

ON THE WATER

PALISADE BAY

Guy Nordenson
Catherine Seavitt
Adam Yarinsky

with

Stephen Cassell
Lizzie Hodges
Marianne Koch
James Smith
Michael Tantala
Rebecca Veit

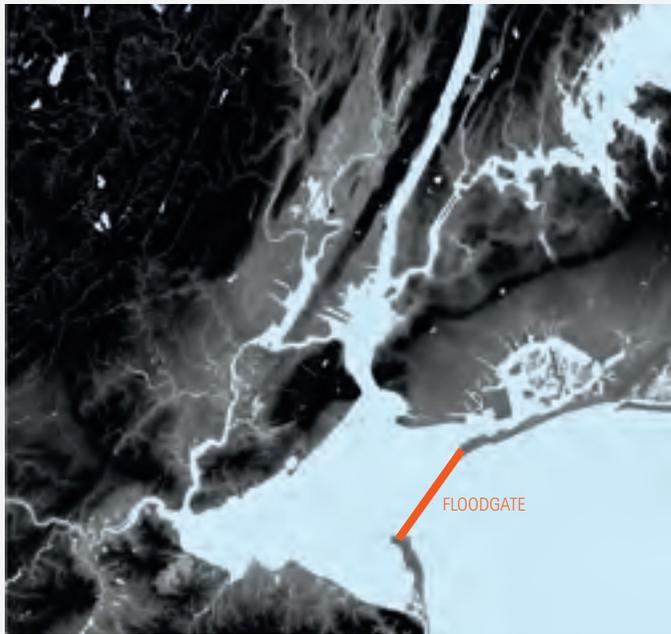
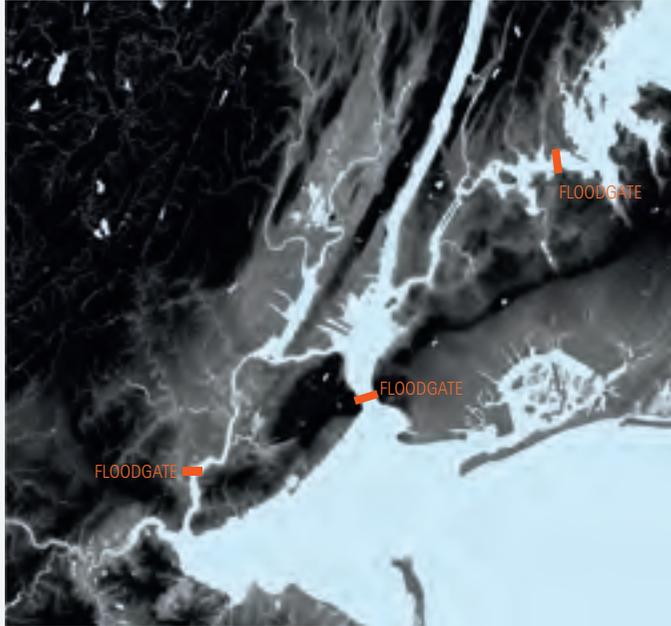
Foreword by Michael Oppenheimer
Afterword by Barry Bergdoll

**HATJE
CANTZ**

MoMA

PRINCETON UNIVERSITY
SCHOOL OF ARCHITECTURE

Center for
Architecture,
Urbanism
+ Infrastructure



Two possible locations for storm surge barriers

Opposite
Historical North Atlantic Hurricane Tracks

PALISADE BAY

The Palisade Bay proposal reinvents the Upper Bay as the central gathering place for the region. The proposal implements a series of “soft infrastructure” strategies to alternatively buffer or absorb flooding, while also creating a new destination on the water.

RESILIENCE

Approaching the design for the Upper Bay requires an overall strategy which satisfies both the need to protect the region from storm surge and also introduces a new program within the harbor and along its edge. Considering this two-fold criteria led to a new kind of infrastructure—soft infrastructure—that is dispersed throughout the region and implemented by combining natural and artificial landscape elements to provide new ground to eroded areas, remediation to polluted areas, and protection to areas at high risk of storm surge damage. By using the techniques of landscape design, instead of building fortified edges, we can layer programs such as housing and parks, or fresh water storage and urban farms to create activities and destinations within the revitalized harbor zone. A comprehensive harbor transportation system is necessary to facilitate mobility between these new destinations and define this harbor as the center of the New York/New Jersey urban region.

The notion of building a single, massive structure to prevent storm surge—such as in London, Venice (forthcoming), and Rotterdam—is an obvious solution for mitigating storm damage. Malcolm C. Bowman and his colleagues have proposed such a system of storm surge gates to handle the expected consequences of climate change in the Upper Bay. These barriers would be located in three strategic places: at the Narrows, the mouth of the Arthur Kill, and at the upper end of the East River where it meets the Long Island Sound. However, there are unanswered questions regarding the effectiveness of such structures, the degree of flooding on the weather-side of the structures, and the protection provided by partial blockage barriers at certain locations. In theory, the barriers would be closed for just a few hours during hurricane surges, and for several days during high tides in the case of a nor'easter event.¹⁸ A similar solution would be to build a storm gate outside of the harbor along the New York Bight, which is the gulf formed by the geographical indentation of New Jersey and Long Island along the Eastern Seaboard. Placing a flood gate here would prevent surge from severe storms just off the coast from entering the harbor region.

Simply cutting off the flow of water into the bay when such a gate is closed is appealing in some respects because the water basin is controlled to a specific design capacity. While massive storm blockades are invariably expensive to build, they are also manageable construction projects with clear boundaries and extents. The risk of such an



Major Storm Tracks
New York /New Jersey Region



Waterborne shipping traffic routes through the Upper Bay

Shoals and flats in the Upper Bay

Opposite

Exploded axonometric showing elevation relationships between new design components and existing topography and bathymetry

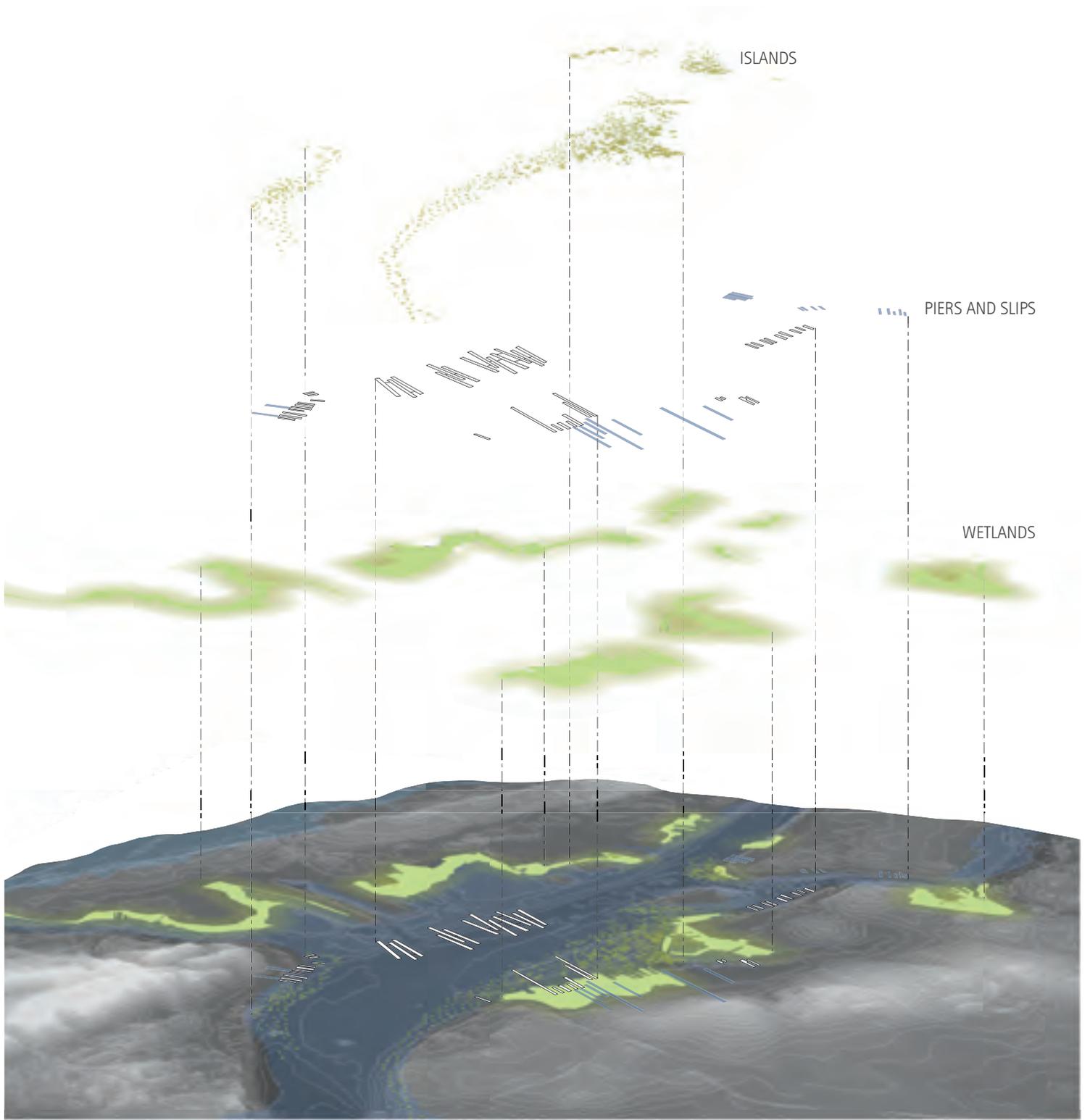
approach is the unpredictable disturbance a massive infrastructure might have upon the existing estuarine ecosystems both locally and regionally. It is also a great risk to rely on a single defense system to prevent damage from a natural disaster; the failure of the levees in New Orleans after Hurricane Katrina is clear evidence of the devastation which can result from positioning a city against nature in this way.

By implementing a defense strategy that consists of soft infrastructure, the city becomes a place that is resilient to, rather than fortified against, the impact of natural disasters. The components of this soft infrastructure are clusters of constructed islands within the harbor, restored piers in addition to new elongated piers along the southeast and southwest coasts, and constructed wetlands along the harbor perimeter. By combining these elements throughout the harbor in various ways to suit the distinct urban and geographical conditions of a particular site, new places for wildlife, recreation, and industry emerge from the existing harbor area.

MOVEMENT CORRIDORS AND CONSTRAINTS

Maritime traffic in the Upper Bay includes recreational sailboats, the Staten Island Ferry, and industrial container ships. While container shipping has predominantly been relocated from the piers of the Upper Bay to the Port Elizabeth Marine Terminal, massive container ships still need to travel through The Narrows and along the Kill Van Kull to reach these ports. Other ports in Red Hook, Brooklyn are the destination of large cruise ships, as well as container ships operated by American Stevedoring Incorporated. Thus, it is necessary to maintain deep channels in the harbor to accommodate the passage of large ships along specific pathways. These paths are maintained by a dredging process executed by the Army Corps of Engineers.

Adjacent to these corridors are zones of shallow shoals and flats. These areas have not been dredged and thus could be built up with artificial islands, reefs, and wetlands. Roughening these shoals with additive landforms would contribute to curbing the force of storm surge in the harbor.





Sunset Park, Brooklyn, existing condition 2006

Sunset Park, Brooklyn, a proposed future transformation

Opposite
Palisade Bay Master Plan

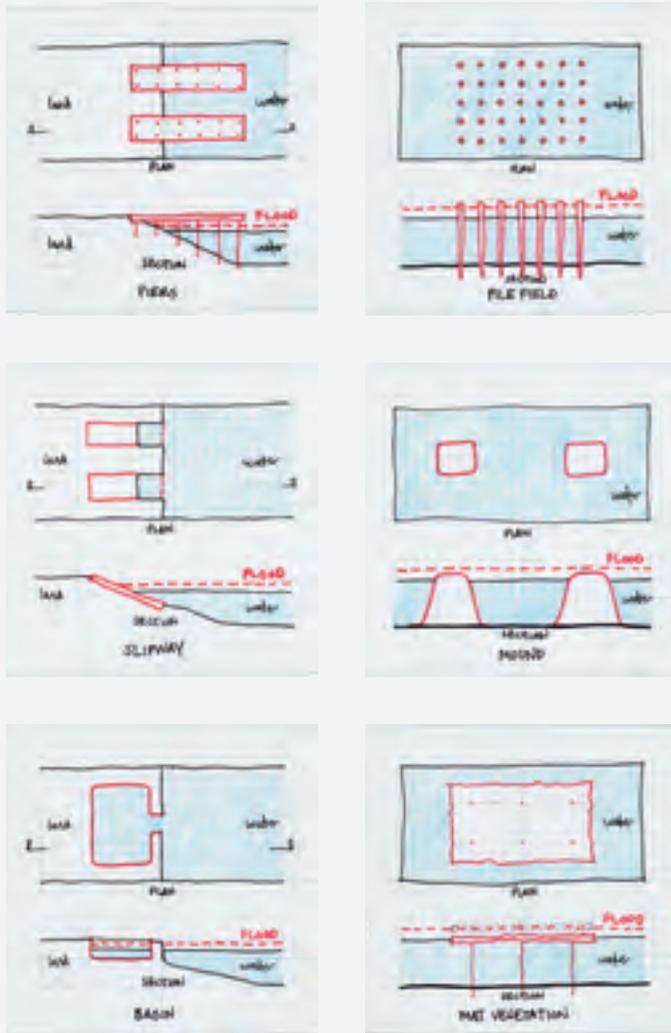
HERITAGE OF THE HARBOR

Transformation of the waterfront edge of the New York–New Jersey Harbor has occurred continually over hundreds of years. After the founding of the city in 1626, the edge was first altered by human intervention to accommodate landing ships. As the shipping industry developed, long piers extended along more and more edges to create a characteristic fingered waterfront edge. Over hundreds of years, the ecosystem of the harbor has come to coexist with the pier/slip typology—the shade provided below the piers, in fact, has become a valuable habitat for certain species of spawning fish and other benthic plants and animals. After the peak of the shipping industry in the New York Harbor this infrastructure has gone into disuse, but still contributes to local habitats by providing protected areas of still water and ecological refuge away from the dynamic current conditions in the harbor’s tributaries. As the city has grown to incorporate all of the landmasses surrounding the harbor, nearly the entire coastline has been fortified by a sea wall backfilled with earth. The edge is no longer a natural shoreline but rather a border zone of artificial lands which have been filled into the bay.

