New York State Offshore Wind Master Plan

Assessment of Ports and Infrastructure

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NYSERDA Report 17-25b
December 2017

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New York State Offshore Wind Master Plan Assessment of Ports and Infrastructure

Final Report

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New York State Energy Research and Development Authority

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New York, New York

NYSERDA Report 17-25b December 2017

Notice

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Acronyms and Abbreviations

AoA	Area of Analysis
BIWF	Block Island Wind Farm
BOEM	U.S. Bureau of Ocean Energy Management
DOS	New York State Department of State
ft.	feet
GBF	Gravity-Based Foundation
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
m	meters
M&F	Manufacturing and Fabrication
Master Plan	New York State Offshore Wind Master Plan
MARSEC	Maritime Security (U.S. Coast Guard)
MHW	Mean High Water
MOTBY	Military Ocean Terminal at Bayonne
MT	Metric Tonne
MW	megawatt
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide Permit (USACE)
O&M	Operations and Maintenance
OCS	Outer Continental Shelf
OEM	Original Equipment Manager
OESP	Offshore Electrical Service Platform
OPC	Opinion of Probable Cost
OSA	Offshore Study Area
OSW	Offshore Wind
OTM	Offshore Transformer Module
psf	Pounds per Square Foot
SBMT	South Brooklyn Marine Terminal
SSP	Steel Sheet Pile
USACE	U.S. Army Corps of Engineers
WEA	Wind Energy Area
WTIV	Wind Turbine Installation Vessel

Executive Summary

This New York State Offshore Wind Assessment of Ports and Infrastructure is one of a collection of studies being prepared on behalf of the State. This study addresses the needs and capacity of New York State's port facilities to support the implementation of offshore wind (OSW) along the New York Bight. This study aims to assist New York's goal to acquire 50 percent of its electricity from renewable resources (such as wind and solar) by 2030, as part of New York's Clean Energy Standard.

This report provides OSW and port stakeholders with information necessary to assess New York's existing port infrastructure that could potentially be used for the future construction and maintenance of wind farms off of New York’s shores. Waterfront facilities play a critical role in all phases of OSW farms. Many large, heavy OSW components, such as nacelles, blades and foundations, can only be transported by water; therefore, manufacturing and fabrication facilities dedicated to a future OSW effort must be located on the water with their own wharves. Additional waterfront facilities will be needed to serve as installation and staging areas where components can be accumulated prior to being loaded onto the installation vessels and transported offshore. During both the construction and operations phases, crew transfer vessels will need to make frequent transits to the wind farm, transporting the technicians responsible for construction, planned maintenance, and unplanned repairs. The information presented herein is intended to be used as a basis for selecting the most readily available potential waterfront facilities, understanding potentially necessary upgrades, and determining each facility's most suitable function in the construction and maintenance of OSW farms.

This Study identified and investigated 54 distinct waterfront sites in New York Harbor and along the Hudson River, as well as 11 distinct areas, each of which contain multiple small sites, along the coast of Long Island. Twelve waterfront sites and five distinct areas are particularly notable for their potential to be used or developed into facilities capable of supporting OSW projects. These areas and sites are identified in the following table and are further detailed in Table 26. As a result of this study, a few of the waterfront sites were determined to be unavailable due to ongoing and planned operations.

Table ES-1. Waterfront Sites with Notable Potential to Support OSW Development

Area – Sub Area	Site
New York Harbor – Upper Bay	Military Ocean Terminal at Bayonne (MOTBY) Weeks Marine, Inc. South Brooklyn Marine Terminal (SBMT) Red Hook Brooklyn
New York Harbor – Newark Bay	Veckridge Chemical Co.
New York Harbor – Arthur Kill	Rossville Waterfront Vanbro Former GATX Site
New York Harbor – Raritan Bay	Werner Power Station
Hudson River Waterways – Tappan Zee Bridge to Mid-Hudson Bridge	Indian Point Energy Center
Hudson River Waterways – Mid Hudson Bridge to Dunn Memorial Bridge	Port of Coeymans Marine Terminal Port of Albany-Rensselaer
Long Island Waterways – Jones Inlet and East Hempstead Bay Area	Coast Guard Station at Jones Beach
Long Island Waterways – Great South Bay Area	Captree State Park Unqua Corinthian Yacht Club
Long Island Waterways – Shinnecock Bay Area	Oaklands Restaurant and Marina Shinnecock Inlet West Side-County Park
Long Island Waterways – Montauk Harbor Area	East Hampton Town Docks Montauk Marine Basin Inlet Seafood 9 Acre Compound
Long Island Waterways – Shoreham Inlet Area	Shoreham Nuclear Plant

Due to their location, size and accessibility, a number of potential sites in New York Harbor and on the Hudson River are particularly suitable for use as manufacturing and fabrication facilities. Nearly all identified sites require some level of infrastructure upgrades (minimal to significant) depending on the OSW activities intended for the site (e.g., manufacturing turbine blades, fabricating steel foundations). Particular sites of interest include, but are not limited to, Red Hook–Brooklyn, the South Brooklyn Marine Terminal (SBMT), the Port of Albany-Rensselaer, and the Port of Coeymans.

Five potential waterfront facilities were identified that may be used either as manufacturing and fabrication facilities or as staging and installation facilities, including Red Hook, SBMT, MOTBY, the decommissioned Werner Power Station, and the inactive Shoreham Nuclear Generating Station. Similar to many ports on the U.S. East Coast, there would be challenges to using these sites for staging and installation of OSW components. Red Hook, SBMT, and MOTBY are located upriver of the Verrazano Narrows Bridge. The "air draft" at the bridge, or the vertical clearance for vessels to safely navigate below the bridge, would require some components to be transported horizontally, rather than vertically as is typically preferred in Europe. The air draft of the bridge may prevent some installation vessels from transiting to the upriver sites. The other two sites, Werner Power Station and the Shoreham Nuclear Generating Station, would require significant investment and redevelopment as they not currently functioning waterfront terminals.

Several areas along the Long Island coast, such as Montauk Harbor, display potential to serve as operations and maintenance facilities with only minor upgrades required due to their available acreage, proximity to inlets, and existing waterfront infrastructure.

It may be possible to build new facilities on undeveloped/greenfield areas along the Hudson River and Long Island coast (there are virtually no undeveloped areas in New York Harbor), although new construction would likely require substantial community and political support and significant environmental mitigation. Due to the length of available shoreline and challenges associated with developing a greenfield site, these undeveloped areas were typically not catalogued by this study unless they were located adjacent to existing facilities in close proximity to a navigable inlet. Several waterfront sites identified on Long Island are located on public lands (state and municipal parkland, public docks, etc.). In comparison to private property, repurposing public lands requires a different and potentially more challenging process. Developing an operations and maintenance (O&M) facility on public lands would require substantial political support, stakeholder involvement and environmental approvals.

In order to investigate New York's port capabilities, this study was broken into several tasks, including: studying existing OSW port facilities; determining facility requirements, which was based on investigating existing and next generation OSW components and vessel operations required to move those components; and completing a desktop assessment to identify and assess potentially viable waterfront sites in New York that could be used as an OSW port. An Opinion of Probable Cost analysis for likely site preparation and upgrade activities was prepared (using concept designs for three heavy load rating piers), including design, permitting, and construction.

As determined by the case studies of completed OSW projects, the most significant facility parameters necessary to support various stages of OSW development generally include sufficient upland staging area, wharf structure live load capacity, air draft, navigable channel depth, accessible wharf frontage, and interface with other transportation modes. Table ES-2 summarizes the range of the values for significant facility parameters per facility type, combining all key components. The recommended facility parameters are intended to be used as a general guideline when identifying and selecting potential facilities and when planning for infrastructure upgrades at the selected facility. Recommended facility parameters were also used to develop the representative upgrade scenarios, for which costs were approximated for typical infrastructure upgrades based on the associated load capacity.

Table ES-2. Summary of Significant Facility Parameters

	Minimum Upland Staging Area	Minimum Wharf Live Load Capacity	Minimum Air Draft	Minimum Navigable Channel Depth	Minimum Wharf Length
Manufacturing and Fabrication Facility Parameters[a]	6 hectares (15 acres) - 10 hectares (25 acres)	2 metric tonnes (MT)/sq.m (500 pounds per square foot [psf])[b] - 20t/sq.m (4000 psf)	15m (50 feet [ft.])[b] - 120m (400 ft.)[c]	4m (13 ft.)[d] - 12m (38 ft.)[5]	50m (165 ft.) - 200m (650 ft.)[e]
Staging and Installation	10 hectares (25 acres)	20MT/sq.m (4,000 psf)	120m (400 ft.)	4m (13 ft.)[d] - 12m (38 ft.)[5]	100m (330 ft.)[d] – 200m (650 ft.)[f]
Operations and Maintenance	4 hectares (10 acres)	2MT/sq.m (500 psf)	20m (65 ft.)	5m (16 ft.)	20m (65 ft.)

Notes:

[a] Includes the manufacturing and fabrication of nacelles, towers, blades, foundations and cables.

[b] Minimum requirement for horizontal transport of turbine or foundation components.

[c] Minimum requirement for vertical transport (preferred) of turbine or foundation components.

[d] Minimum requirement based on feeder barge concept.

[e] Recommended parameter for latest generation wind turbine installation vessel (WTIV).

[f] Minimum requirement based off latest generation WTIV

The results of this Study present State and local governments, agencies, developers, contractors, manufacturers, and other OSW stakeholders with an outline of the capabilities of the port infrastructure assets available in New York State to support future OSW development.

1 Introduction

This Assessment of Ports and Infrastructure (Study) is one of a collection of studies prepared on behalf of New York State in support of the New York State Offshore Wind Master Plan (Master Plan). These studies provide information on a variety of potential environmental, social, economic, regulatory, and infrastructure-related issues associated with the planning for future offshore wind (OSW) energy development off the coast of the State. When the State embarked on these studies, the initial focus was on a study area identified by the New York State Department of State (DOS) in its two-year Offshore Atlantic Ocean Study (DOS 2013). This original study area, the "offshore study area (OSA)," is a 16,740-square-mile (43,356-square-kilometer) area of the Atlantic Ocean extending from New York City and the south shore of Long Island to beyond the continental shelf break and slope into oceanic waters to an approximate maximum depth of 2,500 meters (refer to the Master Plan for a depiction of the OSA). While the location of future OSW development is planned in an area encompassing much of the original OSA, each of the State's individual studies ultimately focused on a geographic Area of Analysis (AoA) that was unique to that respective study. The AoA for this study is described below in Section 1.1.

The State envisions that its collection of studies will form a knowledge base for the area off the coast of New York that serves a number of purposes, including (1) informing the preliminary identification of potential wind energy areas that were submitted to the Bureau of Ocean Energy Management (BOEM) on October 2, 2017 for consideration and further analysis; (2) providing current information about potential environmental and social sensitivities, economic and practical considerations, and regulatory requirements associated with any future OSW energy development; (3) identifying measures that could be considered or implemented with OSW projects to avoid or mitigate potential risks involving other uses and/or resources; and (4) informing the preparation of a Master Plan to articulate New York State's vision of future OSW development. The Master Plan identifies potential future wind energy areas for BOEM's consideration, discusses the State's goal of encouraging the development of 2,400 megawatts (MW) of wind energy off the New York coast by 2030, and sets forth suggested guidelines and best management practices that the State will encourage to be incorporated into future OSW energy development.

Each of the studies was prepared in support of the larger effort and was shared for comment with federal and State agencies, indigenous nations, and relevant stakeholders, including non-governmental organizations and commercial entities, as appropriate. The State addressed comments and incorporated feedback input into the studies. Feedback from these entities helped to strengthen the quality of the studies, and also helped to ensure that these work products will be of assistance to developers of proposed OSW projects in the future. A summary of the comments and issues identified by these external parties is included in the Outreach Engagement Summary, which is appended to the Master Plan.

The Energy Policy Act of 2005 amended Section 8 of the Outer Continental Shelf Lands Act to give BOEM the authority to identify OSW development sites within the Outer Continental Shelf (OCS) and to issue leases on the OCS for activities that are not otherwise authorized by the Outer Continental Shelf Lands Act, including wind farms. The State recognizes that all development in the OCS is subject to future review processes and decision-making by BOEM and other federal and State agencies. Neither this collection of studies nor the Master Plan commit the State or any other agency or entity to any specific course of action with respect to OSW energy development. Rather, the State's intent is to facilitate the principled planning of future offshore development off the New York coast, provide a resource for the various stakeholders, and encourage the achievement of the State's OSW energy goals.

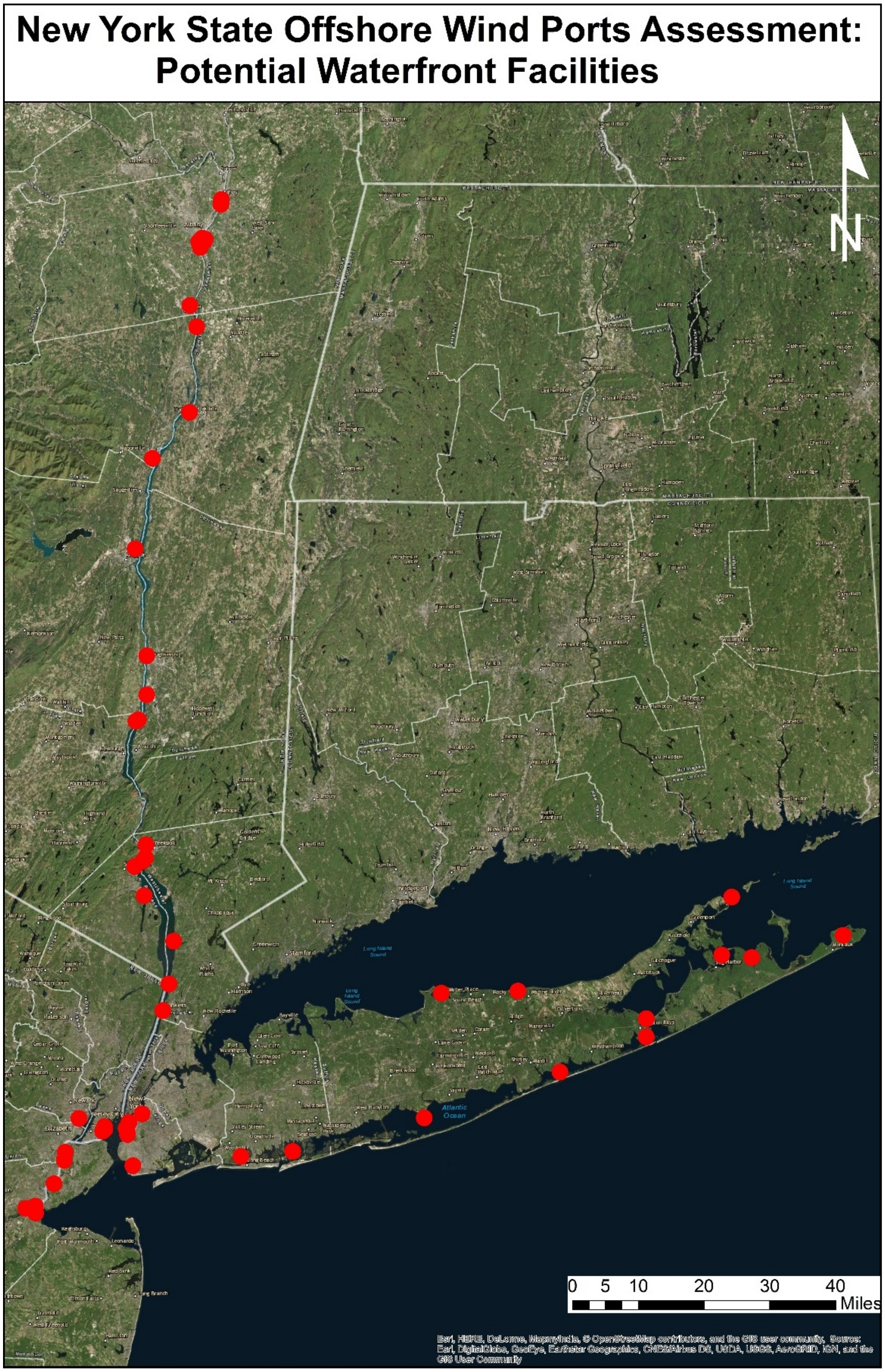
The intent of this OSW ports study is to evaluate and illustrate the potential of New York ports to fulfill the needs of the OSW industry. This will provide readily accessible information for developers, manufacturers, fabricators, and other OSW port stakeholders to consider when deciding to support or pursue business and investment opportunities in the New York OSW market.

1.1 Scope of Study

New York State has a rich and robust maritime history. Throughout its history, waterfront facilities have been developed to service the needs of a variety of water-dependent uses. As a result, New York has a strong maritime tradition with a capable workforce and numerous waterfront facilities. There are 54 distinct waterfront sites and 11 distinct areas along the New York Harbor, Hudson River, and Long Island coast that could be considered to serve the needs of OSW development to 2030 and beyond. Each potential site is identified by a red dot on Figure 1, the AoA for this Study. Potential sites, which include both public and private properties, were identified based on the parameters critical to facilitating OSW operations. Operating parameters were determined by examining existing European markets and facilities, which have been developing since 1991, as well as the latest best practices for OSW installation and construction. Based on these parameters, most potential waterfront facilities in New York State will require some level of modification or upgrade in order to meet the specific demands of the OSW industry.

Figure 1. Potential Waterfront Facilities in New York State

Source: COWI (December 2017); ESRI (ArcGIS, World Imagery Basemap)



In order to evaluate New York State's needs and capacity to develop and integrate OSW as a renewable source of energy, this New York Offshore Wind Ports Assessment is broken into the following tasks:

- **Case Studies**
  Select European and forerunner US waterfront facilities were examined in order to identify the key characteristics that enable those facilities to support OSW operations.
- **Port Requirements**
  Based upon current industry best practices, existing and projected component sizes and the vessels anticipated to transport those components were tabulated to determine waterfront facility requirements. The major component parameters used to identify these requirements are associated with technology anticipated to be installed in the 2020-2030 time frame.
- **Facility Development and Upgrade Considerations**
  Part of this study involved developing a basic understanding of the costs associated with developing a waterfront site to support future OSW endeavors. While development costs can vary widely and are specific to each site, certain infrastructure is necessary at all sites. This study prepared representative OSW port concept designs based on facility purpose and typical site preparation activities. A corresponding range of Opinions of Probable Cost (OPC) for the upgrades was then prepared. As these OPCs are not site specific, costs are presented as typical unit cost per infrastructure upgrade (e.g., cost per extra-heavy- load-rated Turbine Installation Vessel pier) to allow for extrapolation at multiple sites, where possible.
- **Identify and Assess Potential Waterfront Sites**
  A desktop assessment of potential sites within New York Harbor and along the Hudson River and Long Island was completed using publicly available information. For each site, the compilation included relevant site information and tabulated existing characteristics of the site, according to the categories developed in the port requirements task. The compiled facility characteristics may be used to determine the feasibility of using and/or developing each site to serve as either a manufacturing and fabrication, staging and installation, or operations and maintenance facility.

Through this study, the State, developers, and manufacturers are provided with information that can be used to decide where to locate future OSW manufacturing and fabrication facilities, staging and installation facilities, and operations and maintenance facilities to service OSW energy development in the New York Bight.

2 Offshore Wind Port Case Studies

Europe is the world leader in OSW energy development. As of January 26, 2017, Europe has commissioned 12,631 MW of installed capacity from 3,589 turbines, according to a recent report from *WindEurope*. The report further states that, in 2016, Europe added 338 new offshore turbines totaling a net 1,558 MW of installed grid capacity, and 11 more projects, totaling approximately $19.9 billion and 4,948 MW of new capacity, reached Final Investment Decision.

In the U.S., Deepwater Wind commissioned the Block Island Wind Farm (BIWF) in December 2016. BIWF is located 6.1 kilometers (km) (3.8 miles) southeast of Block Island, Rhode Island, in the Atlantic Ocean. The 5-turbine, 30 MW project is the first—and currently only—operational OSW farm in the U.S.

Europe's experience in the development of OSW facilities over the past decades, through both successes and failures, offers relevant guidance for the U.S. industry, providing current infrastructure requirements and a basis for projecting future demands of the industry. This study considers examples of existing European facilities that are currently in operation or are undergoing upgrades to facilitate OSW development. It is noted that a number of additional port facilities in Europe and elsewhere have contributed to OSW developments. Two U.S. ports are included in the case studies to provide insight into how U.S. ports are beginning to be developed to plan for the needs of a future OSW industry along the Northeast Atlantic Coast.

This study examines existing European OSW facilities in order to identify specific characteristics that support OSW development. Notable factors that contribute to successful facilities are described in detail in Section 3. Principal considerations include factors such as upland area, wharf dimensions, wharf and upland load capacity, navigable channel depth, and air draft restrictions.

2.1 European Offshore Wind Ports

2.1.1 Offshore Wind Port Bremerhaven, Germany

Table 1. Offshore Wind Port Bremerhaven, Germany Summary

Port Summary	

Owner	Bremenports GmbH & Co. KG / BIS Bremerhavener Gesellschaft für Investitionsförderung und Stadtentwicklung mbH (Bremerhaven Economic Development Company)
Upland Area	178 hectares (440 acres)
Wharf Length	ABC-Halbinsel: 900m (3,000 feet [ft.]) Container Terminal 1: 500m (1,600 ft.) Labradorhafen: 1,130m (3,700 ft.) OTB: 500m (1,600 ft.)
Load Capacity	ABC-Halbinsel: 10MT/m^2 (2,000 pounds per square foot [psf]), with a maximum of 1,000MT (1,100 tons) for single components Container Terminal 1: 5MT/m^2 (1,000 psf), with a total maximum weight of 60MT (65 tons) Labradorhafen: 7MT/m^2 (1,500 psf) OTB: 51MT/m^2 (10,500 psf), 20MT/m^2 (4,000 psf) on the wharf, and 10MT/m^2 (2,000 psf) in the terminal area

Table 1 continued

Navigable Depth	ABC-Halbinsel: 10.5-11m (34-36 ft.) Container Terminal 1: 12.5-14.5m (41-48 ft.) Labradorhafen: 7.60m (25 ft.) OTB: 14.10m (46 ft.)
Lock Restrictions	ABC-Halbinsel: 305x55m (1,000x180 ft.) Container Terminal 1: none Labradorhafen: 182x35m (600x115 ft.) OTB: none
Air Draft	Unlimited
Transportation	Railway access available on site. The facility is within 2.5 km (1.5 miles) of a highway

Comments. The Port of Bremerhaven, as seen in Table 1, is located in northern Germany at the mouth of the River Weser. The port's robust infrastructure and proximity to the North Sea have contributed to Bremerhaven's ongoing participation in OSW projects. The Port of Bremerhaven has supported several projects, including, in part, Germany's first OSW endeavor, Alpha Ventus, and the Nordsee Ost OSW farm. Some of Bremerhaven's clients include Adwen, Senvion SE, and PowerBlades. The port consists of four terminals: Labradorhafen, Offshore Terminal Bremerhaven (OTB), Offshore Terminal ABC-Halbinsel, and Container Terminal 1.

The European Commission has granted subsidies for OTB, since they consider the Port of Bremerhaven to be a driving factor for the development of OSW in the region. OTB is undergoing facility upgrades, originally scheduled for completion by 2015. The current build out of OTB is scheduled for the beginning of 2019; however, construction operations are currently halted due to ongoing legal proceedings. The site development of Luneort (former area of a small airport) was scheduled for 2016, but this was also postponed by the legal dispute. Luneort, together with the former industrial park Luneplate, which is also subject to development, are expected to provide an additional area of around 300 hectares (740 acres).

2.1.2 Cuxhaven, Germany

Table 2. Cuxhaven, Germany Summary

Port Summary

Owner	Cuxport GmbH (owned by Rhenus SE & Co. KG and HHLA Container Terminals Gesellschaft mbH)
Upland Area	Terminal 1: 245 hectares (600 acres) Terminal 2: 18 hectares (45 acres)
Wharf Length	Terminal 1: 840m (3,000 ft.) Terminal 2: 250m (820 ft.)
Load Capacity	Deck: 20MT/m^2 (4,000 psf)
Navigable Depth	Terminal 1: 15.80m (52 ft.) at one berth, 13.50m (45 ft.) at two berths, and 6.50m (21 ft.) at one berth Terminal 2: 14.50m (48 ft.) at one berth, and 8m (26 ft.) at one berth
Lock Restrictions	N/A
Air Draft	Unlimited
Transportation	Railway access available. The facility is within 2 km (1.2 miles) of a heavy traffic motorway and 120 km (75 miles) of the nearest international airport

Comments. The Port of Cuxhaven, as seen in Table 2, is located at the mouth of the Elbe River, in northern Germany. The Port, which was not developed as a deepwater port until 1997, boasts access to the North Sea and the Baltic Sea by way of the Kiel Canal. Cuxhaven has provided staging, fabrication, and maintenance facilities for OSW projects in the North Sea. The port consists of two facilities: Terminal 1 (Europakai) and Terminal 2 (Steubenhöft).

Construction is ongoing at the Port of Cuxhaven. Additional berths at Terminal 1 are scheduled to be available in 2017, including an additional area of 8.5 hectares (21 acres) and an additional 290m (950 ft.) of wharf.

2.1.3 Esbjerg, Denmark

Table 3. Esbjerg, Denmark Summary

Port Summary

Owner	Municipality of Esbjerg
Upland Area	450 hectares (1,100 acres) (scheduled for fall 2017)
Wharf Length	See Table 4
Load Capacity	N/A
Navigable Depth	10.30m (34 ft.) MHWS
Lock Restrictions	N/A
Air Draft	Unlimited
Transportation	Direct railway and highway access, airport 15 minutes away by road

Comments. The Port of Esbjerg is one of the leading ports in Europe in terms of handling and exporting wind power. The port played a key role in the rise of Denmark's OSW industry which launched over a decade ago with the installation of the world's first large-scale OSW farm, Horns Rev I. Today the Port of Esbjerg has facilities and areas for transporting, pre-assembling, exporting, and servicing OSW turbines. Due to the significant amount of available space, Siemens Wind Power ships a significant number of offshore turbines through this port.

Table 4. Properties of the sites of the Port of Esbjerg

	Length	**Navigable Channel Depth**
Nordhafnen	5,000m (16,500 ft.) total	10.50m (34 ft.)
Trafikhafnen	2,000m (6,500 ft.) total	7.50-11.50m (25-38 ft.)
Dokhavnen	1,025m (3,300 ft.) total	6.70m (22 ft.)
Sønderhavnen consisting of: Humberkaj, Baconkaj, Smørkaj, Englandskaj, Østre Forhavnskaj, Vestkraftkaj and Europakaj	Equipped with facilities for ferry and container traffic, offshore activities, and general cargo	8.40-10.50m (28-34 ft.)
Atlantkaj	250m (820 ft.)	10.50m (34 ft.)
Australienkaj	290m (950 ft.)	10.50m (34 ft.)
Arieskaj	400m (1,300 ft.)	10.50m (34 ft.)
Tauruskaj	380m (1,200 ft.)	10.50m (34 ft.)
Geminikaj	330m (1,000 ft.)	10.50m (34 ft.)
Østhavnen: Leokaj	150m (500 ft.)	10.50m (34 ft.)
Østhavnen: Virgokaj	545m (1,800 ft.)	10.50m (34 ft.)
Østhavnen: Librakaj	180m (600 ft.)	9.30m (31 ft.)

2.1.4 Eemshaven, the Netherlands

Table 5. Eemshaven, the Netherlands Summary

Port Summary	
	
Owner	Groningen Seaports
Upland Area	93 hectares (230 acres)
Wharf Length	Beatrixhaven: 1,200m (4,000 ft.) Julianahaven: 1,200m (4,000 ft.) Emmahaven: 500m (1,600 ft.)
Load Capacity	Deck: Beatrixhaven: 30MT/m² (6,000 psf) Julianahaven: 2.5-20MT/m² (500-4,000 psf) depending on location Emmahaven: 4-6MTm² (800-1,200 psf)
Navigable Depth	Beatrixhaven: 7.50m (25 ft.) Julianahaven: 11.5m (38 ft.) Emmahaven: 7.50m (25 ft.)
Lock Restrictions	N/A
Air Draft	Unlimited
Transportation	Helipad, convenient railway access

Comments. Eemshaven, as seen in Table 5, is situated close to the North Sea and is well equipped to support OSW farms. The port offers service and maintenance locations, adequate storage area, and high-load-capacity quays and jetties, which makes this location convenient as a staging, marshalling, or service port. Eemshaven is strategically located near existing and planned OSW farm sites.

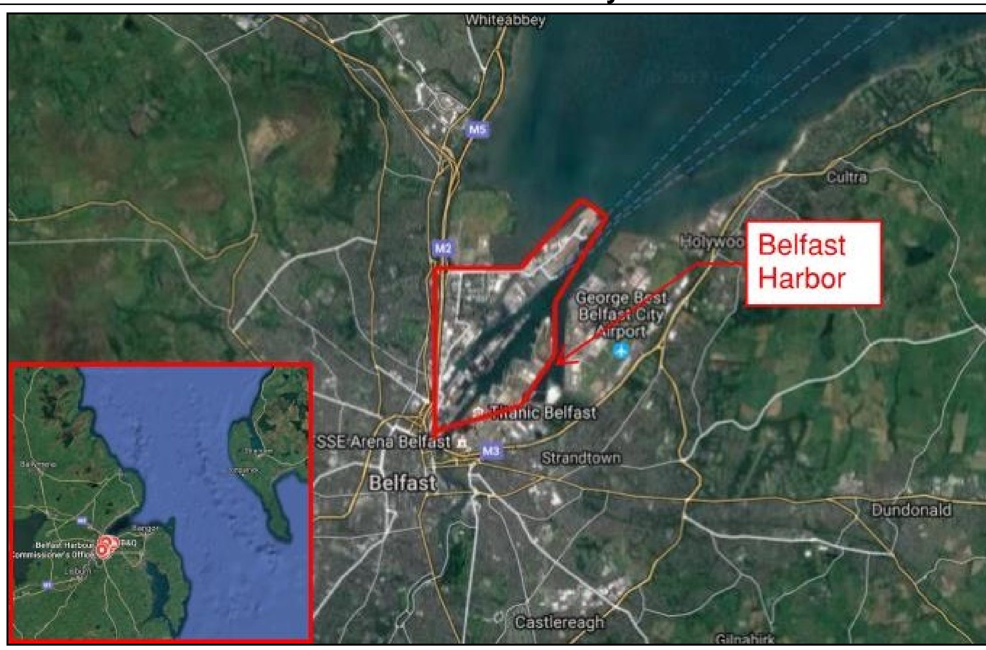
The following is a non-inclusive list of wind farms that were launched from the Eemshaven: Alpha Ventus, Bard Offshore I, Borkum Riffgat, Merkur Offshore, Borkum Riffgrund I, Trianel Windpark Borkum, Global Tech I, Gemini, Gode Wind I & II, Veja Mate, and Race Bank. Currently, the port is supporting the construction of the wind farm Nordsee One, and Merkur Offshore is scheduled to begin construction activities from Eemshaven in the near future.

