Restoration (0.5 acres); Fish Passage Opening (~7 river miles opened +16 miles following upstream weir modifications) [Total Habitat: 0.53] | 19.2 | $4,978,000 | $5,971,000 | $3,881,150 | $2,089,850 | $9,661 | |
| Bronx Zoo & Dam/Stone Mill Dam | | 21.1 | $16,714,000 | $19,850,000 | $12,902,500 | $6,947,500 | $25,314 | |
| Shoelace Park | Emergent Wetland (2.07 acres); Forested Scrub/Shrub Wetland (1.1 acres); Invasives Removal/Native Planting (7.9 acres); Bed Restoration (5.7 acres); Streambank (7,415 linear feet) [Total Habitat: 16.77 acres] | 9.6 | $22,085,000 | $29,795,000 | $19,366,750 | $10,428,250 | $22,690 | NYC Parks |
| Bronxville Lake | Emergent Wetland (0.86 acres); Forested Scrub/Shrub Wetland (2.49 acres); Invasives Removal/Native Planting (1.39 acres); Bed Restoration (0.65 acres); Sediment Forebay (0.3 acres) [Total Habitat: 5.69 acres] | 3.8 | $16,437,000 | $23,683,000 | $15,393,950 | $8,289,050 | $5,044 | Westchester County |
| Garth Woods - Harney Road | Emergent Wetland (0.82 acres); Wet Meadow (1.67 acres); Forested Scrub/Shrub Wetland (0.57 acres); Invasive Removal/ Native Planting (1.63 acres); Bed Restoration (2.19 acres); Streambank (200 linear feet) [Total Habitat: 6.88 acres] | 4.3 | $10,968,000 | $13,940,000 | $9,061,000 | $4,879,000 | $12,871 | Westchester County |
| | **Total:** | **47.1** | **$100,144,000** | **$128,150,000** | **$83,297,500** | **$44,852,500** | **$70,558** | |
| **Newark Bay, Hackensack River and Passaic River Planning Region** | | | | | | | | |
| Oak Island Yards | Low Marsh (5.32 acres); High Marsh (0.85 acres); Scrub/Shrub (0.44 acres); Maritime Forest (2.85 acres); Tidal Channel Restoration (1.36 acres) [Total Habitat: 10.82 acres] | 2.8 | $16,458,000 | $27,619,000 | $17,952,350 | $9,666,650 | $4,308 | NJDEP |
| Essex County Branch Brook Park | Emergent Wetland Creation (10.25 acres); Forested Scrub/Shrub Wetland (8.8 acres); Invasives Removal/Native Planting (8.91 acres); Bed Restoration (18.09 acres) [Total Habitat: 46.05 acres] | 26.9 | $55,164,000 | $80,406,000 | $52,263,900 | $28,142,100 | $7,864 | NJDEP |
| Metromedia Tract | Low Marsh (26.5 acres); High Marsh (11.7 acres); Scrub/Shrub (13.8 acres); Tidal Channel Restoration (2.79 acres); Shallows (6.51 acres) [Total Habitat: 61.3 acres] | 20.6 | $33,087,000 | $45,787,000 | $29,761,550 | $16,025,450 | $5,171 | NJDEP<br>NJSEA* |
| Meadowlark Marsh | Low Marsh (56.2 acres); High Marsh (6.5 acres); Scrub/Shrub (5.4 acres); Tidal Channel Restoration (4.6 acres) [Total Habitat: 72.7 acres] | 14.6 | $31,590,000 | $49,347,000 | $32,075,550 | $17,271,450 | $5,066 | NJDEP<br>NJSEA* |
| | **Total:** | **64.9** | **$136,299,000** | **$203,159,000** | **$132,053,350** | **$71,105,650** | **$22,409** | |

| HUDSON RARITAN ESTUARY ECOSYSTEM RESTORATION RECOMMENDED PLAN (FY2022 Price Levels) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Site** | **Proposed Habitat Types and Actions (Acres/Linear Feet/Miles)** | **Net Ecological Output (AAFCU/AAHU)** | **First Costs ($)** | **Fully Funded Cost ($)** | | | **Annual OMRR&R Cost ($)** | **Sponsor** |
| | | | | **Total ($)** | **Federal** | **Non-Federal** | | |
| **Oyster Reef Restoration (Multiple Planning Regions)** | | | | | | | | |
| Naval Weapons Station Earle | Oyster restoration with oyster castles, shell and gabions (10.0 acres) | 9.6 | $9,057,000 | $10,999,000 | $7,149,350 | $3,849,650 | $8,334 | NJDEP<br>NY/NJ Baykeeper* |
| Bush Terminal | Oyster restoration with spat on shell, oyster castles and gabions (31.9 acres) | 19.5 | $7,376,000 | $10,113,000 | $6,573,450 | $3,539,550 | $10,107 | NYC Parks<br>NY Harbor School* |
| Head of Jamaica Bay | Oyster restoration with spat on shell and gabions (10.1 acres) | 5.2 | $6,047,000 | $7,725,000 | $5,021,250 | $2,703,750 | $11,911 | NYCDEP |
| | **Total:** | **34.3** | **$22,480,000** | **$28,837,000** | **$18,744,050** | **$10,092,950** | **$30,352** | |
| **HRE Program Summary** | | | | | | | | |
| **Jamaica Bay Planning Region: Perimeter Sites** | Low Marsh (35.1 acres); High Marsh (9.8 acres); Scrub/Shrub (9.8 acres); Maritime Forest/Upland (18.7 acres); Tidal Channels (2.31 acres) and Bed/Channel (45.08 acres)[Total Habitat Restoration: 120.79 acres] | 67.2 | $79,517,000 | $120,248,000 | $78,161,200 | $42,086,800 | $9,627 | NYSDEC<br>NYCDEP |
| **Jamaica Bay Planning Region: Marsh Islands** | Low Marsh (95.4 acres); High Marsh (57.71 acres); Shrub/Scrub (16.99 acres); Tidal Channel Restoration (4.73 acres); Shallows (30.83 acres) Using 1,329,665 CY of dredged material [Total Habitat Restoration: 205.66 acres] | 127.8 | $112,767,000 | $164,228,000 | $106,748,200 | $57,479,800 | $23,075 | NYCDEP |
| **Harlem River, East River Western Long Island Sound Planning Region** | Low Marsh (9.76 acres); High Marsh (2.47 acres); Scrub/Shrub (1.8 acres); Maritime Forest (3.89 acres); Shallows (1.37 acres); Emergent Wetland (4.91 acres); Wet Meadow (1.67 acres); Forested Scrub/Shrub (4.64 acres); Invasive Removal/Native Planting (11.37 acres); Bed Restoration (9.04 acres); Sediment Forebay (0.30 acres); Fishway Opening (23.70 miles opened); Streambank (8,365 linear feet) [Total Habitat Restoration: 51.22 acres] | 47.1 | $100,144,000 | $128,150,000 | $83,297,500 | $44,852,500 | $70,558 | NYCDEP<br>NYC Parks<br>Westchester County Planning |
| **Newark Bay, Hackensack River, and Passaic River Planning Region** | Low Marsh (88.02 acres); High Marsh (19.05 acres); Scrub/Shrub (19.64 acres); Maritime Forest (2.85 acres); Tidal Channel Restoration (8.75 acres); Shallows (6.51 acres); Emergent Wetland (10.25 acres); Invasive Removal/Native Planting (8.91 acres); Forested Scrub/Shrub (8.8 acres); Bed Restoration (18.09 acres) [Total Habitat Restoration: 191.57 acres] | 64.9 | $136,299,000 | $203,159,000 | $132,053,350 | $71,105,650 | $22,409 | NJDEP<br>NJSEA* |
| **Oyster Reef Restoration** | Oyster restoration using spat on shell, gabions, oyster castles or shell [Total Habitat: 52.0 acres] | 34.3 | $22,480,000 | $28,837,000 | $18,744,050 | $10,092,950 | $30,352 | NJDEP<br>NYC Parks<br>NY/NJ Baykeeper"<br>NY Harbor School* |