STRATEGIES FOR THE UPPER BAY

This project proposes a new infrastructural system for the Upper Bay with three main design elements: wetlands; piers and slips; and islands. These elements act alone and in conjunction with one another, and with a series of more isolated and smaller-scale interventions such as oyster beds and offshore windmills, to generate habitat, energy, and a sense of place that is the Upper Bay.





Catalogue of design strategies for the edges (left column) and the flats (right column)

Opposite

Palisade Bay, key to elements used in the masterplan

STRATEGY FOR THE EDGES AND THE FLATS

We see a potential design and planning strategy for the Upper Bay that would serve to remediate the harbor region ecologically; provide the potential for transit links and recreation; and mitigate both the effects of global warming induced flooding, as well as the forces of storm surges due to hurricanes and nor'easters. These design strategies would be implemented within two broad strategic categories, defined here as the edge and the flats. Various design strategies have been catalogued for possible interventions within each zone.

The Edges

The image of the Upper Bay found at the beginning of the Edge Atlas is a temporal overlay of a century of fluctuation along the water's edge, reflecting both the movement of the shoreline in and out, as well as the filling and dredging of the shallow-water flats. The edge is considered to be not just a line dividing water from land, but a zone of varying width. This edge surface expands and contracts between four abstract lines that historically circumscribe the entire Upper Bay: the pier-head line, the bulk-head line, the former coastline, and the extent of former wetland marsh. Our catalog of intervention strategies at the water's edge works with both additive and subtractive methodologies within that zone. The shoreline strategies presented here are deployed either perpendicular or parallel to the edge. Most of the perpendicular strategies have evolved from the shipping language of access—wharves, piers, and slips—whereas the parallel strategies tend to reflect protective natural or man-made conditions such as wetlands, mangroves, and reefs.

The Flats

The flats, sometimes called beds, middle ground shoals, or anchorages, are areas where the bathymetry of the underwater surface approaches the surface of the water. These shallow zones have historically been the site of shellfish beds and ship anchorages, and are often the foundations for landfill. This may be seen with Governors Island, Liberty State Park, and Ellis and Liberty Islands. In some areas, particularly the flats to the southwest of Red Hook and the mouth of the Gowanus Canal, the shoal has been accentuated due to the dredging of shipping channels around its perimeter. The catalog of intervention strategies at the flats examines various possibilities of the creation of "islands" at the surface or transformations of the underwater bathymetry. In both cases these strategies aim to serve as anchorages for the establishment of a new natural growth and habitat, as well as acting to absorb and mitigate wave energy within the bay.





Proposed wetlands in Palisade Bay occupy the lands within the FEMA-designated one-hundred-year flood zone.

Opposite

Mapping of original shoreline and marshes of Red Hook and the Gowanus Canal, overlaid on the existing street grid, 1875

View of Liberty State Park Nature Center, Jersey City, NJ, 2008

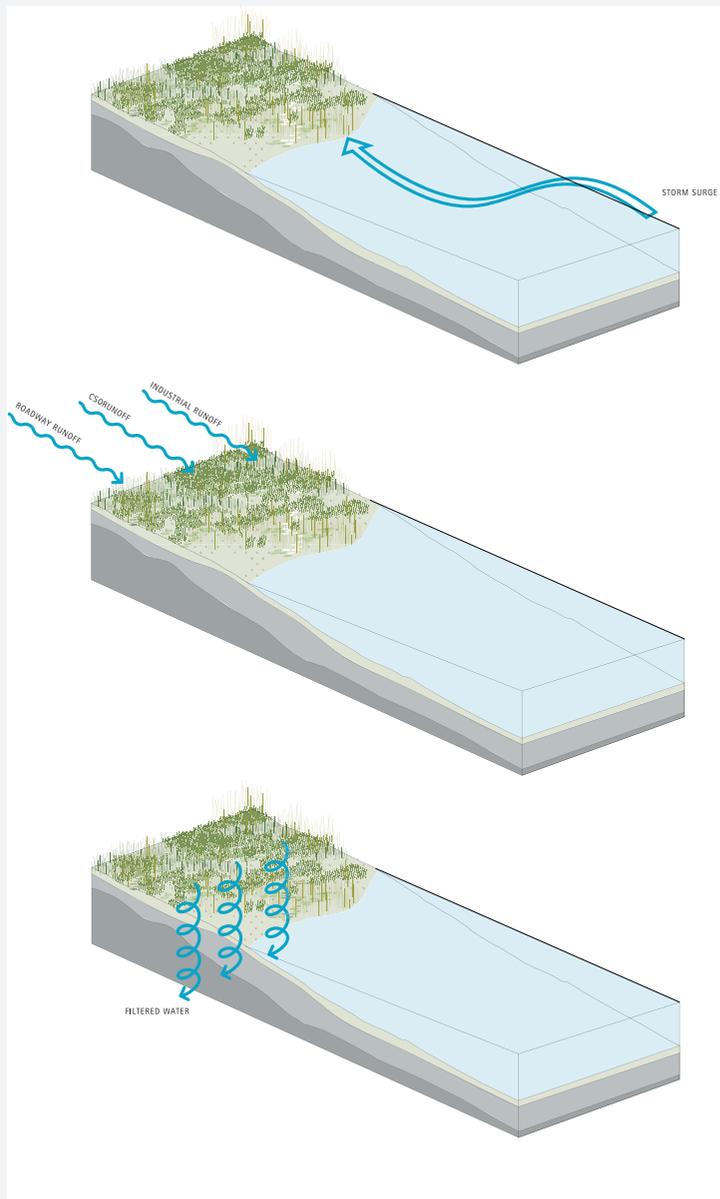
WETLANDS

Natural saltwater wetlands were once extensive along the waterfronts of Bayonne and Jersey City in New Jersey and Red Hook, Gowanus Canal, and Sunset Park in Brooklyn. As well as supporting the diverse habitat of the estuarine ecosystem, these wetlands also acted as biofilters, removing sediments from the water. Constructed wetlands are designed to emulate these natural features, by treating storm water runoff, wastewater, and pollutants. The use of constructed wetlands as an ecological infrastructure within the Upper Bay addresses several issues. These wetlands provide habitat to a diverse range of organisms; they provide visual interest and public space for leisure and recreation; and they act to filter polluted waters and remediate polluted lands.

ZONE OF IMPLEMENTATION

We propose an extensive implementation of constructed wetlands along the New Jersey and Brooklyn waterfronts, generally in locations which are most susceptible to flooding and sea level rise, and which were once the site of marshlands. The strategy of implementing wetlands along the edge of the Upper Bay creates a broad, soft fringe where city grid abuts the watery void, revealing tidal variations to the region's inhabitants. Blurring this land/water interface with the texture, plant life, and depth of the wetlands also provides a natural buffer that adjusts fluidly to flood events and sea level rise.





Wetlands serve to dampen storm surge, prevent polluted run-off water from contaminating harbor waters, and filter clean water to be reused as grey water.

Opposite

Hundreds of combined sewer outlets currently line the harbor edge (red circles). Only three major water treatment locations service the area (yellow circles).

FILTERING

The federal Clean Water Act of 1972 authorized the Environmental Protection Agency to begin a National Estuary Program to protect, preserve, and restore American estuaries. This radically transformed the New York-New Jersey Bay, as the Clean Water Act stipulated that sewage must be treated, and the water quality in the bay has since greatly improved. Before the Clean Water Act, the dumping of raw sewage into the bay had been unregulated and resulted in widespread illnesses such as typhoid as well as the loss of native wetlands.

Despite this legislative progress, the city's combined sewer infrastructure, which collects both raw sewage wastewater and storm water in the same pipes, is easily overwhelmed by storm water during moderate rains. As little as one-tenth of an inch of rainfall can trigger combined sewage overflow (CSO) outfalls, discharging raw sewage directly into the Upper Bay at 450 outlets along the shoreline.

New York City's PlaNYC 2030 has addressed the issue of combined sewage overflow outfalls through a "best management practice" strategy. This would harness natural strategies such as the implementation of permeable surfaces, bioswales, and green roofs that would help prevent stormwater from overwhelming the sewage system, by retaining, detaining, or cleansing the water.

But even more radical interventions at a much larger, infrastructural scale are necessary to return the estuary to a state of ecological health. A chain of constructed wetlands in the areas adjacent to the CSO outlets would filter contaminated water before it enters the main current of the harbor.





In the Palisade Bay Plan, historic piers are restored, new piers are added, and a series of parallel jetties are constructed on the edge of the shoals and between designated boat anchorages.

Opposite
Hudson and East Rivers from West 67th Street to Blackwells Island, New York, 1906 (detail)

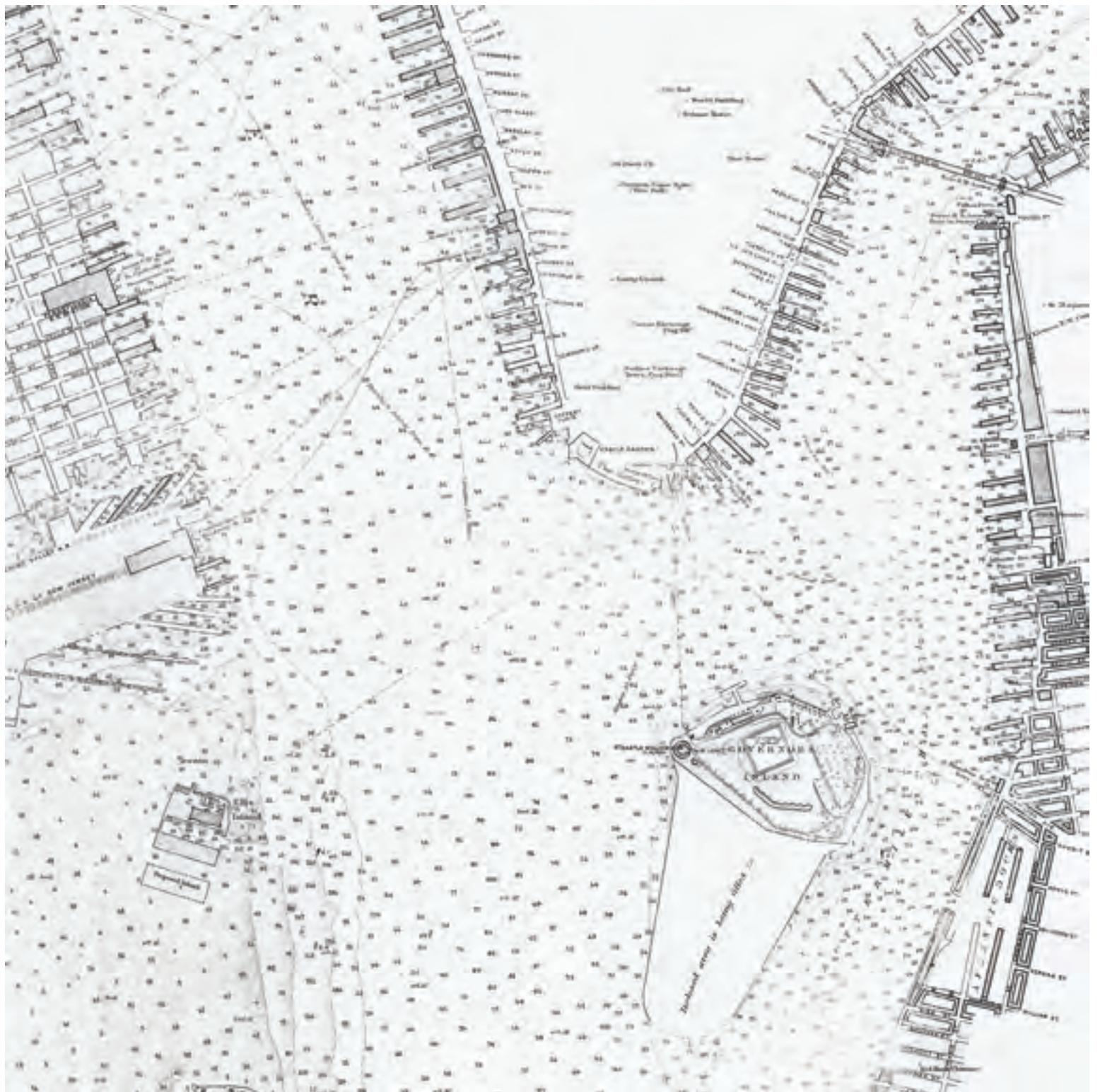
PIERS AND SLIPS

A pier is a raised walkway over water, supported by widely spread piles or pillars. This light structure allows tides and currents to flow almost unhindered below the pier. The solid foundations of a quay and closely-spaced piles of a wharf create the effect of a breakwater, more liable to silting but tending to reduce the intensity of wave action. Piers can range in size and complexity, from a simple lightweight wooden structure, to major structures extending over a mile out to sea. Finger piers extending perpendicular to the shoreline essentially maximize the available length of shoreline for ships to berth, allowing ships to dock and unload perpendicular to the shore. With the development of container shipping in the 1960s, finger piers became relatively obsolete for the handling of bulk cargo ships. A slip, sometimes called a slipway, is the conceptual inverse of a pier. It is an extraction into the land, a ramped sectional channel, rather than an extension outward from it. Slips are used to move ships or boats from the land to the water. Historically slips would be used as the location for building and repairing boats as well as launching newly constructed ships.

Transformation of the shoreline edge of the New York–New Jersey Upper Bay has occurred continually over hundreds of years. Since Henry Hudson sailed beyond the Narrows and up the Hudson River in 1609, the approach to the island of Manhattan and its surrounding landmasses has always been by way of the sea. After the founding of the city in 1626, the edge was first transformed to accommodate the landing of ships. It was transformed again to ward off both unwanted intruders and the encroachment of rising tides. This duality between accessibility and protection led to a sophisticated range of strategies that both mimic and suppress naturally existing conditions. An examination of the chronology of Manhattan's waterfront development reveals the long history of the region's characteristic fingered waterfront edge—the language of piers and slips.