Beatrixhaven, Eemshaven's newest harbor basin, is dedicated entirely to OSW projects. Julianahaven and Emmahaven are also parts of the large port area where OSW operations take place. Jacking is permitted in Beatrixhaven, not allowed in Emmahaven, and permitted in Julianahaven at a minimum of 13m (43 ft.) away from the quay wall.

2.1.5 Belfast Harbor D1 Offshore Wind Terminal, Northern Ireland

Table 6. Belfast Harbor D1 Offshore Wind Terminal, Northern Ireland Summary

Terminal Summary



Terminal Summary	
Owner	N/A
Upland Area	40.5 hectares (100 acres), with an additional 41 hectares (110 acres) zoned for industrial use
Wharf Length	480m (1,500 ft.) heavy-duty quay
Load Capacity	Deck: 50MT/m² (10,000 psf)
Navigable Depth	11.50m (38 ft.)
Lock Restrictions	N/A
Air Draft	Unlimited
Transportation	N/A

Comments. The development of OSW farms in the Irish Sea has enabled Belfast Harbor to develop the D1 Offshore Wind Terminal for Ørsted, as seen in Table 6. In 2012 and 2013, it was a key asset in the successful delivery of the West of Duddon Sands Wind Farm (108 turbines), a joint venture between Ørsted and Scottish Power Renewables. Belfast Harbor has extensive waterfront development sites suitable for the development of quayside facilities for manufacturers.

2.2 U.S. Offshore Wind Ports

2.2.1 New Bedford Marine Commerce Terminal, Massachusetts, USA

Table 7. New Bedford Marine Commerce Terminal, Massachusetts, USA Summary

Terminal Summary

Terminal Summary	
Owner	Port of New Bedford (managed by the Massachusetts Clean Energy Center)
Upland Area	10.5 hectares (26 acres)
Wharf Length	305m (1,000 ft.)
Load Capacity	Deck Uniform Loads: 20MT/m² (4,000 psf)
Navigable Depth	8.6m (28 ft.)
Air Draft	Unlimited
Transportation	Site is within 4 km (2.4 miles) of Interstate 195

Comments. The New Bedford Marine Commerce Terminal, as seen in Table 7, is one of the first facilities in North America designed to support the construction, assembly, and deployment of OSW projects. When operational, it is expected to support the construction of OSW farms in federal leasing areas off the coasts of Massachusetts and Rhode Island. The port of New Bedford is protected from ocean storms by the Elizabeth Islands, as well as a 5.6-km (3.5-mile) -long hurricane barrier, which temporarily narrows the navigable channel to a width of 46m (150 ft.).

The terminal area was an abandoned brownfield until 2013 when construction of the terminal began under the management of the Massachusetts Clean Energy Center. Originally intended to support the Cape Wind project, the terminal has been relatively unused since Cape Wind canceled their lease of the facility in 2015. In September 2016, three OSW developers, Deepwater Wind, Ørsted's U.S. subsidiary Bay State Wind, and Vineyard Wind, cosigned a two-year lease to use the terminal as a staging facility for local OSW projects as part of the state's goal to produce as much as 1,600 MW from OSW power by 2027. All three companies have procured leasing rights to federal waters off the coasts of Massachusetts and Rhode Island.

Targeting the unique demands of the OSW industry, the terminal can accommodate vessels with an overall length of up to 167.6m (550 ft.) and a beam of 12.4m (80 ft.). Over 8.5 hectares (21 acres) of the facility have a high load capacity, allowing for cranes of all sizes to be mobile throughout the site.

2.2.2 Quonset Business Park - Port of Davisville, Rhode Island, USA

Table 8. Quonset Business Park - Port of Davisville, Rhode Island, USA Summary

Port Summary	
	
Owner	Quonset Development Corporation
Upland Area	3.2 hectares (8 acres) for the three berths and 20.2 hectares (50 acres) of yard storage capacity
Wharf Length	Four berths at two piers, each berth approximately 365.8m (1,200 ft.) long
Load Capacity	Pier 1: 1.5-2.4MT/m^2 (300-500 psf) Pier 2: 2.9-4.9MT/m2 (600-1,000 psf) with a maximum of 9.7MT/m^2 (2,000 psf)
Navigable Depth	9.8m (32 ft.)
Air Draft	Newport Bridge - 59m (194 ft.) or Jamestown Bridge - 41m (135 ft.)
Transportation	Railway access is available. The site is within 14.5 km (9 miles) of Interstate 95. The site is adjacent to Quonset Airport.

Comments. Quonset - Port of Davisville, as seen in Table 8, played a key role in Deepwater Wind's Block Island Project. Quonset served as the principal port for the project's heavy installation vessels over a two-year period. In addition, various project materials such as steel jackets and cable arrived at Quonset. Deepwater Wind has its own worker and equipment facility on-site at Quonset.

The port has a 150MT (165 short tons) mobile harbor crane, which allows handling of a wide range of project cargoes, including some OSW components (e.g., tower sections, blades). The Atlantic Pioneer, the first U.S.-built crew transfer vessel engineered to service OSW projects, is based at Quonset. The location of the Port of Davisville enables wind energy companies to participate in OSW projects from Cape Cod to New Jersey.

Quonset Development Corporation was awarded a $22.3 million grant from the U.S. Department of Transportation to support wind energy manufacturing, logistics operations, and port infrastructure improvements at Quonset Business Park. In addition, Rhode Island's Governor Raimondo has proposed a $90 million investment in the Port of Davisville to extend the facility’s service life for an additional 50 years, which would ensure that this facility will continue to play a key role in future OSW projects.

3 Recommended Facility Characteristics

Waterfront facilities play a critical role in all phases of OSW farms. Many large, heavy OSW components, such as nacelles, blades, and foundations (see Section 3.1), can only be transported by water; therefore, the manufacturing and fabrication facilities must be located on the water with their own dedicated wharves. For a future OSW farm, installation facilities will serve as staging areas where components are accumulated prior to being loaded onto the installation vessels and transported offshore. During the operations phase, operations and maintenance (O&M) vessels will make frequent transits to the wind farm, transporting the technicians responsible for planned maintenance and unplanned repairs.

This study has determined the minimum and recommended parameters for each facility type by examining existing ports (Section 2), primary OSW components moving through the ports, and the vessels used to transport and install OSW components. These recommendations are intended to support OSW development in and around New York State from 2020 to 2030 and beyond.

3.1 Major Offshore Wind Components

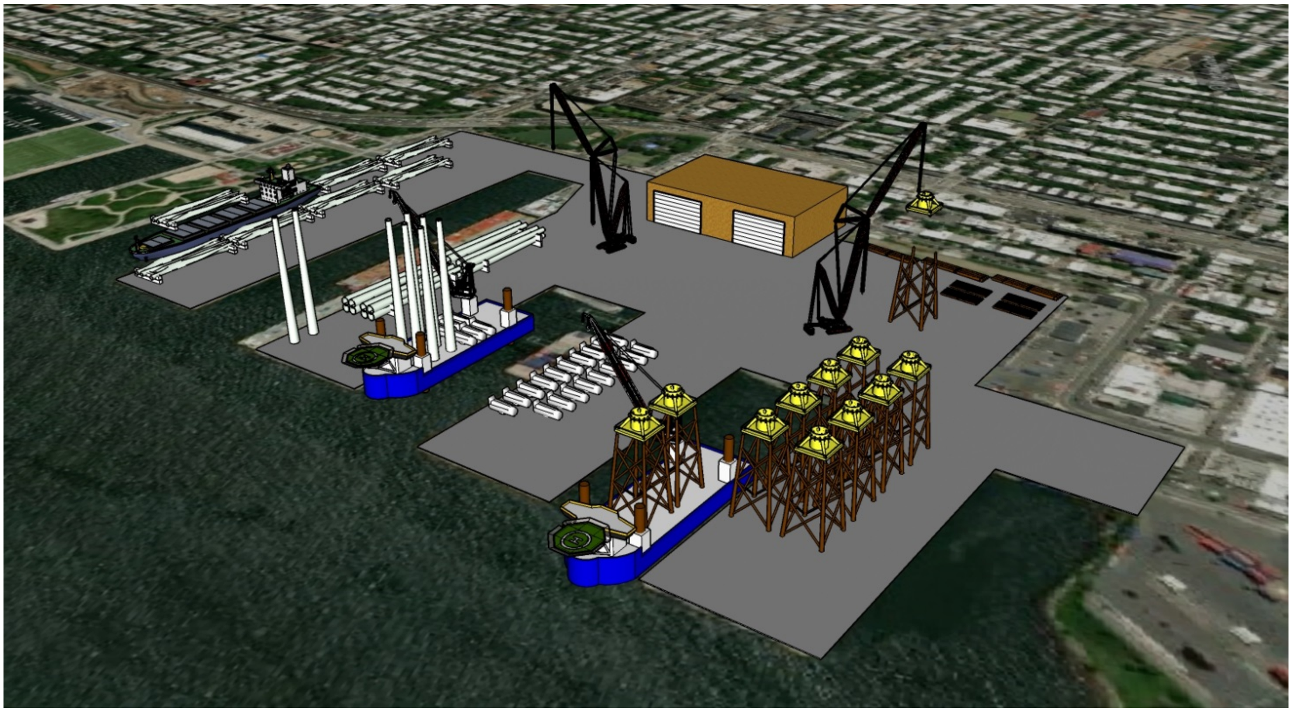
In order to understand each future facility's service requirements, it is first necessary to understand the components that will be handled by the facilities. Figure 2 shows a representative staging facility, handling a variety of components, as envisioned at Red Hook Brooklyn.

This section presents major specifications of OSW component projected to be installed through 2030. Based on these projected specifications, the anticipated OSW vessels utilized to transport and install the components are discussed in Section 3.2. Finally, the resulting required facility parameters are quantified in Section 3.4.

For projects developed in the 2020–2030 time frame, it is anticipated that bottom-fixed turbine foundation types will remain the most cost-effective solutions for projects in the New York OSA. The areas within the OSA likely to be developed first are in relatively shallow water. Floating turbine foundations are more commonly used in deeper waters, greater than 50m (165 ft.) and are unlikely to be necessary to meet New York State's 2,400 MW capacity goal. While there is considerable interest in the development of floating OSW technology in the U.S., it is unlikely that such technology will be deployed at a utility scale in the subject time frame. Due to the widely varying technology used by floating turbines, the facility requirements for floating turbines also vary widely. Therefore, this facility assessment focuses primarily on commonly accepted bottom-fixed foundation technologies.

Figure 2. Representation of a staging facility, as envisioned at Red Hook Brooklyn

Source: COWI 2017; Trimble Inc. (SketchUp, Google Earth Imagery)



3.1.1 Turbines

OSW turbine development has been characterized by significant technological advances within relatively short innovation cycles. Unconstrained by typical onshore wind farms' restrictions, such as the logistical limits posed when transporting large components via roadways, OSW turbine technology is trending towards larger and more powerful turbines in all respects (rotor diameter, hub height, tower diameter, component masses). Figure 3 shows a representation of a facility manufacturing blades for 8 MW offshore turbines, as could be envisioned at the Port of Albany-Rensselaer. The prevailing wind turbine technology is the three-bladed horizontal axis wind turbine. This technology is expected to remain the status quo into the 2020s. It is not the intent of this facility assessment to report on individual model specifications; therefore, data from leading turbine suppliers (e.g., Adwen, GE, MHI Vestas, and Siemens Wind Power) have been generalized and presented in Table 9. Turbine manufacturers consider specifications of future turbines as highly confidential proprietary information; therefore, the characteristics of turbine technology for 2025 and 2030 are understood to be estimations that entail a degree of uncertainty.

Figure 3. Representation of a blade manufacturing facility, as envisioned at the Port of Albany-Rensselaer

Source: COWI 2017; Trimble Inc. (SketchUp, Google Earth Imagery)

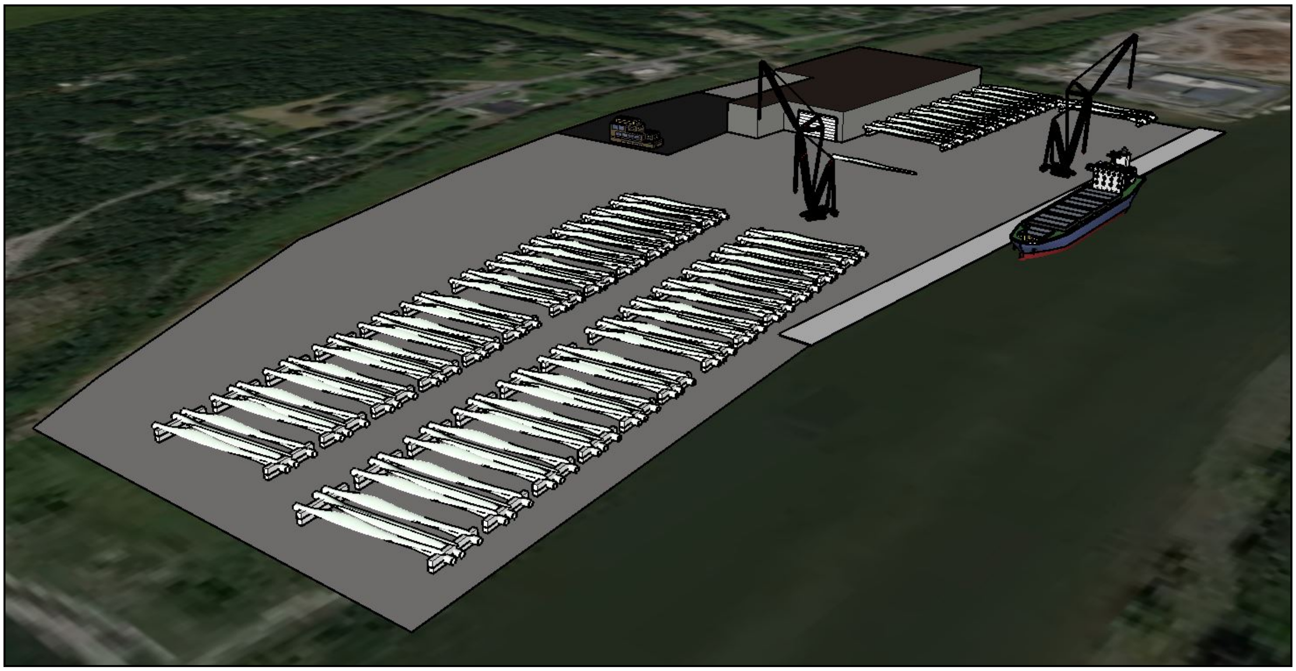


Table 9. Representative Wind Turbine Key Characteristics

Year	Rated Output	Blade Length	Rotor Diameter	Blade Weight	Tower Length	RNA Weight	Tower Bottom Diameter	Nacelle Dimensions Height / Width / Length
2010	3-4 MW	60m (200 ft.)	120m (400 ft.)	25 MT (28 tons)	70m (230 ft.)	250 MT (275 tons)	5m (16 ft.)	4/4/14m (13/13/50 ft.)
2017	6-8 MW	80m (260 ft.)	160m (520 ft.)	35 MT (38 tons)	90m (300 ft.)	460 MT (500 tons)	6.5m (21 ft.)	7/7/20m (23/23/65 ft.)
2025[a]	10-15 MW	90-100m (300-330 ft.)	180-200m (590-650 ft.)	~45 MT (~50 tons)	~110m (~360 ft.)	~550 MT (~600 tons)	~8m (~26 ft.)	10/10/25m (33/33/82 ft.)
2030[a]	15-20 MW	100-125m (330-410 ft.)	200-250m (650-820 ft.)	~55 MT (~60 tons)	~135m (~440 ft.)	~650 MT (~720 tons)	~9m (~30 ft.)	10/10/25m (33/33/82 ft.)

Note:

[a] estimated.

Key:

RNA = Rotor Nacelle Assembly

Naturally, the specific details regarding the future development of wind turbines are difficult to accurately predict. However, it is reasonable to assume that wind turbine capacity will increase to 10 MW with rotor diameters of up to 200m (650 ft.) by 2025, and to a range of 10 to 20 MW between 2030 and 2050 (DNVGL 2017).

3.1.2 Foundations

A wide variety of bottom-fixed foundation structure types have been proposed for OSW farms around the world, and they can be categorized into three principal structure types: monopile, jacket, and gravity-based foundation (GBF) concepts. A number of hybrid and variant concepts (e.g., suction bucket, twisted jacket, etc.) have been proposed and are in various stages of technological development. Foundation variants do not result in significant changes to facility requirements and therefore are considered within the primary structure types.

Based on the development of projects in Europe, it is anticipated that when offshore development begins off the state of New York, the most advantageous wind farm sites will be developed first. Thus, it is expected that site selection for future OSW development will be driven by high wind speeds, shallow water depth, and favorable soil and wave conditions, which corresponds directly to a lower levelized cost of energy. It is likely that proven foundation types will be deployed. Given the characteristics (e.g., water depth) of the New York OSA, it is likely that foundation dimensions for New York Offshore Wind Projects between 2020 and 2030 will be similar to those observed in Europe.

Monopile Foundations. Monopile foundations comprise the actual monopile, which is driven into the seabed, as well as a transition piece, which is typically grouted or bolted onto the monopile to facilitate connection to the turbine tower. Typical dimensions of monopile foundations that have been realized in Europe are summarized in Table 10. As of 2017, the latest monopile foundations have been designed for water depths approaching 40m (130 ft.). In water depths greater than 40m (130 ft.), monopile foundation design becomes more challenging and alternative concepts are preferred. Leading European monopile fabricators have recently completed facility upgrades that allow for fabrication of "XL monopiles" with diameters up to 10m (33 ft.).

Table 10. Typical dimensions of monopile foundations utilized and expected in the North Sea

Year	Monopile Diameter	Monopile Length	Typical Monopile Mass	Transition Piece Height	Transition Piece Mass	Water Depth
2010	4-6m (13-20 ft.)	40-60m (130-200 ft.)	400-800MT (440-880 tons)	15-25m (50-80 ft.)	100-250MT (110-275 tons)	15-30m (50-100 ft.)
2017	6-8m (20-26 ft.)	50-80m (165-260 ft.)	800-1300MT (880-1430 tons)	15-30m (50-100 ft.)	200-400MT (220-440 tons)	30-40m (100-130 ft.)
2025[a]	8-10m (26-33 ft.)	70-90m (230-300 ft.)	1,200-1,600MT (1,320-1,760 tons)	15-30m (50-100 ft.)	300-550MT (330-600 tons)	40-50m (130-165 ft.)
2030[a]	8-12m (26-40 ft.)	> 100m (> 330 ft.)	1,200-2,000MT (1,320-2,200 tons)	15–30m (50-100 ft.)	300-600MT (330-660 tons)	< 60m (< 200 ft.)

Note:

[a] estimated.

Jacket Foundations. Jacket substructures are typically selected when water depth and/or soil conditions do not favor installation of monopile structures. Foundation fabricators are currently working towards streamlining jacket fabrication into a serial production by using standard pipe sections and joint geometries to reduce fabrication cost. As only a limited number of projects with similar site conditions have been realized, the general foundation layout of jackets has not changed significantly over the past decade, although structural details vary for each project.

The dominant design concept is the 4-legged jacket. It consists of the jacket frame and a transition piece (typically assembled at the fabrication site). Pin piles, which may be pre-installed via a template or post-installed through the jacket legs, are required to anchor the foundation to the seabed. The dimensions of three representative jacket structure projects are presented in Table 11.

Table 11. Characteristic dimensions of existing jacket foundations in Europe

	Jacket Mass	Jacket Height	Footprint	Foundation Pile Length	Foundation Pile Diameter	Water Depth
Project 1	600MT (660 tons)	50m (165 ft.)	23 x 23m (75 x 75 ft.)	30-50m (100-165 ft.)	2.0-2.5m (7-8 ft.)	35m (115 ft.)
Project 2	850MT (940 tons)	70m (230 ft.)	24 x 24m (80 x 80 ft.)	30-60m (100-200 ft.)	2.0-2.5m (7-8 ft.)	45m (150 ft.)
Project 3	900MT (990 tons)	60m (200 ft.)	25 x 25m (82 x 82 ft.)	30-50m (100-165 ft.)	2.0-2.5m (7-8 ft.)	40m (130 ft.)

Future developments are primarily intended to lower the cost for fabrication and installation and thereby enable broader applications for jacket foundations in OSW projects.

Gravity-Based Foundations. Some of the first OSW projects were installed with GBFs. GBFs consist of large concrete elements, which are fabricated onshore, brought to the project site, lowered onto prepared gravel mats, and then filled with ballast for additional stability. GBFs rely on the size and mass of the structure, rather than driven piles, to support the turbines. The lack of specialized construction vessels, harsh sea ice conditions, and challenging soil conditions favored the early GBFs. With the subsequent development of specialized installation vessels, monopiles were favored for many of the projects that followed. However, for some recent projects (e.g., St. Nazaire, Fecamp), there is renewed interest in GBFs as water depths approach the economical limit for monopile installation. Furthermore, for the U.S. market, GBFs may become preferred foundation types because of the challenging pile driving conditions due to heterogeneous soil conditions (i.e., glacial till, boulders) found off the Atlantic Coast, especially offshore of New York. Representative dimensions from three existing projects with GBFs in Europe are summarized in Table 12.

Table 12. Characteristic dimensions of gravity-based foundations realized in Europe

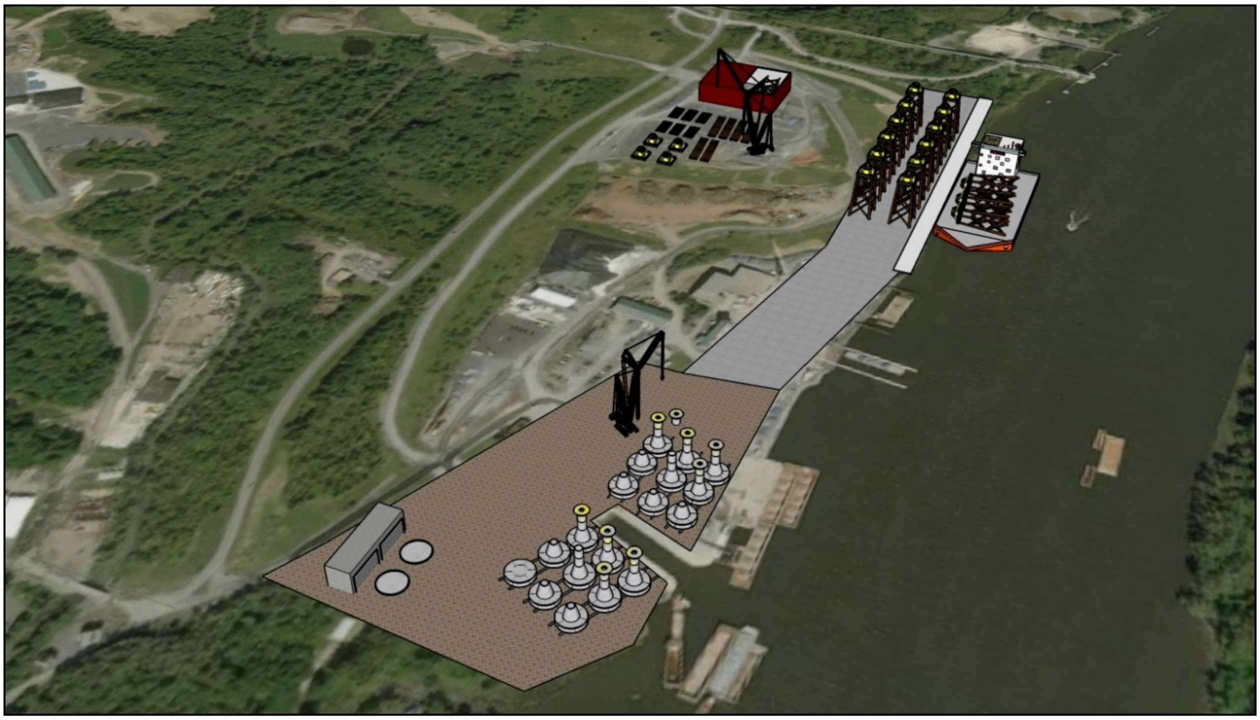
	Mass	Base Diameter	Structural Height	Water Depth
Project 1	3,000MT (3,300 tons)	17m (55 ft.)	45m (145 ft.)	28m (90 ft.)
Project 2	1,300MT (1,430 tons)	17m (55 ft.)	17m (55 ft.)	12m (40 ft.)
Project 3	3,000MT (3,300 tons)	30m (100 ft.)	50m (165 ft.)	30m (100 ft.)

Typical current generation tower bottoms observed on recent European OSW farms have diameters of 6.0m to 6.5m (19 ft. to 21 ft.). Within the next decade, diameters are likely to increase to approximately 8.0m (26 ft.). Similar dimensions are expected for OSW farms proposed in the New York OSA.

Figure 4 shows a representative GBF and jacket foundation manufacturing facility as envisioned at the Port of Coeymans.

Figure 4. Representation of a GBF and jacket foundation manufacturing facility, as envisioned at the Port of Coeymans

Source: COWI 2017; Trimble Inc. (SketchUp, Google Earth Imagery)



3.1.3 Cables

OSW farms require both inter-array cables, which electrically connect the turbines within the farm, and export cables, which connect the farm with the onshore grid. In general, however, facility infrastructure requirements do not vary between cable types. Typically, cables are loaded from the manufacturer fabrication site directly onto the cable-laying vessel, which travels directly to the installation site. If required, cables can be stored on dedicated vessels/barges at a port.

Table 13 provides general information for three commissioned OSW farms. Cable quantities, such as those shown below, can be transported by most modern dedicated cable-laying vessels in one transit.

Table 13. Cable information for commissioned OSW projects

Project Name	Year Commissioned	Number of Turbines	Total Nameplate Capacity	Total Length of Cable
Horns Rev 1 (Denmark)	2002	80	160 MW	Array: 63 km (39.1 miles) Export: 34 km (21.1 miles)
Nordsee Ost (Germany)	2015	48	295.2 MW	Array: 63 km (39.1 miles) Export: 8.4 km (5.2 miles)
BARD Offshore 1 (Germany)	2013	80	400 MW	Array: 112 km (69.6 miles) Export: 2.2 km (1.4 miles)

A number of turbine manufacturers are investigating the potential for increasing the inter-array cable voltage from 33 kilovolts to 66 kilovolts to facilitate the increase in rated turbine capacity. This technology change is not anticipated to result in changes to required facility parameters.

3.1.4 Offshore Electrical Service Platform

For wind farms located distantly from the point of electrical interconnection, typically more than approximately 10 km (6 miles) from shore, power is transmitted to shore through high-voltage alternating-current (HVAC) cables. HVAC transformer platforms are required in order to increase the voltage from the inter-array cabling to the export cable. If distance from shore exceeds approximately 70 km (45 miles), high-voltage direct-current (HVDC) technology may be considered for export cables. It is reasonable to assume the first wind farms developed off of New York State would be relatively close to shore and that only AC platforms would be required (if any).

As an alternative to the traditional stand-alone HVAC platform concept, Siemens has recently developed the offshore transformer module (OTM) concept, aiming to reduce component sizes considerably. OTMs are small, decentralized modules placed in standard containers that eliminate the need for a dedicated platform. Potentially one to three such modules could be sufficient for an entire wind farm. OTMs can be arranged on a separate foundation that is of the same type as the turbine foundation, or they can be combined together with a wind turbine on a single foundation. The first OTM scheduled to be installed in 2019 (Beatrice Offshore Wind Farm), with a second following in 2020 (Albatros Offshore Wind Farm). The decentralized modules show potential for a significant cost savings.

Table 14. Characteristic dimensions of electrical service platforms realized in Europe

	Platform Type	Topside Mass	Substructure Mass	Mass of Piles
Project 1	HVAC	1,100MT (1,200 tons)	1,900MT (2,100 tons)	1,000MT (1,100 tons)
Project 2	HVAC	2 x 1,200MT (2 x 1,320 tons)	1,100MT (1,200 tons); And 1,400MT (1,540 tons)	500MT (550 tons); 1,300MT (1,440 tons)
Project 3	HVAC	1,200MT (1,320 tons)	1,000MT (1,100 tons)	700MT (770 tons)
Project 4	HVDC	8,500MT (9,400 tons)	5,800MT (6,400 tons)	1,800MT (2,000 tons)
Project 5	HVDC	7,500MT (8,300 tons)	4,500MT (5,000 tons)	2,300MT (2,500 tons)

The equipment associated with HVDC technology is more expensive and requires more space on an offshore platforms, than as compared to an HVAC platform. This results in HVDC platforms that are larger and heavier than HVAC platforms, as can be seen in Table 14. For projects anticipated through 2030, two primary considerations prevent electrical service platforms from growing much larger. First, some redundancy is desirable; thus, very large wind farms may employ two platforms rather than one very large one. Second, offshore lifting capacity is limited and also expensive above certain thresholds.

Typically, both the platform topside and the foundation are loaded on a vessel at the fabrication site and then brought to the installation site. Though not necessary, the structures may be temporarily stored within a base port.

3.2 Vessel Operations

In order to define the parameters necessary for OSW facilities, it is important to understand the operations of the vessels calling at those facilities. A number of other OSW vessel studies have been completed for U.S. markets. This section explains the role of vessels as they affect facility parameters.

The current trend in marine transportation vessels (OSW, oil and gas, import/export, etc.) is to continually increase vessel size and cargo carrying capacity. For OSW, the trend toward larger vessels is due, in part, to the increase in turbine and foundation dimensions and weights. In addition, increased vessel size and carrying capacity corresponds to installing more components with fewer transits offshore, resulting in an overall lower energy cost. In Europe, the demand for larger vessels is expected to continue into the future as the sizes of turbines increase and the locations of wind farms move further offshore into deeper water.

While a similar trend is expected to eventually occur in the U.S., there are significant wind resource areas that can be developed with current generation OSW vessels. Shallower water, resulting in smaller and lighter foundations, means that smaller vessels may be adequate.

3.2.1 The Jones Act

The Merchant Marine Act of 1920, more commonly known as the Jones Act, requires that all goods transported by water between U.S. ports be transported by U.S.-flagged ships constructed in the U.S., owned by U.S. citizens, and crewed by U.S. sailors. This study assumes that sufficient vessels compliant with the Jones Act will be available to support future offshore development when necessary.