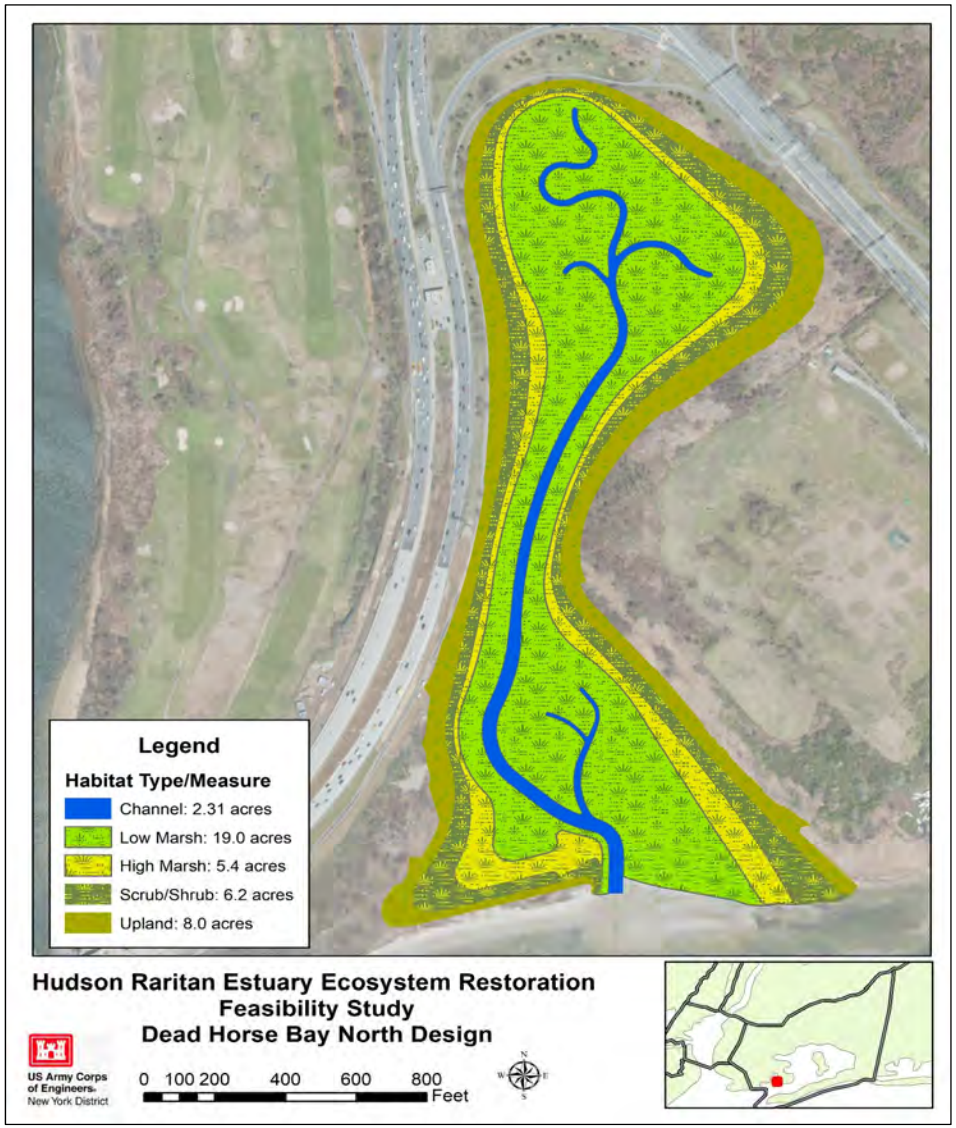
| HUDSON RARITAN ESTUARY ECOSYSTEM RESTORATION RECOMMENDED PLAN (FY2022 Price Levels) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Proposed Habitat Types and Actions (Acres/Linear Feet/Miles) | Net Ecological Output (AAFCU/AAHU) | First Costs ($) | Fully Funded Cost ($) | | | Annual OMRR&R Cost ($) | Sponsor |
| | | | | Total ($) | Federal | Non-Federal | | |
| All Sites | Low Marsh (228.28 acres); High Marsh (89.03 acres); Scrub/Shrub (48.23 acres); Maritime Forest/Upland (25.44 acres); Emergent Wetland (15.16 acres); Shallows (38.71 acres); Wet Meadow (1.67 acres); Forested Scrub/Shrub (13.44 acres); Invasive Removal/Native Planting (20.28 acres); Tidal Channels (15.79); Channel/Bed Restoration (72.21 acres); Sediment Forebay (0.3 acres); Bank Stabilization (8,365 linear feet); Fish Passage (23.7 miles opened); Oyster Reef (52 acres) [Total Habitat Restored: 620.54 acres] | 341.3 | $451,207,000 | $644,622,000 | $419,004,300 | $225,617,700 | $156,021 | All |