WATERFRONT CHRONOLOGY

At the time of the 1624 purchase by Peter Minuit, the boundaries of Manhattan were defined as the perimeter of the high-water mark circumscribing the island. But with the 1686 Dongen Charter, which transferred ownership of the land from the British Crown to the City of New York, the city limits were extended from the high-water mark to the low-water mark. The city could thus fill and develop these tidal waterfront parcels, which were generally sold to private individuals. The owners were required to improve the street and wharf along the property's waterfront edge. Owners often expanded their land holdings outward with ship ballast, dredge spoils, and even garbage. Finger piers were extended at the ends of the perpendicular streets, and these docks were built out farther, steadily reducing the width of the





Construction of Pier 58, Chelsea Pier, North River, Manhattan, 1908

Aerial photograph of Red Hook, Brooklyn, ca. 1935

Opposite
Proposed wharfage, piers, and improved harbor front for the City of New York,
plate from *Knights New Mechanical Dictionary*, 1884

waterways. By 1856 the New York Harbor Commission recommended permanent pier and bulkhead lines, to be regulated by the State.

In 1870, the city established the Department of Docks, a municipal agency with exclusive control of all waterfront property—piers, slips, bulkheads, and pier sheds. Private ownership along the waterfront was effectively terminated. General George McClellan, who had lost his presidential bid in 1864 to Abraham Lincoln, was appointed chief engineer of the department. McClellan executed sanitary improvements as well as port facility improvements. At that time, piers were constructed on solid cribwork foundations, or with the block-and-bridge technique, creating a virtually solid rectangular barrier extending perpendicularly to the bulkhead. This led to still water zones between piers, gathering both sediment and raw sewage, emptying from the new duct outlets located at the ends of the city's east-west sewer lines. McClellan recommended the adoption of an open piling system of pier construction, consisting of supporting columns anchored several feet apart, driven into the river bottom and topped with a concrete or wood deck. This allowed the river currents and tides to pick up the sewer debris and sediment, push it through the pilings, and carry it out to the open sea.

Another significant transformation begun by McClellan was his plan to extend a new bulkhead line and establish a wider waterfront street at Manhattan's perimeter. The bulkhead was to be defined by a continuous solid precast concrete retaining wall faced in granite, rising six feet above the high-water line and descending twenty feet below. Beyond the bulkhead line, sixty to one hundred foot long piers were to be constructed to a newly established pier head line. This project for a continuous bulkhead was executed over an extended period, and substantially completed by 1879 under a subsequent chief engineer, George Greene Jr. In 1888, the Federal Rivers and Harbors Act was passed by Congress, establishing the United States Army Corps of Engineers as the agency with jurisdiction over pier head and bulkhead lines. Manhattan's bulkhead construction continued—by 1916, almost half of the island's entire waterfront perimeter was corseted by a massive seawall, extending over 100,000 linear feet.

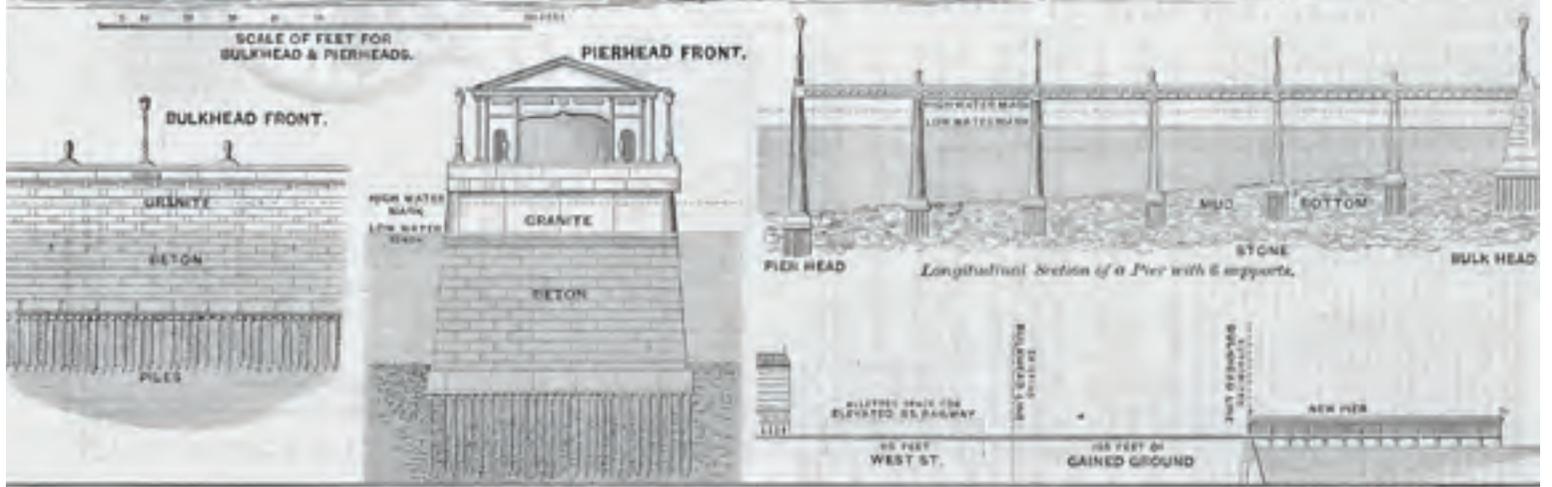
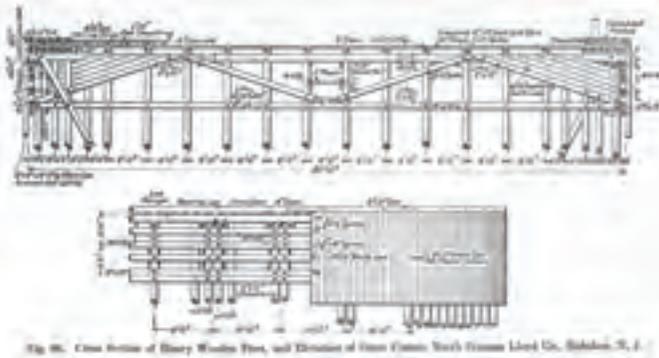


PLATE LXXV.

PROPOSED WHARFAGE, PIERS, AND IMPROVED HARBOR-FRONT FOR THE CITY OF NEW YORK.

See page 276.



Plan of the railroad terminus on the Military Ocean Terminal, Bayonne, NJ, 1965 (detail)

North German Lloyd Co., Hoboken, NJ, cross-section of heavy wooden piers and elevation of outer corner, 1917

Opposite

Collage view of a proposed slip in Sunset Park, Brooklyn

ZONE OF IMPLEMENTATION

As the city grew into the twentieth century, another form of shoreline transformation began, the strategy of further extension through landfill. The waterfront edge zone, between the bulkhead line and the pier head line, was often designated as an area for landfill and development. By contrast, our proposal for the Upper Bay returns to the feathered edge of fingers and slips, transforming the edge with the re-implementation of a fringe of piers. Our proposal implements these piers along the shorelines of Lower Manhattan, Brooklyn's Sunset Park, and Staten Island. This fringe will serve to disperse wave energy from storms as well as create a protective zone at the water's edge. By cutting slips back into the land, we address the issue of stormwater runoff, filtering this water with bioswales and permeable surfaces. We suggest potentially harvesting and reusing this filtered fresh water before letting it run into the saline bay; thus treating storm water as a resource, not a liability. Detached piers are also proposed along the anchorages offshore of the Jersey Flats, and we are investigating the potential of developing housing along these piers.

DETACHED PIERS

The detached piers that are proposed for the central region of the harbor are constructed from recycled and dredged earthen materials on a shallow shoal. These piers are oriented perpendicularly to the direction of waves as to diminish wave velocities that accelerate through the narrows, dispersing this energy within the basin before the waves impact the harbor edge. While the elongated form of the detached piers is essential to mitigating storm impact, these piers are intended to replicate the scale and organization of typical New York City blocks. Overlaid on the complex and transformative history of the harbor, it is easy to imagine that the fringed watery gap between the mainland and the detached piers had been gradually erased, leaving the piers a remnant of land. Most of all, the tradition of building places for industry and recreation on the New York piers is also carried forward in a new way.





The islands in the Palisade Bay Master Plan are arrayed in chains along the harbor shoals and flats.

Opposite
Archipelago of New Caledonia, 2001

ISLANDS

The etymology of the word island is rooted in the Old English, for (e)gland, meaning watery land. An island is defined as any emergent piece of land completely surrounded by water at high tide and isolated from other landmasses. An archipelago is a grouping of geographically and geologically related islands.

Many natural islands and reefs are found within the Upper Harbor of New York–New Jersey. Islands include Shooters Island, Ellis Island, Liberty Island, Governors Island, and of course Manhattan Island, all of which have been expanded with landfill. Flats and shoals include the Bay Ridge Flats, the Jersey Flats, the Gowanus Flats, Robbins Reef, and Diamond Reef. Many small islands and shoals that once emerged from the Upper Bay no longer exist, lost over the centuries to the blasting and dredging of navigational channels within the bay. Our proposal for the Upper Bay includes an extensive addition to the existing archipelago and underwater reefs of New York–New Jersey, above, below, and between the tidal fluctuations. In addition to providing an infrastructural field of obstructions to break up the wave energy generated by storm surges, these new artificial islands and reefs will also provide habitat for plants, invertebrates, fish, and birds, enriching the ecosystem, diversity, and health of the harbor.

ZONE OF IMPLEMENTATION

The unit of the archipelago of artificial islands that we are proposing is a circular module of approximately 80 feet in diameter. These will be arrayed in fields, in the shallowest bathymetric zones of the Upper Bay, particularly along the Bay Ridge and Gowanus Flats, along the southern shore of Governors Island, and below the southern tip of Manhattan. Some will also be arrayed along the northern edge of the Jersey Flats. Reef construction using decommissioned subway cars is proposed at the northern Jersey Flats and at Gravesend Bay, southeast of the Narrows.

By examining various arrays and forms for the islands, as well as hypothesizing the effects of current and silting, several construction possibilities for the islands have emerged: floating mesh supporting estuarine grasses, caisson perimeters with solid fill, caisson perimeters with permeable mesh walls, and solid islands versus ring-shaped atoll islands.

We propose to implement this transformation using both cost efficient and environmentally sound and sustainable methods. One potential strategy for achieving the desired bathymetric changes is the use of clean dredge spoils from current and future dredging projects. The Harbor Deepening Project, the largest such undertaking for the Port of New York and New Jersey, will make available an





Mad'an Reed House, Iraq, 2008

Opposite

Elevation and section of caisson fortification at Cherbourg, France, 1782–83

estimated 40 million cubic yards of dredged material. Habitat restoration and environmental improvement, in conjunction with dredging projects, is a mutually beneficial endeavor.

Costs and feasibility for the use of dredge material in the creation of caisson island fill, mudflats and dredged rock reef construction are promising. Likewise, the use of recycled materials such as decommissioned subway cars to create artificial reefs has proven economical and successful on other waterfronts. Other possibilities for fill material include clean garbage and construction debris, as well as the enormous volume of earth and rock that may be excavated for future subway tunnel construction.

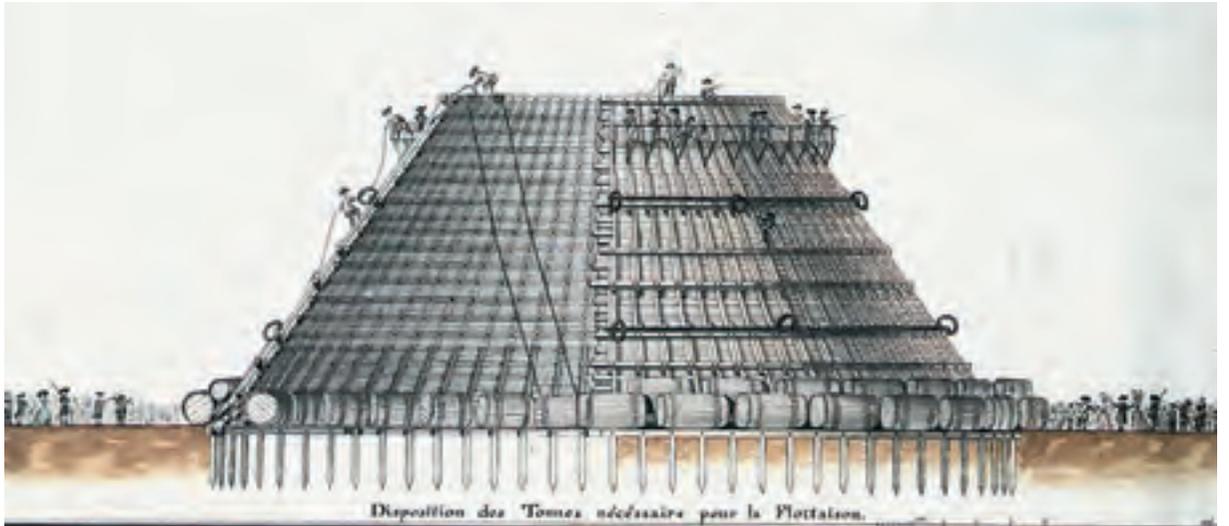
ANCIENT ARTIFICIAL ISLANDS

Artificial islands are formed by humans rather than through natural means. They have a long history, despite the current trend of highly artificial islands created as real estate in the Middle East. Historically, there were two types of artificial islands: wooden or stone structures constructed in shallow waters, and floating structures found in still waters.