3.2.2 Vessel Calls

A cursory analysis was completed to determine the approximate number of vessel calls at the staging port(s) that may be anticipated to install the wind turbines and foundations for hypothetical wind development off of New York State in the future. In this scenario, which is based on New York's stated goal of encouraging 2,400 MW of OSW development by 2030, approximately 735 trips may be expected, including vessels transporting major components from the manufacturing facilities to the staging facility and the wind turbine installation vessels (WTIVs) moving from the staging facility to the OSW project. Campaign trips from the staging port to the OSW site via WTIV are based upon the parameters outlined in the "U.S. Jones Act Compliant Offshore WTIV Study" (GustoMSC 2017). A variety of vessels, including barges and heavy lift vessels, are assumed to transport components from the manufacturing facility to staging port. Therefore, it should be noted that the number of vessel calls may vary based upon transport methods chosen. Table 15 details the assumptions regarding each vessel, their characteristics, and the number of components transported. The analysis does not include vessel calls associated with offshore electrical service platforms, cables, or crew transfers. The key assumptions are listed below:

- Total Installed OSW capacity by 2030: 2,400 MW.
- Average Capacity per Turbine: 8 MW.
- WTIV design: GustoMSC NG-9800C-US (GustoMSC 2017).
- Installation completed in three campaigns:
    - Campaign 1: Install four foundation piles within pile-driving template.
    - Campaign 2: Install four-leg jacket substructure on foundation piles.
    - Campaign 3: Install wind turbine tower, nacelle, and blades.
    - Foundation piles and jacket substructures transported to staging facility by barge.

- Wind turbine tower and nacelle transported to staging facility by heavy lift project cargo vessel.
- Wind turbine blades transported to staging facility by barge.

Table 15. Principal Information per Vessel Type

Vessel Type	Hull Length	Hull Breadth	Hull Draft	Number of Components
WTIV[a]	127.8m (419 ft.)	42m (138 ft.)	5.8m (19 ft.)	Campaign[b] 1: 16 pin piles, guide frame
				Campaign 2: 4 jackets
				Campaign 3: 4 sets of tower sections + nacelles + blades
Heavy Lift Project Cargo Vessel[c]	130m (427 ft.)	25m (82 ft.)	4m (13 ft.)	5 full tower section, 5 nacelles[c]
Barge 1[d]	91.4m (300 ft.)	30.5m (100 ft.)	5.5m (18 ft.)	2 jackets, 2 sets of foundation piles
Barge 2[d]	91.4m (300 ft.)	24.4m (80 ft.)	5.5m (18 ft.)	6 blades

Notes:

[a] Based upon the GustoMSC NG-9800C WTIV model.

[b] Campaign refers to the specified trip from staging port to OSW site.

[c] Nacelles (5) and tower full sections (5) ship together to the staging site via heavy lift project cargo vessel.

[d] Based on Cashman's ABS deck barges used for Deepwater Wind's BIWF

3.2.3 Component Transport Vessels

Primary components (e.g., turbines, foundations) are typically manufactured or fabricated at a centralized location and then transported to the staging facility prior to being loaded onto installation vessels for the trip offshore. Heavy lift or breakbulk project cargo vessels are used to transport components from the manufacturing facilities to the staging facilities. Alternatively, depending on proximity to the offshore site, some manufacturing facilities may ship components directly.

Figure 5. Wikinger Jackets transported by barge

Source: Bladt Industries 2017

In the U.S., a significant percentage of large breakbulk project cargo is transported by barges, which are plentiful throughout U.S. waters. Figure 5 depicts the jacket foundations used for the Wikinger (Germany) project being transported by barge, an example that could be re-created using the existing U.S. barge fleet. As the OSW industry develops, additional specialized vessels may be added to the U.S. fleet.

3.2.4 Turbine and Foundation Installation Vessels

The recommendations developed by this study for staging and installation facilities are based on a number of assumptions. Following the European experience, facility capacities are based primarily on the assumption that offshore installation will be the critical path in the turbine deployment rate.

This analysis assumes that turbines (rotor, nacelle, and tower) and foundations will be installed using specialized WTIVs. WTIVs are "jack-up" vessels, which have the capability to lift themselves out of the water in order to perform lifting operations independent of the water level and sea state. WTIVs are typically loaded by jacking up adjacent to the installation facility wharf and using the WTIV's onboard crane. Soil preparation or strengthening of sea floor at the port may be required to enable repeated jacking operations.

WTIVs and their ports of call do not require the same deep draft necessary for large modern cargo vessels (e.g., container and tanker vessels). Although WTIVs are becoming larger, even the latest generation vessels are much smaller than commercial cargo vessels. In Table 16, typical WTIV dimensions are compared to those of a Neo-Panamax Container vessel. To determine the minimum efficient facility operating parameters, this study based its recommended development model on the capabilities of the latest generation wind installation vessels under construction for the European and Asian OSW markets.

Table 16. Dimension Comparison of a Cargo Vessel to a WTIV

	Neo-Panamax Container Vessel	Latest Generation WTIV
Length Overall	365m (1,200 ft.)	50-180m (160-600 ft.)
Beam	49m (160 ft.)	20-60m (65-200 ft.)
Loaded Draft	15m (50 ft.)	6-9m (20-30 ft.)
Cranes	Land-based Gantry 45-72MT (50-80 tons)	Vessel-based heavy lift 540-1,500MT (600-1,650 tons)

3.2.5 Cable Installation Vessels

Cable-laying vessels are typically loaded with their cable reels at the cable manufacturer and thus do not require significant berthing facilities at staging and fabrication facilities.

3.2.6 Operations and Maintenance Vessels

Crew and support vessels can use smaller, local facilities, thereby reducing demand for small vessel facilities at the staging and fabrication facilities.

O&M activities at OSW farms will require vessels to transport technicians, equipment, replacement components, and lubricants to and from the wind farm. European OSW farm operators have used a number of vessel types and sizes, including monohulls, catamarans, and small waterplane area twin-hull vessels.

High-speed catamarans have become a favored vessel type by OSW farm operators due to the seakeeping ability, cargo capacity, relative comfort to crew and passengers, speed, and fuel efficiency. Table 17 details approximate specifications that have been noted as typical to O&M service vessels built within the last three years in Europe.

Table 17. Service Vessel Specifications

Service Vessel Specifications	
Length Overall	15-19.7m (50-64 ft.)
Beam	6-10m (20-33 ft.)
Draft	1.5-2m (4-6 ft.)
Crew	2-3
Passengers	12
Onboard Crane	3-4MT (3-4 tons)
Cargo Area	12-40m2 (130-425 ft.^{2})
Service Speed	20-25 knots
Endurance (@ Service Speed)	18-24 hours
Range	550-950 km (300-500 nautical miles)

The number of service vessels required to support an OSW farm varies based on a number of factors, including but not limited to: number of turbines, turbine model, distance from port, age of the farm, speed of the vessel, carrying capacity and endurance of the service vessel, available weather windows, and available working hours on site. Based on observations of European operators, one crew vessel can support a maximum of 80 turbines, with one vessel per 30 turbines being more common.

The broad range in the number of vessels required is evidence of rapidly evolving O&M strategies as larger projects move further offshore. As Original Equipment Manufacturers (OEMs) continue to gain experience offshore and new technologies are being developed and tested, larger and more powerful turbines are being designed to require fewer service visits.

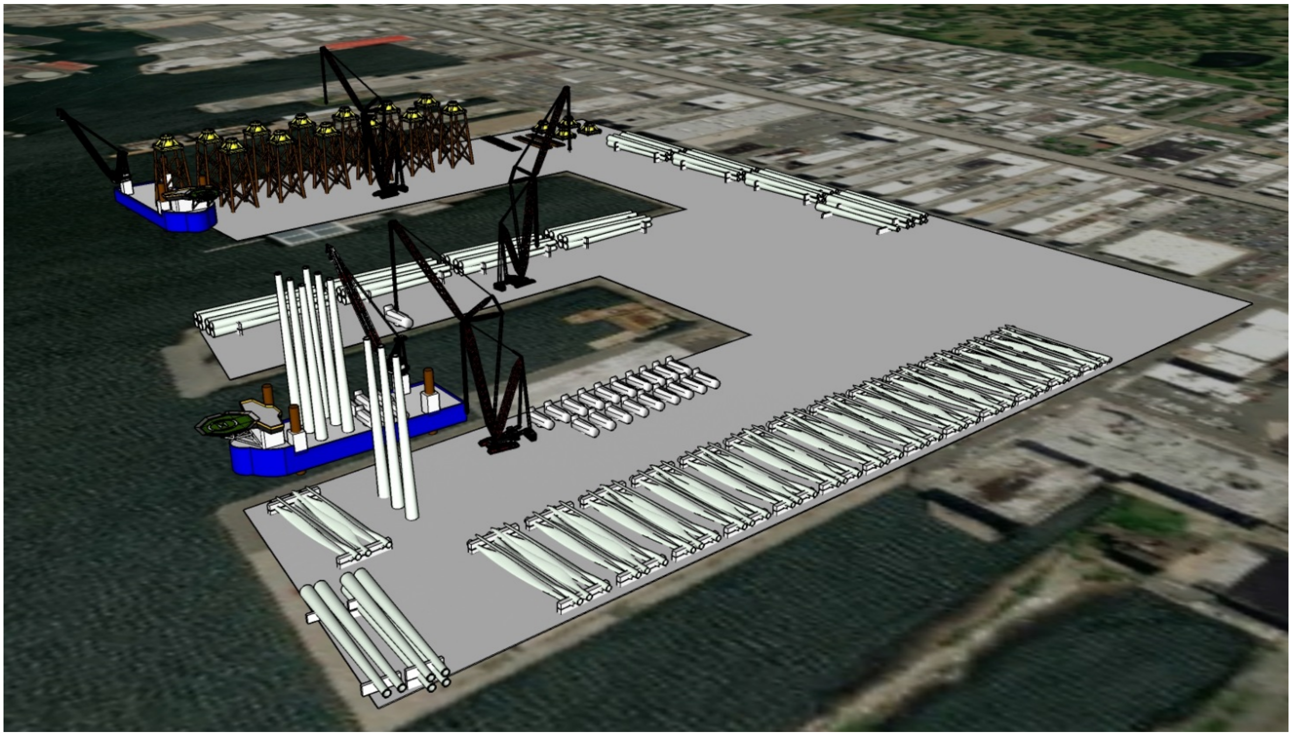
Major unplanned malfunctions may require large installation class jack-up vessels, similar to those used to install the turbines. These vessels are not typically assigned to any particular wind farm. The types of repairs that require these vessels may include replacing the gearbox, one or more blades or the hub, or the entire nacelle.

3.3 Facility Parameters

This study identified key facility parameters associated with major OSW components and vessel operations through the examination of existing OSW facilities. Because these parameters will vary based on facility type, they were further defined based on manufacturing and fabrication, staging and installation, and operations and maintenance facilities. The values presented are the minimum recommended to support the OSW industry from 2020 to 2030 and beyond. A representation of a staging facility handling a variety of components, as envisioned at South Brooklyn Marine Terminal, is shown in Figure 6.

Figure 6. Representation of a staging facility, as envisioned at the South Brooklyn Marine Terminal

Source: COWI (December 2017); Trimble Inc. (SketchUp, Google Earth Imagery)



This section quantifies the facility parameters needed to support various stages of OSW development. These parameters are based on the case studies, the expected dimensions of the OSW equipment, and the characteristics of the vessels described in sections 3.1 and 3.2. These parameters include the following:

- Upland area
- Wharf length
- Live load capacity
- Navigable depth
- Air draft
- Interface with other transportation modes

These parameters are indicative guidelines derived from observing successful practices in the OSW industry. However, the values presented here should not be considered absolute requirements. Atypical and developing technological logistics alternatives may accommodate variations from the published values. For example, OSW components in Europe are typically transported by heavy lift ships; in the

U.S., a significant amount of this transportation would be handled by intracoastal barges, which require less navigable depth than their European equivalents. Waterfront terminal selection should be based, in part, on the role of the facility and the vessels intending to call there.

In addition to the above parameters, a number of other parameters are important to the operational success of an OSW port. These parameters are not necessarily specific to the location of a particular facility; they relate more to operations and services that should be available to the offshore contractor. Facility parameters are discussed qualitatively in this section. Minimum and recommended facility parameters for specific types of facilities are specified in Sections 3.4 through 3.6.

3.3.1 Upland Area

Upland area may be defined as the total landside area of a facility. Upland areas may be used for component manufacturing or fabrication of components, storing or staging of completed components, or assembly of subcomponents prior to being loaded onto the WTIV. Many European ports encompass areas of 40.5 hectares (100 acres) and greater. These large-scale facilities are able to support multiple operations (e.g., foundation and superstructure components) and, in some cases, multiple OSW farms in varying capacities throughout the farms' construction and operation. The recommendations for upland area presented in this section are generally intended to be the minimum required space for a facility to be functional for a single purpose (e.g., blade manufacturing, foundation staging). There may be operational, schedule, and cost benefits to facilities with greater upland area at which multiple operations can be colocated.

3.3.2 Wharf Length

Wharf length is the linear distance available to vessels loading and unloading components at the berth. The minimum wharf length is determined by the berth layout and the size and configuration of vessels calling at the berth. There must be sufficient space for transport vessels to load and unload components and other cargo. In addition to the transport vessels, installation facilities must provide berthing facilities for WTIVs. Due to their high day rates and frequent material loading requirements, best practices observed in Europe suggest that contractors and owners provide exclusive wharf access for the WTIVs. The facility operator should consider the dimensions and type of vessel that will call at that location. Due to the nature of the cargo, it is recommended that the length of the wharf exceed the vessel length by approximately 10m (33 ft.).

3.3.3 Live Load Capacity

Wharf Capacity. OSW components are extraordinarily heavy, even by industrial maritime shipping standards. Most OEMs prefer to work at facilities with a minimum deck live load capacity of $10t/m^2$ (2,000 psf). Newer terminals intended for OSW service in Europe are being constructed with capacities approaching and exceeding $20t/m^2$ (4,000 psf). Piers and wharves with a lower-rated deck live load may be used; however, weight distribution strategies of lower capacity wharves may restrict component movements and reduce the material handling efficiency. The current trend in Europe is for significantly higher deck capacity to accommodate larger turbines and foundations for deeper waters. The recommended wharf capacities in this study reflect the anticipated demands of the OSW industry by 2030 and beyond.

Staging Area Live Load Capacity. Live load capacity in staging areas may be somewhat less than the capacity at the wharf. However, staging area live load requirements still exceed the capacity found in many U.S. waterfront facilities.

3.3.4 Navigable Depth

WTIVs constructed within the last three years typically require 6-8m (20-26 ft.) of water depth when fully loaded. In order to allow for tidal fluctuations and the latest WTIVs, terminals for OSW construction should have a minimum of 9m (29.5 ft.) of water available at mean low water. Some heavy lift transport vessels may require additional water depth. All design vessels should be evaluated in conjunction with the facility. Water depths presented in this study are relative to mean lower low water.

3.3.5 Air Draft

Various logistics strategies may require that some components be transported in a vertical position. For example, turbine installation vessels are most efficient when towers are transported vertically and preassembled. Turbine manufacturers typically do not permit tower sections to be transported horizontally once they have been outfitted. Transporting the towers in shorter vertical sections is possible, but it increases offshore construction time. Jackets may be transported upright to save space on the installation vessel or material barge.

Restrictions on air draft (i.e., the vertical clearance between the water's surface and the maximum height above the water) can take several forms. Bridges and utility lines over navigable waterways limit the height of a vessel in transit. The vessel may be limited not only by the components carried on deck, but some jack-up vessels may be limited due to the height of their jack-up legs in the transport position. The latest generation of jack-up vessels used in Europe and proposed for the U.S. market have jack-up leg lengths approximately 90-95m (295-310 ft.) long. These vessels are unable to transit below New York area bridges. New York State is currently investigating additional vessel strategies, including alternative jack-up vessel designs and feeder barge strategies to mitigate the challenge of transiting below New York's bridges so that some of New York's existing waterfront facilities can be used as staging ports. The results of these investigations will be published in other reports.

Additional air draft restrictions may be due to the vicinity to approach guide slopes to airports. Military considerations (low-level flight training routes, defense radar interference) may also limit air draft at a port or along the installation vessel route. The air draft restrictions presented in this study are relative to Mean High Water (MHW).

For early wind projects in the UK, it had been suggested that installation facilities have a minimum of 100m (330 ft.) air draft from the staging area all the way to the OSW farm. However, due to increasing turbine and foundation sizes, most developers and contractors prefer sites with unlimited air draft.

It may be possible to utilize sites with more limited air draft restrictions by shipping some components horizontally, or completing more of the installation (e.g., blades installed onto hub) offshore. However, offshore installation is typically less efficient, resulting in increasing overall construction prices and high energy costs.

3.3.6 Access to Other Transportation Methods

Logistics are a major consideration in all large construction projects. Proximity to rail, highway, and airport connections will all be valuable to a staging and fabrication facility. Facilities may require personnel to arrive from other locations on short notice; therefore, proximity to an airport is beneficial.

3.3.7 Additional Facility Operations Capabilities

A number of additional facility operations capabilities are important to operations of an OSW facility. While the occurrence or prevalence of these capabilities may have direct or indirect cost impacts, they may or may not provide substantial differentiators between facilities.

Steaming Distance. Traditional marine cargo terminals are often located upriver, as far inland as possible, to reduce the need for more expensive land transportation. OSW port facilities benefit from being closer to project sites, which reduces transit times and offshore costs for the installation and material transport vessels.

Navigable Channel Width. Offshore wind installation vessels generally have wide beams and, depending on configuration, larger components might hang over. However, it is possible to carry components in other configurations; therefore, most channel widths in and around New York Harbor can accommodate installation vessels.

Competent Sea Floor at Berth. Due to the weight and sensitivity of components, some critical lifts may be performed by the crane onboard the WTIV. WTIVs often jack-up in the harbor, adjacent to the berth, in order to reduce risks associated with vessel movements due to lifting heavy components. The sea floor adjacent the berth must be competent (dense sand or gravel, rock, etc.) in order for the jacking operation to be completed safely. The availability of wharfs where jacking operations are possible may also be a limiting factor, so this should be evaluated at the time of facility selection. The seabed must be free from other navigational hazards, such as pipes, cables, and submerged structures.

Quay Width. Staging and installation facilities must have an unobstructed level area inshore of the wharf face in order to manipulate components. Turbine OEMs have recommended that 40-50m (130-165 ft.) of unobstructed open space be made available upland of the berthing face.

On-Site Heavy Lift Transport. Due to the weights and sizes of OSW components, staging and fabrication facilities must have heavy lift capabilities to move components around the site. Heavy lift cranes, self-propelled modular trailers, and skidding rails are all potential methods. In order for some equipment to operate safely, OSW port facilities must be flat.

Security. Staging and fabrication facilities must be secure facilities. The minimum security level must be compliant with the U.S. Coast Guard's Maritime Security system known as MARSEC. Other security requirements include gated access with security guard, closed-circuit television cameras, and lighting. OEMs may require higher levels of security.

Working Hours. Offshore construction occurs 24 hours per day, seven days per week. Fabrication and staging facilities should be located in areas where sounds and lights associated with loading ships around the clock will not create disturbances to adjacent properties. Upland fabrication and pre-assembly noises can be controlled to some degree; however, these activities are still loud and can disturb local residents.

Utilities. The full range of utilities will be required at a fabrication and staging facility, including electricity, potable water, wastewater, trash collection, recycling, and hazardous material disposal.

Office Space. Office space must be provided for project management staff, owner's engineers, turbine OEM's engineers, and any other staff anticipated to play a role in a project.

Covered Storage. Covered storage is required to store equipment and materials that should not be exposed to the elements. Covered storage is more important to a manufacturing facility than a staging facility; however, both facility types require covered storage. A number of components that make up wind turbines, such as nacelles and blades, are manufactured in controlled environments. Completed components, once ready for offshore installation, are typically stored outdoors and do not require covered storage in the staging areas. For a staging facility, the amount of covered storage will depend on the turbine model selected. For a fabrication facility assembling steel foundations, it would be advantageous to have a paint shop on-site to apply marine coatings and paint to the finished foundation components. O&M facilities require some protected storage area to keep stock components for maintenance.

3.4 Manufacturing and Fabrication Port Parameters

Due to their size and weight, most major OSW components are manufactured or fabricated at waterfront facilities. Manufacturing processes are defined as operations producing a significant quantity of substantially the same product (e.g., nacelles), whereas fabrication processes produce a smaller quantity of similar but varying products (e.g., jackets for varying water depths).

Manufacturing and fabrication facilities must provide sufficient areas for production and for storing completed components. Different amounts of space are required depending on the type of component provided. In addition, some facility components requiring intensive capital investment (e.g., those for nacelle manufacturing) may be intended to service larger areas, which will further increase the required on-site staging area. Some space is required for parking, office, and cafeteria facilities; however, the amount of space required for on-site management personnel is relatively insignificant compared to the area required for the other operations.

The requirements for primary waterfront manufacturing facilities are provided below.

3.4.1 Turbines (Nacelle, Blades, Hub, Towers)

Offshore wind turbines are produced at a few select, large, capital-intensive facilities. Blades and towers can be produced at collocated or independent facilities and can be built more readily. Figure 7 below shows a representative nacelle manufacturing facility, as envisioned at the Port of Albany-Rensselaer. Table 18 summarizes the facility parameters associated with turbine manufacturing and fabrication.

Figure 7. Representation of a nacelle manufacturing facility, as envisioned at the Port of Albany-Rensselaer

Source: COWI (December 2017); Trimble Inc. (SketchUp, Google Earth Imagery)

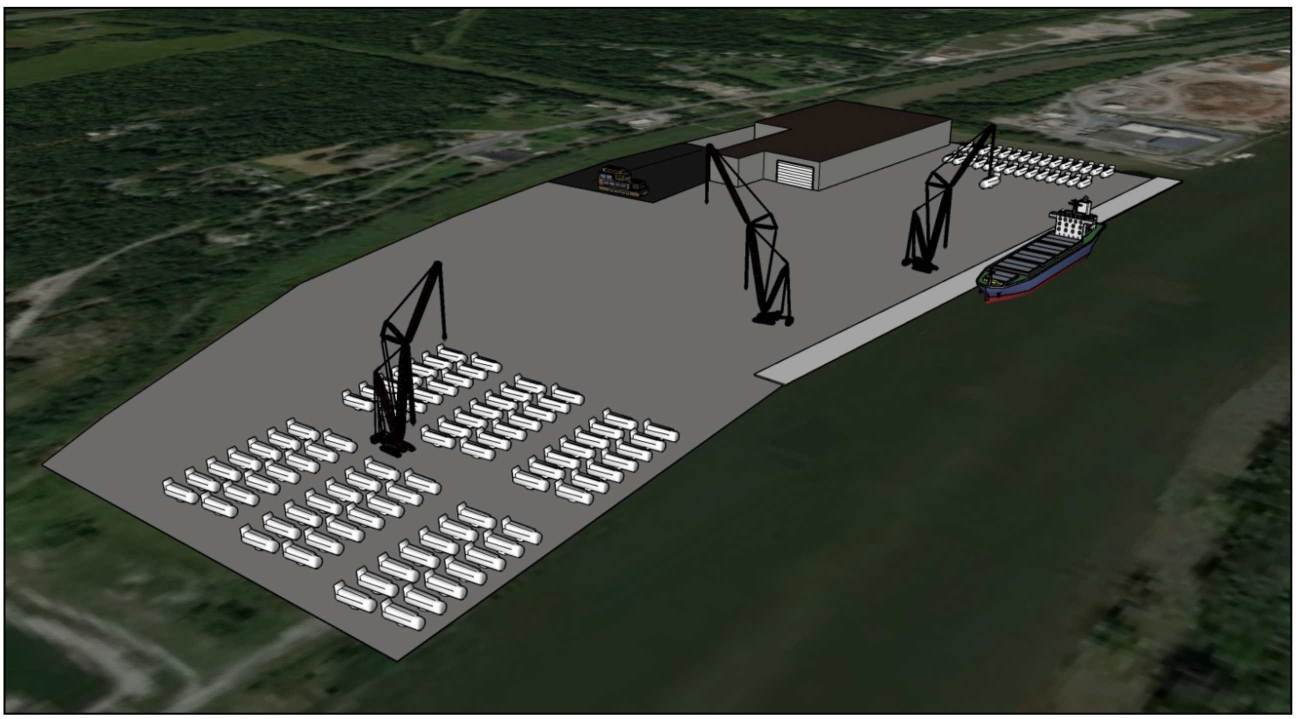


Table 18. Turbine Manufacturing and Fabrication Facility Parameters

	Upland Staging Area	Wharf Live Load Capacity	Air Draft	Navigable Channel Depth	Wharf Length[e]
Nacelle	10 hectares (25 acres)	20MT/m² (4,000 psf)	120m (400 ft.)[a] 15m (50 ft.)[b]	12m (38 ft.)[c] 4m (13 ft.)[d]	50m (165 ft.)
Tower	10 hectares (25 acres)	10MT/m² (2,000 psf) 5MT/m² (1,000 psf)[e]	120m (400 ft.)[a] 15m (50 ft.)[b]	12m (38 ft.)[c] 4m (13 ft.)[d]	50m (165 ft.)
Blade	10 hectares (25 acres)	10MT/m² (2,000 psf) 2MT/m² (500 psf)[e]	120m (400 ft.)[a] 15m (50 ft.)[b]	12m (38 ft.)[c] 4m (13 ft.)[d]	120m (400 ft.)

Notes:

[a] Minimum requirement for vertical transport (preferred).

[b] Minimum requirement for horizontal transport.

[c] Recommended parameter for latest generation WTIV.

[d] Minimum requirement based on transport barge concept.

[e] Minimum requirement for single-purpose facility.

3.4.2 Foundation

Required facility parameters vary based on the foundation selected, and storage area can vary based on the water depth even within a foundation type, as seen in Table 19. Fabrication of steel structures is very different from the serial construction of large-volume concrete structures in terms of storage, deck loads, and logistics. For example, transition pieces (for monopiles) must be stored upright so that the corrosion protection coating is not damaged. Storage areas should be paved to avoid pitting from sandy or gravelly surfacing. Transition pieces also require interior equipment to be installed and must remain upright after its installation. Figure 8 shows a representative GBF manufacturing facility, as envisioned at the Port of Coeymans.

Due to the weight of GBFs, it can be difficult to maintain pavement surfaces, so casting yards are often gravel surfaces over solid fill piers that can be repaired quickly and cheaply following onshore transport of the heavy load.

Table 19. Foundation Manufacturing and Fabrication Facility Parameters

	Upland Staging Area	Wharf Live Load Capacity	Air Draft	Navigable Channel Depth	Wharf Length
Monopile	10 hectares (25 acres)	20MT/m² (4,000 psf)	18m (60 ft.)[b]	12m (38 ft.)[c] 6m (20 ft.)[d]	200m (650 ft.)[e] 130m (4230 ft.)[f] 80m (262 ft.)[d]
Jacket	10 hectares (25 acres)	20MT/m² (4,000 psf)	70m (230 ft.)[a] 30m (100 ft.)[b]	12m (38 ft.)[c] 4m (13 ft.)[d]	50m (165 ft.)
GBF	10 hectares (25 acres)	20MT/m² (4,000 psf)	Concept dependent	Concept dependent	Concept dependent

Notes:

a Minimum requirement for vertical transport (preferred).

b Minimum requirement for horizontal transport.

c Recommended parameter for latest generation WTIV.

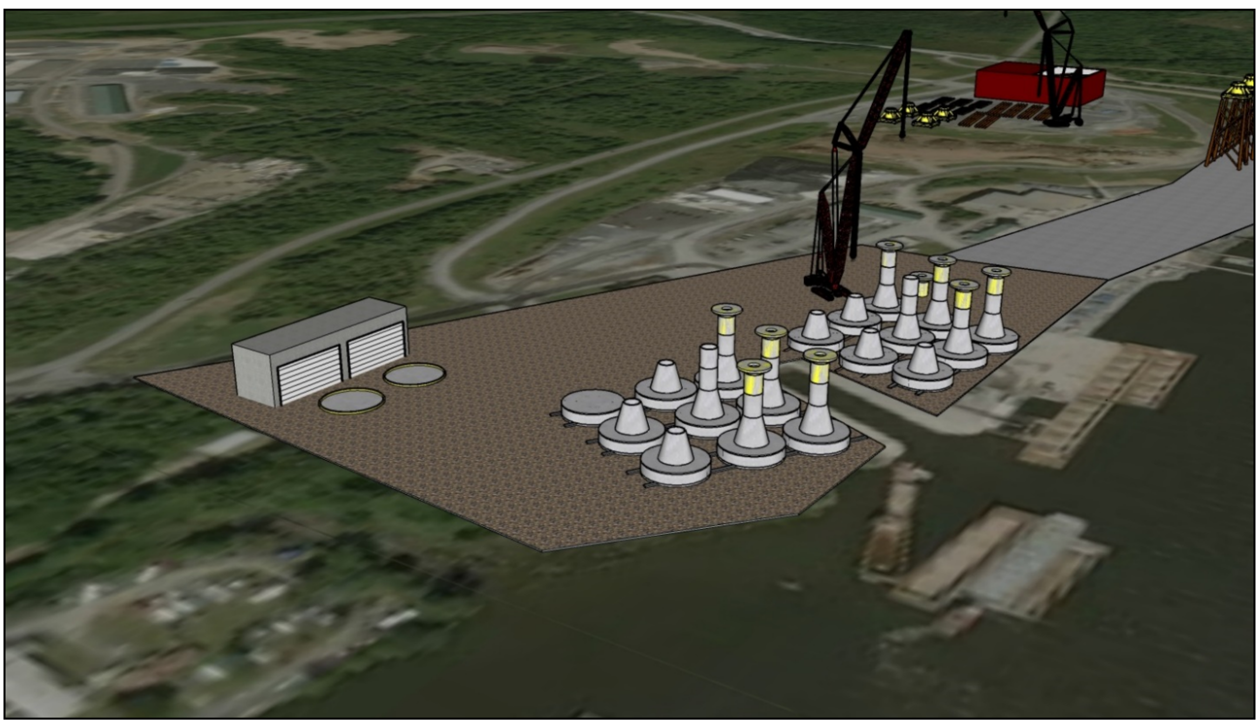
d Minimum requirement based on transport barge concept.

e Minimum requirement based off latest generation WTIV.

f Minimum requirement based off 1st generation WTIV.

Figure 8. Representation of a GBF manufacturing facility, as envisioned at the Port of Coeymans.

Source: COWI (December 2017) Trimble Inc. (SketchUp, Google Earth Imagery)



3.4.3 Cables

Submarine cables are transported on rotating carousels located directly on the cable installation vessel. Due to the weight of the carousels and risk to damaging the cable, most submarine cables are loaded onto the installation vessel directly from the cable manufacturer's facility. Due to the niche specialty of manufacturing submarine cable, few examples are available for analysis. The values presented in Table 20 are produced based on observations at existing facilities.

Table 20. Cable Manufacturing Facility Parameters

	Upland Staging Area	Warf Live Load Capacity	Air Draft	Navigable Channel Depth	Wharf Length
Cables	12 hectares (30 acres)	5MT/m^2 (1,000 psf)	50m (165 ft.)	12m (38 ft.)	125m (410 ft.)

3.4.4 Offshore Electrical Services Platform

Offshore electrical service platforms (OESP) are produced in very low quantities, typically with a maximum of one or two per OSW project. Accordingly, it is unlikely to be cost effective to build a dedicated OESP fabrication facility in the New York Harbor area. Instead, it is more likely that the electrical components of the substation will be manufactured in some of the same facilities that manufacture onshore electrical components. The foundations for OESP's may be fabricated at the same facilities manufacturing turbine foundations or facilities that manufacture offshore foundations for other industries. Components manufactured elsewhere can be assembled at the staging facility before installation at the wind farm site.