Initiation of Pre-construction Engineering and Design Phase in FY22

* Construction Partner

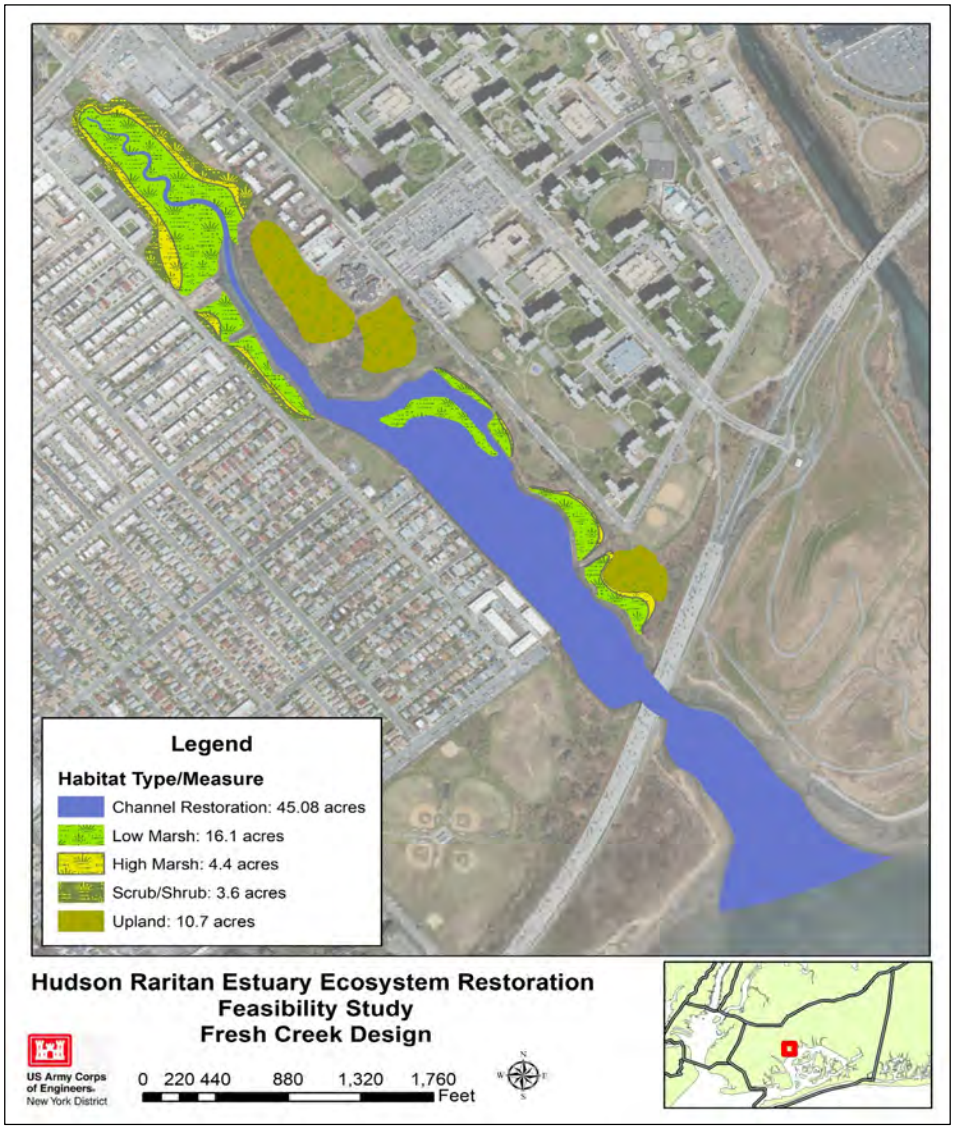
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Jamaica Bay Perimeter Sites

## Dead Horse Bay




40.91 acres of Habitat Restoration

## Fresh Creek



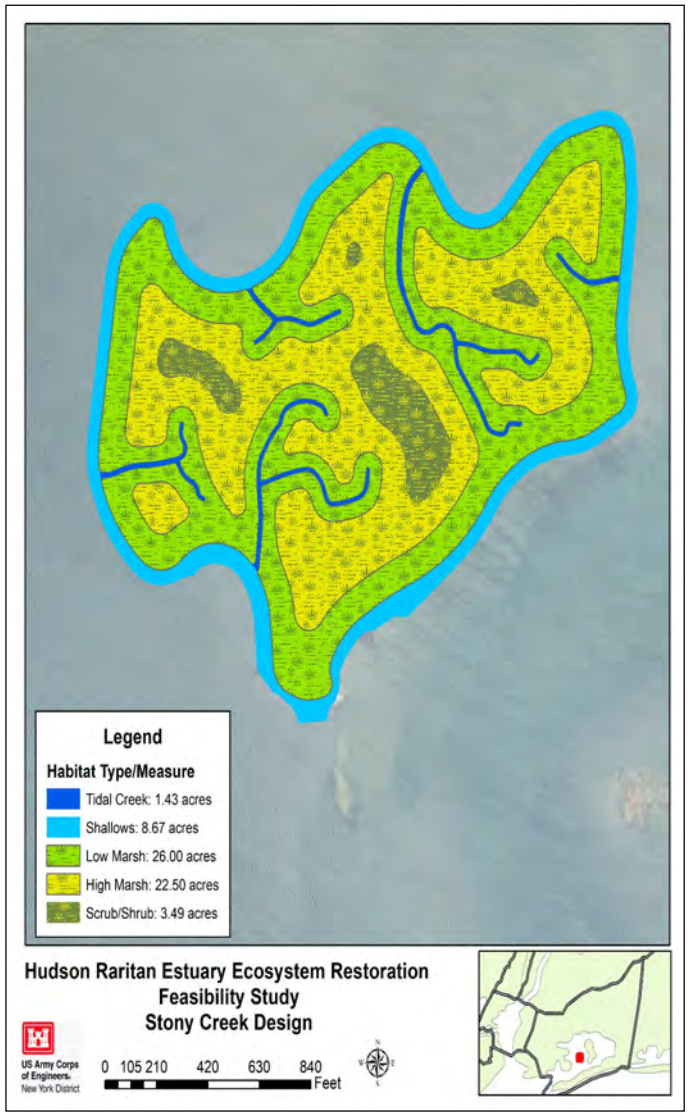

79.88 acres of Habitat Restoration

# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Jamaica Bay Marsh Island Sites