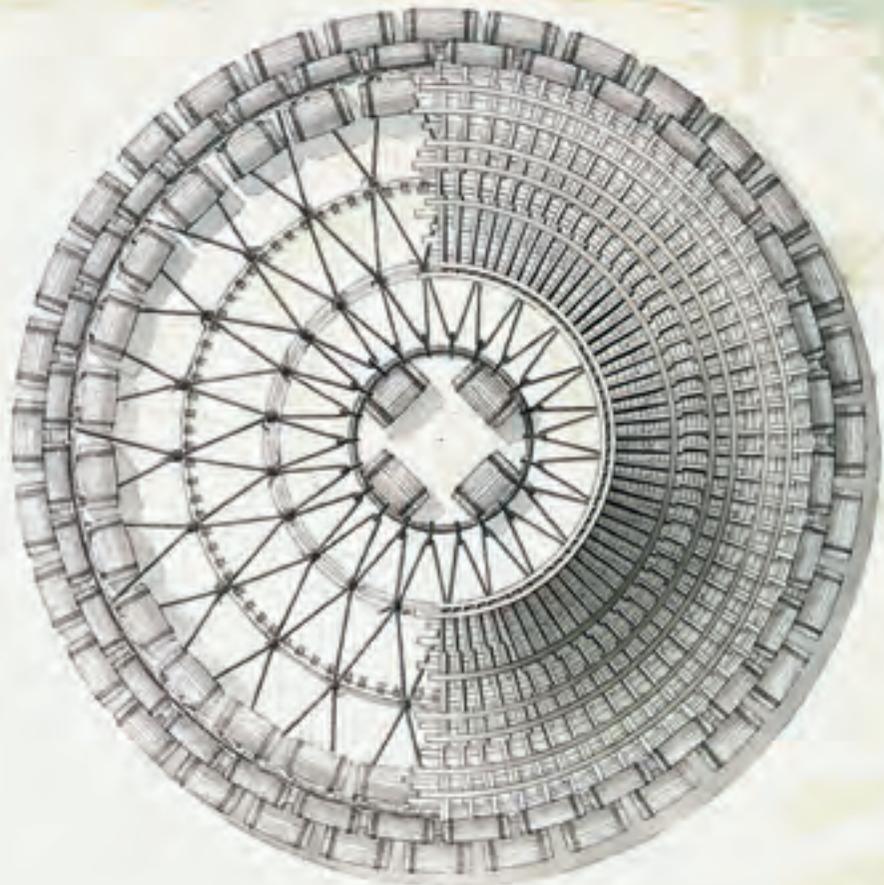
In prehistoric Ireland and Scotland, artificial circular islands called crannógs were constructed in lakes, rivers, and estuarine waters. They were between approximately 30 and 200 feet in diameter, defined at their edges by a wooden oak pile palisade enclosure. Thousands of crannóg ruins are found today in Ireland and hundreds in Scotland, now overgrown with trees and shrubs.

Tenochtitlan, the Aztec predecessor to Mexico City, was founded on a small natural island in Lake Texcoco, surrounded by countless artificial chinampa islands. The chinampa is a method of ancient agriculture, almost 1,000 years old, developed in the Valley of Mexico using small rectangular areas of fertile land on the shallow lake beds to grow crops.

On Lake Titicaca on the border of Peru and Bolivia, the pre-Incan Uros people created and still inhabit the floating Uros islands, created with dry bundles of the totora reed. These were anchored with ropes to stakes driven into the lakebed and could be moved if a threat arose. Forty-two of these islands still exist today. Similarly, the Ma'dan, or Marsh Arabs, of Iraq constructed floating islands and houses of dried bundled reeds and mud in the wetland marshes known as Hor in southern Iraq. The Iraqi dictator Saddam Hussein embarked on an extermination campaign against the region's Shiite population in the 1980s and 1990s, draining and mining the marshes where this unique culture had developed for over 5,000 years.



Disposition des Tonnes nécessaire pour le Flottage.





Liberty Island and Ellis Island in the New York–New Jersey Upper Bay, 2008

Opposite

The city of New York, with Castle Williams and Governors Island on the bottom right, and Battery Park and Castle Clinton in the center, Cheltnam, 1855

ARTIFICIAL ISLANDS OF THE UNITED STATES

NEW YORK

U Thant Island (Belmont Island)

In New York's East River, the U Thant Island (officially Belmont Island, renamed in 1976 for U Thant, the UN Secretary General from 1961–71), is a tiny artificial island measuring 100 by 200 feet and located at the southern end of Roosevelt Island opposite the UN Headquarters. The island was constructed in the 1890s as a byproduct of William Steinway's trolley tunnels, connecting Manhattan to his company town in Queens. This project was later completed as the IRT subway Flushing Line by August Belmont.

NEW YORK

Ellis and Liberty Islands

Ellis Island, first Little Oyster Island, served as the main entry facility for 12 million immigrants to the United States between 1892 and 1954. It is now property of the federal government and is a monument operated by the National Park Service.

Liberty Island is a small uninhabited island offshore of Liberty State Park. Formerly called Bedloe's Island, it has been the site of a private home, a smallpox quarantine station, and a fort following the Revolutionary War. Today the fort, in the shape of an eleven-pointed star, serves as the pedestal for the Statue of Liberty.

SAN FRANCISCO

Treasure Island

In the San Francisco Bay, Treasure Island is a 395-acre artificial island connected by a small isthmus to Yerba Buena Island. It was constructed by the Federal Government in 1936–37 for the Golden Gate International Exposition, and built of imported fill upon existing shoals. After the exposition the island was to have become a military airport, but this was constructed at an alternate site and the island instead served as a naval base during World War II. Although still owned by the navy, it was decommissioned and opened to the public in 1996; approximately 1,500 people currently live on the island.





CHICAGO Northerly Island

Northerly Island is a 91-acre artificial island along Chicago's lakefront. It is connected to the mainland via a narrow isthmus. The idea for the island, which began construction in 1920, emerged from Daniel Burnham's 1909 Plan of Chicago, in which he imagined Northerly Island as a lakefront park and one of the northernmost points in a series of five of man-made islands stretching along the waterfront. In 1933-34 the island served as the location of the world's fair. Merrill Meigs recommended converting the island into an airfield in 1935, and in 1946 it became Meigs Field. It was removed in 2003, and the island was converted into a park.

SEATTLE Harbor Island

Harbor Island is an artificial island in the mouth of Seattle's Duwamish Waterway. It was completed in 1909 and at 350 acres in size, it was at the time the largest man-made island in the world. Since 1912, the island has been used for various commercial and industrial activities. It is currently a Superfund site and is on the Environmental Protection Agency's National Priorities List. Harbor Island was made from 24 million cubic yards of earth removed in the regrading of city streets as well as dredge material taken from the Duwamish River. It was not surpassed as the world's largest artificial island until 1938, with the completion of Treasure Island in the San Francisco Bay.

MIAMI The Venetian Islands

The Venetian Islands are a chain of artificial islands in Biscayne Bay, linking the Florida mainland to Miami Beach with the scenic Venetian Causeway. The eleven islands, six of which are inhabited, were built by developers during the Florida land boom of the 1920s, adding valuable new real estate to the city. When the stock market crashed in 1929, additional projects were abandoned.

Daniel Burnham, Chicago, Plan of the City, showing the general system of boulevards and parks existing and proposed (includes Northerly Island and others), 1909

Opposite
Star and Venetian Islands, Miami, 2008





Grids overlaid on the harbor to create different patterns of islands

Following pages

Preliminary studies for island infill in the Upper Bay

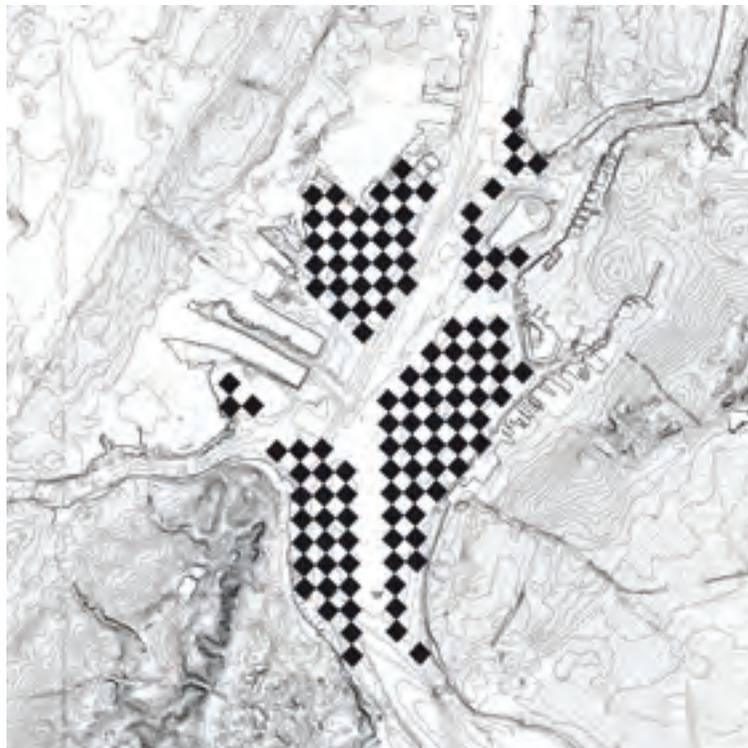
ISLAND INFILL

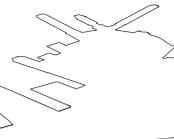
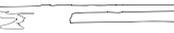
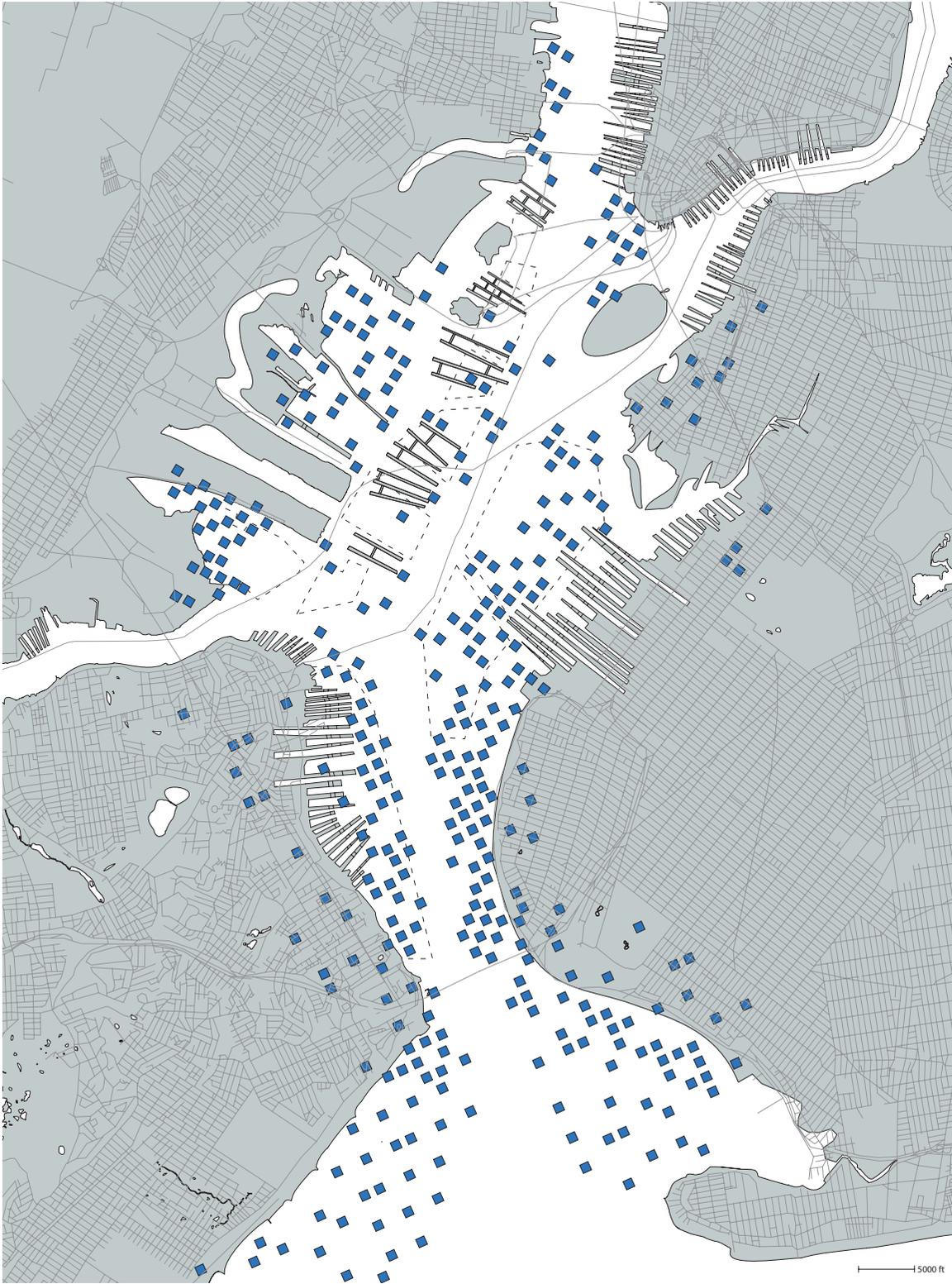
Islands can serve as a porous land infill within the watery void of the harbor. Such constructed land in the harbor would help to diminish the force and impact of storm surge and protect the established neighborhoods and business districts further inland. A formal study of the size, orientation, placement, and density of these islands begins to shape the design by marking the range of programmatic and topological differences within the harbor zone. Our final island arrangement traces both the city grid and the depths of the harbor waters. As a starting point, we can consider infilling the harbor with an alternating grid of generic square islands to yield a new harbor figure which is equally land (figure) and water (ground). These islands are densely packed so that each island is discreet but touches four adjacent islands on its corners.

To accommodate a necessary corridor for shipping routes, swaths of these islands are removed from the central area of the harbor so that four to five discreet island areas are identified. These areas are neither land nor water but rather a transition zone between the edge of the land and the harbor waters. To further articulate these zones, we explored a gradient in island heights; the islands might get taller as they approach established land and then sink below the surface of the water at the extremities.

STRETCHING THE CITY GRID

The following pages document the design studies of how 800 by 800 foot islands can create new land in the harbor waters while relating the edge of the five major urban zones which define the figure of the harbor. These zones include Manhattan, Brooklyn, Staten Island, Bayonne, and Jersey City. The street grid is established differently in each zone and thus orients the city blocks to the harbor in a unique way. These studies extend the array of urban grids into the harbor void and infill its fringes and intersections with islands. The final scheme rotates the orientation of the islands according to an extension of grid lines derived from the Verrazano Bridge, the Gowanus Expressway, Canal Street in Manhattan, and the massive Bayonne piers. This array of islands starts to indicate a new shape to the harbor by diminishing its clear boundaries and establishing land that can accommodate new types of urban landscapes.





5000 ft





Wetlands and salt marshes create a rich biodiverse habitat.

Opposite

NOAA map of Bayonne piers overlaid on satellite image illustrating the shallow flats that are ideal locations for salt marshes (detail)

GENERATING HABITAT

The word estuary is derived from the Latin aestus, meaning tide. An estuary is a semi-enclosed coastal body of water with one or more rivers flowing into it, with an open connection to the sea. As estuaries are usually located at the tidal mouths of rivers, they are associated with high levels of silt and sedimentation. The mixing of tidal sea water and fresh river water creates a brackish environment with varying levels of salinity. An estuary is often associated with high levels of biodiversity—it is characterized by estuarine-dependent plants, invertebrates, fish, and bird species.