3.5 Staging and Installation Facility

Staging and installation facilities are used to assemble material and equipment in a central location prior to being loaded onto installation vessels and being installed offshore. Components may arrive from a number of manufacturers from various locations. Initially, turbine, tower, and foundation components may originate from Europe, Asia, or the Gulf of Mexico, and components will likely arrive by ship. As the OSW industry develops, increasing local content is expected. Turbine manufacturers are likely to open domestic manufacturing facilities, and foundations will be fabricated locally with more, smaller, subcomponents arriving by rail or highway.

Staging facilities will need to be capable of stockpiling a certain inventory of components prior to their being loaded onto the installation ships. Installation vessel day rates in Europe can exceed 300,000€ ($450,000). Stockpiling components reduces risks of delaying the installation vessels, whether due to reduced factory production rates, worker strikes, transportation delays, storm delays, or a host of other potential issues. Staging facilities also need to have sufficient space to complete a number of pre-assembly tasks prior to loading the installation vessel. The degree of preassembly depends on a number of factors, including capability of the installation vessel, the installation strategy, capability of the facility, and navigation restrictions.

An area should be provided between the upland storage area and the wharf face for manipulating large components. This area may be used to assemble towers, turn blades, or assemble rotors to the proper orientation before loading; standing up or laying down large foundation components; or otherwise manipulating large components to reduce the amount of work offshore. Steel structures are externally coated with sensitive corrosion protection paint, and the turbine nacelle and composite blades are very sensitive to damages from loose material. Therefore, the storage site should be clean, i.e. no gravel on the ground.

Offshore wind installation vessels do not require draft as large as cargo vessels. However, it is important that unlimited air draft is provided in order to maximize efficiency of the logistics scheme. Preferably, no limitations due to locks should exist.

The quantity of turbines included in the project and logistics strategy significantly impact the storage requirements. Based on observation and experience, this study has approximated the minimum and recommended parameters for staging and installation facilities (Table 21).

Table 21. Staging and Installation Facility Parameters

	Upland Staging Area	Warf Live Load Capacity	Air Draft	Navigable Channel Depth	Wharf Length
Staging and Installation	10 hectares (25 acres)	20MT/m² (4,000 psf)	120m (400 ft.)	12m (38 ft.)[a] 4m (13 ft.)[b]	200m (650 ft.)[c] 130m (430 ft.)[d] 100m (330 ft.)[e]

Notes:

[a] Recommended parameter for latest generation WTIV.

[b] Minimum requirement based on transport barge concept.

[c] Minimum requirement based off latest generation WTIV.

[d] Minimum requirement based off 1st generation WTIV.

[e] Minimum requirement based on feeder barge concept

3.6 Operations and Maintenance Facilities

Offshore wind farms are complicated facilities that have significant O&M requirements in order to function at peak efficiencies. Offshore wind turbines are located in high-energy environments and are constantly subject to wind, waves, currents, corrosion, and other forces that stress turbine and foundation components. In addition, the operation of gearboxes, generators, and other equipment requires routine maintenance.

Each component has a finite lifespan. In order to maintain that lifespan and overall reliability of the system, O&M operations are planned and executed to complete routine maintenance, monitor critical components, change lubricants, and complete condition evaluations.

O&M facilities are intended to serve as a base of operations to maintain and repair OSW turbines. Similar to a staging and fabrication facility, an O&M facility must meet certain geographic and operations criteria to effectively service a wind farm.

The most critical parameter of an O&M facility is its proximity to the project. As regular voyages will be conducted from this port, the transit costs associated with offshore maintenance are directly related to the distance the service vessels must travel. Proximity to the wind farm also allows for service during clear weather windows.

Other criteria, such as wharf length and staging area, while still important, are less critical, due primarily to the smaller size of O&M vessels and the amount of equipment being transported offshore. Recommended parameters for O&M facilities are described in Table 22.

The recommended navigable channel depth is based in existing crew transfer vessels in the European market and the *Atlantic Pioneer*, the first U.S.-built crew transfer vessel. Alternative O&M strategies are rapidly developing and therefore are not able to be considered fully in this study.

Table 22. Operations and Maintenance Facility Parameters

	Upland Staging Area	**Warf Live Load Capacity**	**Air Draft**	**Navigable Channel Depth**	**Wharf Length**
Operations and Maintenance	4 hectares (10 acres)	2MT/m² (500 psf)	20m (65 ft.)	5m (16 ft.)	20m (65 ft.)

4 Facility Development and Upgrade Considerations

This study includes a high-level engineering analysis to determine the upgrades required to prepare a typical waterfront site for OSW activities. The analysis provides order-of-magnitude estimates of construction costs associated with preparing a waterfront facility for the OSW industry, including a typical unit cost per infrastructure upgrade (e.g., cost per extra-heavy-load-rated Turbine Installation Vessel pier). Since upgrade costs are very site specific, each facility is generalized to have a base case with common New York characteristics (geotechnical properties, water depth, etc.) and no existing infrastructure. The construction of new structures to accommodate the facility-type needs was assumed. The main construction elements quantified and priced for each facility base case are pier/wharf, fender system, steel sheet pile (SSP) bulkhead, and paving of upland area.

The following sections identify the assumed New York characteristics, describe the representative design and cost breakdown per facility type, and present regulatory considerations and exclusions.

4.1 Structure Designs: Representative Pier / Wharf Design

This study prepared a concept design for three heavy-load-rated piers at 5MT/m² (1,000 psf) (Figure 9), 10MT/m² (2,000 psf) (Figure 10) and 20MT/m² (4,000 psf) (Figure 11) and prepared an OPC for each load rating. The concept designs were prepared according to typical design codes and modern best practices for design life, resiliency, materials, and construction methods. Each design assumed a concrete deck is supported by steel pipe piles and concrete pile caps. Based on experience in New York Harbor and with the design of similar structures, typical geotechnical parameters are assumed for New York Harbor.

The structures were given arbitrary dimensions for analysis and are intended to be general designs of a typical structure type for the area; they are not site specific.

The wharf is assumed to be constructed in 10.7m (35 ft.) of water depth over level bathymetry with the deck positioned 2.4m (8 ft.) above the waterline. The calculations were made for a 50-year design life.

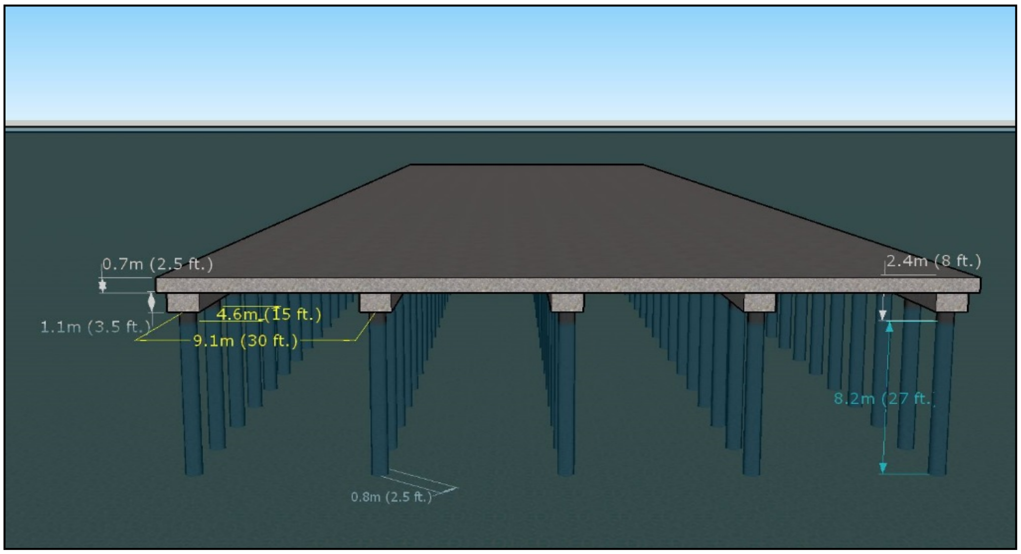
Each design is intended to be indicative of a structural design concept that could be installed given typical conditions in New York Harbor. The design of wharves or piers for a specific site will vary based upon conditions specific to that site.

4.1.1 5MT/m² (1,000 psf) Pier / Wharf

The 5MT/m² (1,000 psf) live load can be supported by 76cm x 19cm (30 in. x 0.75 in.) steel pipe piles with a bent spacing of 9.1m (30 ft.) and a row spacing of 4.6m (15 ft.).

Figure 9. Conceptual design for a Wharf or Pier capable of supporting a 5MT/m² (1,000 psf) live load

Source: COWI 2017; Trimble Inc. (SketchUp)

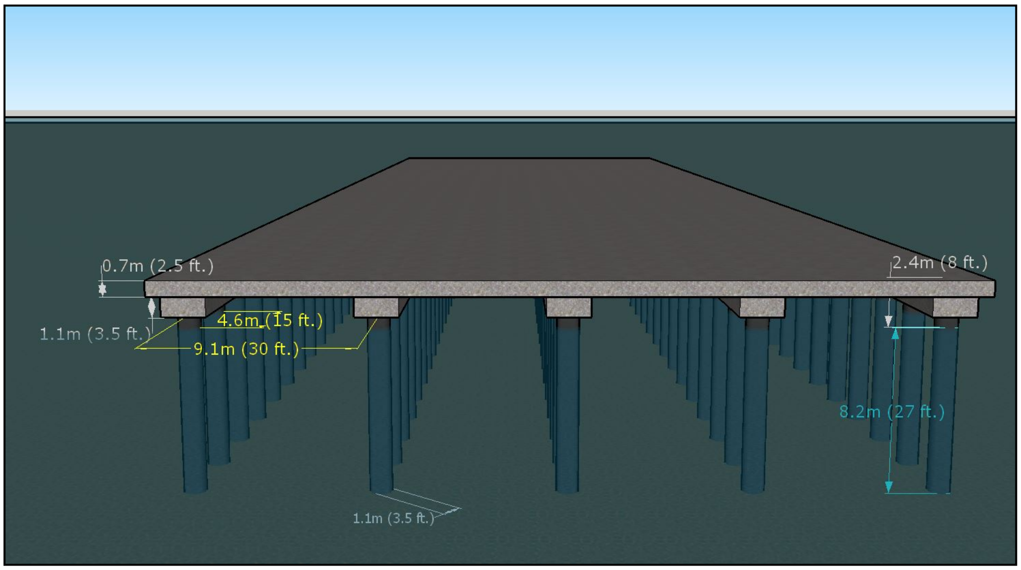


4.1.2 10MT/m² (2,000 psf) Pier / Wharf

The 10MT/m² (2,000 psf) and live load can be supported by 106.7cm x 19cm (42 in. x 0.75 in.) steel pipe piles with a bent spacing of 9.1m (30 ft.), and a row spacing of 4.6m (15 ft.).

Figure 10. Conceptual design for a Wharf or Pier capable of supporting a 10MT/m^2 (2,000 psf) live load

Source: COWI 2017; Trimble Inc. (SketchUp)

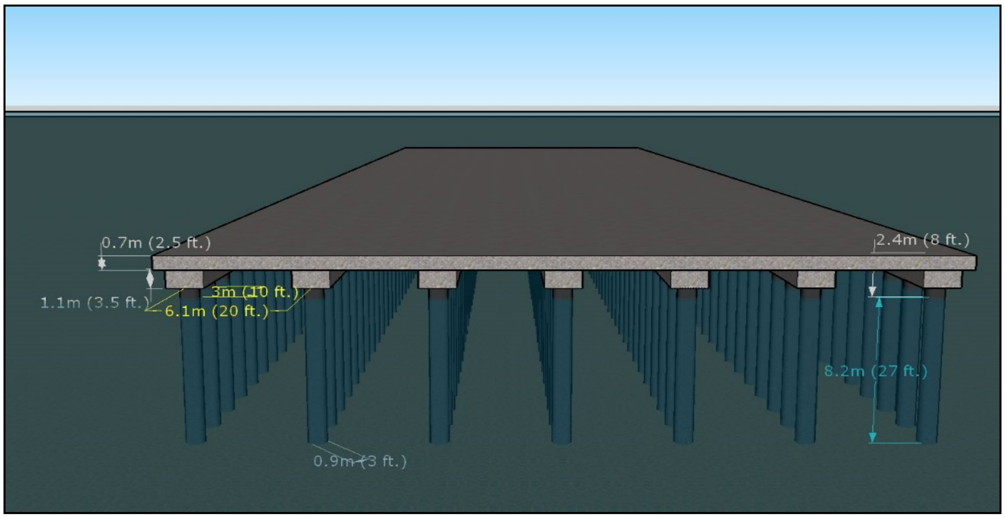


4.1.3 20MT/m² (4,000 psf) Pier / Wharf

The 20MT/m² (4,000 psf) live load can be supported by 91.4cm x 19cm (36 in. x 0.75 in.) steel pipe piles with a bent spacing of 6.1m (20 ft.), and a row spacing of 3m (10 ft.).

Figure 11. Conceptual design for a Wharf or Pier capable of supporting a 20MT/m^2 (4,000 psf) live load

Source: COWI 2017; Trimble Inc. (SketchUp)



4.2 Opinion of Probable Cost Background

A cost analysis of required upgrades was performed, and includes design, permitting, and construction. Consistent with work on previous federal and State OSW port studies, the cost analysis was performed in accordance with AACE International Class 4 Estimate guidelines and RS Means Heavy Construction Cost Data. Class 4 estimates are used for concept screening, where the current project definition is between 1% and 15% of full project definition, with actual costs typically falling within 50% above to as little as 30% below the estimate. In addition to a large range of national and international projects, cost estimates were calibrated based on extensive experience with marine terminal retrofit and rehabilitation projects completed in and around New York Harbor. Costs are generally applicable within the State; however, there may be minor geographic variations (e.g., labor costs may be lower in upstate New York as compared to New York City).

Where possible, costs were compiled on a per-unit basis to allow for interpolation or extrapolation of cost data.

These OPCs are provided in 2017 U.S. dollars.

4.2.1 Exclusions

Due to variations between potential sites and the site-specific nature of cost estimating, cost estimates may vary widely. The intent of the following OPCs is to determine approximate order of magnitude costs to prepare a waterfront site for an OSW operator. In order to present cost data more clearly and reduce the range of uncertainty, following items were excluded from the cost analysis for facility upgrades.

Property Ownership. The associated costs of land acquisition, taxes, and real estate and legal fees are not included in the OPCs.

Professional Services. A number of professional services are required prior to, and during, the development of a facility. Planning, architecture, engineering, permitting, and legal services may account for approximately 10-20% of the capital expenditure of the project.

Demolition and Site Preparation. Multiple sites have existing structures that may need to be demolished to create space for OSW operations. Other sites are brownfield or Superfund sites that will require extensive site remediation before construction of redeveloped facilities can commence. Additional site preparation measures such as landscaping, maritime and site security, and clearing and grubbing may be necessary. The extent of these site preparation measures is specific to the particular site; therefore, these were excluded from the general OPCs.

Upland Structures. Offshore wind ports are needed to serve a wide variety of needs. Accordingly, different ports will require different structures depending upon their purpose. For example, a nacelle manufacturing facility will require a substantial structure with a controlled environment, whereas a jacket foundation fabricating area will require significant amounts of open space in order to manipulate the jackets during fabrication. The costs of upland structures are not included in the following OPCs.

Dredging. Offshore wind ports require frequent vessel calls. If current water depths are insufficient for the design vessels, the area offshore of the berth must be deepened by dredging. Considerations that may affect the cost of dredging include, but are not limited to, the volume of material removed, dredge method (mechanical versus pump), type of dredged material, disposal location, contamination of the material, and frequency of dredging (one time versus recurring contract). Without site-specific information, precise estimation of dredging costs is not possible. However, based on observations of recent dredging projects in New York Harbor, the range of unit costs for dredging, including transportation and disposal of dredged material, is anticipated to be between $130 and $222 per cubic meter ($100 and $170 per cubic yard).

Environmental Mitigation and Public Access. If development of a site causes adverse environmental impacts, regulatory agencies may require mitigation of those impacts. If the site is in an area identified as a habitat for endangered, threatened, or special concern species, any activity performed must not threaten the continued existence of that species and precautionary measures will need to be put in place. Newly constructed facilities may require that some form of public access to the water be provided. These considerations are specific to the particular site and thus are excluded from the following OPCs.

Utilities. A non-inclusive list of utilities required for a functional OSW port facility includes water, electrical, communications, fuel storage and distribution, and trash and sanitation management. If access to these utilities are not available at the existing site, upgrades to the site will be necessary. That cost is excluded from the following OPCs.

Intermodal Connections. The identified waterfront sites vary in their availability of intermodal connections for the transport of construction materials, as well as OSW turbine materials and components when the site is operational. The OPCs do not include the costs of upland infrastructure construction, improvements to existing roadways, rail construction, or mooring hardware.

Operational Infrastructure and Equipment. An OSW port facility requires unique infrastructure and equipment. Similar to upland support structures, the selection of this equipment is specific to the type of facility. For example, a facility specifically tasked to nacelle manufacturing does not require the ability to lift components the same height as a port where turbines are pre-assembled or foundations are erected. Construction and transport equipment for the construction and conveyance of wind farm components such as cranes, trucks, self-propelled modular trailers, and forklifts are excluded from these OPCs. Waterfront-related considerations such as wave attenuation structures and marina facilities for work boats and small crafts are also excluded.

4.3 Infrastructure Upgrades by Facility

The OPCs were based on the representative conceptual designs that accompany this report, in conjunction with the design and construction of similar structures in the New York Harbor area. The OPCs should be considered to be order-of-magnitude construction costs, reflective of the absence of site selection and specific structure design. The following sections detail anticipated costs of facility upgrades required for the distinct categories of OSW ports.

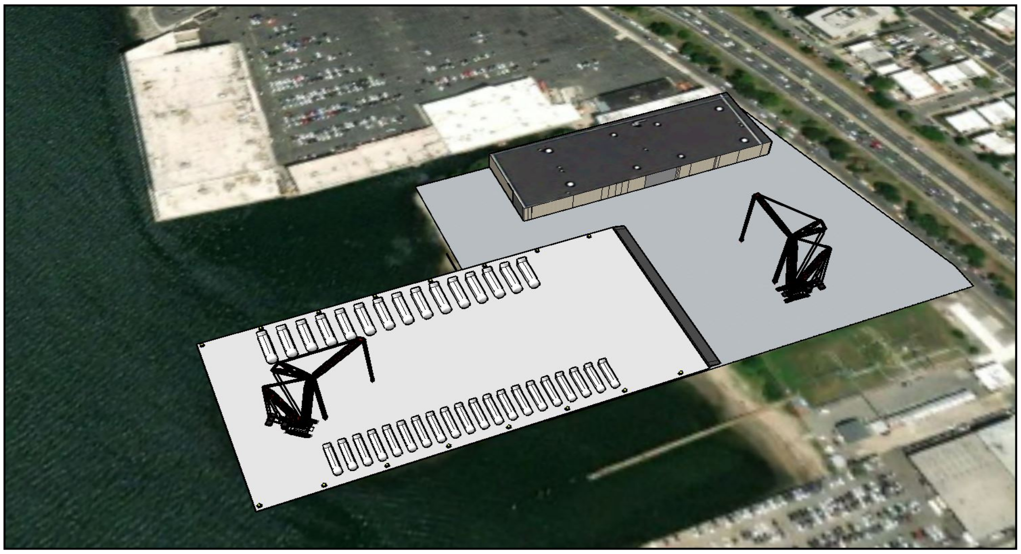
Note that there is no control over the cost of labor, materials, equipment, or services furnished by others, over the Contractor's methods of determining prices, or over competitive bidding or market conditions. The OPCs provided herein are formulated based on the best judgment of experienced and qualified Professional Engineers familiar with the construction industry. However, this study cannot and does not guarantee that proposals, bids, or actual project or construction costs will not vary from the OPCs prepared in this study.

4.3.1 Manufacturing and Fabrication Ports

Due to their size and weight, most major OSW components are manufactured or fabricated at waterfront facilities. The specific parameters recommended for a manufacturing or fabrication port are detailed in the Task 1 summary memo from this project (COWI May 2017). A representative manufacturing port for New York Harbor is depicted on Figure 12.

Figure 12. Indicative Nacelle Manufacturing concept for NY Harbor: 3.6 MW shown front row, 8 MW back row.

Source: COWI 2017; Trimble Inc. (SketchUp, Google Earth Imagery)



Pier/Wharf. It is anticipated that an upgrade to, or replacement of, the pier or wharf structure will likely be required at most facilities identified by this study in order to accommodate the size and weight of current and next-generation OSW turbine components. Depending on the component being manufactured or fabricated at the port, the pier may be designed with a live load capacity between $10MT/m^2$ (2,000 psf) and $20MT/m^2$ (4,000 psf). Given experience with the design and construction of similar coastal structures and the conceptual designs produced, a cost range of approximately $6,400 to $8,600 per square meter ($590 to $800 per square foot) is expected. This includes the construction of the concrete platform and steel pipe pile foundation.

A fender system will be required to protect the wharf or pier from impact and abrasion from berthing vessels. The design of the fender system is a function of the type of structure to be protected and the vessels it is to be protected against. In the OPC, it is assumed that a fender system typically used for similar applications elsewhere will be required. Purchasing materials and installation of a fender system can range from approximately $4,600 to $7,500 per linear meter ($1,400 to $2,300 per linear foot) of wharf face.

It is likely the shoreline adjacent to the wharf or pier will require stabilization to protect from erosion. For the purposes of the OPC it is assumed that an SSP bulkhead will be constructed parallel to the shoreline where the wharf or pier meets the shoreline. A typical SSP bulkhead structure comprises HP anchor piles, a cast-in-place concrete cap, the structural fill behind the bulkhead, and the steel sheet piles themselves. Costs can range from approximately $32,800 to $65,600 per linear meter ($10,000 to $20,000 per linear foot) of bulkhead wall.

Upland Area. The OPC produced for this task assumes that the upland area will need to be paved with high-load-capacity reinforced concrete pavement for the on-site transport and storage of turbine components. The cost is anticipated to range between $155 and $215 per square meter ($130 and $180 per square yard) of pavement.

Manufacturing and Fabrication Port Summary. The OPC for the Manufacturing and Fabrication Port is summarized in the Table 23. The OPC is based on a representative facility consisting of 10 ha (25 acres) of upland area and a wharf approximately 130m x 18m (430 ft. x 60 ft.).

Table 23. OPC for Manufacturing and Fabrication Port Upgrades

Construction Element[a]	Unit Cost	Extended
Pier/wharf	$6,400 to $8,600 / Sq. m ($590 to $800 / Sq. ft.)	$15,222,000 to $20,640,000
Fender System	$4,600 to $7,500 / Lin. m ($1,400 to $2,300 / Lin. ft.)	$602,000 to $989,000[b]
SSP Bulkhead	$32,800 to $65,600 / Lin. m ($10,000 to $20,000 / Lin. ft.)	$6,300,000 to $12,600,000[c]
Upland Area paving	$155 to $215 / Sq. m ($130 to $180 / Sq. yd.)	$15,730,000 to $21,780,000

Notes:

[a] OPC exclusions are detailed in Section 4.2.1.

[b] Assumes 131m (430 ft.) of wharf face.

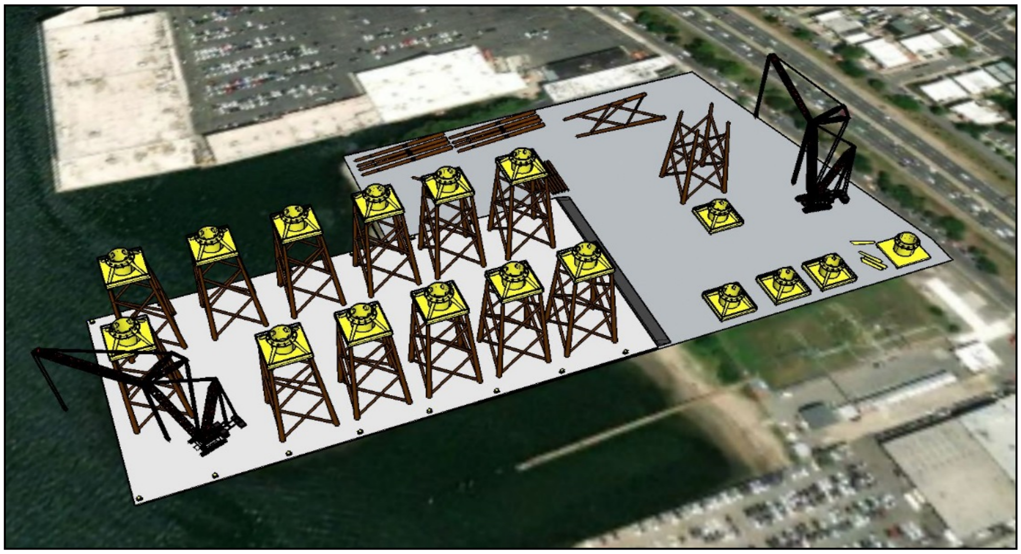
[c] Assumes 131m (430 ft.) of wharf face plus 30m (100 ft.) of additional shoreline stabilization on either side of the wharf face.

4.3.2 Staging and Installation Ports

Staging and installation ports are used to assemble material and equipment in a central location prior to being loaded onto installation vessels and transported offshore. The specific parameters recommended for staging and installation ports are detailed in Section 3. A representative staging port for New York Harbor is depicted on Figure 13.

Figure 13. Indicative concept design for how a Jacket Staging Port in New York Harbor may be developed.

Source: COWI 2017; Trimble Inc. (SketchUp, Google Earth Imagery)



Pier/Wharf. Staging and installation ports, similar to manufacturing and fabrication ports, require a high-load-capacity wharf or pier structure for the loading and unloading of OSW turbine components from shipping and installation vessels. A wharf or pier will need to be constructed with a deck live load capacity of $10MT/m^2$ (2,000 psf) to $20MT/m^2$ (4,000 psf) at a cost range of approximately \$590 to \$800 per square foot. Similarly, fender systems and shoreline protection will be required for any staging and installation port facility.

Upland Area. Staging and installation ports require an area between the upland storage area and the wharf face for manipulating large components. The design of heavy load paving systems will be similar to that detailed for manufacturing and fabrication ports in Section 4.1.2.

Staging and Installation Port Summary. The OPC for the staging and installation port is summarized in Table 24. The OPC is based on a representative facility consisting of 10 ha (25 acres) of upland area and a wharf approximately 200m x 18m (650 ft. x 60 ft.).

Table 24. OPC for Staging and Installation Port Upgrades

Construction Element[a]	Unit Cost	Extended
Pier/wharf	\$6,400 to \$8,600 / Sq. m (\$590 to \$800 / Sq. ft.)	\$23,010,000 to \$31,200,000
Fender System	\$4,600 to \$7,500 / Lin. m (\$1,400 to \$2,300 / Lin. ft.)	\$910,00 to \$1,495,000[b]
SSP Bulkhead	\$32,800 to \$65,600 / Lin. m (\$10,000 to \$20,000 / Lin. ft.)	\$8,500,000 to \$17,000,000[c]
Upland Area paving	\$155 to \$215 / Sq. m (\$130 to \$180 / Sq. yd.)	\$15,730,000 to \$21,780,000
Upland Structure(s)	Varies	Varies[c]

Notes:

[a] OPC exclusions are detailed in Section 4.2.1.

[b] Assumes 200m (650 ft.) of wharf face.

[c] Assumes 200m (650 ft.) of wharf face plus 30m (100 ft.) of additional shoreline stabilization on either side of the wharf face.

4.3.3 Operation & Maintenance Ports

O&M ports are intended to serve as a base of operations during the day-to-day maintenance and repair of OSW turbines. Similar to a staging and fabrication port, an O&M port must meet certain geographic criteria as well as operations criteria to effectively service a wind farm.

The most critical parameter of an O&M port is its proximity to the project. As regular voyages will be conducted from this port, the transit costs associated with offshore maintenance are directly related to the distance the service vessels must travel. Proximity to the wind farm also allows for service during the clear weather windows.

Other criteria, such as wharf length, water depth, and staging area, while still important, are less critical, primarily due to the smaller size of O&M vessels and the amount of equipment being transported offshore.

Pier/Wharf. O&M facilities have lower live load capacity requirements than manufacturing or staging ports since the massive turbine components are not handled at these sites. Deck live load capacities of 2.5MT/m^2 (500 psf) to 5MT/m2 (1,000 psf) are sufficient for most modern O&M ports. Based on experience with the design and construction of similar coastal structures and the conceptual designs produced, a cost range of approximately \$500 to \$590 per square foot is expected. This includes construction of the concrete platform and steel pipe pile foundation.

As with the previous cases, a fender system and shoreline protection will be required for any OSW port facility. Purchasing materials and installation of a fender system can range from approximately $1,400 to $2,300 per linear foot of wharf face. Costs can range from approximately $10,000 to $20,000 per linear foot of bulkhead wall. The lighter service requirements of the O&M facilities trend toward the lower costs within each range.

Upland Area. O&M ports do not require a large amount of upland area compared to manufacturing or staging ports. If pavement of the upland area is required, the cost is anticipated to range between $130 and $180 per square yard of pavement.

Dredging. O&M vessels are smaller and have a shallower draft than installation and cargo vessels. However, if current water depths are insufficient, deepening the areas by dredging must occur. As previously stated, dredging costs are site specific and excluded from this OPC. If necessary, the range of unit costs for dredging, including transportation and disposal of dredged material, is anticipated to be between $100 and $170 per cubic yard. Due to smaller quantities anticipated for the smaller areas required by smaller vessels, dredging costs at O&M ports are typically on the higher side of the unit cost range as they are less likely to benefit from economies of scale.

Operation and Maintenance Port Summary. The OPC for the Operation and Maintenance Port is summarized in the Table 25. The OPC is based on a representative facility size of 4 ha (10 acres) and a wharf approximately 4m x 20m (20 ft. x 65 ft.).

Table 25. OPC for Operation and Maintenance Port Upgrades

Construction Element[a]	Unit Cost	Extended
Pier/wharf (Dimensions)	$6,400 / Sq. m ($590 / Sq. ft.)	$650,000
Fender System	$4,600 to $7,500 / Lin. m ($1,400 to $2,300 / Lin. ft.)	$91,000 to $149,500[b]
SSP Bulkhead	$32,800 to $65,600 / Lin. m ($10,000 to $20,000 / Lin. ft.)	
Upland Area paving (Dimensions)	$70 to $110 / Sq. m ($60 to $90 / Sq. yd.)	$2,904,000 to $4,356,000
Upland Structure(s)	Varies	Varies[c]

Notes:

a OPC exclusions are detailed in Section 4.2.1.

b Assumes 19.8m (65 ft.) of wharf face.

c Assumes 19.8m (65 ft.) of wharf face plus 30m (100 ft.) of additional shoreline stabilization on either side of the wharf face.