## Duck Point

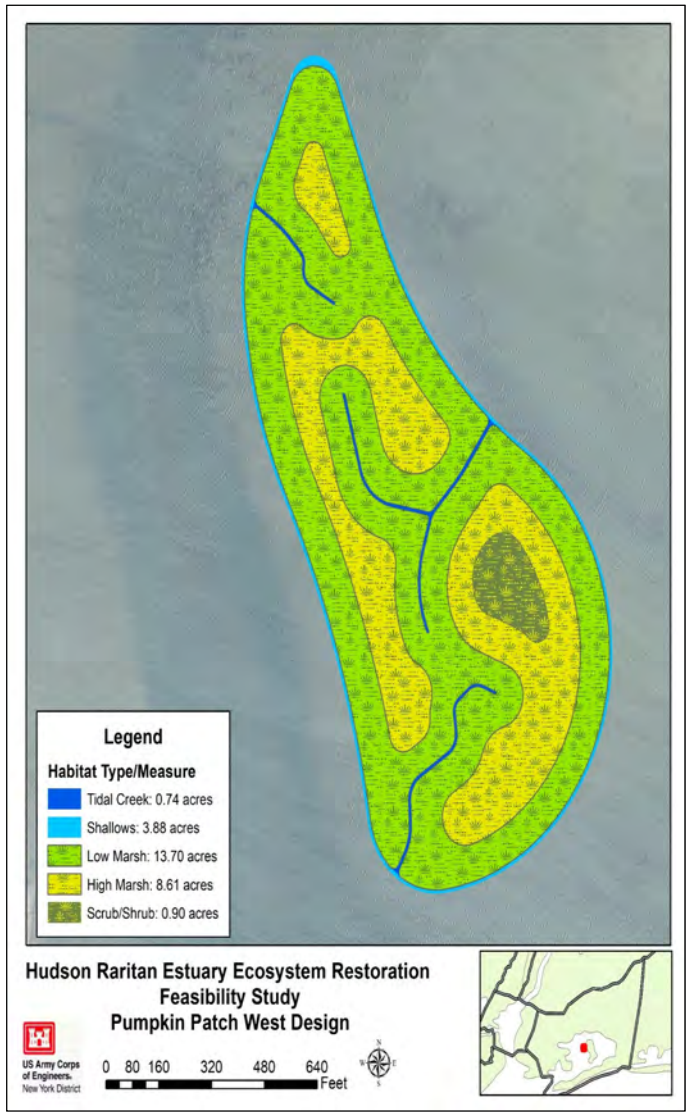

39.63 acres of Habitat Restoration using
213,776 CY of dredged material

## Stony Creek




62.1 acres of Habitat Restoration using
151,360 CY of dredged material

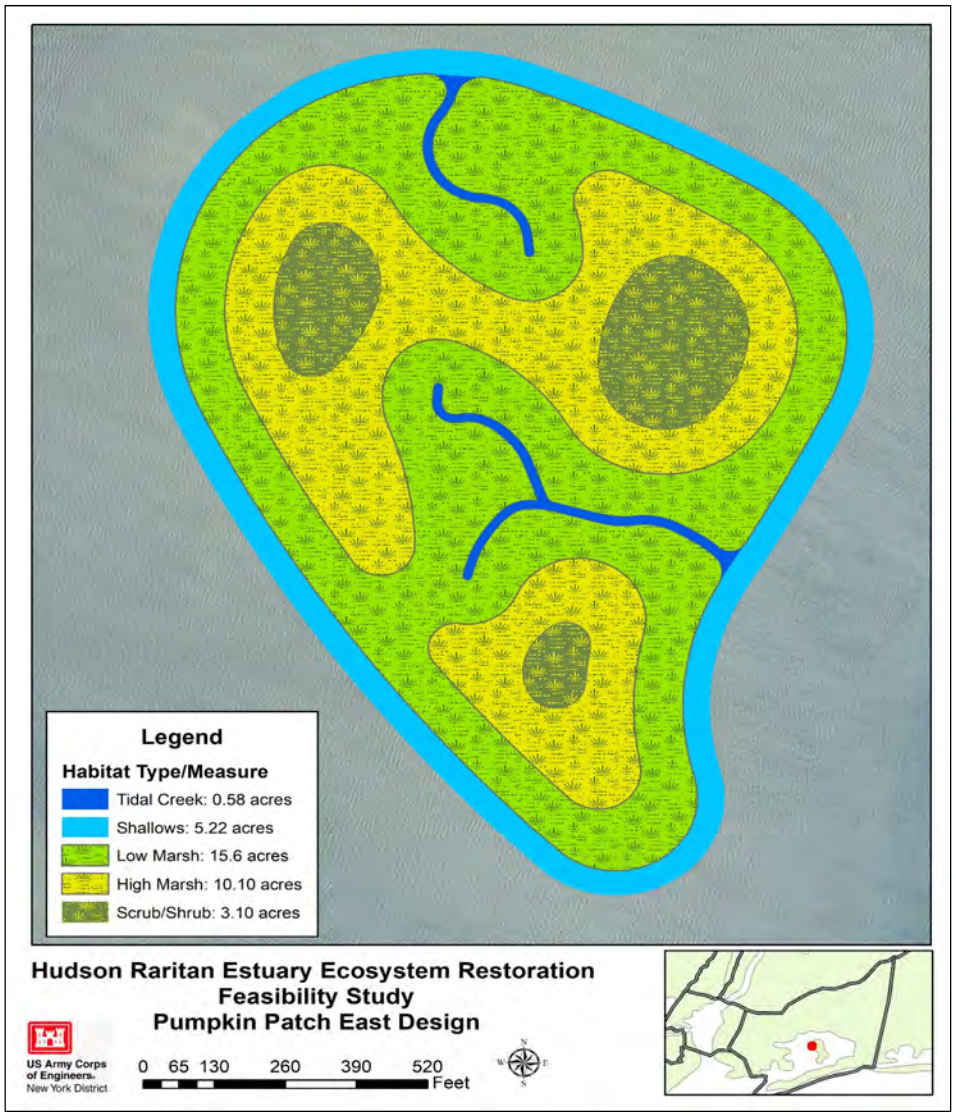
## Pumpkin Patch West




23.95 acres of Habitat Restoration using
327,686 CY of dredged material

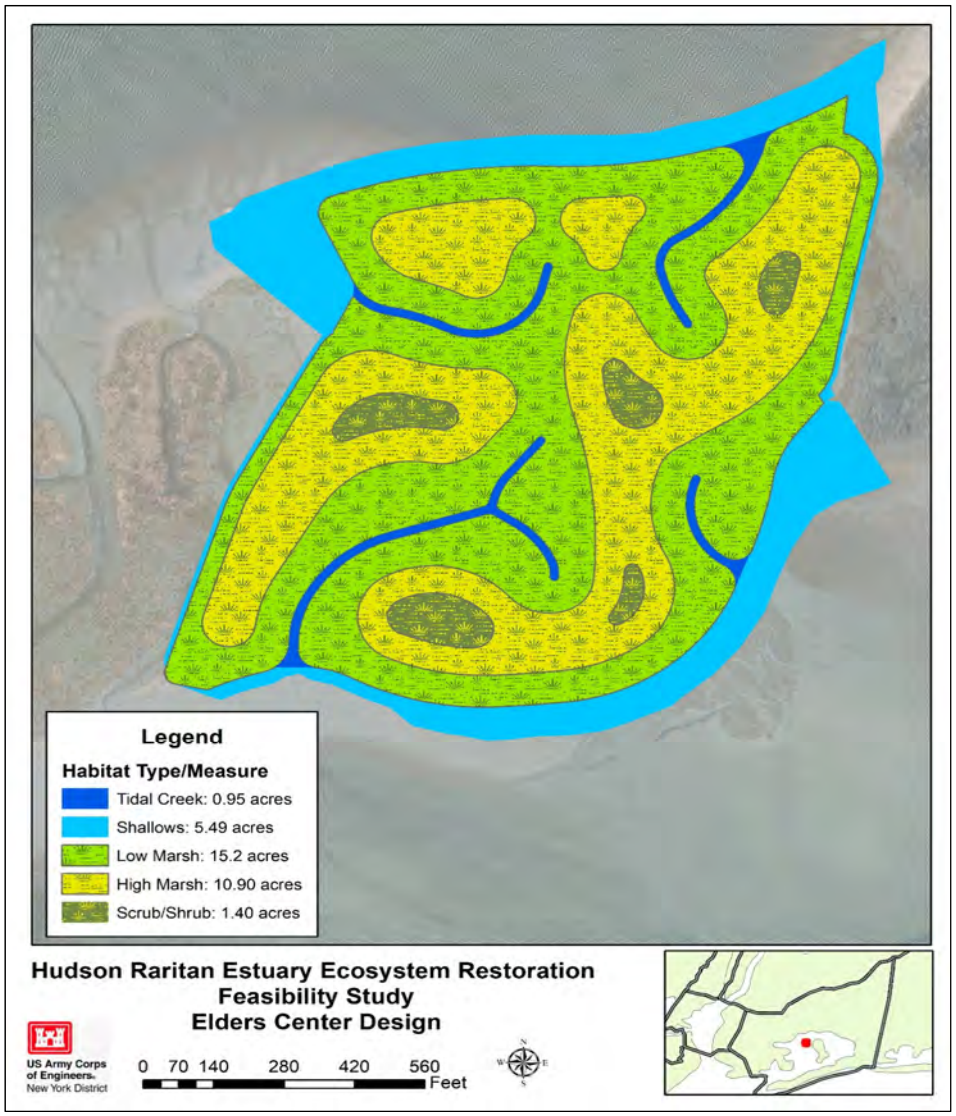