HABITAT: NATURAL AND ARTIFICIAL

Estuaries consist of moving and still waters, and the mixing of fresh, brackish, and salt waters where rivers meet the sea. They are characterized by the existence of mudflats, wetlands, and marshes. These systems are rich in native organisms, resilient species that have high tolerances for the estuary's extremes of temperatures and salinity and thrive in the rich organic environment found here. However, it is the seasonal and migratory organisms that enhance the rich diversity of an estuary system. The ecological richness of the New York–New Jersey Harbor is in particular due to its role as a place of transition, a zone of interchange of diverse ecologies and species, each with specific needs.

The habitat of the New York–New Jersey Upper Bay exists in both the waters and the banks and bottoms of its bays and rivers. Centuries of human activities on its shores, with the consequential effects of industrial pollution, storm and sewage runoff, and even hunting and fishing activities, have massively degraded this fragile habitat. Huge areas of native wetlands, particularly on the New Jersey shores, have been landfilled and destroyed. But as ecological sensitivity has risen, and the region has begun to abate pollution and the adverse effects of industry, the ecosystem of the New York–New Jersey estuary has improved substantially.

With the decline of shipping and other waterfront industries, the ecosystem of the harbor has begun to adapt over time to new artificial habitats. Living organisms have come to coexist with the pier and slip typology at the shoreline. For example, the shade and shadow provided below pile-supported piers has become precious habitat for certain species of spawning fish. These areas of deep shadow and shade provide valuable complexity to the habitat along the shorelines of the bay. This construction technique of open pile structures was specifically adapted for New York's waterfront piers, to allow waste and silt to wash between the piles and flush out to the sea, rather than accumulating and silting between piers. Shipping basins, particularly along the Brooklyn waterfront of the East River, are a remnant of the former shipping industry.





Spartina alterniflora growing in brackish tidal waters

Hauling the largest shad seine in the world on the Potomac River, ca.1870

Opposite

Collage showing sunken, retired subway cars creating artificial reefs in the shallow waters along the New Jersey coastline

Even the granite and concrete block bulkheads that corset much of the waterfront of Manhattan and Brooklyn provide a reef-like underwater habitat, with firm surfaces and protective crevasses, for mollusks and fish.

Much of what we propose as soft infrastructural design strategies to mitigate storm surge effects—reefs, improved wetlands, archipelago islands, new piers and slips—also serves to improve and strengthen the ecology of the bay. Improving ecology and creating habitat works significantly to protect the uplands from storm surge and flooding damage. Adaptive design strategies addressing the consequences of global warming work handsomely with habitat creation and restoration.

WETLANDS AND PLANTS

Habitat consciousness today is particularly focused on the restoration of wetlands, which are considered to be the richest element within the food web of coastal estuaries. Establishing a plant base is necessary to the development or restoration of wetlands. Although many plants are adapted to coastal habitat, salt spray, and occasional inundation, only two species of land plants can thrive in the salty tidal waters of the east coast of North America. Both belong to the genus *Spartina*, the perennial deciduous grass which is the fundamental component of a healthy salt marsh. It grows on the peat formed by accumulated sediment and its own rhizomatic biome over time. *Spartina patens*, commonly known as saltmarsh hay, grows best at higher marsh elevations that are only incrementally flooded by saltwater. It is a short, sturdy, matted grass that was often used as animal feed. At lower elevations that are more affected by regular tidal inundation, *Spartina alterniflora* thrives. Also known as smooth cordgrass, this species is coarser and taller than *Spartina patens*, and it is able to spend considerably more time submerged in saltwater. *Spartina* is unique in its ability to concentrate salt at a cellular level and exclude salt from entering its roots, thus preventing the loss of fresh water and the withering effects of saltwater exposure that other plants experience. A healthy salt marsh is dependent on the presence of these two grasses, which together create a rich nutrient base and a protective habitat to numerous organisms, particularly crustaceans and mollusks, which are then sought as food by fish and birds.





N. N. Kondakov, *American Eel*, 1957, drawing

Opposite

Osprey nests on U Thant Island in the East River, New York, 2007

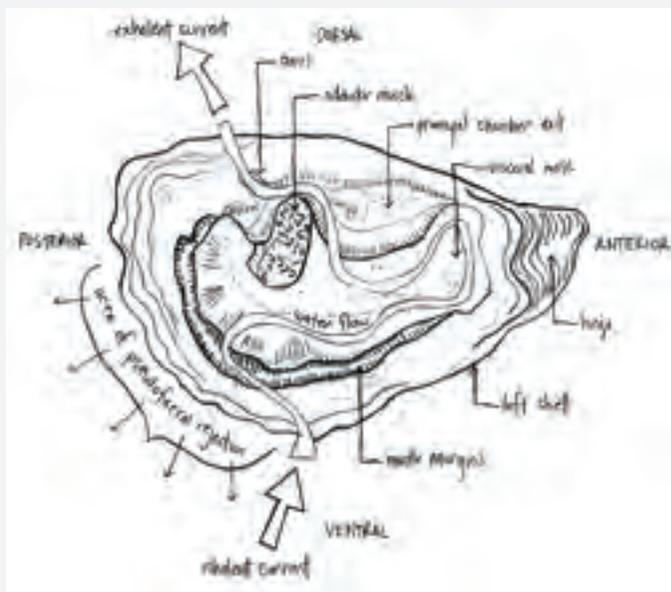
FISH

Estuaries, as a place where saltwater and freshwater meet, are productive and diverse systems, and as nutrient traps, they are important fish nursery habitats. The great diversity of fish species found in an estuary is due to the presence of fresh water, estuarine, and marine fish that utilize the tidal river and its grassy shoals and wetlands for spawning habitat. The resultant abundance of fish and invertebrates adds to the productivity of the entire system, by providing a forage base of substantial quantity for fish-eating birds. It is these seasonal migratory fish that enhance the rich diversity of an estuary system—diadromous fish migrants that travel between salt and fresh water. Of the diadromous fish, there are two types of migrants. Anadromous (meaning upward running) fish live mostly in the ocean, and breed in fresh water. Catadromous (meaning downward running) fish live in fresh water, and breed in the ocean. In the New York–New Jersey estuary system, striped bass, American shad, and Atlantic sturgeon are some of the anadromous fish that live in the ocean but return every spring to swim up the harbor and the Hudson River to spawn. These fish leave the river soon after spawning in spring, and in autumn their progeny swim back to the ocean in an endless stream, to the delight of migrating birds. Journeying in the opposite direction is the freshwater American eel of the genus *Anguilla*, whose larvae drift on the open ocean feeding on dissolved nutrients. These larvae develop into glass eels and then young eels, often traveling thousands of miles back to their original streams. Many invertebrates such as shrimp also reproduce in the shelter of the region's wetlands and then move out to the ocean for their adulthood.

BIRDS

The diversity of life in the waters of the estuary supports the feeding habits of wading birds. These birds—glossy ibis, great egrets, snowy egrets, yellow and black-crowned night herons, and green herons—have recently surged in number as the water quality and harbor habitat have improved. They nest in large numbers around the Upper Bay shores but only in particular locations. Some, like Shooters Island, have been acquired by New York City's Department of Parks and Recreation and designated as "forever wild" sites. Interestingly, the various types of wading birds share nesting sites but minimize competition for feeding by specializing in their habits. They carve out separate but overlapping niches by relying on differences in tidal levels, feeding times, salinities, and favored prey. Also, many Neotropical migratory songbirds along the Atlantic flyway stop to feed in the Bay. Both types of birds thrive on the diversity of the estuarine food web. The interdependence of plants, invertebrates, fish, and birds in this rich ecosystem is extremely complex.





Open oyster at market, 2006

Anatomy of an oyster, 2008, drawing

Opposite

Oyster racks off the north coast of New Zealand, 2007

OYSTERS

The shallow brackish intertidal zones along the edge of the New York Harbor were once home to millions of mollusks, the *Crassostrea virginica*, more commonly known as the eastern oyster. Biologists estimate that in the seventeenth century, the Hudson river estuary held half the world's oyster population. The oyster, a bivalve (two-shelled) filter feeder, inhales sea water, drawing it over its mantle and through its gills, extracts nutrients, and exhales the filtered water. It is believed that in the eighteenth century, the flourishing oyster beds of the New York Harbor were capable of filtering the bay's entire water volume of excess nutrients every three or four days.

As the population of New York grew, it industrialized rapidly, and polluted extensively. A 1929 study correlating the location of sewage outlets and the location of shellfisheries resulted in a ban on the "drinking" of oysters. This practice held harvested oysters in perforated tanks at the mouths of the freshwater tributaries feeding the bay to rinse them of salt and grit. But these tributaries were carrying raw sewage and waste to the bay. Several typhoid outbreaks in the 1920s were directly connected to the consumption of raw oysters harvested in the bay and, by 1927, governing bodies officially closed all of the harbor's oyster beds in order to control the spread of typhoid and other food-borne diseases. Although oyster harvesting ceased, water pollution did not. Raw sewage continued to be pumped directly into the waters of the bay. As industry grew, industrial waste including heavy metals, toxic PCBs (polychlorinated biphenyls), and even Agent Orange were also dumped into the harbor waters. The oysters could not digest these poisons, and by the 1960s they had completely disappeared.

The restoration of native oyster populations is an important aspect of our constructed wetland strategy. We propose to establish seed beds for oysters along the New Jersey tidal flats, reintroducing *Crassostrea virginica* into the complex food web of marine and terrestrial ecosystems. Oysters consume algae and blooms of phytoplankton that rob the water of oxygen, needed by fish, crabs, and other marine life. Their creviced beds create underwater reefs, consummate habitat for worms, shrimp, crustaceans, and fish.

Crassostrea virginica is an important element of the marine food web, interconnecting multiple food chains in the estuarine community. Their filtering capability would curb pollution and sediment, digesting or shaping this material into small packets that are then deposited onto the seabed, where they are harmless. Seeding the waters with plentiful oysters would cleanse the waters of the bay and may lead to a revival of aquaculture. However these oysters would not be edible until the issues of pollution have been significantly abated.