4.4 Regulatory Considerations

Waterfront construction projects must comply with various federal, State, and local regulations. Understanding governing laws and policies, as well as knowing the path to acquiring the required permits and licenses, is an essential part of determining which potential waterfront facilities are most suitable for service as OSW ports.

4.4.1 Federal Jurisdiction

Federal regulations for waterfront construction projects in New York are administered by the U.S. Army Corps of Engineers (USACE). The USACE issues several types of permits under their regulatory interpretation of the Rivers and Harbors Act of 1899 and the Clean Water Act, which respectively define the federal responsibilities for structures proposed in U.S. waters and "fill" in those waters. Section 10 of the Rivers and Harbors Act authorizes the USACE to regulate certain structures or work in or affecting navigable waters of the U.S. The Clean Water Act dictates that when delegating management of the Water Quality Management program to a state, "the Corps of Engineers must btain a State Water Quality Certificate for their action (permitting the activity) before a Federal authorization can be completed." The Clean Water Act also requires that when applying for approval of the placement of any fill or dredged materials, alternatives to the action be submitted for review.

The USACE also coordinates compliance with related federal laws, including the National Environmental Policy Act, Coastal Zone Management Act, the Fish and Wildlife Coordination Act, the Endangered Species Act, National Flood Insurance Act of 1968 (as amended), Executive Order 11988 on Flood Management, the Magnuson-Stevens Fishery Conservation and Management Act (as amended by the Sustainable Fisheries Act of 1996) and other lesser legislation with the agency charged with the legislation's management. These agencies are typically referred to as "consulting agencies"; some specific consulting agencies are described in further detail below in Section 4.4.4. As described below, in New York, the USACE implements the above regulations through a Nationwide Permit or Individual Permit process.

The Nationwide Permit (NWP) Program encompasses 50 nationwide permits, each of which pre-authorize a specific type of activity that has been pre-determined to have minimal individual and cumulative adverse environmental effects. The NWP Program is reauthorized every five years. This programmatic permit allows for streamlined USACE review of certain classes of projects (e.g., maintenance and rehabilitation of existing structures). Typically, these projects are also regulated by states. The NWP projects have to be assessed, coordinated, and found to contain minimal individual and/or cumulative impacts. However, DOS reserves the right to assess proposed permit actions by the USACE and certify that they are consistent with the Coastal Zone Policies of the State of New York (see below). Coastal Zone Policies are a result of the Coastal Zone Management Act (CZMA), which encourages the appropriate development and protection of the nation's coastal resources and gives states the primary role in managing these areas. The Nationwide Permits most relevant to future OSW development include: NWP 12 – Utility Line Activities, NWP 13 – Bank Stabilization, NWP 19 – Minor Dredging, NWP 39 – Commercial and Institutional Developments, and NWP 51 – Land-Based Renewable Energy Generation Facilities.

New structures, or structures that are significantly modified in terms of purpose or construction, typically require an individual permit from the USACE. Individual permits are required when the project activities do not meet the requirements of the Nationwide General Permit and, therefore, are evaluated by the USACE on an individual project-specific basis. Projects that require an Individual Permit are thoroughly assessed for impacts on the environment and surrounding stakeholders. Pre-application consultation usually involves one or several meetings between an applicant, USACE staff, interested resource agencies (federal, state, or local), and sometimes the interested public. The basic purpose of such meetings is to provide for informal discussions about the pros and cons of a proposal relative to its effects on the aquatic environment while the applicant is still in the planning process.

4.4.2 State Jurisdiction

All activities in tidal, coastal, or navigable waters, in tidal wetlands, and in prescribed buffer areas are regulated by the New York State Department of Environmental Conservation. The buffer area is defined to be 45.6m (150 ft.) landward of the high tide line in New York City and 91.4m (300 ft.) landward of the high tide line in New York State outside of New York City. The Department's regulations are contained within Article 25, Environmental Conservation Law Implementing Regulations – 6 NYCRR Part 661. These regulations are enforced through the various regional offices and guided by the Division of Environmental Permits within each of those regional offices.

Under any of the above permit applications, activities proposed in connection with the future development of OSW farms will be reviewed to determine their potential effect on coastal resources and uses, as defined by CZMA. The federally approved New York State Coastal Management Program, administered by the DOS, delineates the state's coastal zone and establishes coastal policies that guide coastal management in accordance with the CZMA. Generally speaking, if coastal resources cannot be avoided, one must try to minimize the impact on them. If minimizing the impact on the resources is not a practical option, then the last alternative would be to compensate for them through mitigation. This tiered approach is often presented in shorthand as "avoid, minimize, mitigate or compensate". Each tier must be exhausted before one can move to the next.

4.4.3 Local Jurisdiction

As a result of the Waterways Act, which establishes the DOS as the state agency responsible for implementing the Coastal Management Program, New York City (including Staten Island) and most of the waterfront communities throughout the state, have adopted Local Waterfront Revitalization Programs for activities within the coastal boundary and landward of the mean high water line. These programs include special area designations (Special Waterfront Areas, Significant Maritime and Industrial Areas, etc.) and generally articulate the priorities of the subject community and maintain the policies of the State's Coastal Management Program. As such, the Local Waterfront Revitalization Programs policies are the basis for federal, State, and local consistency determinations for activities affected the coastal zone in New York City. Review of the policies is undertaken during a Coastal Area Management Site Plan Review Application. An administrative review under the jurisdiction of the Planning and Zoning Commission will determine whether the project complies with local coastal management ordinances. If any thresholds are exceeded for the activity, a public hearing with the Zoning Board of Appeals may be required. In addition, the municipality has the discretion to request a review by the New York State DOS's Office of Communities and Waterfronts. Once such a request is made, the DOS may provide comments, which may include suggested conditions or recommendations to the municipality for activities within the coastal zone.

Typical issues of concern during the Coastal Area Management review include maintaining water-dependent uses and ensuring public access to the water.

4.4.4 Consulting Agencies

In addition to the traditional stakeholders considered for waterfront development, some of the site uses are specific to OSW, and a number of additional stakeholder agencies may be requested to comment on permit applications. The lead regulatory agency responsible for issuing future required permits is tasked with coordination with the consulting agencies.

Pilots Association. The Sandy Hook Pilots Association is responsible for navigating vessels inside New York Harbor. The Association may be requested to comment on the ability of design vessels to navigate to and approach any proposed facility.

Federal Aviation Administration. Due to the height of OSW components, specifically at staging and installation ports, the Federal Aviation Administration may be consulted to comment on potential impacts on commercial and recreational aviation.

Military. The U.S. National Resource Defense 'Council's Renewable Energy and Defense Geospatial Database is responsible for reviewing all renewable energy-related applications and their potential impacts on the U.S. military. This group is responsible for all armed services and the U.S. Coast Guard.

5 Desktop Site Study

The New York Harbor and Hudson River have a rich maritime history and have been developed to service the needs of a variety of water-dependent uses. Long Island, although mainly occupied by residential and commercial properties, also provides opportunity for OSW development. This study evaluates waterfront properties along the New York Harbor, Hudson River, and Long Island by breaking each waterway into distinct areas in order to get a more in-depth view of potential sites that could be utilized during the development and operation of future OSW sites. This study identifies 4 active waterfront facilities on the New York Harbor and Hudson River, as well as 11 distinct areas that were examined along the coast of Long Island, all with the potential to serve the needs of future OSW to 2030 and beyond. Some waterfront facilities are more likely than others to be suitable (and thus more likely to be considered) for OSW uses, due either to existing use, capacity, or geographic location. Emphasis was placed on underutilized sites, greenfield/undeveloped sites, or brownfield sites that are able to be redeveloped. Smaller sites, especially those on Long Island, were considered for O&M facilities. As a result of this study, some of the waterfront sites were determined to be unavailable due to ongoing and planned operations; where applicable, this has been noted the comments section of the respective site within the Appendices.

5.1 Research Methods

For the purposes of this New York Offshore Wind Ports Assessment, the waterways in the New York Harbor, Hudson River, and along the coast of Long Island are divided into distinct areas (see Figure 14, Figure 23, and Figure 28). The areas are typically defined by existing geographic or navigation infrastructure (e.g., channel depth, bridge air draft) limitations.

5.2 Reference Sources

Extensive experience with waterfront facilities in and around New York Harbor, as well as internal databases and public mapping sources (e.g., Google Earth, Microsoft Bing Maps) were used to identify waterfront facilities that may be suitable for future OSW development. For each identified site, publicly available information was located and documented.

- Ownership and address information was typically obtained from New York City Department of Finance Tax maps, State of New Jersey Transparency Center, or Internet search.

- The vessel steaming distance to the New York Wind Energy Area (WEA), which is used as a representative distance for this analysis, was determined using ArcGIS and National Oceanic and Atmospheric Association (NOAA) navigation charts from the facility to the geographic centroid of the Bureau of Ocean Energy Management's Lease OCS-A 0512. The distance was determined following established navigation channels. The distance is intended to be an indicative comparison of port locations, rather than an absolute distance as this study assumes development of a number of additional projects in the 2020-2030 timeframe in order to meet the 2,400 MW target.
- Available upland areas and water frontage were obtained from facility web sites or approximated using ArcGIS or Google Earth Pro.
- Wharf length and load capacity were obtained from facility web sites where possible; wharf lengths may be approximated using ArcGIS.
- Navigable depths and air drafts were obtained from NOAA navigation charts and USACE Project Condition Surveys and Controlling Depth Reports.
- Intermodal connections were determined using publicly available mapping web sites such as Google Maps and Microsoft Bing Maps.

In addition to the above sources, this study noted additional considerations obtained from facility web sites and local and national news sources.

5.3 New York Harbor

New York Harbor is one of the largest and most active natural harbors in the world, home to the Port of New York and New Jersey. New York Harbor is located at the mouth of the Hudson River where it empties into New York Bay and the Atlantic Ocean. The port is outlined by New Jersey and Staten Island to the west, Manhattan to the north, and Brooklyn to the east. Vessels traveling between the Hudson River and the OSA must pass through New York Harbor.

For this desktop study, the areas have been arranged beginning offshore, closest to the New York WEA and then proceed counterclockwise inshore.

The site-specific figures and summary tables for potential WEAs are provided in Appendix A.

Figure 14. New York Harbor Areas

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

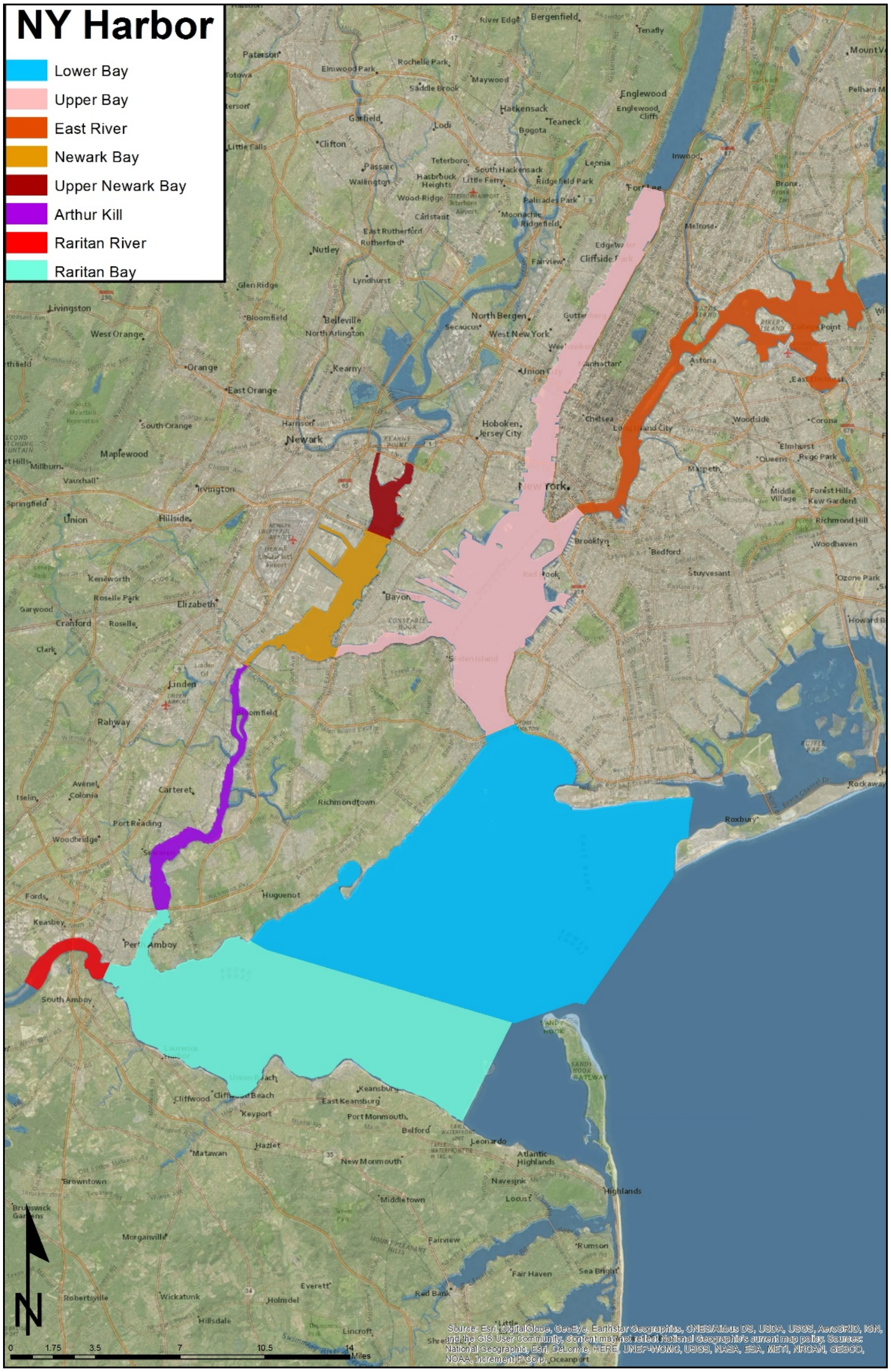


Table 26. Notable Waterfront Sites for potential Offshore Wind use

Area – Sub Area	Site	Usage	Investment / Upgrade Required	Distance to NY WEA	Upland Area	Water Frontage	Minimum Wharf Length	Navigable Depth	Limiting Air Draft Restriction	Notes
New York Harbor - Upper Bay	Military Ocean Terminal at Bayonne	Manufacturing and Fabrication (M&F), All Components Staging	Minimal-Moderate	84.8 km (52.7 miles)	21 hectares (52 acres)	6,294.1m (20,650 ft.)	Berth A: 68.6m (225 ft.); Berths B & C: 106.1m (348 ft. total); L-Shaped Pier: 36.6+30.5+33.5+27.4m (120+100+110+90 ft.)	Channel - 16.1m (53 ft.) Berth - 14.6m (48 ft.)	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline	Existing facility for break bulk and other project cargo. Air draft challenges if used as a staging port.
New York Harbor - Upper Bay	Weeks Marine, Inc.	M&F, All Components Staging	Minimal-Moderate	87.4 km (54.3 miles)	17.8 hectares (43 acres)	1,359.4m (4,460 ft.)	(2) each x 300m (1,000 ft.)	Channel - 16.1m (53 ft.) Berth - Not Identified	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline	Existing facility for marine contractor. Air draft challenges if used as a staging port.
New York Harbor - Upper Bay	South Brooklyn Marine Terminal	M&F, All Components Staging	Minimal-Moderate	85.6 km (53.2 miles)	35.6 hectares (88 acres)	2,859m (9,380 ft.)	39th Street (southern) Pier: Face: 216.1m (709 ft.); Lower Side: 306.3m (1,005 ft.); Upper Side: 167.6+185.9m (550+610 ft.)	Channel - 16.1m (53 ft.) Berth - Varies 0 to 10.9m (0 to 36 ft.)	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline	Underutilized waterfront site. Site has additional availability. Air draft challenges if used as a staging port.
New York Harbor - Upper Bay	Red Hook Brooklyn	M&F, All Components Staging	Minimal-Moderate	89.8 km (55.8 miles)	32 hectares (80 acres)	4,876.8m (16,000 ft.)	4,876.8m (16,000 ft.)	Channel - 11.5-12.8m (38-42 ft.) Berth - 12.8m (42 ft.)	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline	Existing waterfront terminal. Site has additional availability. Air draft challenges if used as a staging port.
New York Harbor - Upper Newark Bay	Veckridge Chemical Co.	M&F, Blades and Tower Sections	Significant	95.4 km (59.3 miles)	9.2 hectares (22.8 acres)	576.1m (1,890 ft.)	N/A	Channel - 9.1m (30 ft.) Berth - N/A	I-78 Newark Bay Bridge: 41.1m (135 ft.)	Small brownfield industrial site. Significant air restriction due to Newark Airport, in addition to navigable bridge restrictions. Air draft challenges if used as a staging port.
New York Harbor - Arthur Kill	Rossville Waterfront	M&F, All Components	Significant	96.1 km (59.7 miles)	32.37 hectares (80 acres)	280.4m (920 ft.)	304.8m (1,000 ft.) with dolphins	Channel 10.7m (35 ft.) Berth: N/A	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Outerbridge Crossing to the south: 43.6m (143 ft.)	Brownfield LNG site. NYC is exploring potential for redevelopment. Adjacent parcels on either side may be available.
New York Harbor - Arthur Kill	Vanbro	M&F, All Components	Moderate-Significant	95.4 km (59.3 miles)	21.4 hectares (53 acres)	216.4m (710 ft.)	N/A	Channel – 10.7m (35 ft.) Berth – N/A	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Or Outerbridge Crossing to the south: 43.6m (143 ft.)	Existing waterfront site with ongoing operations. Site has additional availability.
New York Harbor - Arthur Kill	Former GATX Site	M&F, All Components	Significant	92.2 km (57.3 miles)	273.6 hectares (676 acres)	1,996.4m (6,550 ft.)	Berths 3, 5, 6, & 7: 335.3m (1,100 ft.); Berth 2: 64m (210 ft.) with dolphins; Berth 1: 109.7m (360 ft.)	Channel 10.7m (35 ft.) Berth – N/A	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Outerbridge Crossing to the south: 43.6m (143 ft.)	Underutilized brownfield site. Amazon has committed to using some of the site. Additional waterfront area available for continued redevelopment.
New York Harbor - Raritan Bay	Werner Power Station	M&F, All Components Staging	Significant	86.9 km (54 miles)	36.3 hectares (89.8 acres)	1,868.4m (6,130 ft.)	35m (115 ft.)	Channel – 7.6m (25 ft.) Berth – 6.4m (21 ft.)	Unrestricted	Decommissioned industrial site seeking redevelopment opportunities.

Table 26 continued

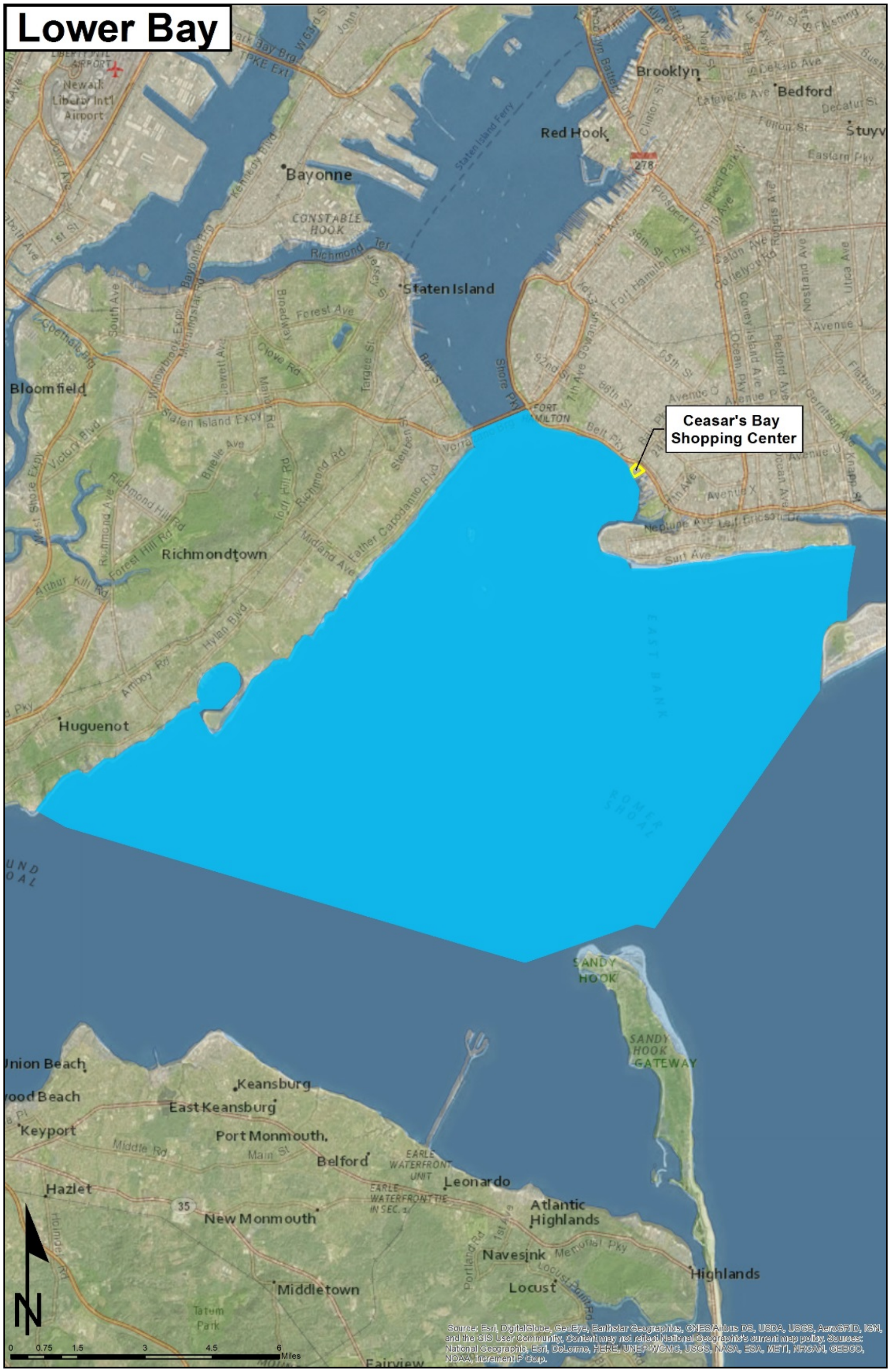
Area – Sub Area	Site	Usage	Investment / Upgrade Required	Distance to NY WEA	Upland Area	Water Frontage	Minimum Wharf Length	Navigable Depth	Limiting Air Draft Restriction	Notes
Hudson River Waterways - Tappan Zee Bridge to Mid-Hudson Bridge	Indian Point Energy Center	M&F, All Components	Significant	152.9 km (95 miles)	78 hectares (192.8 acres)	1,962.9m (6,440 ft.)	74m (244 ft.)	Channel – 9.8m (32 ft.) Berth – Not Identified	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)	Existing nuclear generating station scheduled for decommissioning in 2020-2021.
Hudson River Waterways - Mid Hudson Bridge to Dunn Memorial Bridge	Port of Coeymans Marine Terminal	M&F, All Components	Minimal-Moderate	298.5 km (185.5 miles)	161.8 hectares (400 acres)	993.6m (3,260 ft.)	Can accommodate vessels up to 228.5m (750 ft.)	Channel – 9.8m (32 ft.) Berth – 9.1m (30 ft.)	Mid-Hudson Bridge: 40.8m (134 ft.)	Existing waterfront terminal used for large-scale construction projects.
Hudson River Waterways - Mid-Hudson Bridge to Dunn Memorial Bridge	Port of Albany-Rensselaer	M&F, All Components	Minimal-Moderate	314.1 km (195.2 miles)	107.6 hectares (266 acres)	2,398.8m (7,870 ft.)	Albany side (west): 1,280m (4,200 ft.) Rensselaer side (east): 335.3m (1,100 ft.)	Channel – 9.8m (32 ft.) Berth – Not Identified	Mid-Hudson Bridge: 40.8m (134 ft.)	Existing port facility with short- and long-term leases available within port property. Additional land acquisition in progress; may build to suit.
Long Island Waterways - Jones Inlet and East Hempstead Bay	Multiple	O&M	Moderate	39.3 km (24.4 miles)	N/A	N/A	N/A	Channel – NOAA Chart 12352: "The buoys and soundings in this inlet are not charted because of continual change."	None at inlet. Meadowbrook State Parkway Bascule Bridge: Horizontal restriction of 15.2m (50 ft.)	Undeveloped land adjacent to Coast Guard Station Jones Beach may be suitable for O&M; may present significant regulatory challenges to develop park lands.
Long Island Waterways - Great South Bay	Multiple	O&M	Moderate	37 km (23 miles)	N/A	N/A	N/A	Channel – Varies: 1.5m (5 ft.) Bellport Bay Reach and Long Island Intracoastal Waterway	Robert Moses Causeway Bridge: 19.8m (65 ft.) for the middle 141m (646 ft.) of the center span	Underutilized land adjacent to the recreational fishing fleet in Captree State Park may be suitable for O&M; may present significant regulatory challenges to develop park lands.
Long Island Waterways - Shinnecock Bay	Multiple	O&M	Moderate	93.2 km (57.9 miles)	N/A	N/A	N/A	Channel – 1.8m (6 ft.) as of 1978	Shinnecock Railway Bridge (located approximately halfway through the canal): 6.7m (22 ft.)	Unused and underutilized land adjacent to dock facilities at Oaklands Restaurant in Shinnecock County Park. May be suitable for O&M; may present significant regulatory challenges to develop park lands.
Long Island Waterways - Montauk Harbor	Multiple	O&M	Minimal	170.6 km (106 miles)	N/A	N/A	N/A	Channel – Reach A (east): 3.7m (12 ft.); Reach B (west, boat basin): 3m (10 ft.)	Montauk Airport	Existing commercial and recreational harbor suitable for O&M.
Long Island Waterways - Shoreham Inlet	Shoreham Nuclear Plant	M&F, All Components Staging	Significant	252 km (156.6 miles)	N/A	1,456m (4,777 ft.)	N/A	Channel – Not Determined	None	Underutilized industrial site with no air draft restrictions.

5.3.1 Lower New York Bay

Lower New York Bay is defined as the entrance to New York Harbor (between Sandy Hook, New Jersey, and Breezy Point, New York), north to the Verrazano Bridge, west to Seguine Point, Staten Island, and south to Raritan and Sandy Hook Bays. Lower New York Bay is separated from the Upper Bay by the Narrows, a narrow strait of water between Staten Island and Brooklyn (see Figure 15). Air draft in Lower New York Bay is unlimited, which differs from most other sites identified by this study. The unlimited air draft would present a major benefit to a staging or installation port located in this area. However, the majority of shoreline in this area is occupied by residential areas, parks, and marinas. One commercial waterfront facility was identified in this area, Caesar's Bay Shopping Center, which is not likely to be used as an OSW port due to its existing use as a shopping center.

Figure 15. Lower New York Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



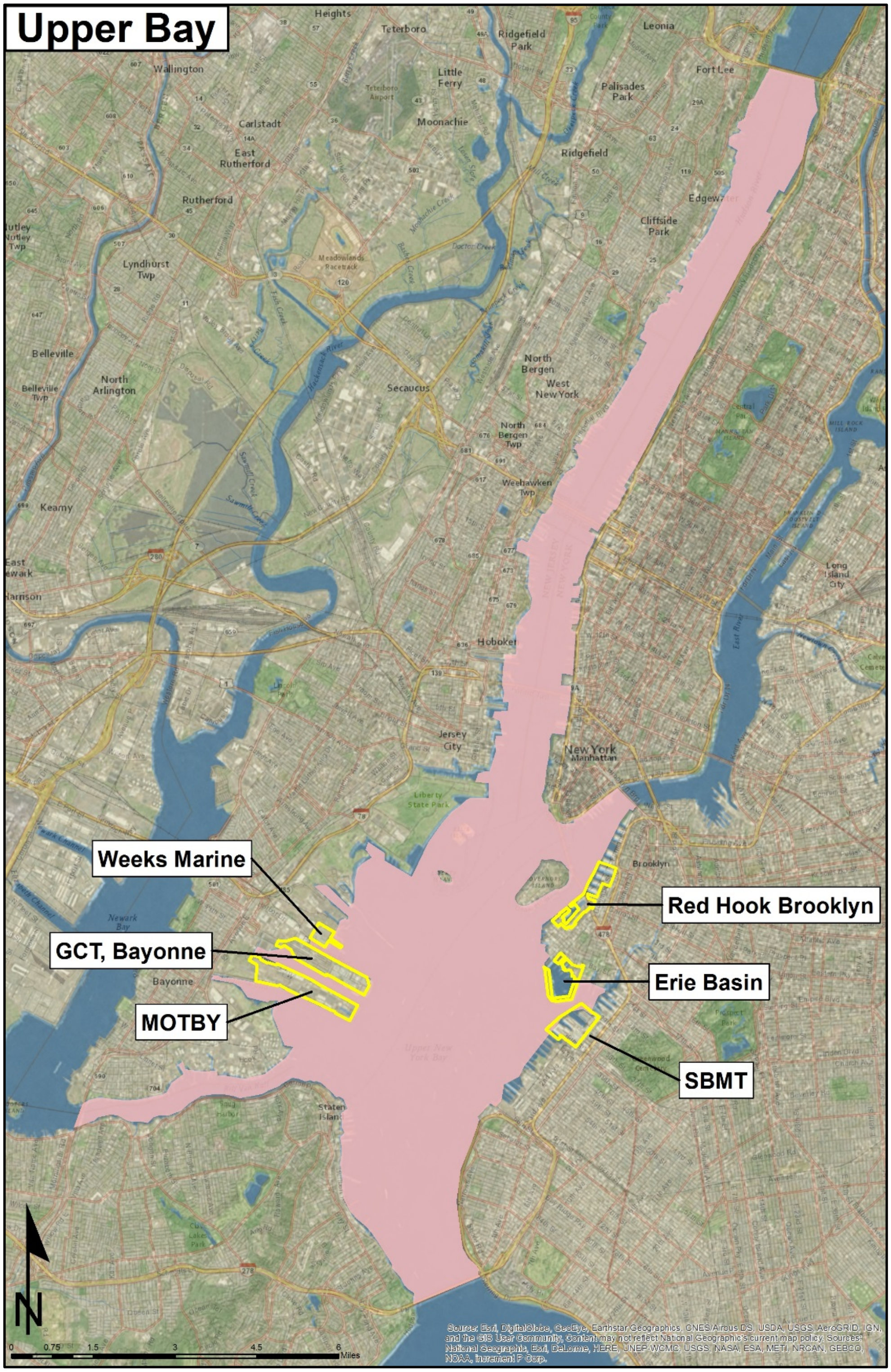
5.3.2 Upper Bay

Upper New York Bay, as seen in Figure 16, is separated from Lower New York Bay by the Narrows. For this study, the Upper bay is bounded by the East River, beginning at the Brooklyn Bridge. To the north, the upper bay includes the Hudson River south of the George Washington Bridge, and to the west, it includes the Kill Van Kull east of the Bayonne Bridge. Air draft in this area is limited by Interstate I-278 over the Verrazano-Narrows Bridge. The air draft clearance of the Verrazano Narrows Bridge is taken as 60m (198 ft.) for the center 610m (2,000 ft.) of the main span; however, a maximum clearance of 65.5m (215 ft.) is available at the center of the bridge. Per the U.S. Army Corps of Engineers' Controlling Depth Report for the Ambrose Channel (September 1, 2017), the water depth below the bridge ranges from approximately 22.9m (75 ft.) at the west edge of the channel to 29m (95 ft.) at the east edge of the channel, with a maximum depth of approximately 29.9m (98 ft.) just east of the centerline. Considering the air draft for the center 610m (2,000 ft.) of the bridge over the navigation channel, the minimum available water depth below the span, and the tidal range, this results in an approximately 84.7m (278 ft.) clearance between the bottom of the navigation channel and the bottom of the bridge.