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Jamaica Bay Marsh Island Sites

## Pumpkin Patch East




29.38 acres of Habitat Restoration using 351,952 CY of dredged material

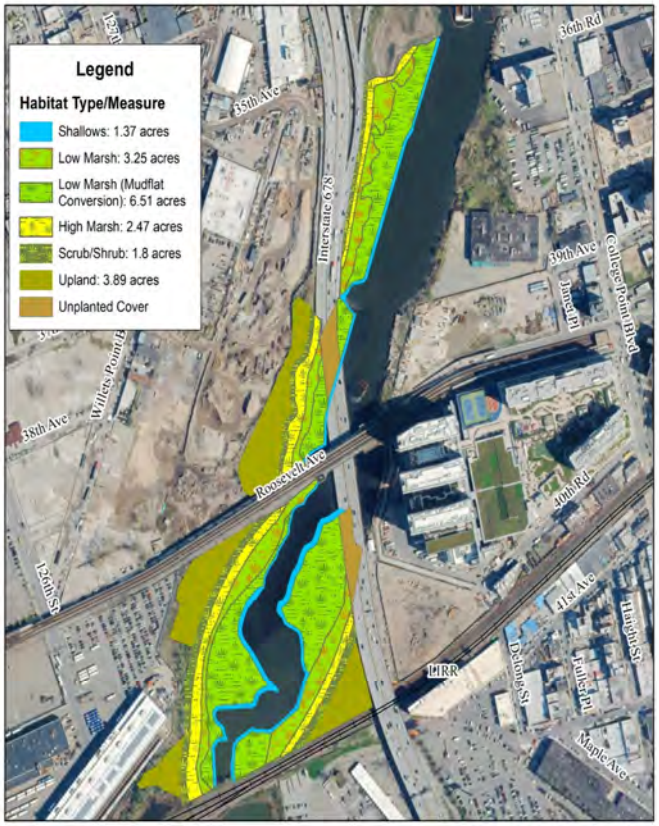
## Elders Center




28.45 acres of Habitat Restoration using 284,891 CY of dredged material

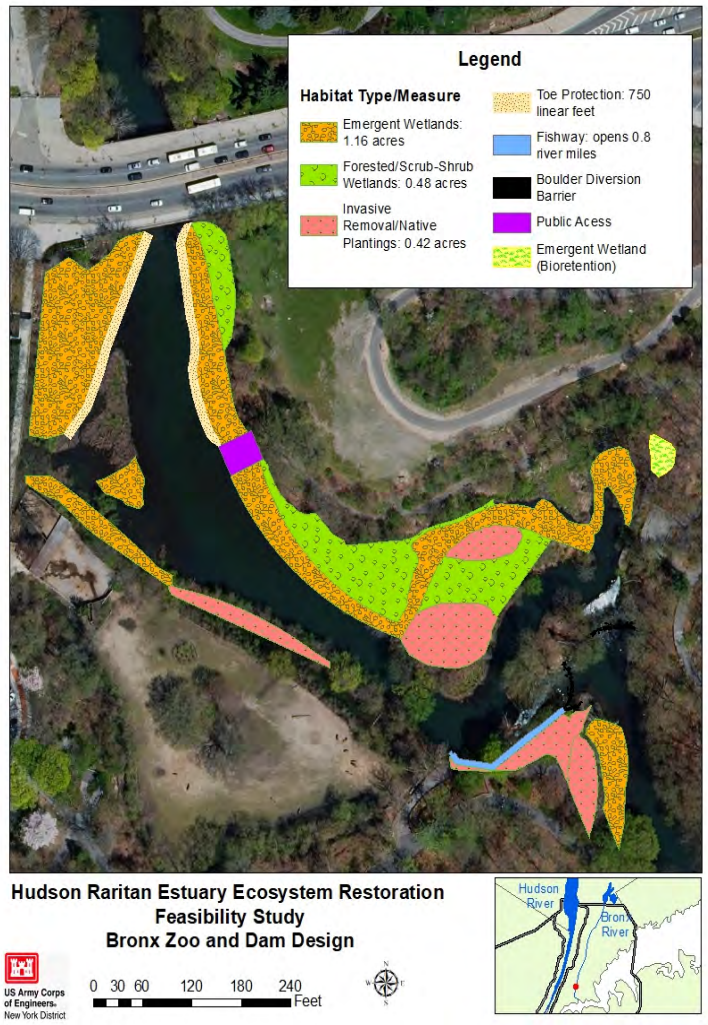
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Flushing Creek and Bronx River Sites