Perennial saltmarsh aster /
Aster subulatus



Northern bayberry /
Myrica pensylvanica



Salt marsh bulrush /
Scirpus robustus



Sea Blite /
Bassia hirsute



Salt Grass /
Distichlis spicata



Poison ivy /
Toxicodendron radicans



Purple loosestrife /
Lythrum salicaria



Narrow Leaf cattail /
Typha angustifolia



Common reed /
Phragmites australis



Marsh orach /
Atriplex patula



Saltspray rose /
Rosa rugosa



Seaside goldenrod /
Solidago sempervirens



Saltmeadow rush /
Juncus gerrardii



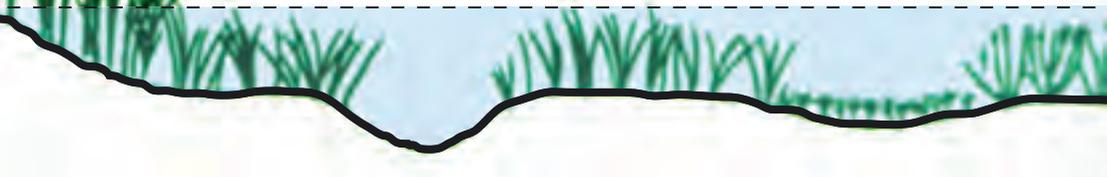
Common glasswort /
Salicornia europea



Sea lavender /
Limonium nashii



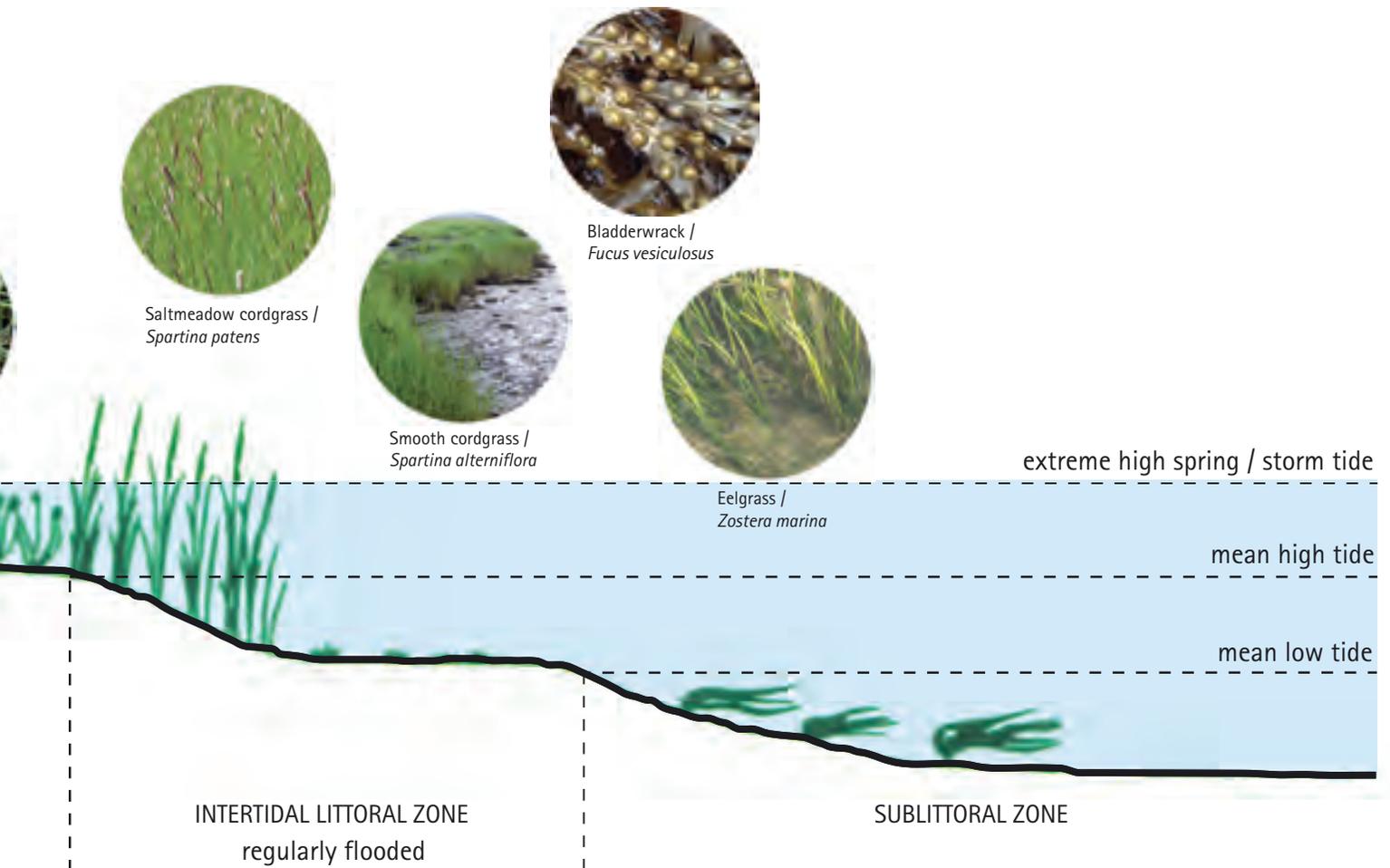
SUPRALITTORAL ZONE



INTERTIDAL LITTORAL ZONE
irregularly flooded

ESTUARINE HABITAT

MARSH PLANTS





Blue-green algae / *Cyanobacteria*



Rough periwinkle / *Littorina saxatilis*



Northern rock barnacle / *Balanus balanoides*



Red plumed worm / *Diopatra cuprea*



Atlantic horseshoe crab / *Limulus polyphemus*



Ghost crab / *Ocypode quadrata*



Smooth periwinkle / *Littorina obtusata*



Ribbed mussel / *Geukensia demissa*



Razor clam / *Ensis directus*



Eastern mud snail / *Ilyanassa obsoleta*



Beach flea / *Orchestiidae*



Soft-shell clam / *Mya arenaria*



Quahog clam / *Mercenaria mercenaria*



SUPRALITTORAL ZONE

INTERTIDAL LITTORAL ZONE
irregularly flooded

ESTUARINE HABITAT

MOLLUSKS AND INVERTEBRATES



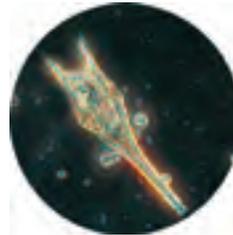
Eastern oyster /
Crassostrea virginica



Hydroids /
Hydrozoans



Portuguese man-of-war /
Physalia physalis



Dinoflagellates



Dinoflagellates



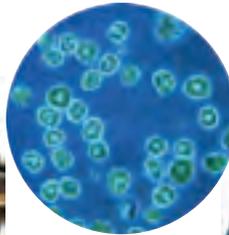
Blue mussel /
Mytilus edulis



Amphitrite worm /
Amphitrite ornata



Blue crab /
Callinectes sapidus



Dinoflagellates



Dinoflagellates



Sand shrimp /
Crangon septemspinosa



Parchment worm /
Chaetopterus variopedatus



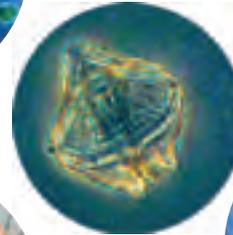
Atlantic dogwinkle /
Nucella lapillus



Atlantic mole crab /
Emerita analoga



Lady crab /
Ovalipes ocellatus



Dinoflagellates



Moon jelly fish /
Aurelia aurita

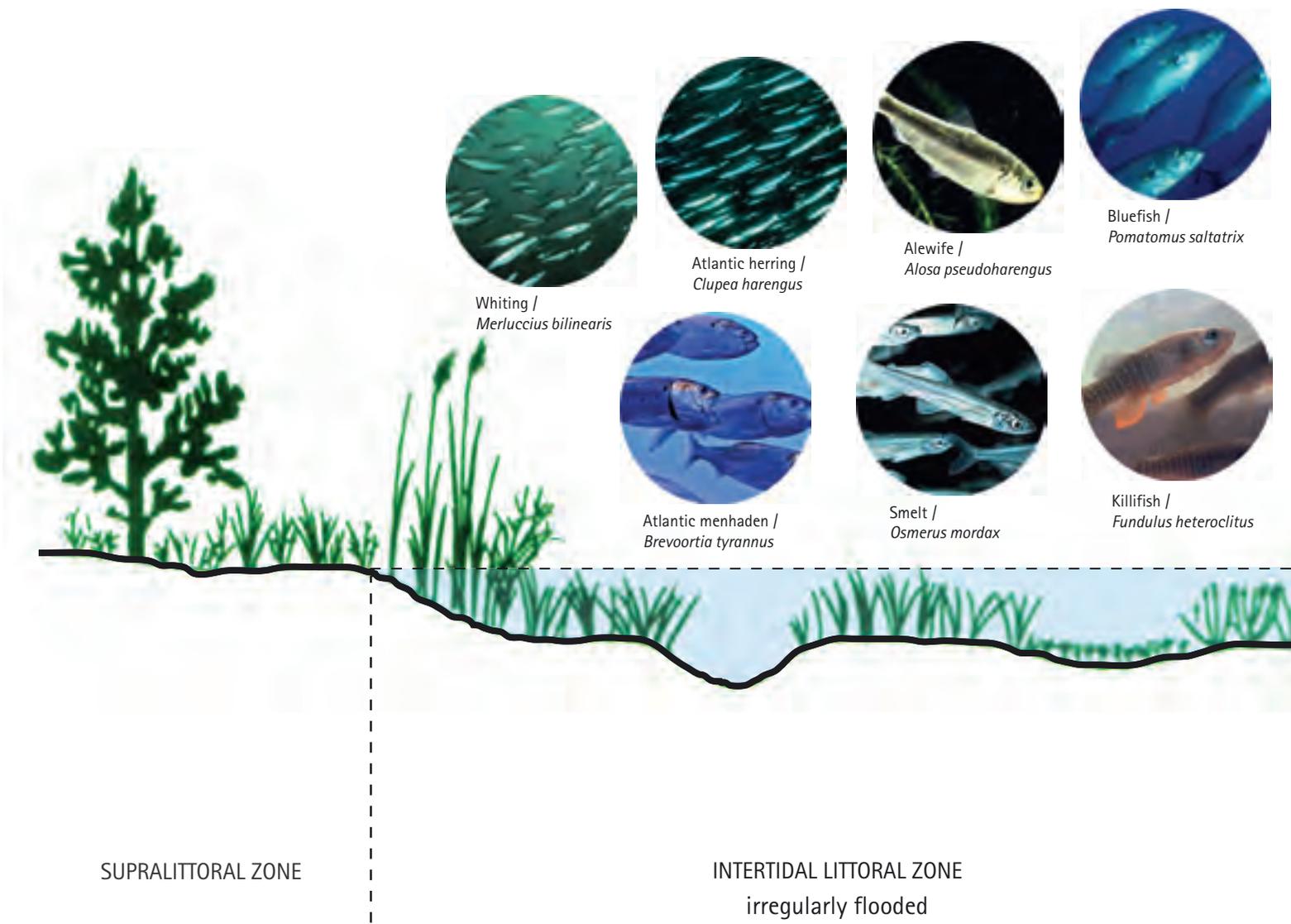
extreme high spring / storm tide

mean high tide

mean low tide

INTERTIDAL LITTORAL ZONE
regularly flooded

SUBLITTORAL ZONE



ESTUARINE HABITAT

FISH



Porgy /
Stenotomus versicolor



Bluegill /
Lepomis macrochirus



Summer flounder /
Paralichthys dentatus



Winter flounder /
Pseudopleuronectes americanus



American shad /
Alosa sapidissima



American eel /
Anguilla rostrata



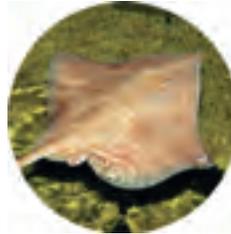
Sea lamprey /
Petromyzon marinus



Atlantic sturgeon /
Acipenser oxyrinchus



Weakfish /
Cynoscion regalis



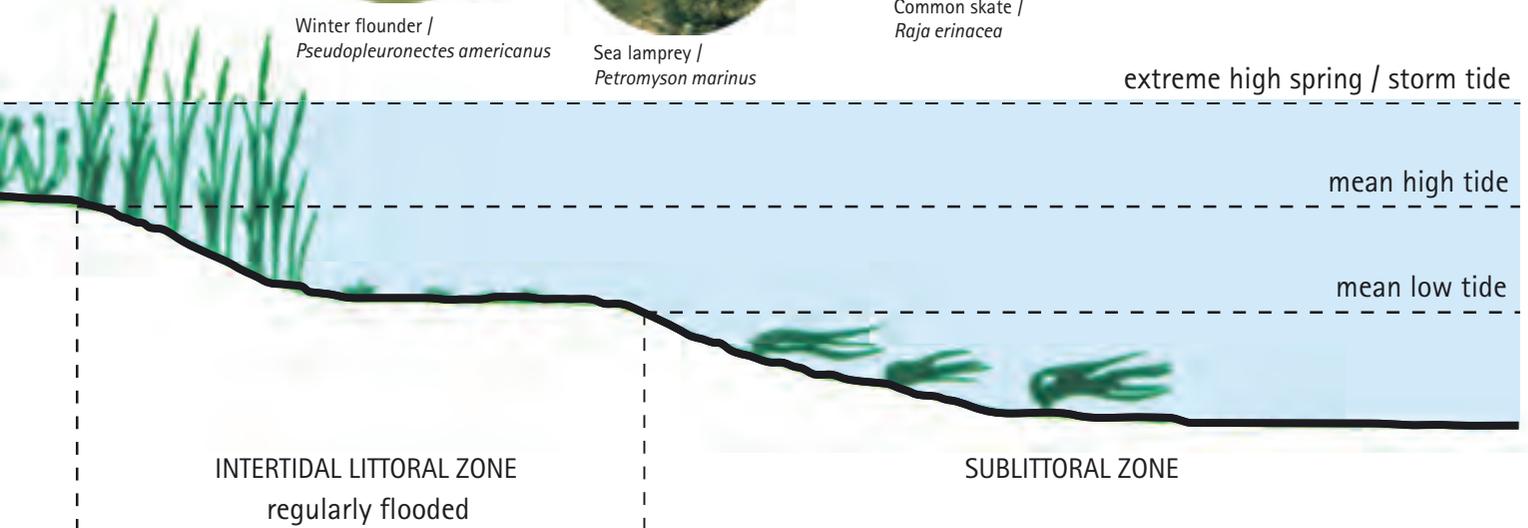
Common skate /
Raja erinacea



Striped bass /
Morone saxatilis



Brown catfish /
Ameiurus nebulosus





Sharp-tailed sparrow /
Ammodramus caudacutus



Red knot /
Calidris canutus



Common tern /
Sterna hirundo



Great blue heron /
Ardea herodias



Marsh wren /
Cistothorus palustris



Ruddy turnstone /
Arenaria interpres



Killdeer /
Charadrius vociferus



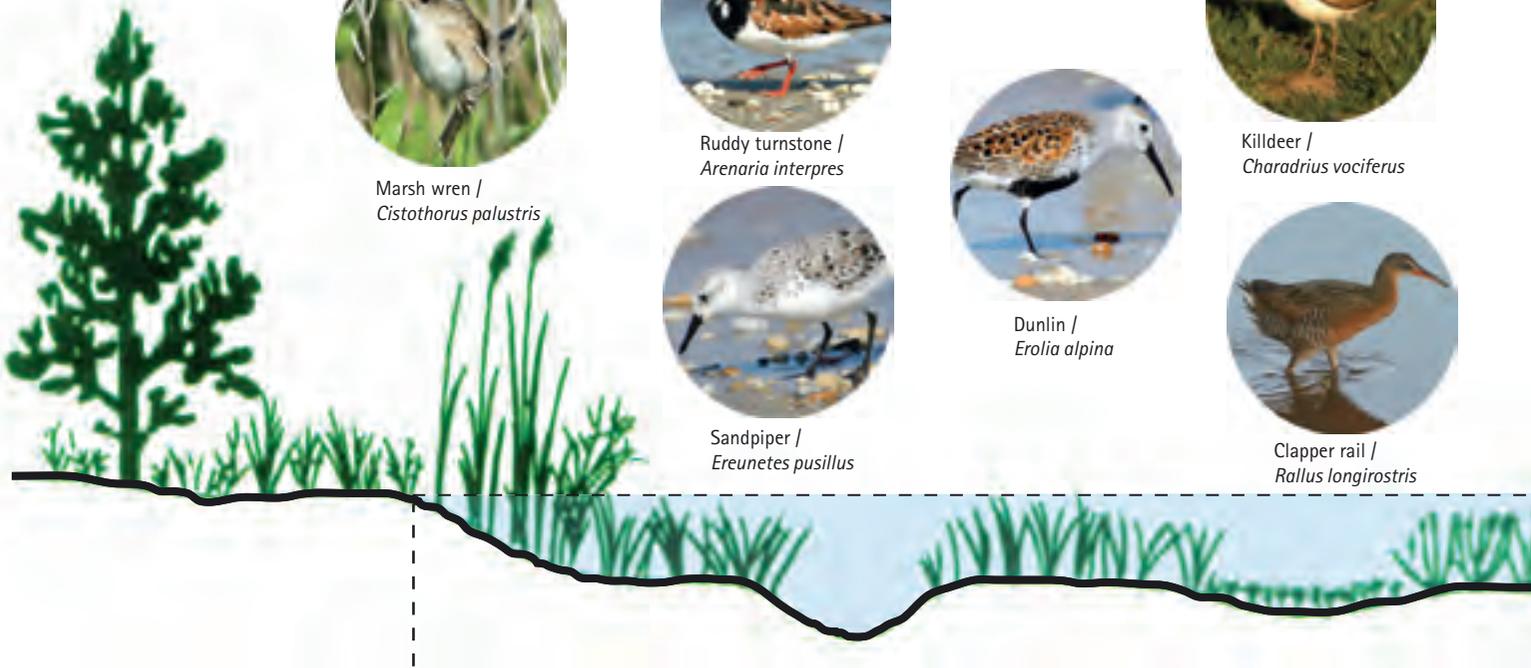
Dunlin /
Erolia alpina



Sandpiper /
Ereunetes pusillus



Clapper rail /
Rallus longirostris



SUPRALITTORAL ZONE

INTERTIDAL LITTORAL ZONE
irregularly flooded

ESTUARINE HABITAT

SHORE BIRDS



Black-crowned night heron /
Nycticorax nycticorax



Double-crested cormorant /
Phalacrocorax auritus



Pied-billed grebe /
Podilymbus podiceps



Herring gull /
Larus argentatus



Glossy ibis /
Plegadis falcinellus



Hooded merganser /
Lophodytes cucullatus



American black duck /
Anas rubripes



Snowy egret /
Leucophoyx thula



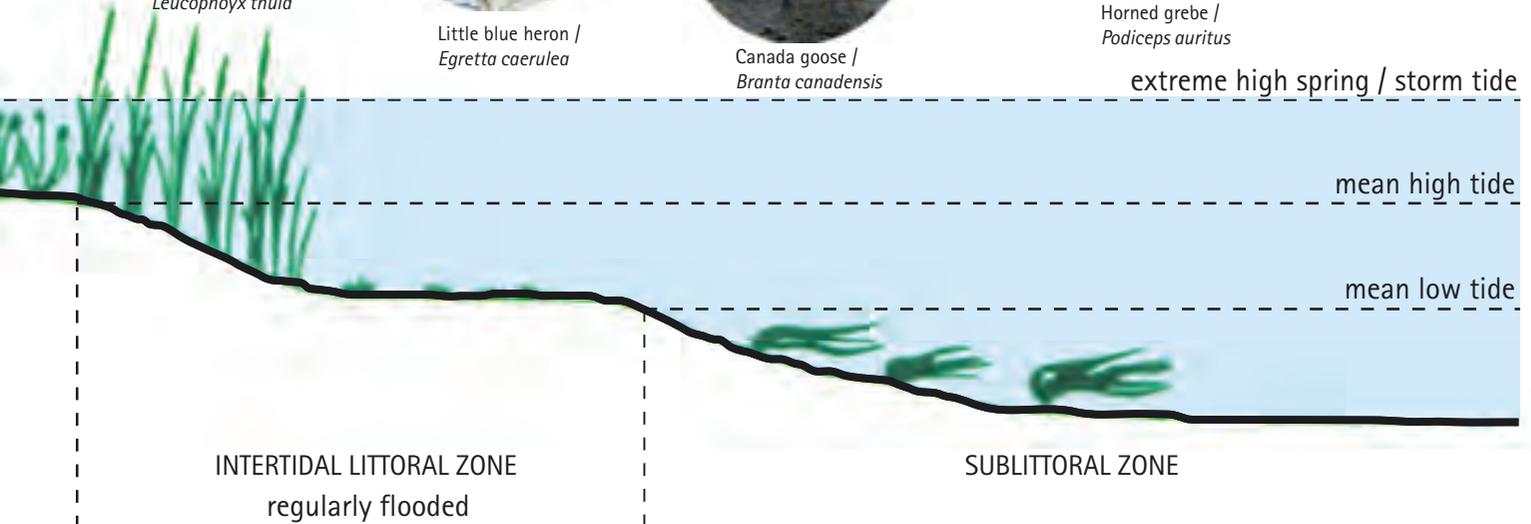
Little blue heron /
Egretta caerulea



Canada goose /
Branta canadensis

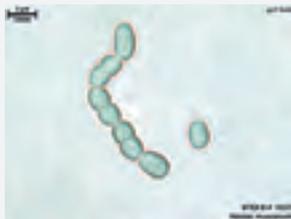
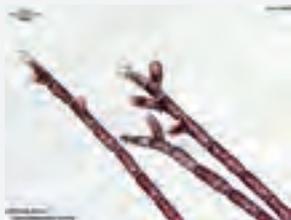


Horned grebe /
Podiceps auritus



INTERTIDAL LITTORAL ZONE
regularly flooded

SUBLITTORAL ZONE



Algae farms have the potential to generate biocrude to be used for fuel.

Opposite

Palisade Bay, proposed offshore wind turbines among oyster racks

GENERATING ENERGY

WIND AND TIDAL TURBINES

We propose that public space and clean energy production could share the same space. In the wetland flats of New Jersey, we have proposed the implementation of a field of wind turbines, interspersed with oyster beds. This proposal would require an extensive study of the energy potential of wind that could be harvested here. Tidal turbines are also currently being studied in the East River, and we would propose their implementation in the Upper Bay as well, perhaps incorporated into the extended and detached pier foundations of our masterplan. Environmental impact analyses of the effects of both wind and tidal turbines would be needed to examine the effects on the wetland environment and fish, as well as on the birds passing through the Atlantic flyway (the migration flyway following the shoreline from the coast of Greenland south to Florida, the Caribbean, and South America). We imagine that our proposed ecological transformations to the Upper Bay will create an attractive stopping point for migratory birds travelling along the flyway, similar to the oasis of Central Park.

ALGAE