The shoreline in this area encompasses a wide range of industrial, commercial, residential, recreational, and government properties. Six potential facilities were identified in this area. The South Brooklyn Marine Terminal (SBMT) is a particularly notable site due to its size, availability, and proximity to open water. The SBMT could be used as a manufacturing or fabrication center with minor to moderate upgrades. While limited with regard to air draft, the SBMT may be used as a staging and installation facility if the offshore contractor were to adopt alternative installation strategies.

Figure 16. Upper New York Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.3.3 East River

The East River is bound to the south by the Upper Bay and to the northeast by the Long Island Sound. Numerous bridges cross the East River, as seen in Table 27 (listed from south to northeast) and on Figure 17.

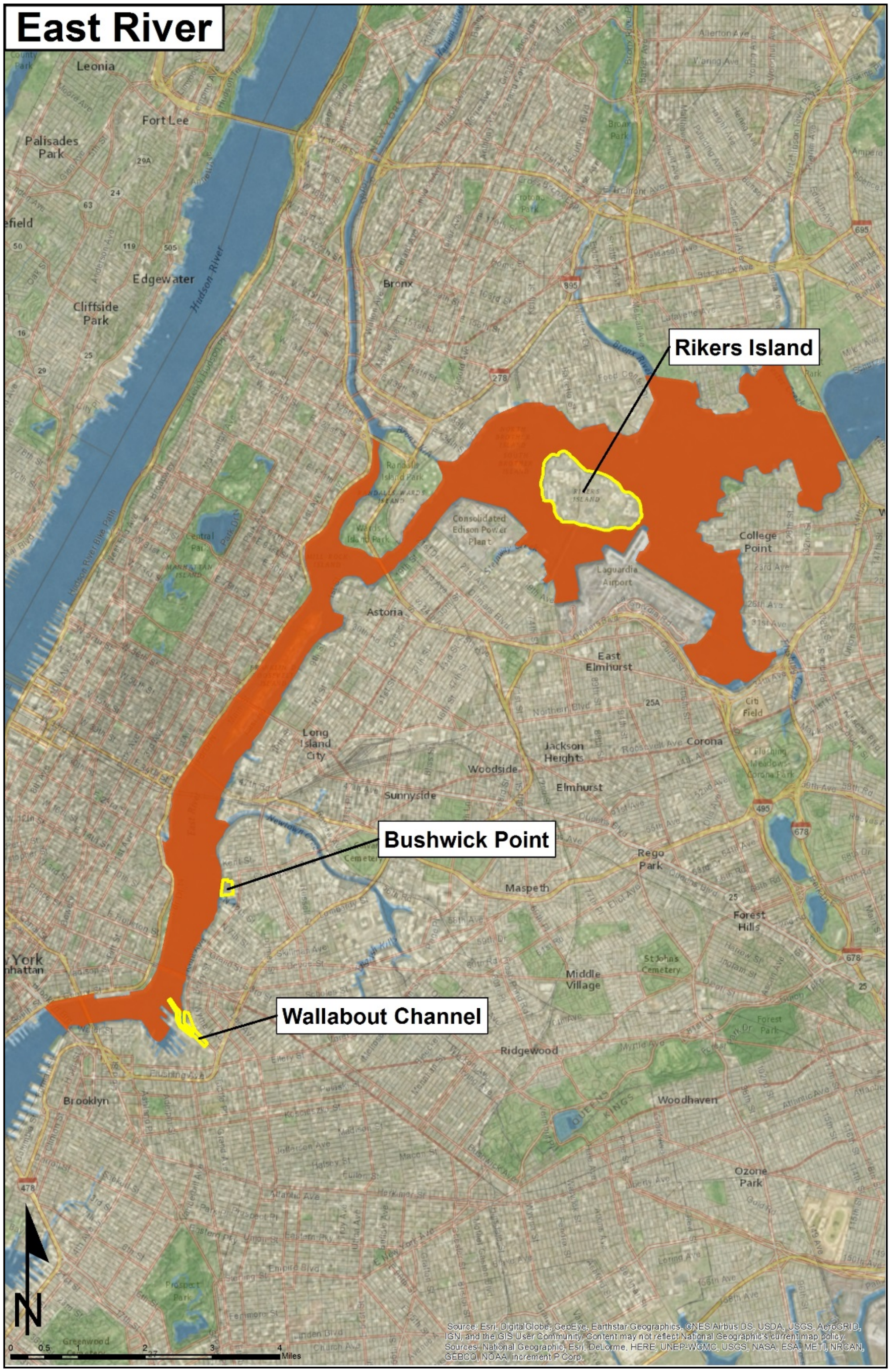
Table 27. East River Bridges Navigational Clearance

Bridge	Vertical Clearance above MHW
Brooklyn Bridge (Entrance to Upper Bay - South end)	38.7m (127 ft.)
Manhattan Bridge	40.8m (134 ft.)
Williamsburg Bridge	40.5m (133 ft.)
Queensboro Bridge	West Span: 39.9m (131 ft.) East Span: 40.5m (133 ft.) and Roosevelt Island Lift Bridge 12.2m down / 30m up (40 ft. down/ 99 ft. up)
Robert F. Kennedy Bridge	42.0m (138 ft.)
Hell Gate Rail Bridge	40.8m (134 ft.)
I-678 Bronx Whitestone Bridge	40.5m (130 ft.) 41.1m (135 ft.) at center
I-295 Throgs Neck Bridge (Entrance to Long Island Sound – North end)	42.0m (138 ft.) main span 37.5m (123 ft.) north span

The shoreline of the East River encompasses a range of industrial, commercial, and residential, recreational, and government properties. This study identified three potential facilities along the East River.

Figure 17. East River Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



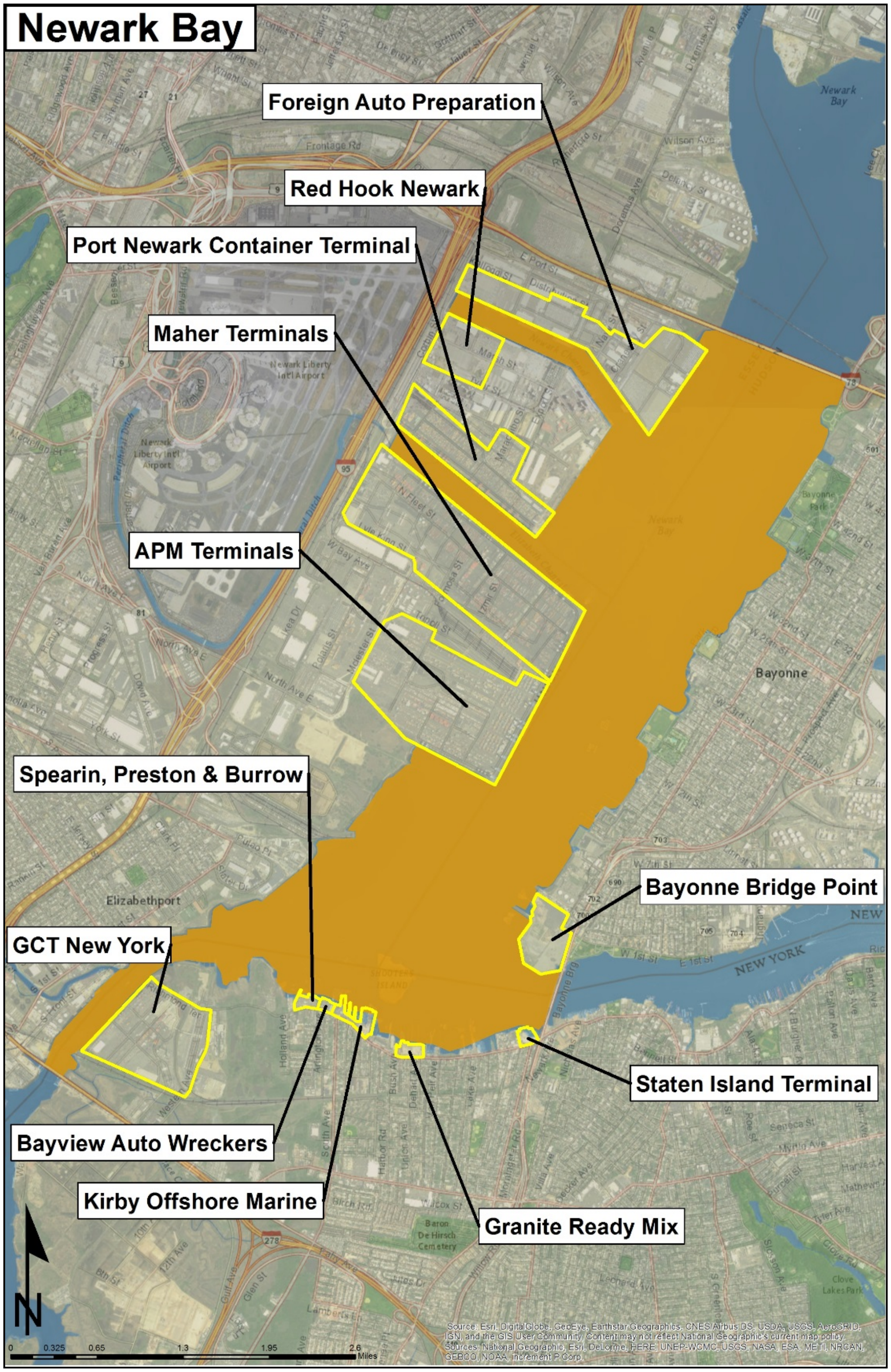
5.3.4 Newark Bay

Newark Bay is located between Newark and Bayonne, New Jersey. Vessels calling at Newark Bay reach the area by transiting the Lower Bay, Upper Bay, and Kill Van Kull, a tributary of the Upper Bay (see Figure 18). Air draft in this area is constrained by the air draft in the upper harbor, which is limited by the Verrazano Narrows Bridge. The air draft clearance of the Verrazano Narrows Bridge is taken as 60m (198 ft.) for the center 610m (2000 ft.) of the main span; however, a maximum clearance of 65.5m (215 ft.) is available at the center of the bridge. The entrance to Newark Bay is also crossed by the Bayonne Bridge, with an air draft restriction of 65.5m (215 ft.). Per the U.S. Army Corps of Engineers' Controlling Depth Report for the Constable Hook Reach to Bergen Point West (March 4, 2016), the water depth below the Bayonne Bridge ranges from approximately 16.5m (54 ft.) at the south edge of the channel to 17m (56 ft.) at the north edge of the channel, with a maximum depth of approximately 17m (56 ft.) just north of the centerline. Considering the air draft of the bridge, the minimum available water depth below span, and the tidal range, this results in an approximately 83.5m (274 ft.) clearance between the bottom of the navigation channel and the bottom of the bridge.

Newark Bay is home to many active marine terminals, including container, bulk, project, and liquid terminals. This study identified 12 facilities in this area; however, many may not be available to OSW given the limited capacity for expanded operations due to ongoing business at the facilities. While each individual facility is limited in size, aggregation of the Spearin, Preston & Burrow, Bayview Auto Wreckers, and Kirby Offshore Marine sites may result in a facility that would be potentially viable for OSW activities.

Figure 18. Newark Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.3.5 Upper Newark Bay

Upper Newark Bay, as seen on Figure 19, is an extension north of Newark Bay; however, air draft in this area is limited by the I-78 Newark Bay Bridge at 41.1m (135 ft.) and Lehigh Valley Railroad Lift Bridge at the same height (raised position: 41.1m [135 ft.]; lowered position 10.7m [35 ft.]). This study identified an additional two facilities in Upper Newark Bay.

Figure 19. Upper Newark Bay Area

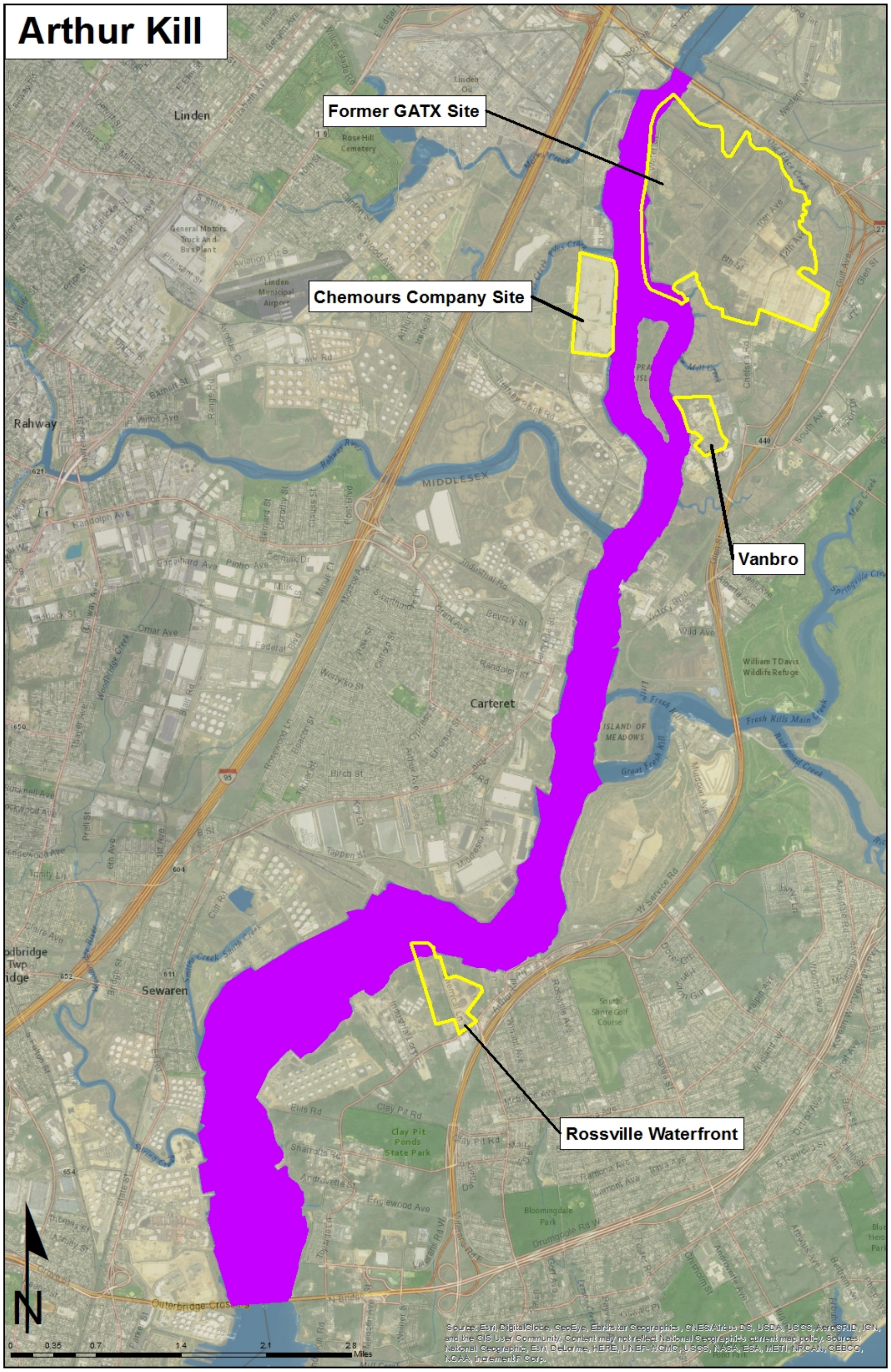
Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

5.3.6 Arthur Kill

The Arthur Kill, as seen on Figure 20, is a narrow waterway that separates Elizabeth, Carteret, Woodbridge, and Perth Amboy, New Jersey, to the west, and Staten Island, New York, to the East. The Arthur Kill connects Newark Bay to the north and Raritan Bay to the south. Vessel navigation is limited by the Arthur Kill Railroad Bridge to the north, with an air draft restriction of 41.1m (135 ft.), and the Outerbridge Crossing to the south, with a vertical clearance of 43.6m (143 ft.). The Arthur Kill is also crossed by the I-278 Goethals Bridge to the north, with an air draft restriction of 41.8m (140 ft.) as per the Port Authority of New York and New Jersey web site. This study identified four potential waterfront facilities along the Arthur Kill. The former GATX site and Rossville waterfront sites are particularly notable sites due to the available upland area and absence of existing use. Both brownfield sites are seeking redevelopment opportunities. A portion of the former GATX site has been leased by Amazon; however, press releases indicate additional area should be available at the site.

Figure 20. Arthur Kill Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

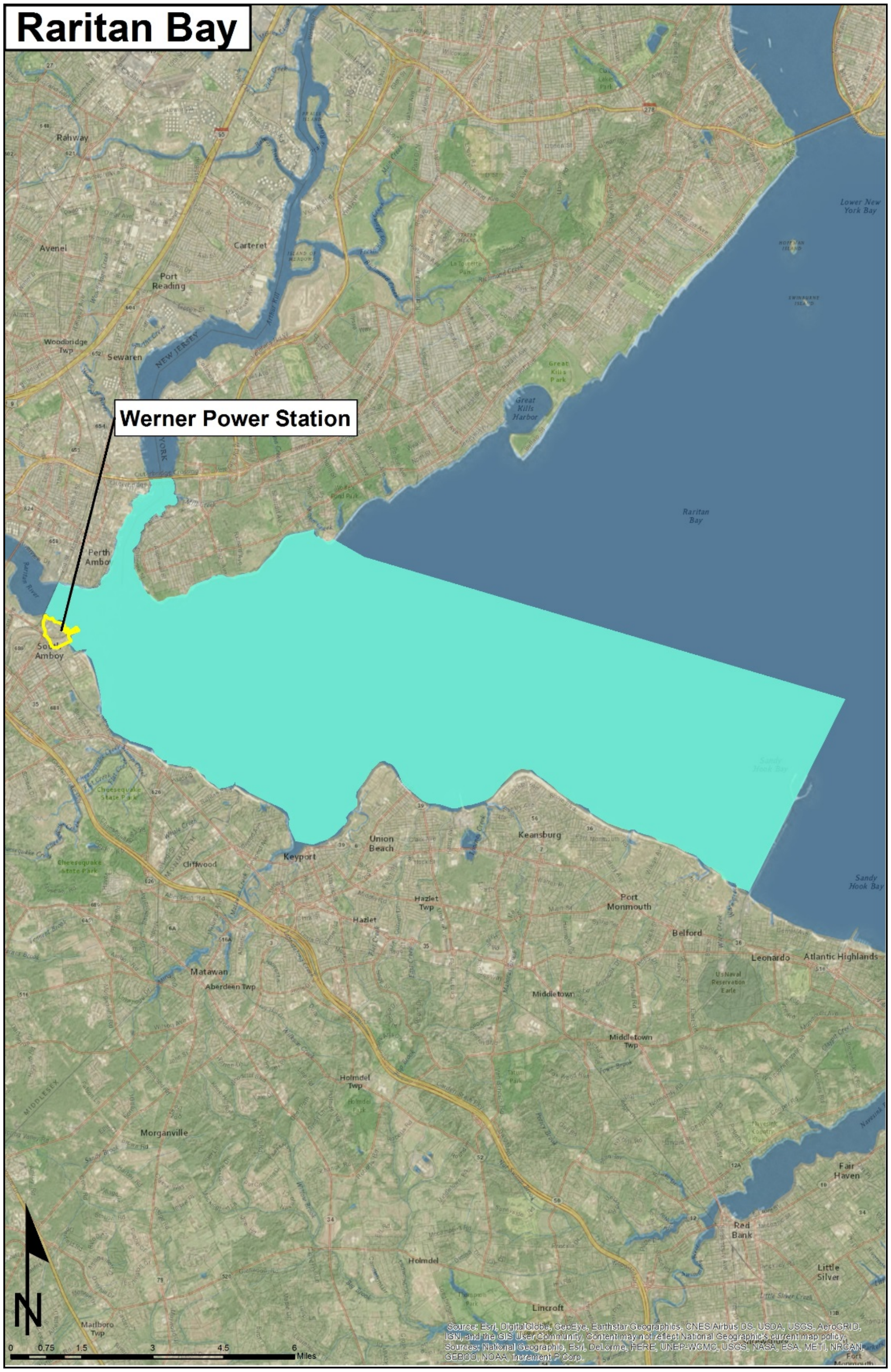


5.3.7 Raritan Bay

Raritan Bay is located southwest of Lower New York Bay, as seen on Figure 21. It is bounded to the north by Staten Island, New York, and Perth Amboy, New Jersey; to the south by South Amboy Union Beach, and Keansburg, New Jersey; and to the east by Lower New York Bay, Navy 2 Mile Pier, and Sandy Hook Bay. Air draft in this area is unlimited, which differs from most other sites (excluding Lower New York Bay). The unlimited air draft presents a major benefit to a staging or installation port located in this area. The majority of shoreline in this area is occupied by residential areas, parks, and beaches. One industrial waterfront facility was identified in this area. The decommissioned Werner Power Station is a brownfield site with interstate and rail access that could be redeveloped as an OSW port facility.

Figure 21. Raritan Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

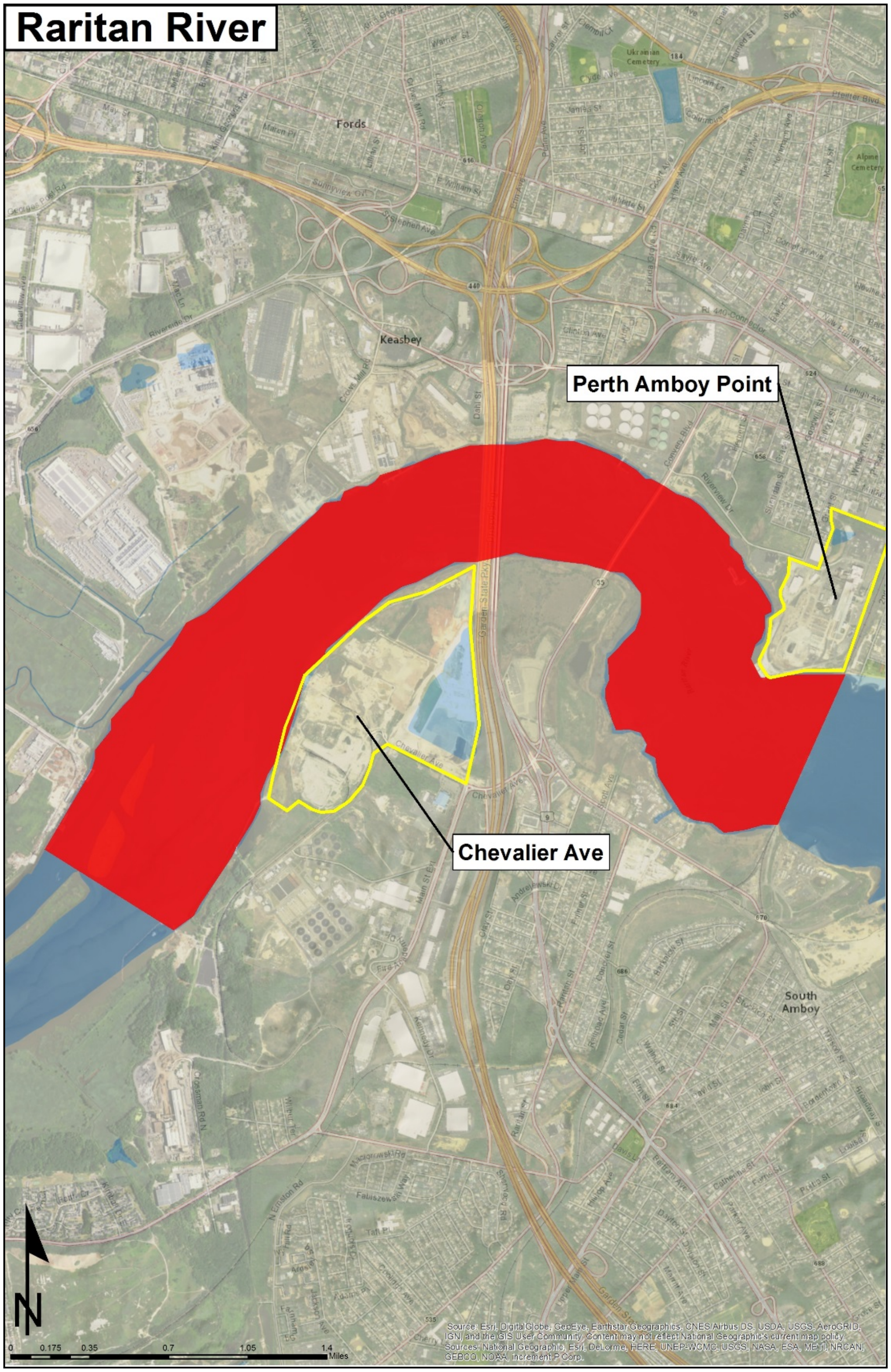


5.3.8 Raritan River

The Raritan River flows into Raritan Bay from the west, as seen on Figure 22. Air draft is restricted on the river by the New Jersey Route 35 Victory Bridge at 33.5m (110 ft.), the Edison Fixed Bridges at 33.5m (110 ft.), and the Alfred E. Driscoll Bridge at 40.8m (134 ft.). The Raritan River Railroad (Swing) Bridge further limits horizontal clearance to 37.8m (124 ft.) at the mouth of the Raritan River, and overhead power cables limit the air draft to 42.7m (140 ft.). Two potential facilities are located on the Raritan River. The bridge clearances on the Raritan River limit the potential of the upriver facilities as staging and installation ports; however, it may still be used as a manufacturing, fabrication, or O&M port.

Figure 22. Raritan River Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.4 Hudson River Waterways

The Hudson River originates in the Adirondack Mountains of upstate New York, flows through the Hudson Valley, and eventually drains into the Atlantic Ocean between New York City and Jersey City, New Jersey. The portion of the Hudson River navigable by commercial vessels flows approximately 200 km (124.3 miles) from the Troy area of New York southward to New York Harbor, as seen on Figure 23. The Congress Street Bridge, in Troy, New York was selected as the northern boundary for this study; north of the bridge, the Hudson becomes part of the New York State Canal System and is used primarily by recreational vessels.

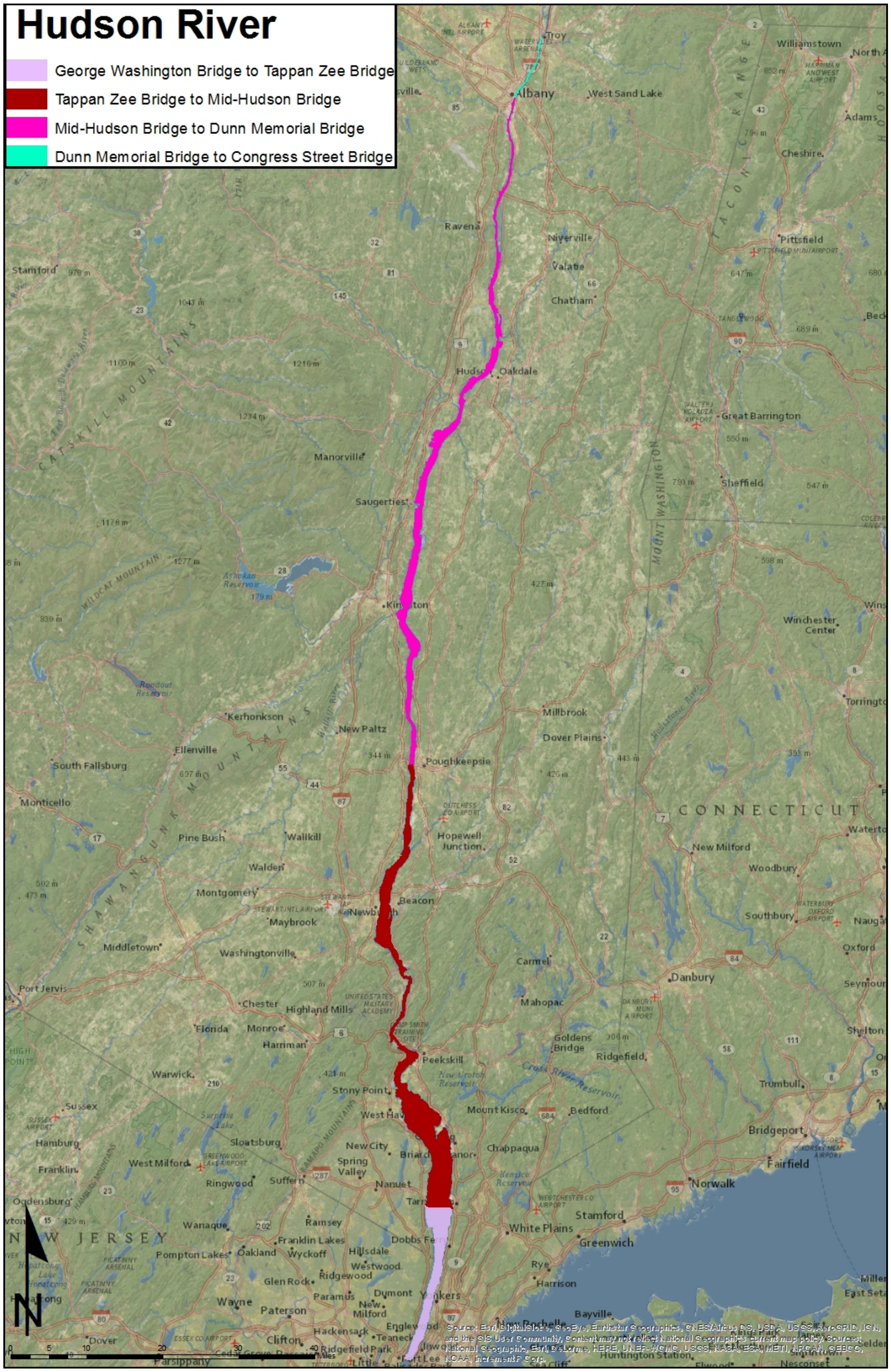
Many waterfront facilities are located along the banks of the Hudson River. This study identified 23 active and potential waterfront facilities that may be considered to serve the needs of OSW into 2030 and beyond. This study divides the Hudson River into distinct areas. The areas have been arranged beginning downriver, closest to the New York OSA, and then proceeds upriver. Due to shoaling in the river, the Hudson River Pilots Association has limited navigation to areas north of Kingston, New York, to a maximum draft of 9.1 m (30 ft.).