## Flushing Creek



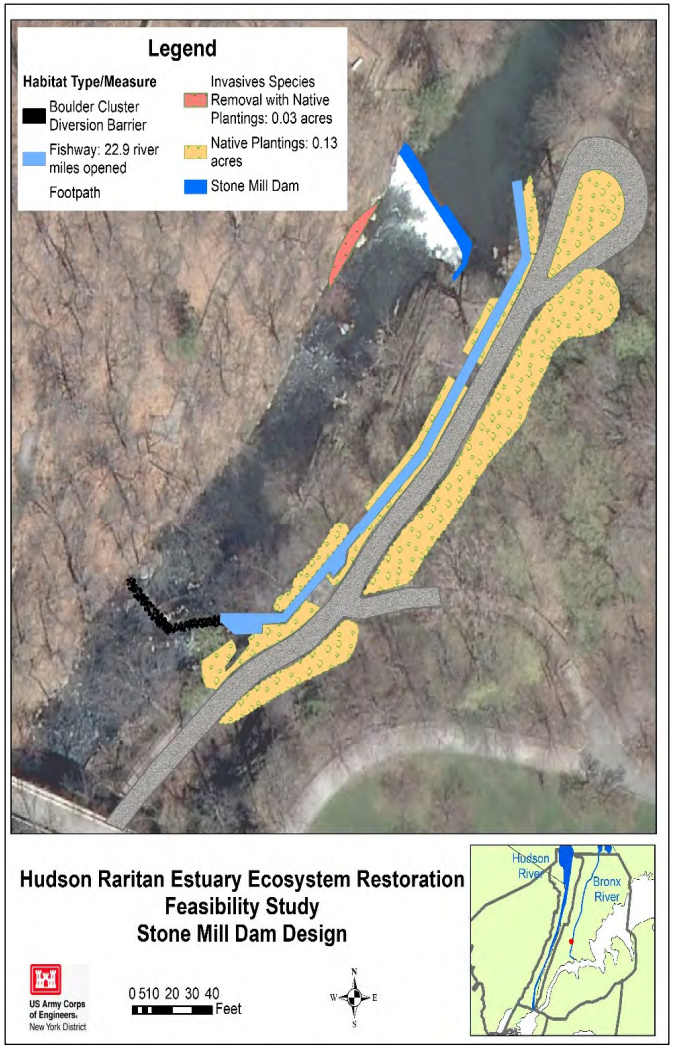

19.29 acres of Habitat Restoration

## Bronx Zoo and Dam




2.15 acres of Habitat Restoration;
0.8 River Miles Opened

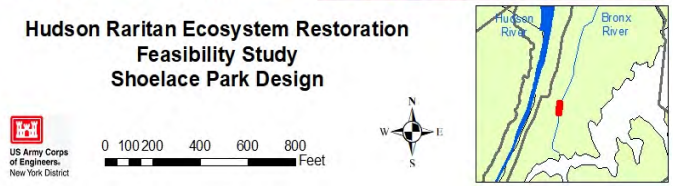
## Stone Mill Dam




0.53 acres of Habitat Restoration
~7 River Miles Opened

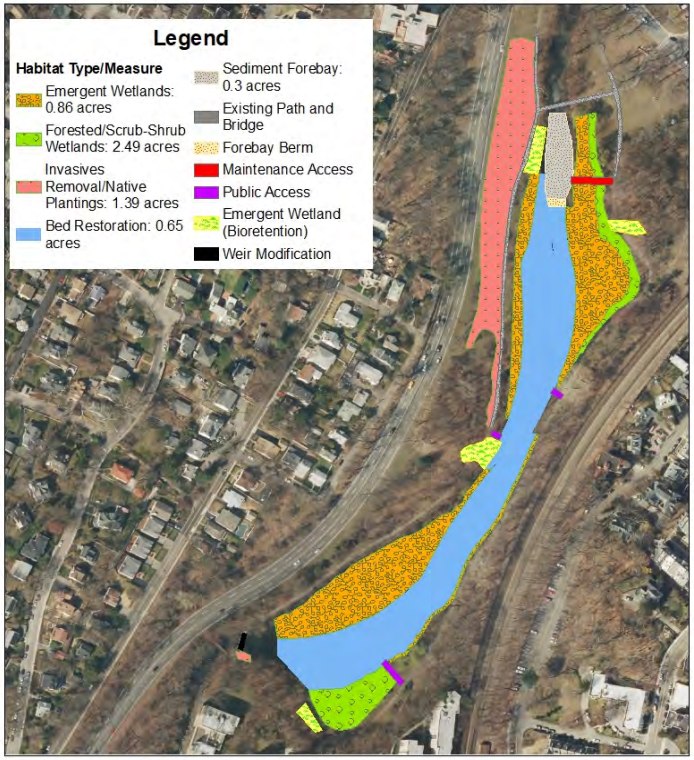
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Flushing Creek and Bronx River Sites