Harnessing certain algae species is an energy-producing strategy that may also produce positive effects on the health of the estuarine ecosystem. We propose locating algae farms producing biocrude (sometimes called "green crude" which can be refined to make gasoline, diesel, or jet fuel) or ethanol in the new wetland regions of the Upper Bay. Many consider algae to be a better source of fuel than food crops, from which ethanol is derived, as the carbon footprint of energy and emissions required to grow algae is very low. Many algae species are high in oils, which they produce naturally—their predecessors helped make oil many millions of years ago. Carbon dioxide, sunlight, and brackish water, the three key ingredients for an algae farm, are plentiful in the Upper Bay. An added advantage is the fact that algae can also clean up waste, by processing nitrogen from wastewater and carbon dioxide from power plants. However, studies are still needed to examine the ecological consequences of introducing algae, which has the potential to become an invasive species, to this ecosystem.





George Hayward, *View in Central Park, Southward from the Arsenal 5th Avenue and 64th Street*, 1858, lithograph

Opposite
Joseph C. Geissler after Pierre Martel, *Martel's New York Central Park, Respectfully Dedicated to the Park Commissioners*, 1864, lithograph

GENERATING PLACE

The Upper Bay has been selected as the site for this proposal because of its potential to create a unified regional place for New York and New Jersey. While it is rarely traversed and primarily serves as a port, this estuarine body of water is the geographic center of the region. We imagine the Upper Bay could be reconceived as a new Central Park for the region by re-centering the city away from Manhattan and towards the boroughs and adjoining New Jersey counties. We envision the bay as a common "ground;" a figure within the mega-city that can be—like the Bacino di San Marco in Venice—a meeting place and cross roads on the water.

CENTRAL PARK

The planning and development of Central Park in Manhattan predated the growth of the city around it. The planners, politicians, and designers of Central Park anticipated this dense development and the plans for Central Park coupled landscape and infrastructure to serve the growing city. Inverting the sequence of city development in the conception of Central Park serves as the metaphor for our contextualization of the Upper Bay today within the development of the New York region. The condition to which this project for the Upper Bay responds is a fully developed urban region which frames a void within itself. In order to develop a resilience to the threats of storms and sea level rise, the region must reinvent its void as the locus for a twenty-first century, ecological infrastructure. This new infrastructure can be contained within the institution of the public park which, as the enormous success and popularity of Central Park demonstrates, is equally vital to the health of the city as any infrastructural public work.

The Greensward Plan by Fredrick Law Olmstead and Calbert Vaux was chosen in a competition for the design of Central Park by the Parks Commissioners on April 28, 1858. The design can be considered an enactment of progressive urban reform: Olmstead and Vaux believed that the use of the park would improve public health across all classes of society. Vaux positioned the project by stating that in a "true and intelligent republicanism," all citizens were entitled to enjoy the comforts and benefits of society's wealth through its public institutions and that a "man of small means may be almost on the same footing as the millionaire."¹⁹ The Parks Commissioners' decision to place Central Park in the center of Manhattan, as well as its vast size—843 acres—supported Vaux's populist revision of the public park. Central Park's enormous reservoir and many fountains served as symbolic elements within the urban landscape. Fed by the new Croton River Aqueduct, each provided a visual testament to the great health achievement of delivering fresh water to New York City from the mountains upstate.





A. Brown and Co., *South Gate House, New Reservoir, during construction: Viewed from the South—Looking into the Reservoir*, 1862, lithograph

Opposite

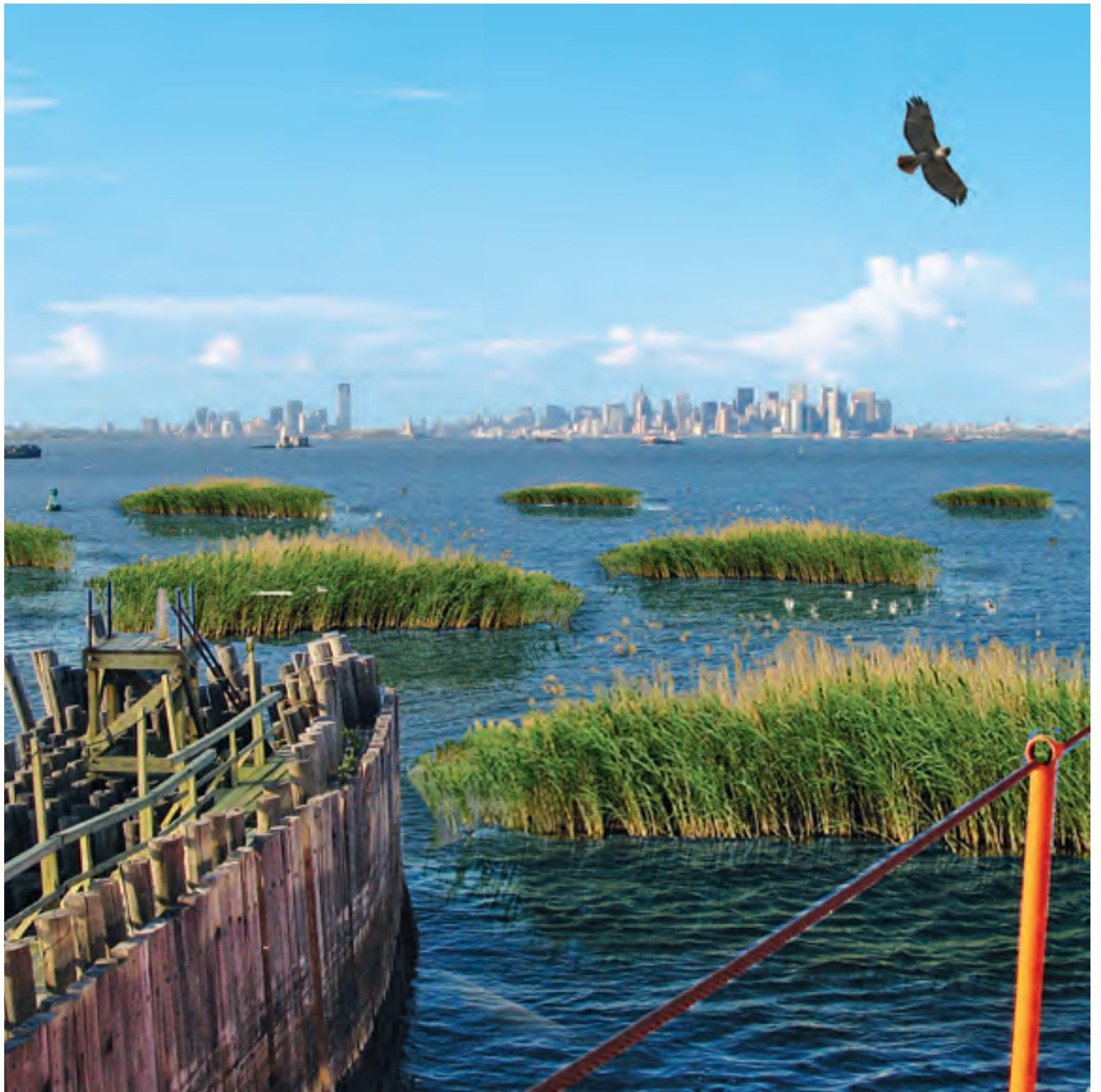
Proposed wetlands along the Staten Island coastline in Palisade Bay

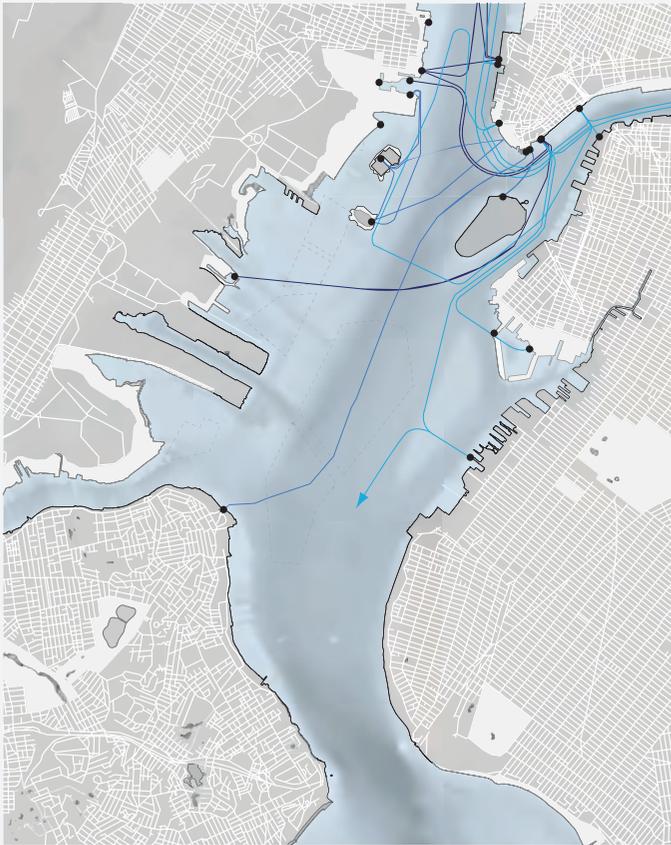
The sectional manipulation in Central Park is particularly sophisticated, sorting several types and modes of transportation into different levels with relatively minimal sectional variation. The section works pragmatically with social programs, as well as ecological and infrastructural programs. For example, vehicular traffic and pedestrian movement are entirely separated throughout the park, and both pathways circulate above and between elaborate waterworks and drainage systems underneath the surface of the park grounds. The various speeds and directions of traffic are directed along various pathways; transverse roadways allow vehicular traffic direct crossing through the park while the looping bridle ways and carriage road allow slow moving traffic to explore the park. Similarly, the Race and the Promenade provide a backdrop for daily fitness while the Ramble allows leisurely pedestrians to wander in the park.