Due to the air draft restrictions and distance from the potential OSW project sites, most of the facilities on the Hudson River are unlikely to be used as construction and staging facilities, or as operations and maintenance facilities. However, the amount of upland area, moderate air drafts, and moderate navigational depths suggest that many of these facilities may be appropriate for OSW manufacturing or fabrication. The presence of numerous quarries suggest that many are especially suitable for fabricating concrete foundations, using the quarry aggregate as raw materials for construction.

The potential OSW site-specific figures and summary tables are provided in Appendix B.

Figure 23. Hudson River Waterway Areas

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

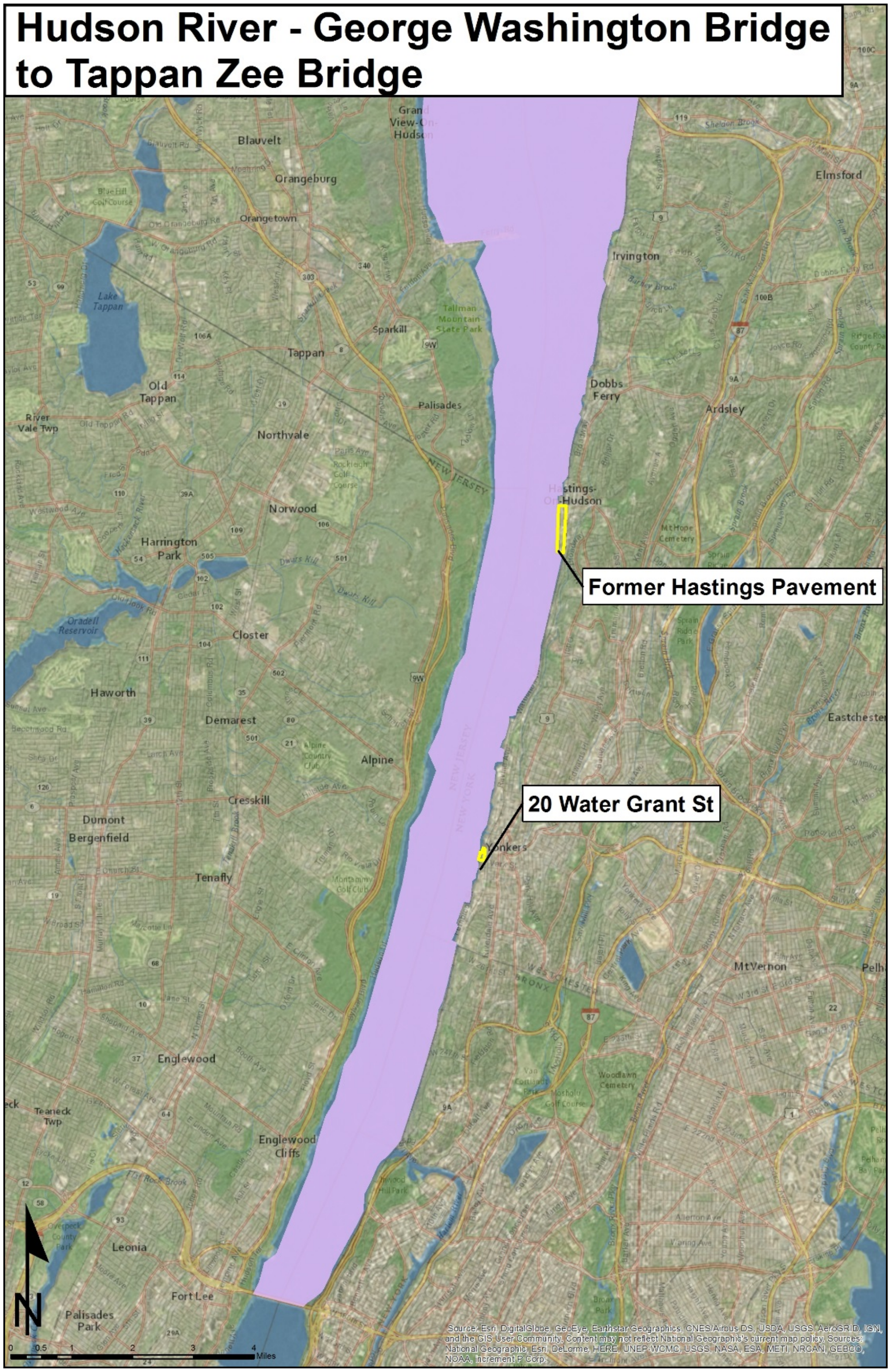


5.4.1 George Washington Bridge to Tappan Zee Bridge

This section of the Hudson River is bounded to the south by the George Washington Bridge and to the north by the Tappan Zee Bridge. Air draft in this area is limited by the George Washington Bridge at 59.4m (195 ft.) for the east end, 64.9m (213 ft.) at the center, and 64m (210 ft.) at the west end (see Figure 24). The shoreline encompasses primarily residential properties; however, two potential facilities were identified along this section of the Hudson River.

Figure 24. George Washington Bridge to Tappan Zee Bridge

Source: COWI 2017;ESRI (ArcGIS, World Imagery Basemap)

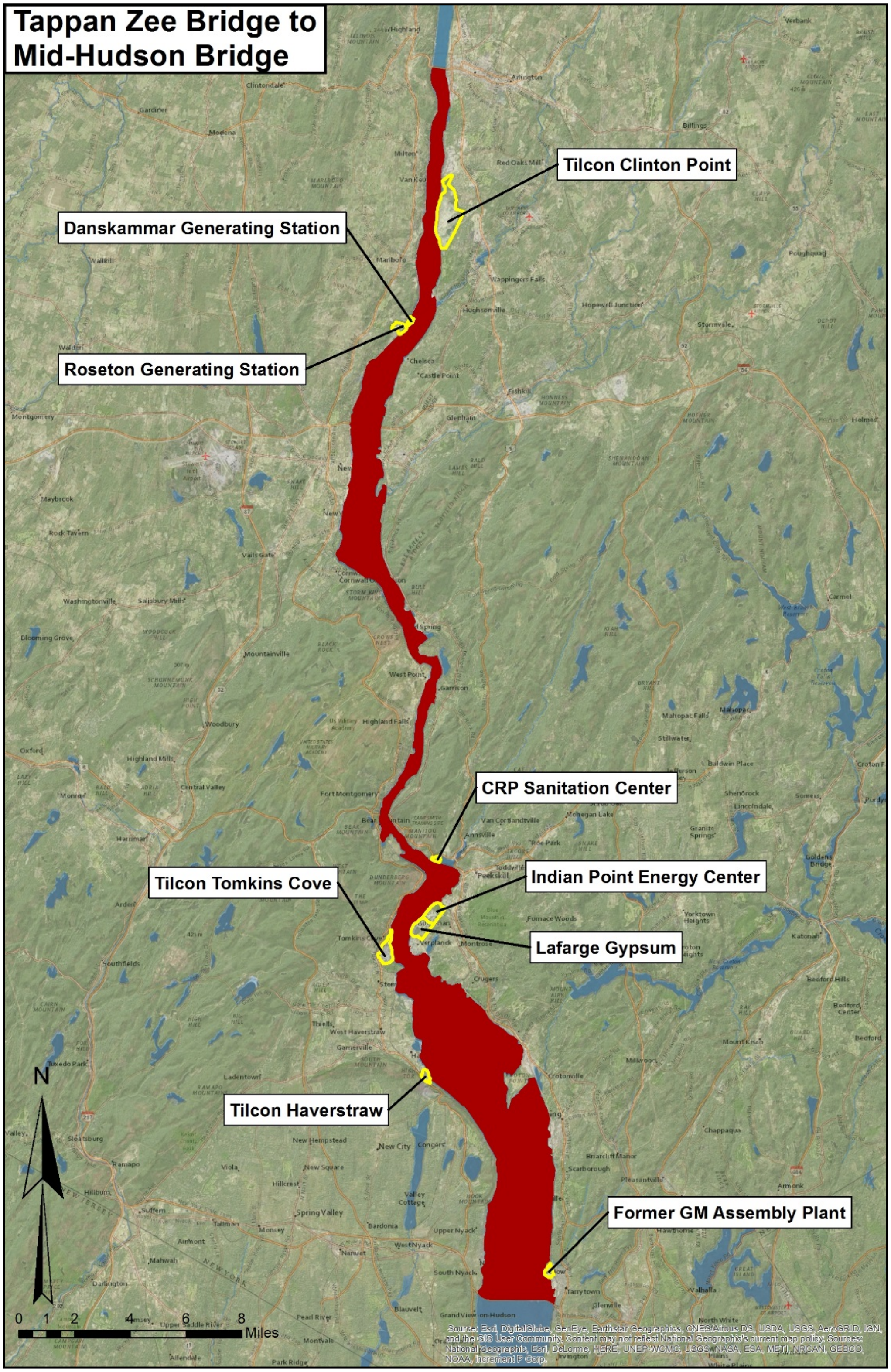


5.4.2 Tappan Zee Bridge to Mid-Hudson Bridge

The section of the Hudson River between the Tappan Zee Bridge to the south and the Mid-Hudson Bridge in Poughkeepsie, New York, to the north is approximately 66.9 km (41.6 miles) long (see Figure 25). Air draft in this section is restricted by I-287 over the Tappan Zee Bridge at a vertical clearance of 42.4m (139 ft.) under the center span, and 37.5m (123 ft.) under both the east and west spans. At the time of this report, construction is underway on the New New York Bridge to replace the Tappan Zee Bridge, which is expected to be completed in 2018. The new bridge will have a vertical clearance of 42.1m (138 ft.). This section of the Hudson River is also crossed by the Bear Mountain Bridge, with an air draft clearance of 47.2m (155 ft.), and the Newburgh-Beacon Bridge, with an air draft clearance of 44.8m (147 ft.) for the middle 231.7m (760 ft.), and a maximum vertical clearance of 52.4m (172 ft.) at the centerline. This study identified nine potential sites along this section of the river. The Indian Point Energy Center, which will be decommissioned in 2020 with no published future plans for the site, is of particular interest. The coastline along this section comprises a wide variety of residential, light industrial, undeveloped, and protected land.

Figure 25. Tappan Zee Bridge to Mid-Hudson Bridge Area

Source: COWI 2017;ESRI (ArcGIS, World Imagery Basemap)



5.4.3 Mid-Hudson Bridge to Dunn Memorial Bridge

The next 98.7-km (61.3-mile) section of the Hudson River is bounded by the Mid-Hudson Bridge to the south and the Dunn Memorial Bridge to the north (see Figure 26). Air draft in this section is restricted by US-44 and NY-55 over the Mid-Hudson Bridge in Poughkeepsie, New York. The vertical clearance of the Mid-Hudson Bridge is 40.8m (134 ft.) above MHW. Multiple bridges and overhead power cables cross this section of the Hudson River, which are listed from south to north in Table 28.

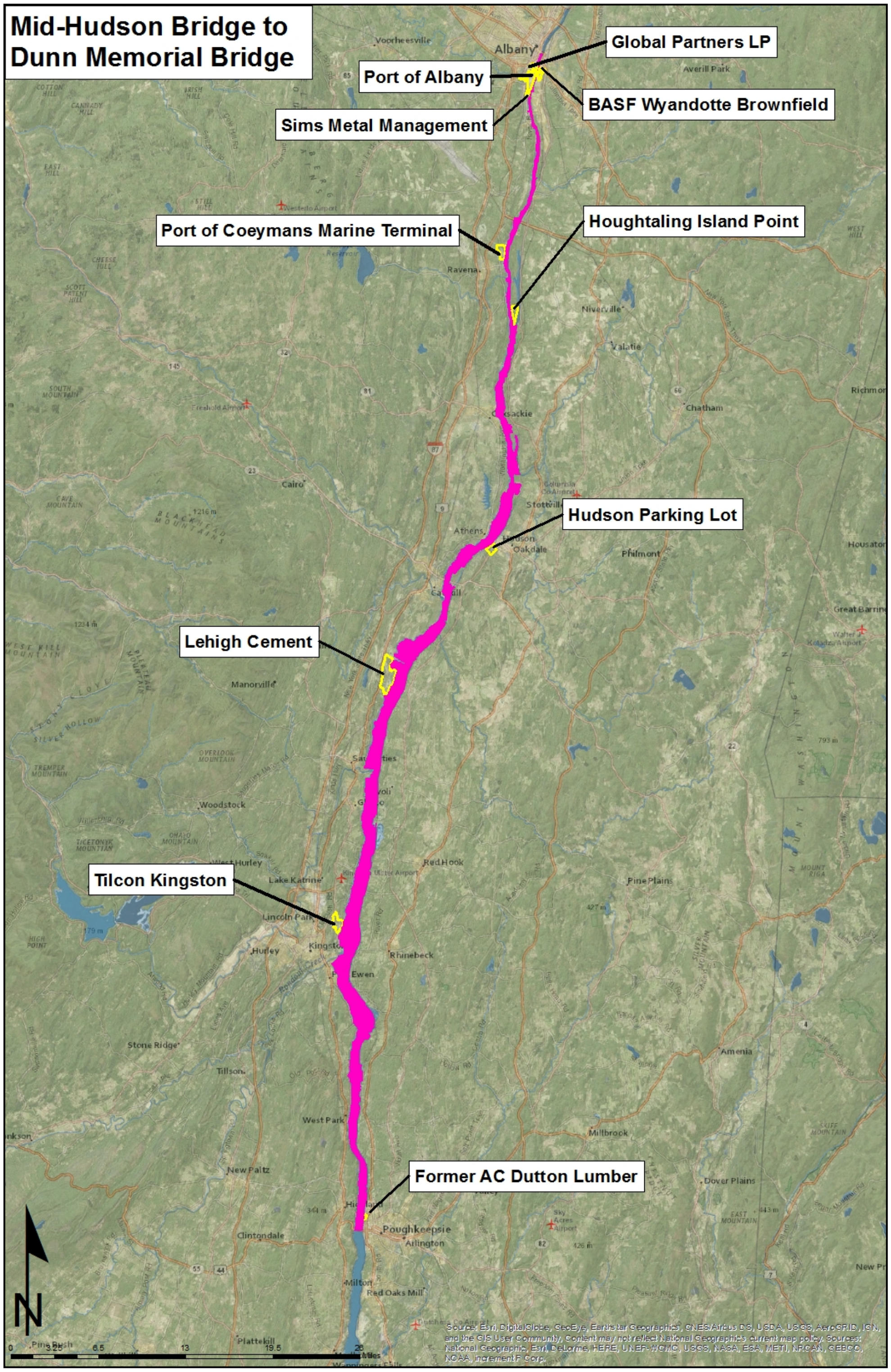
Table 28. Hudson River Navigational Clearances

Crossing	Vertical Clearance Above MHW
Mid-Hudson Bridge	40.8m (134 ft.)
Walkway Over Hudson	50.9m (167 ft.)
Kingston-Rhinecliff Bridge	Two channel spans, both 41.1m (135 ft.)
Rip Van Winkle Bridge	43.3m (142 ft.)
Overhead Power Cables	56.4m (185 ft.), 44.2m (145 ft.)
Railroad Bridge in Castleton	West Span: 42.4m (139 ft.)
Overhead Power Cables	51.5m (169 ft.) and 59.1m (194 ft.)
Castleton-Hudson Bridge	41.1m (135 ft.)

Ten potential sites were identified along this section of the river, where the shoreline comprises of residential, light industrial, and undeveloped land. This stretch of shoreline includes the Port of Coeymans Marine Terminal, which is currently supporting the Mario Cuomo Bridge (the Tappan Zee Bridge replacement) project, and the Port of Albany-Rensselaer. Both facilities have experience supporting on-site manufacturing and fabrication clients and have supported OSW projects. With minor to moderate upgrades, both facilities are potentially viable OSW manufacturing and fabrication ports.

Figure 26. Mid-Hudson Bridge to Dunn Memorial Bridge

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.4.4 Dunn Memorial Bridge to Congress Street Bridge

The Hudson River site study reaches its northernmost extent at the Congress Street Bridge in Watervliet, New York (see Figure 27). The northernmost 9.3 km (5.8 mile) section of the river is bounded to the south by the Dunn Memorial Bridge, which also restricts the air draft in this section with a vertical clearance of 18.3m (60 ft.) above MHW. The Livingston Avenue Railroad Bridge, approximately 1.3km (0.8 miles) to the north of the Dunn Memorial Bridge, has a horizontal clearance of 29.9m (98 ft.). To the north, navigation is limited to a vertical clearance of 16.8m (55 ft.) by the Congress Street Bridge. North of the Congress Street Bridge, the Hudson becomes part of New York State Canal System; the area is charted in a series of recreational navigation charts. The Congress Street Bridge is the northern (upriver) boundary for this study. Multiple bridge and power line crossings cross the Hudson River in this area; they are listed from south to north in Table 29.

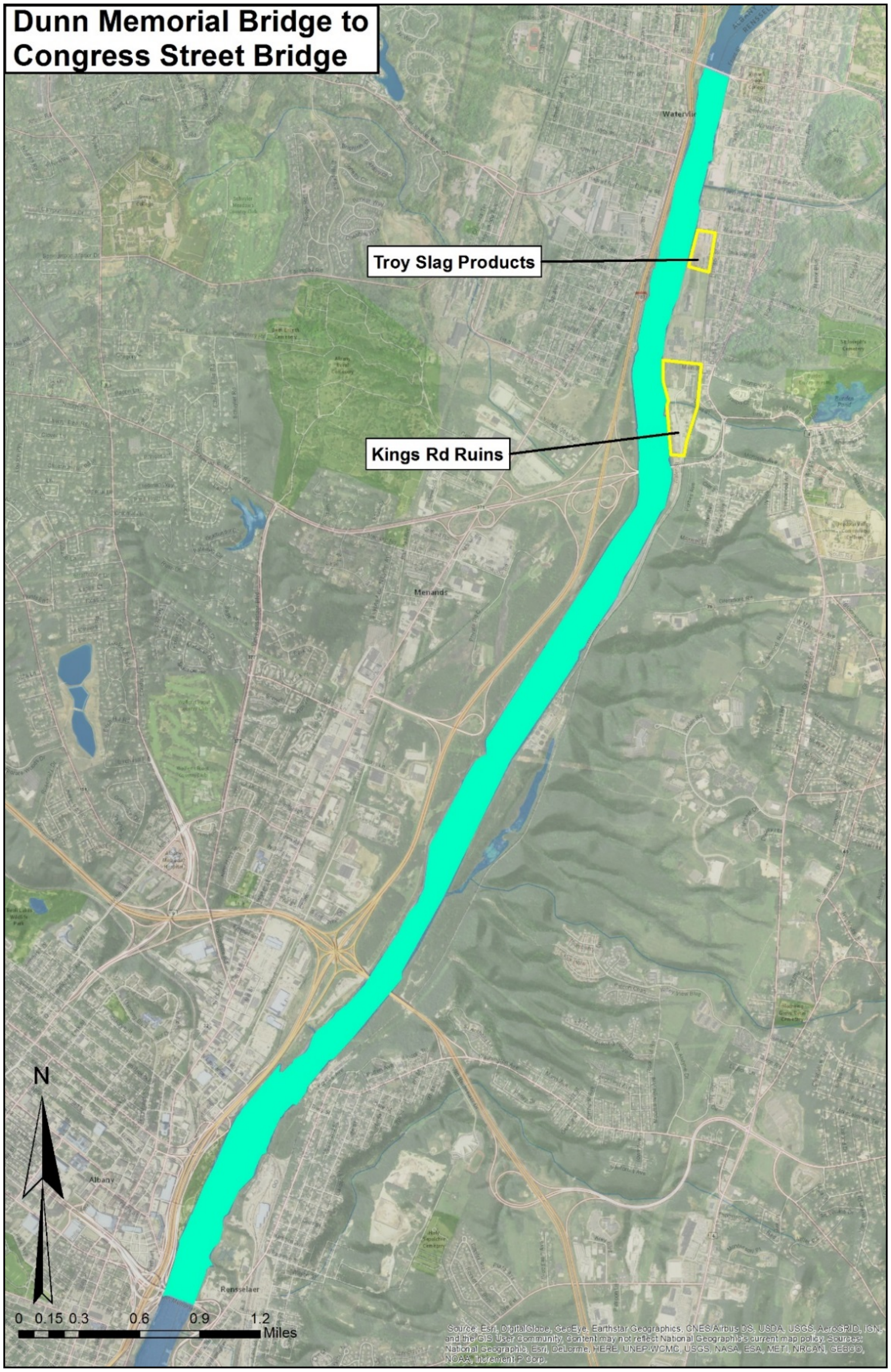
Table 29. Hudson River Navigational Clearances

Crossing	Vertical Clearance above MHW
Dunn Memorial Bridge	18.3m (60 ft.)
Overhead Power Cables	41.1m (135 ft.) and 26.8m (88 ft.)
Patroon Island Bridge	18.3m (60 ft.)
Overhead Power Cables	28.9m (95 ft.) and 26.5m (87 ft.)
Troy Menands Bridge	18.6m (61 ft.)

This study identified two commercial waterfront facilities along this section of the river, including the Kings Road Ruins, a 16.8-ha (41.4-acre) brownfield site in Rensselaer, New York.

Figure 27. Dunn Memorial Bridge to Congress Street Bridge

Source: COWI 2017;ESRI (ArcGIS, World Imagery Basemap)



5.5 Long Island Waterways

Long Island extends approximately 190 km (118 miles) east from New York City into the Atlantic Ocean and has a maximum north-south width of 37 km (23 miles). It is bordered to the south by the Atlantic Ocean, the northeast by Block Island Sound, and to the north by Long Island Sound. This study investigated the inlets, harbors, and bays along the south shore of Long Island from East Rockaway Inlet in the west to Montauk at the eastern extent of the island, and north to Orient Point. The study identified additional facilities along the north shore of Long Island at Port Jefferson and the inlet at Shoreham, New York. The areas investigated on Long Island primarily contain multiple small waterfront facilities (e.g., marinas), while the inlet at Shoreham, New York, is a single-facility location. Some of these waterfront facilities are better suited (and thus more likely) than others to be considered for OSW, due either to existing use, capacity, or geographic location.

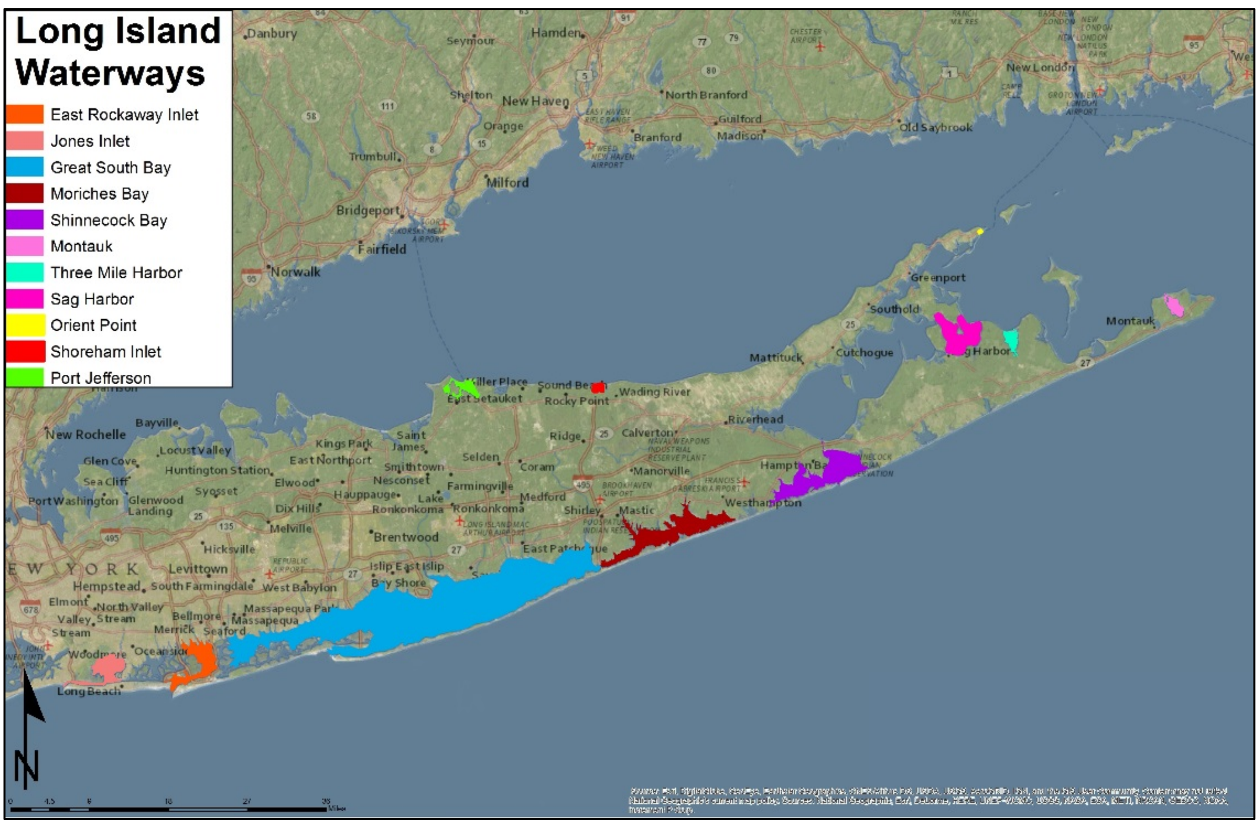
The shoreline of Long Island generally consists of residential, light commercial (marinas and restaurants), and undeveloped lands (primarily parks, nature preserves, marsh lands, and farms). The majority of the light commercial areas identified cater to recreational clientele and are unlikely to support OSW operations. It may be possible to construct a new facility on some of the undeveloped land(s). The potential new-build facilities would likely require significant environmental mitigation as well as political support. Due to the challenges of developing a new-build facility from undeveloped lands and the wide variability in the types of undeveloped lands, this study did not catalogue the extent of undeveloped land within the scope of this study; however, particularly notable undeveloped lands have been documented. Several waterfront sites identified on Long Island are located on public lands (state and municipal parkland, public docks, etc.). In comparison to private property, repurposing public lands requires a different and potentially more challenging process. Developing an O&M facility on public lands would require substantial political support, stakeholder involvement and environmental approvals.

For the purposes of this study, the waterways of Long Island are divided into distinct areas. The areas are defined by the embayment or navigable inlets that separate the protected waterway from the open water of Long Island Sound, Block Island Sound, or the Atlantic Ocean. The areas are arranged beginning closest to New York Harbor at East Rockaway Inlet and proceed counterclockwise around Long Island. The facilities identified on Long Island vary somewhat from the facilities investigated within other parts of this project, because Long Island is primarily occupied by residential, commercial, and natural (marshland, park, or preserve) areas. There are relatively few heavy industrial sites in the general vicinity; therefore, most of the potential sites examined for this study are light commercial facilities such as marinas and commercial fishing docks. Because of the nature and number of the small facilities that exist along the Long Island coast, the potential sites were documented collectively within one summary table per distinct area (see Appendix C).

Due to the lack of available upland space, adjacent property uses, and the shallower navigable depths, most of the Long Island facilities are unlikely to be utilized as manufacturing and fabrication facilities, or construction and staging facilities. However, the proximity to the New York OSA, as well as other proposed future projects in the Northeast, suggests that some Long Island facilities may be well suited to serve as operation and maintenance ports to support future OSW development.

Figure 28. Long Island Waterways

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.1 East Rockaway Inlet

The East Rockaway Inlet separates Far Rockaway in Queens, New York, from Atlantic Beach on the outer barrier and provides vessels access to Hempstead Bay from the Atlantic Ocean (see Figure 29). The mouth of the inlet is a steaming distance of 49.9 km (31 miles) from the New York WEA and 221.6 km (137.7 miles) from Deepwater Wind's proposed South Fork project. The channel through the inlet is authorized to a project depth of 3.7m (12 ft.) and is 76.2m (250 ft.) wide. The channel is approximately 1.5km (0.9 miles) long and passes under the Atlantic Beach Bascule Bridge, which has a horizontal clearance of 38m (125 ft.) and a vertical clearance of 7.6m (25 ft.) when closed. Vessels then travel approximately 4.8 km to 5.8 km (3 miles to 3.6 miles) east through the Reynolds Channel before turning north into the Broad Channel or the Hog Island Channel to access Hewlett Bay at the northern extent of Hempstead Bay. The channels within the bay navigate between numerous salt marsh islands.

The Outer Barrier shoreline, south of Reynolds Channel, is densely populated with residential properties. The western extent of Hempstead Bay is non-traversable marshland. The eastern and northern coastlines of Hempstead Bay comprise private residences, the EF Barrett Generation Station, light industrial and commercial properties, multiple golf courses, and small vessel facilities. Eight potential waterfront sites were identified within the East Rockaway Inlet area (see Figure 30).