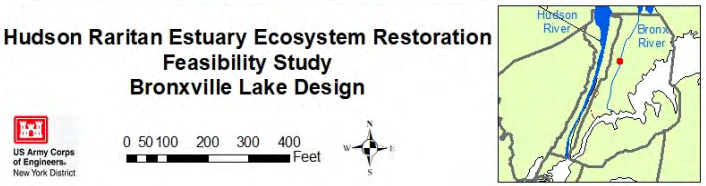
## Shoelace Park


16.77 acres of Habitat Restoration

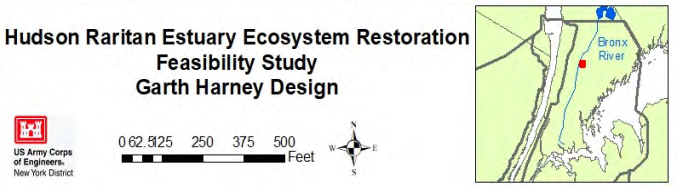
## Bronxville Lake




5.69 acres of Habitat Restoration

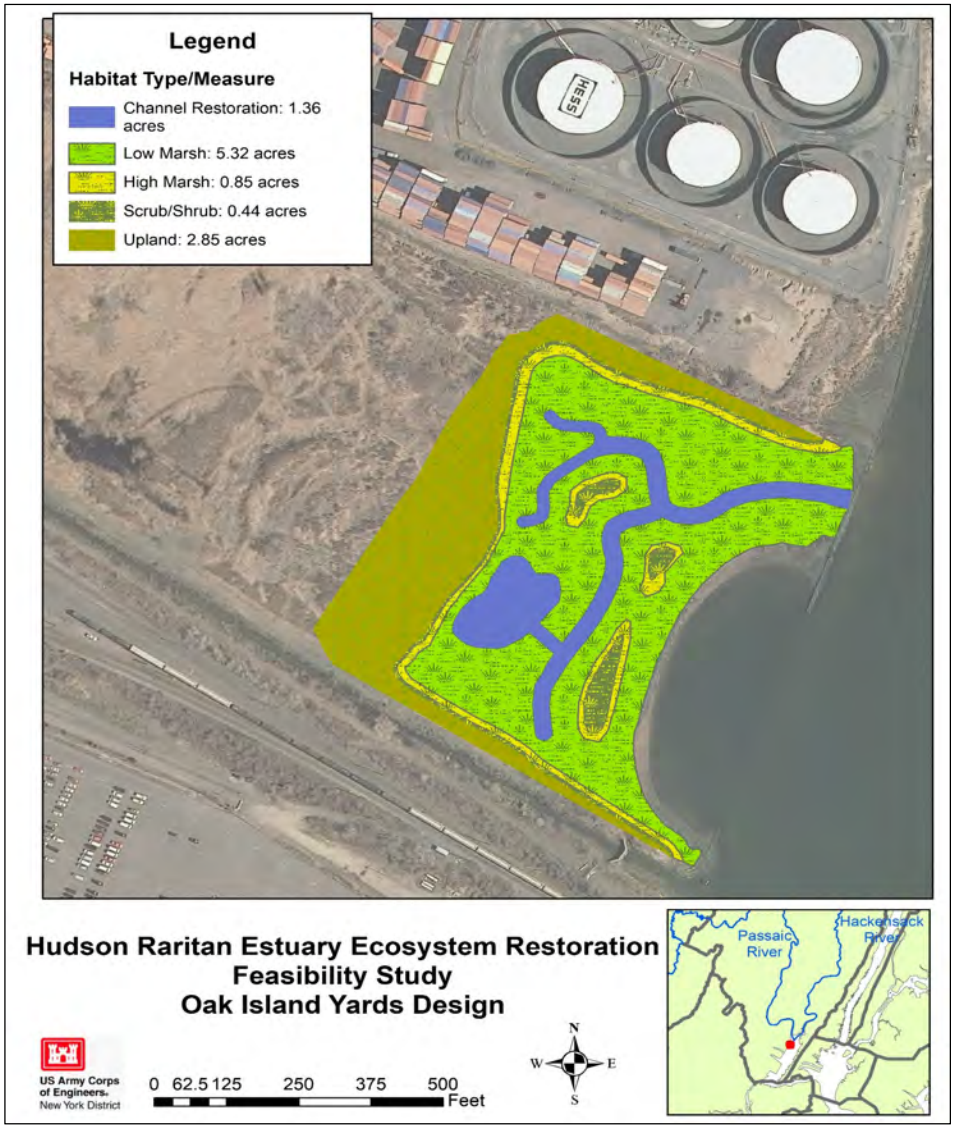
## Garth Woods – Harney Road


6.88 acres of Habitat Restoration

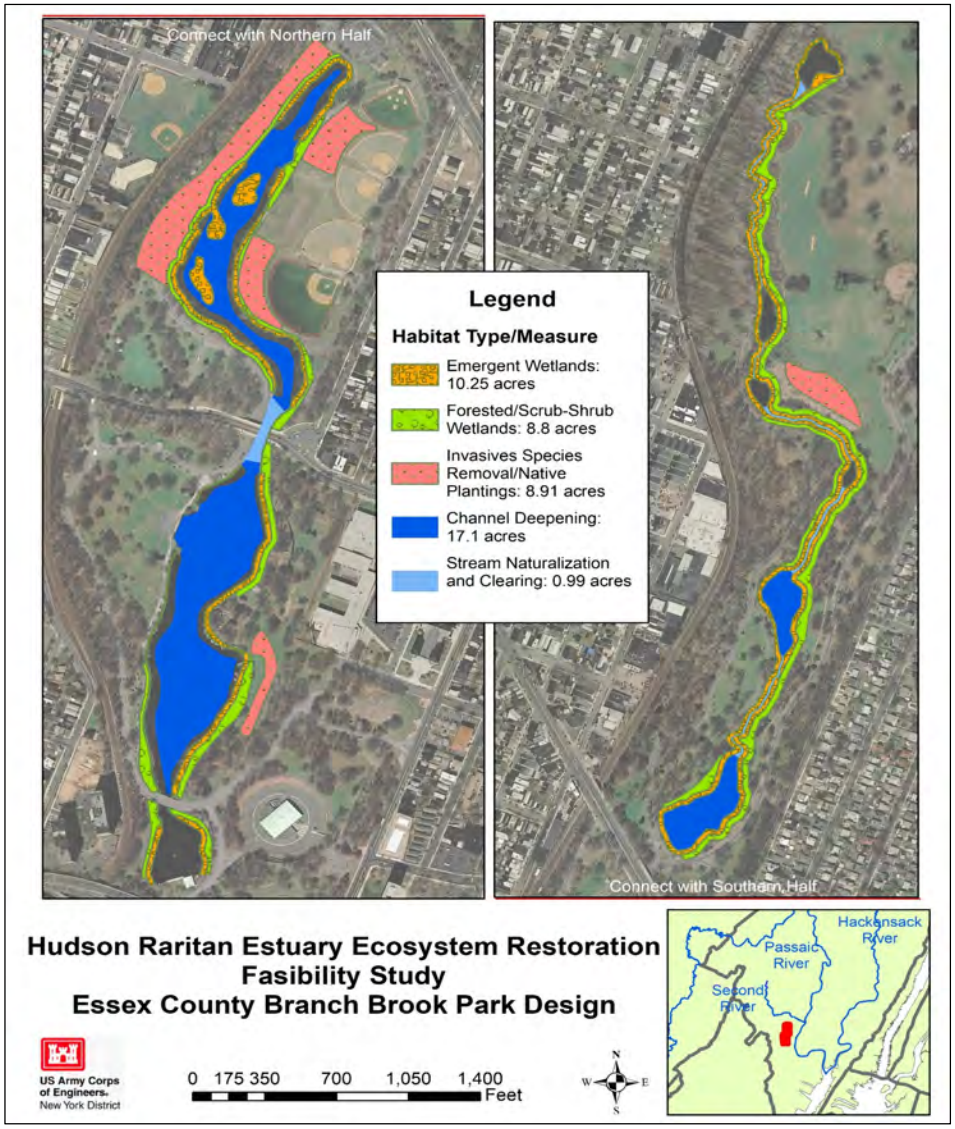
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Lower Passaic Sites