When considering the Upper Bay, the use of section is again critical, albeit in a less obvious way. When wetlands are restored within the intertidal zones along the perimeter of the bay a sectional relationship emerges from layering social and ecological programs; boardwalks might carry pedestrians over tall grasses which retain and filter water to a collection tank below. Landfill piers and constructed islands that cut through the depth of the water create new still water habitats for marine life. In Central Park the imagery tends to be that of a place of a sectional nature, surrounded by a perforated wall with points of entry (the Gates). The surrounding city itself is considered flat and the perceived urban flatness juxtaposes the rolling, pastoral hills in Central Park.

By contrast, the waters of the Upper Bay are perceived as a vast expanse of empty flatness. With our transformation of the bay, and with the reestablishment of thickened intertidal zones at its perimeter, the sectional variation is clearly established at the edges of the void. These zones create both perceptual and literal points of entry through and across the bay. An element of time is introduced as the depth of sections at the edge are hidden and revealed through the daily phases of the tide. Beneath the water, the flats and shoals that describe the harbor bathymetry drive the decisions and formal patterning of the placement of reefs and islands.

Central Park and the Upper Bay plan are both constructed landscapes which are tailored to suit the social and infrastructural needs of the city. By situating this project after the model of Central Park—by accepting the harbor as a found place which is marked by both natural geological processes and hundreds of years of human interaction—the park is inverted.





View of the Staten Island Ferry

Existing ferry routes through the Upper Bay, 2007

Following pages

Proposed waterborne transportation routes in Palisade Bay for future development

URBAN TRANSPORTATION

Despite the relative proximity of New York City's boroughs and eastern New Jersey, which line the Upper Harbor, the perceived distances between Manhattan, Brooklyn, Staten Island, Jersey City, Newark, and Bayonne is much greater than its measured distance. This is because distance in an urban setting is generally equated with travel time, which is determined by public transportation networks. The extensive travel time required to cross the watery divide and then transfer to a subway or bus thus makes cross-borough destinations cumbersome.

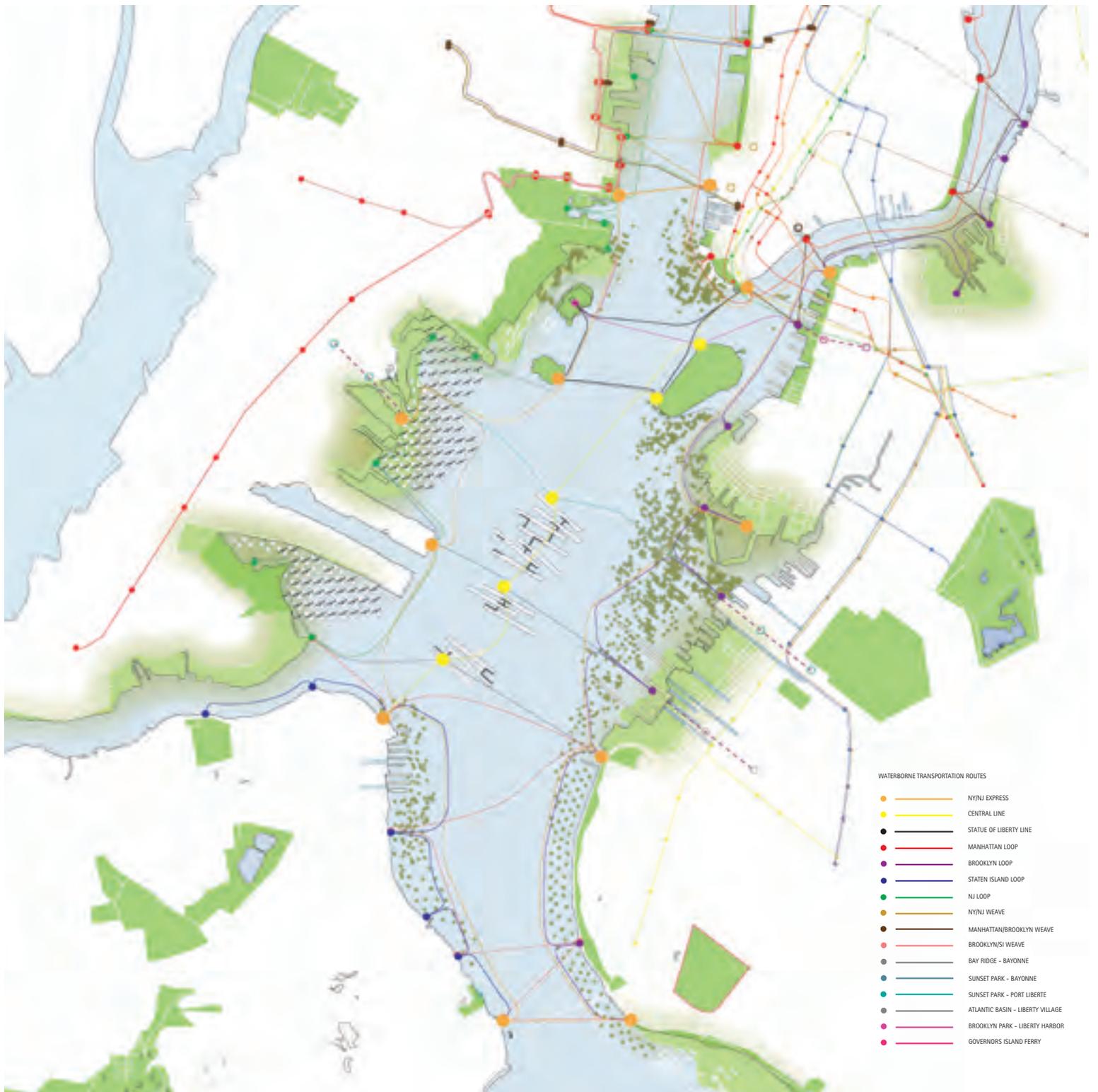
CURRENT TRANSPORTATION NETWORKS

Presently, the Upper Bay is a border and the city's edge is a definite limit which restricts perpendicular movement. This boundary is breached only at key locations, with a series of sunken tunnels and elevated bridges that prohibit interaction with the water itself and a very limited number of ferry routes. In an effort to collapse this perceived distance, and re-envision the bay as shared urban space, our design scheme includes the proposal for a new interborough and interstate water based transportation system—a system that transforms the water from the status of an empty void to the very infrastructure used to facilitate movement.

By surveying the region's existing transportation routes it is evident that the phenomenon of urban transit in New York City has traditionally followed a center-to-edge trajectory, resulting in a lack of connection to the waterfronts and underserved edge territories. By contrast, our scheme identifies an opportunity to re-center the city away from Manhattan to the Upper Bay region which includes with equal emphasis all the boroughs and adjoining NJ cities. Public transit is a vital force for this transformation.

THE VAPORETTO

The Venetian vaporetto—circuit exemplifies an alternative to Manhattan's land bound network of interconnected corridors. Venice's intricate urban pattern denies the possibility of traversing the city in a linear fashion and instead, the principal public routes are pushed outwards, giving new definition to the strict border that exists between land and water. Strung along the city's edge, the Venice circuit is characterized by a system of loops and weaves that trace routes between predetermined points. Moving along a circular course these paths negate the fixed directionality of a transit line with a clear beginning and end, and as a result, the island appears more interconnected with perceived travel distances greatly reduced.



COASTAL ROUTES



CROSS-BAY ROUTES



EXPRESS COASTAL ROUTES



ZIG-ZAG ROUTES

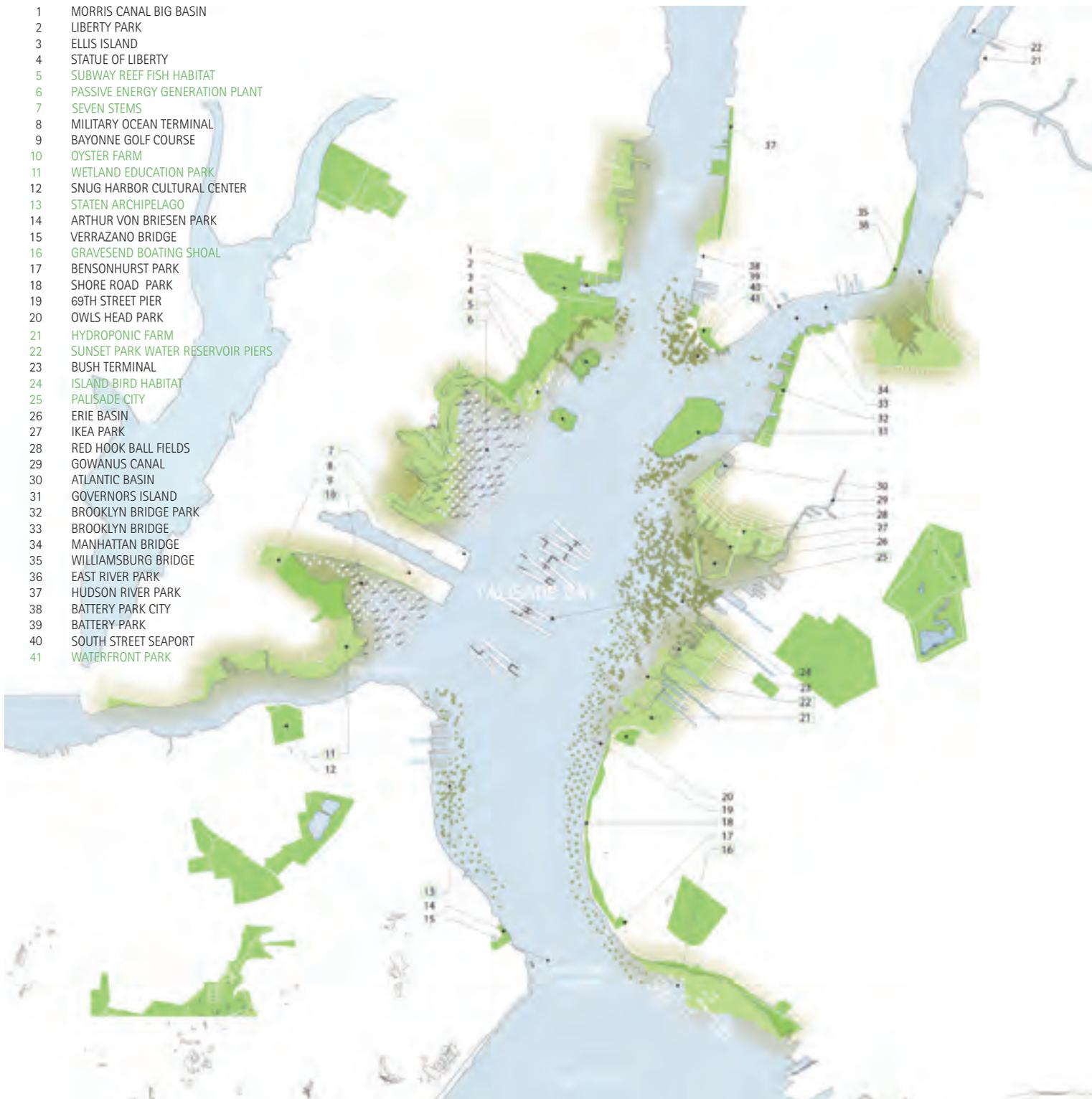


Proposed ferry routes through the Upper Bay

Opposite

Proposed destinations (green) and existing destinations (black) in Palisade Bay

- 1 MORRIS CANAL BIG BASIN
- 2 LIBERTY PARK
- 3 ELLIS ISLAND
- 4 STATUE OF LIBERTY
- 5 SUBWAY REEF FISH HABITAT
- 6 PASSIVE ENERGY GENERATION PLANT
- 7 SEVEN STEMS
- 8 MILITARY OCEAN TERMINAL
- 9 BAYONNE GOLF COURSE
- 10 OYSTER FARM
- 11 WETLAND EDUCATION PARK
- 12 SNUG HARBOR CULTURAL CENTER
- 13 STATEN ARCHIPELAGO
- 14 ARTHUR VON BRIESEN PARK
- 15 VERRAZANO BRIDGE
- 16 GRAVESEND BOATING SHOAL
- 17 BENSONHURST PARK
- 18 SHORE ROAD PARK
- 19 69TH STREET PIER
- 20 OWLS HEAD PARK
- 21 HYDROPONIC FARM
- 22 SUNSET PARK WATER RESERVOIR PIERS
- 23 BUSH TERMINAL
- 24 ISLAND BIRD HABITAT
- 25 PALISADE CITY
- 26 ERIE BASIN
- 27 IKEA PARK
- 28 RED HOOK BALL FIELDS
- 29 GOWANUS CANAL
- 30 ATLANTIC BASIN
- 31 GOVERNORS ISLAND
- 32 BROOKLYN BRIDGE PARK
- 33 BROOKLYN BRIDGE
- 34 MANHATTAN BRIDGE
- 35 WILLIAMSBURG BRIDGE
- 36 EAST RIVER PARK
- 37 HUDSON RIVER PARK
- 38 BATTERY PARK CITY
- 39 BATTERY PARK
- 40 SOUTH STREET SEAPORT
- 41 WATERFRONT PARK





View of Venice's Grand Canal where vaporettos provide an alternative to land based transportation, 2008

Opposite
Giovanni Antonio Canal, known as Canaletto, *Bacino di San Marco, Venice*, ca. 1738,
Photograph © 2010 Museum of Fine Arts, Boston

When Venice's diagram is imposed on the figure of New York's Upper Harbor, these same loops and weaves work to establish new connections and minimize distances both between and within the four distinct land masses. Multiple intermodal hubs are established along the perimeter of the bay connecting the ferry system with the region's existing public infrastructure.

PROGRAM

This intricate new waterborne transportation system for the Upper Bay would serve not only to ease the burden of commuting in the metropolitan area but also to link existing and proposed places of interest on and around the water. Like the Statue of Liberty and Ellis Island, many of the proposed destinations would be accessible only by ferry.

The map on the previous page highlights a selection of these elements of program. New recreational areas would include a Wetland Education Park in Bayonne on a former Superfund site, recreational piers in Sunset Park, Brooklyn, and a new waterfront park at the tip of Manhattan. A boating shoal offshore of Brooklyn below the Verazano Narrows would be a new element of the Gateway National Recreation Area. An oyster farm near Liberty State Park and hydroponic farming in Brooklyn would bolster local food production for the metropolitan area. Residential development is proposed on detached piers near the center of the Upper Bay.

This new transportation system and the destinations it connects will transform the Upper Bay into a body of water which no longer divides but instead binds the region around it.