## Oak Island Yards




10.82 acres of Habitat Restoration

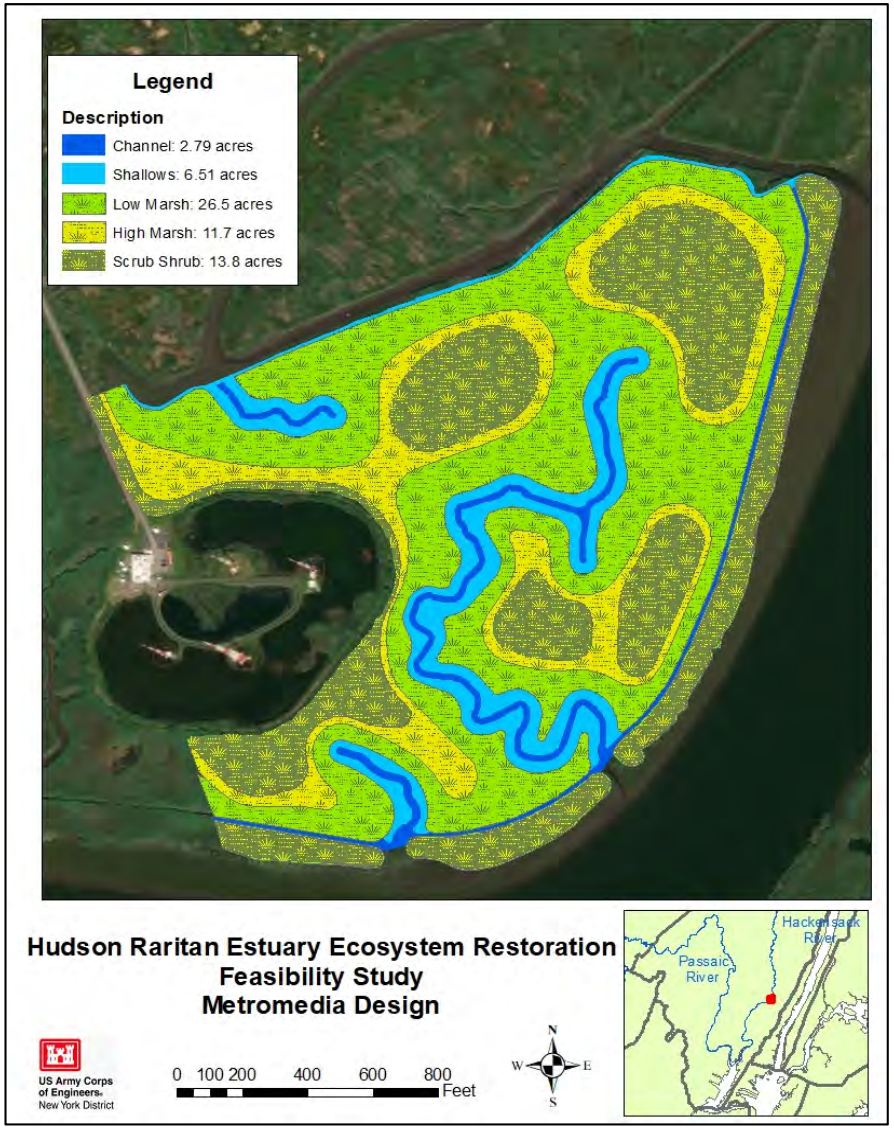
## Essex County Branch Brook Park




46.05 acres of Habitat Restoration

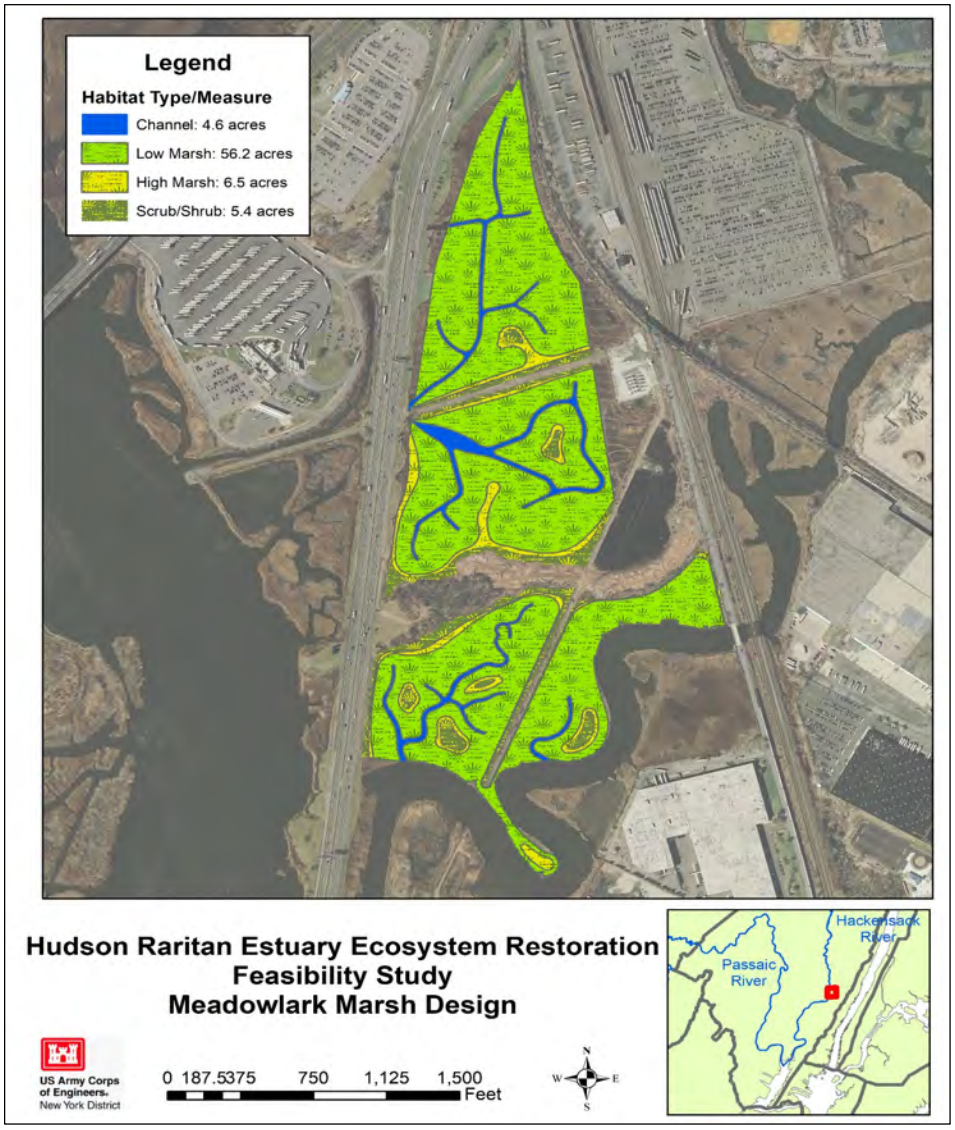
# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Hackensack River Sites

## Metromedia Tract




61.3 acres of Habitat Restoration

## Meadowlark Marsh




72.7 acres of Habitat Restoration

# Hudson Raritan Estuary Ecosystem Restoration Recommended Plan – Oyster Reef Restoration Sites

## Naval Weapons Station Earle


Restoration of 10 acres using Gabions and Oyster Pyramids

## Bush Terminal


Restoration of 31.9 acres using Spat on Shell and Gabions

## Head of Bay


Restoration of 10.1 acres using Gabions, Hanging Super Trays, Oyster Pyramids and Spat on Shell