Figure 29. East Rockaway Inlet Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

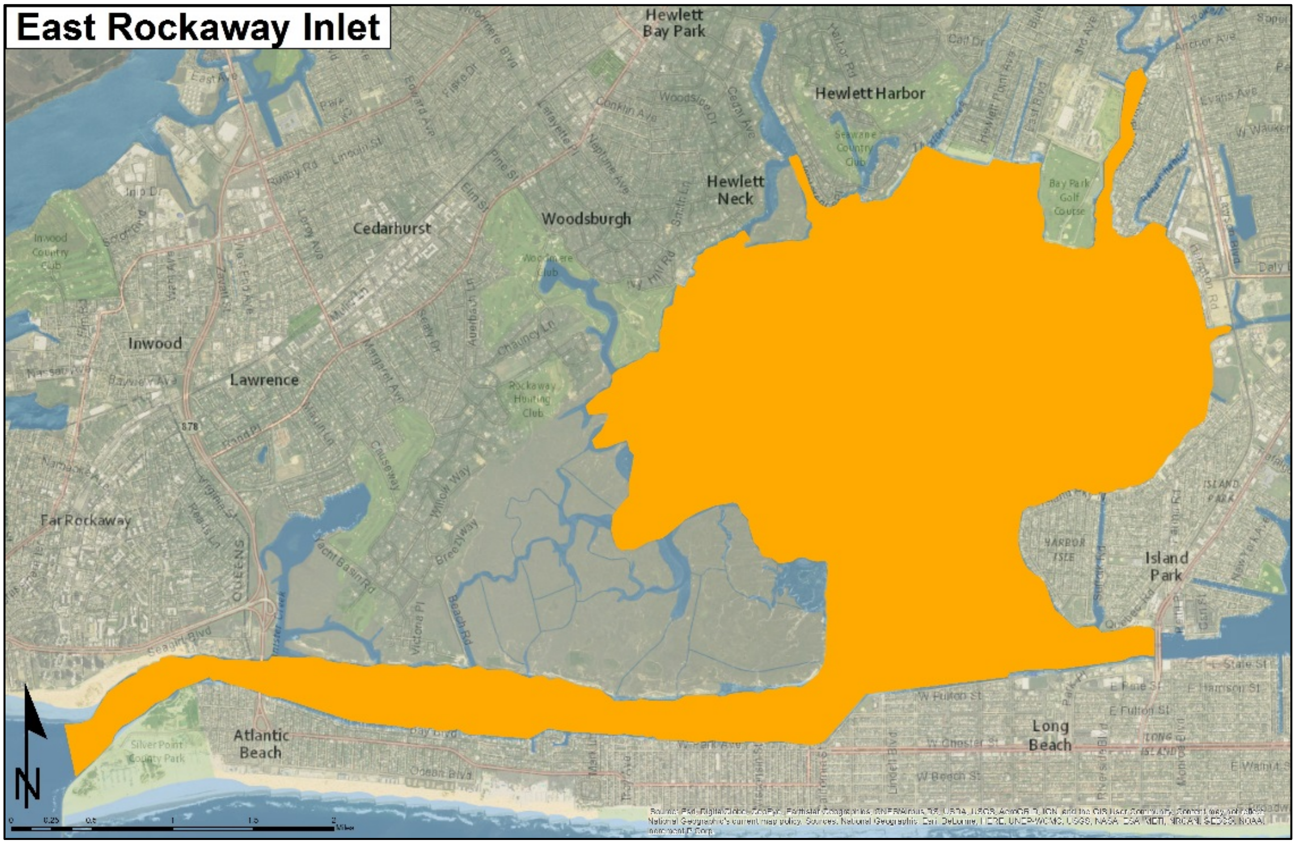


Figure 30. East Rockaway Inlet Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

5.5.2 Jones Inlet and East Hempstead Bay

Jones Inlet is located in Nassau County, Long Island, New York, and provides vessel access to East Hempstead Bay (sometimes referred to as East Bay) from the Atlantic Ocean (see Figure 31). Due to frequent changes in channel conditions, vessel operators should obtain local knowledge before navigating through the inlet. The inlet is a steaming distance of 39.3 km (24.4 miles) from the New York WEA and 206.5 km (128.3 miles) from Deepwater Wind's proposed South Fork project. U.S. Coast Guard Station Jones Inlet is located on the Outer Barrier, east of the inlet. To reach East Hempstead Bay, vessels follow the Sloop Channel east along the Outer Barrier and under the Meadowbrook State Parkway Bascule Bridge, which, when closed, restricts vessel traffic with a vertical clearance of 6.4m (21 ft.) and a horizontal clearance of 22.9m (75 ft.); when open, the horizontal clearance is 15.2m (50 ft.). Vessels then travel north through the channels, either between East Crow Island and Snipe Island, or past the Field 10 Fishing Pier between Snipe Island and Green Island, to enter East Hempstead Bay.

The northern shoreline of East Hempstead Bay consists of multiple rivers, creeks, and inlets heavily populated with residential properties. East Bay is bounded by Meadowbrook State Parkway to the west, Jones Beach Parkway to the east, and marshland and undeveloped islands to the south. This study identified eight waterfront facilities in this area (see Figure 32).

Coast Guard Station Jones Beach is located at the western shoreline of the boat basin within Jones Beach State Park at a distance of approximately 2.3 km (1.4 miles) from the mouth of Jones Inlet. If an OSW O&M facility could be built on the undeveloped land behind Coast Guard Station Jones Beach, it would be in an optimal location for servicing projects developed within the New York WEA as well as others within the New York OSA.

Figure 31. Jones Inlet and East Hempstead Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

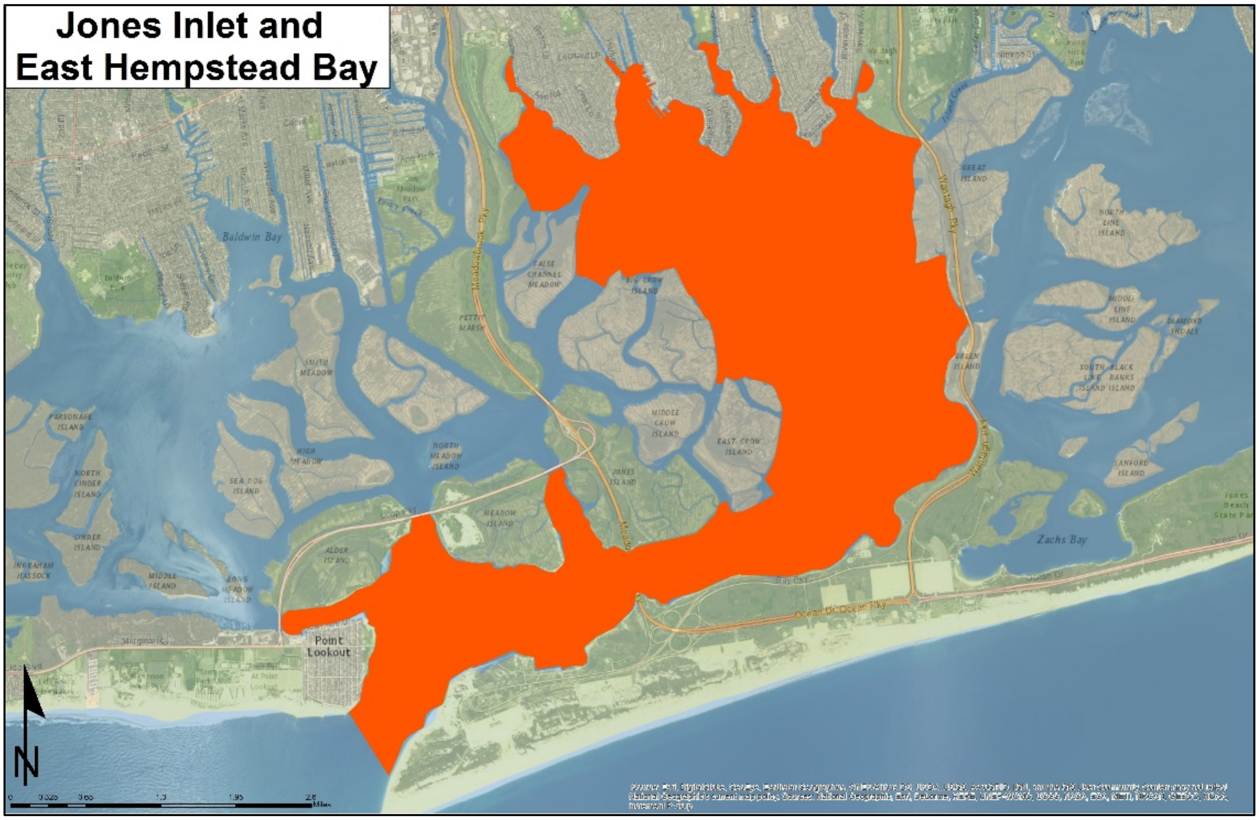
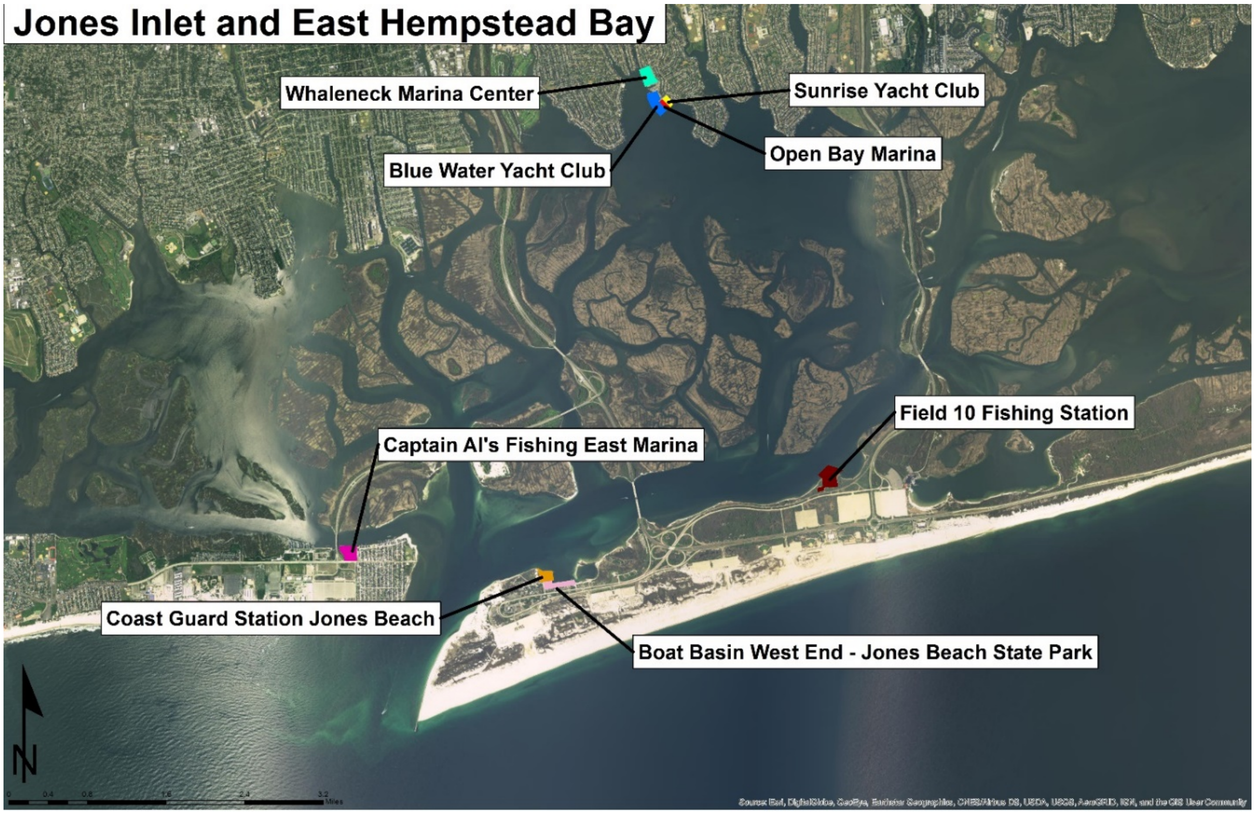


Figure 32. Jones Inlet and East Hempstead Bay Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.3 Great South Bay

Great South Bay is the largest bay along the south shore of Long Island, occupying approximately 243 square kilometers (151 square miles). For the purpose of this study, Great South Bay includes Nicoll Bay, Patchogue Bay, and Bellport Bay (see Figure 33).

Vessels access Great South Bay from the Atlantic Ocean by traveling north through the Fire Island Inlet. Due to frequently changing channel conditions, vessel operators should obtain local knowledge before navigating through the inlet; mariners are warned of extreme tidal turbulence in the inlet. The mouth of the inlet is a steaming distance of 37 km (23 miles) from the New York WEA and 182.8 km (113.6 miles) from Deepwater Wind's proposed South Fork project. Vessels traversing the Fire Island Inlet pass under the southern span of the Robert Moses Causeway Bridge, which restricts air draft to 19.8m (65 ft.) for the middle 141m (646 ft.) of the center span. Vessels then navigate east through the Farm Shoals Channel before entering the main bay by heading either north through the West Channel or east through the East Channel. Navigation within the bay is marked by buoys and beacons maintained by state and local agencies.

The main body of Great South Bay extends west from Heckscher State Park to the Nassau Shores in East Massapequa. The northern shoreline is characterized by numerous inlets, coves, and creeks and is predominantly occupied by residential properties. Multiple waterfront facilities along the northern coastline include various marinas, yacht clubs, and fishing charter operations. The southern shoreline along the Outer Barrier comprises residential properties, Robert Moses State Park, and multiple undeveloped islands and marshland areas. The bay is crossed by the northern span of the Robert Moses Causeway Bridge, which has an authorized vertical clearance of 18.3m (60 ft.) for the middle 140.2m (460 ft.). West of the bridge, navigation becomes complicated as severe shoaling is frequently reported.

Nicoll Bay is bounded to the east by West Sayville and to the west by Heckscher State Park. The Connetquot River is located on the northern shore of Great South Bay. This bay area consists of marinas, restaurants, residential properties, Timber Point Tidal Wetlands Area, the Timber Point Golf Course, and St John's University Oakdale Campus. The Sayville Ferry Service operates within Nicoll Bay, providing passenger service between Sayville and Fire Island.

Patchogue Bay occupies the northern shore of Great South Bay and abuts the western extent of Bellport Bay. In the town of Brookhaven, Patchogue Bay is bordered to the south by Fire Island and to the north by the villages of Blue Point, Patchogue, and East Patchogue. Various rivers and creeks empty into the Bay, and the shorelines of these rivers and creeks comprise multiple waterfront facilities, including marinas, restaurants, and yacht clubs.

Bellport Bay comprises the eastern extent of Great South Bay. Vessels have a steaming distance of approximately 40 km (24.9 miles) from Fire Island Inlet to the center of Bellport Bay. The federal project depth along the Bellport Bay Reach is 1.5m (5 ft.), and NOAA recommends obtaining local knowledge about navigating through the Long Island Intracoastal Waterway due to frequent shoaling reports. The Bellport Inlet to the south breaches the Outer Barrier into the Atlantic Ocean; however, vessel navigation through the inlet is not recommended. The shoreline of Bellport Bay consists predominantly of residential properties, the town of Bellport, and undeveloped land, including the Wertheim National Wildlife Refuge.

Sixteen potential sites were identified within Great South Bay (see Figure 34). The majority of identified sites serve recreational needs and are adjacent to residential properties. Unlike most facilities in the area, the Captree State Park and Unqua Corinthian Yacht Club sites have basic waterfront infrastructure (docks and road access) and are located adjacent to undeveloped land. These characteristics suggest that a portion of these sites may have greater potential for being developed as O&M facilities. Captree State Park is located approximately 6.6 km (4.1 miles) from the mouth of Fire Island Inlet, making it an optimal location for servicing projects developed within the New York OSA. In comparison to private property, the repurposing of public lands, such as a Captree State Park, requires a different and potentially more vigorous process. Strong political support, stakeholder involvement and environmental approvals are likely to be required in order to develop an O&M facility on public lands. Based on available current and historic aerial imagery and other publically available information, the Unqua Corinthian Yacht Club appears underutilized. It is located approximately 15.4 km (9.6 miles) from Jones Inlet and 22.4 km (13.9 miles) from Fire Island Inlet. This location would allow O&M vessels to have convenient access to OSW projects located offshore of either inlet. To access Jones Inlet from the Unqua Corinthian Yacht Club, vessels must pass beneath two bridges, the Wantagh State Parkway Bascule Bridge and the Meadowbrook State Parkway Bridge. The minimum air draft beneath the Wantagh State Parkway Bascule Bridge is unlimited when open and 6.1 m (20 ft.) when closed. The minimum air draft beneath the Meadowbrook State Parkway Bridge is 22.9m (75 ft.).

Figure 33. Great South Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

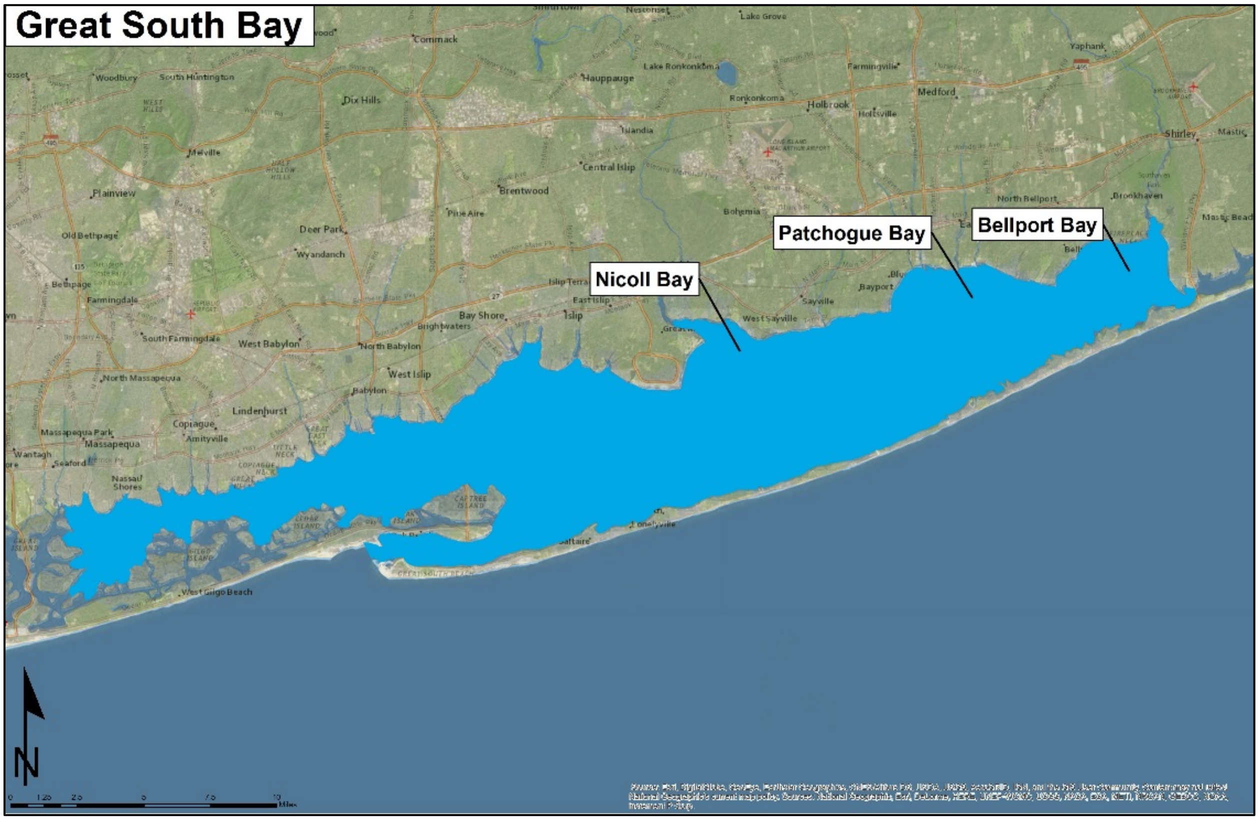
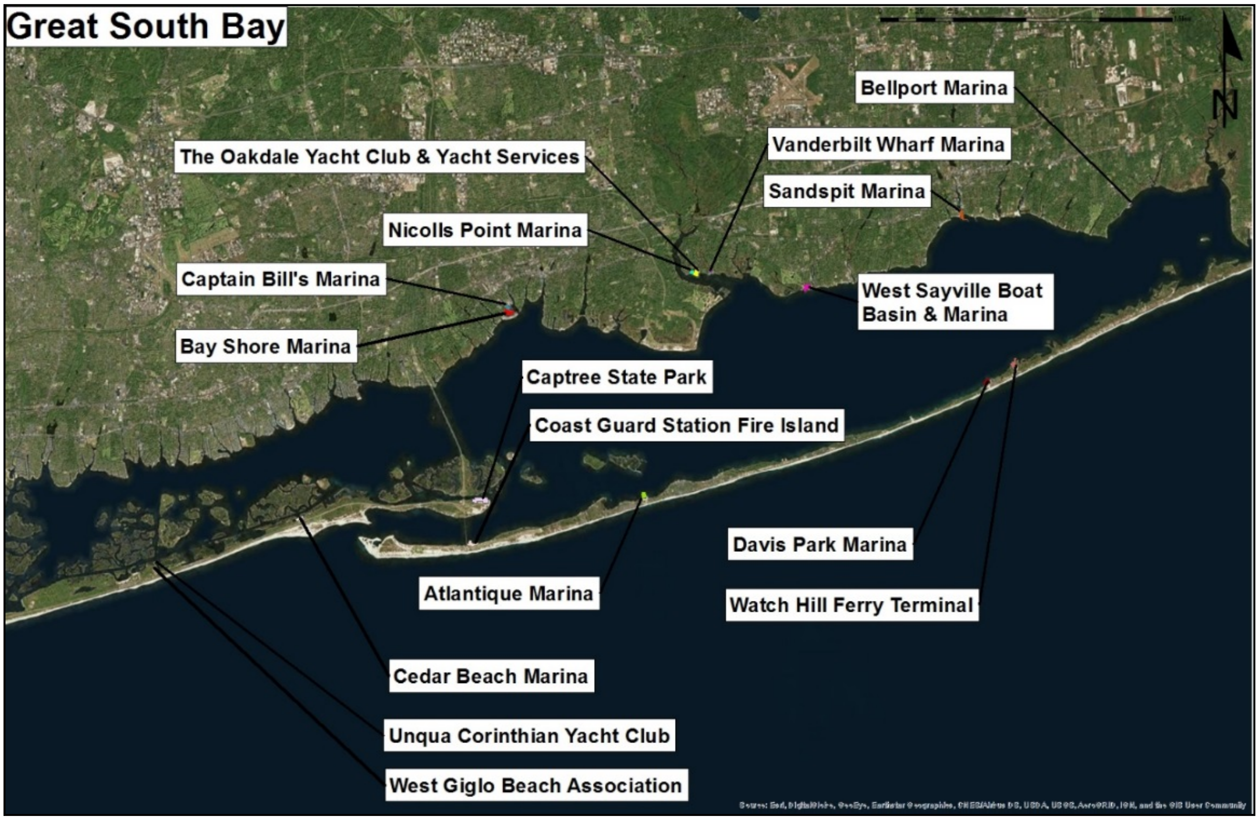


Figure 34. Great South Bay Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.4 Moriches Bay

Moriches Bay is accessed from either the Narrow Bay to the west or the Quantuck Canal to the east (see Figure 35). The Moriches Inlet to the south of the bay is unsafe for vessels to navigate due to rapidly changing shoal conditions and existing dangers. Vessels traveling to Moriches Bay from the Atlantic Ocean must pass through the Fire Island Inlet to the west, the Shinnecock Inlet, or the Shinnecock Canal to the east. The federal project depth is 1.5m (5 ft.) from Bellport Bay to the west to Shinnecock Canal to the east, and NOAA recommends obtaining local knowledge about navigating through the area due to frequent shoaling reports.

After passing through the Fire Island Inlet, vessels travel east through the Great South Bay and Bellport Bay before entering Narrow Bay, which is connected to the western extent of Moriches Bay. Air draft along this route is restricted by the Robert Moses Bridge, with a vertical clearance of 19.8m (65 ft.) for the middle 141m (646 ft.) of the center span, and by the Smith Point Bascule Bridge, with a vertical clearance of 5.5m (18 ft.) and a horizontal clearance of 16.8m (55 ft.). Vessels travelling this path have a steaming distance of 37 km (23 miles) from the New York WEA or 182.8 km (113.6 miles) from Deepwater Wind's proposed South Fork project to the mouth of the Fire Island Inlet, then an additional 59.3 km (36.9 miles) to the center of Moriches Bay.

Accessing Moriches Bay from the east involves passing through the Shinnecock Inlet or the Shinnecock Canal and entering the Quogue Canal on the western extent of Shinnecock Bay. Vessels then travel west through Quantuck Bay and the Quantuck Canal, which opens into the eastern extent of Moriches Bay. Vessels travelling this path have a steaming distance of approximately 93.2 km (57.9 miles) from the New York WEA or 107.8 km (67 miles) from Deepwater Wind's proposed South Fork project to the Shinnecock Inlet, then an additional 25.6 km (15.9 miles) to the center of Moriches Bay. Multiple bridges and overhead power cables cross this route and are detailed from offshore to inshore in Table 30.

Table 30. Air Draft Restrictions in Moriches Bay

Crossing	Vertical Clearance above MHW
Ponquogue Bridge	16.8m (55 ft.). Horizontal clearance of 30.8m (101 ft.)
Quogue (Post Lane) Bascule Bridge	4.6m (15 ft.). Horizontal clearance of 15.2m (50 ft.)
Overhead Power and TV Cables	22.9m (75 ft.)
Beach Lane Bascule Bridge	4.3m (14 ft.). Horizontal clearance of 15.2m (50 ft.)

Residential properties occupy the majority of shoreline in Moriches Bay, which includes numerous coves and inlets. A smaller portion of the Moriches Bay shoreline is undeveloped land, including Cupsogue Beach County Park, Terrell River County Park, Forge and Floyd Points, and Smith Point County Park. Five potential waterfront sites were identified within Moriches Bay (see Figure 36).

The steaming distance to both the New York WEA and Deepwater Wind's proposed South Fork site, as well as the additional complication of navigating multiple narrow, windy channels to reach open water, present challenges to using facilities within Moriches Bay. Facilities within this area may therefore be less suitable than those in other areas to support OSW.

Figure 35. Moriches Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

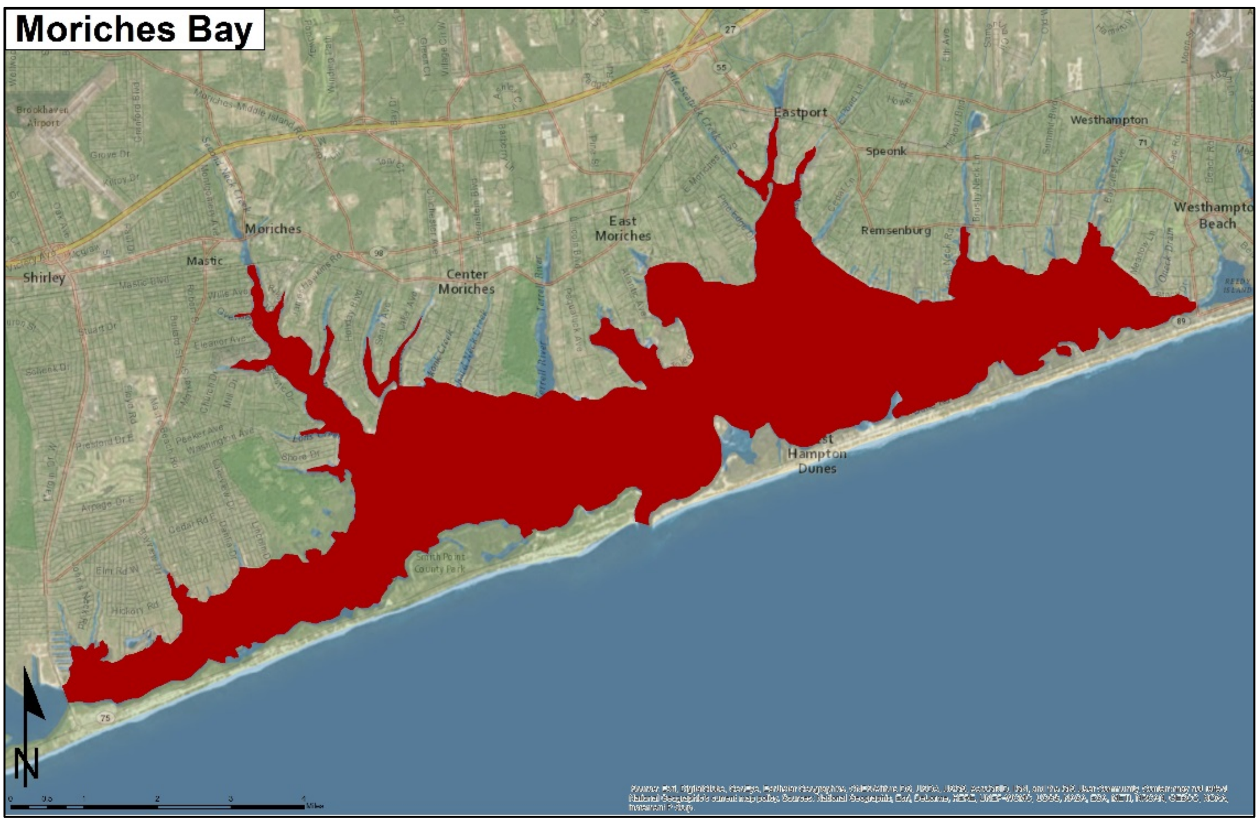


Figure 36. Moriches Bay Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

5.5.5 Shinnecock Bay

Located at the western extent of the South Fork of Long Island, Shinnecock Bay has two access points from open water, the Shinnecock Inlet to the south and Shinnecock Canal to the north (see Figure 37). The inlet was created by the Hurricane of 1938 and gives vessels direct access to the Atlantic Ocean. Shinnecock Inlet frequently exhibits strong currents and frequent changes in channel conditions. Vessels leaving the inlet have a steaming distance of 93.2 km (57.9 miles) to the New York WEA and 107.8 km (67 miles) to Deepwater Wind's proposed South Fork project.

Shinnecock Bay may also be accessed through the Shinnecock Canal, which faces north into Great Peconic Bay. The canal is approximately 1,400m (4,700 ft.) long and is spanned by multiple bridges and overhead power cables, as detailed from south to north in Table 31. The Shinnecock Locks further restrict vessel traffic to a width of 12.5m (41 ft.) and a length of 76.2 (250 ft.). Vessels leaving the northern mouth of the canal have a steaming distance of 232.9 km (144.7 miles) to the New York

WEA and 121.2 km (75.3 miles) to Deepwater Wind's proposed South Fork project. The controlling depth at mean lower low water was 1.8m (6 ft.) as of August 1978. Multiple marinas and waterfront facilities occupy the shoreline along the canal.

Table 31. Air Draft Restrictions along Shinnecock Canal

Crossing (Listed South to North)	Vertical Clearance above MHW
Overhead Power and TV Cables	10.4m (34 ft.)
Montauk Highway Fixed Bridge	7.6m (25 ft.)
Shinnecock Railway Bridge	6.7m (22 ft.)
Overhead Power Cables	13.4m (44 ft.) and 11.6m (38 ft.)
Sunrise Highway Fixed Bridge	7.0m (23 ft.)

Shinnecock Bay is spanned by the Ponquogue Bridge, which connects Hampton Bays to Ponquogue Beach on the Outer Barrier. The bridge restricts vessel traffic with a vertical clearance of 16.8m (55 ft.) and a horizontal clearance of 30.8m (101 ft.). A federal project depth of 1.5m (5 ft.) further restricts navigation along the Long Island Intracoastal Waterway. NOAA recommends obtaining local knowledge before navigating the waterway due to frequent shoaling reports. U.S. Coast Guard Station Shinnecock is adjacent to the northern extent of the bridge, facing east into Shinnecock Bay. West of the bridge, the Shinnecock Bay shoreline is predominantly occupied by residential properties and undeveloped marshland. A non-encompassing list of waterfront facilities west of Ponquogue Bridge includes Hampton Landing Marina, Ponquogue Marine Basin, Ponquogue Marina in Hampton Bays, and Aldrich Boat Yard in East Quogue.

Six potential sites were identified within Shinnecock Bay, most of which are marinas lining Shinnecock Canal (see Figure 38). Just inside the western shoreline of Shinnecock Inlet is a small group of waterfront facilities, including the Oaklands Restaurant and Marina and the adjacent county park. The existing docking facilities are bordered on both sides by undeveloped lands that face north into the protected water of Shinnecock Bay. It may be possible to locate O&M vessels at the existing facilities or to develop the land on either side. Although it should be noted that development on public lands requires a different and potentially more substantial process in comparison to development on private lands. Strong political support, stakeholder involvement, and environmental approvals are likely to be required in order to develop an O&M facility on public lands. This area is approximately 0.7 km (0.5 miles) from the mouth of Shinnecock Inlet. The proximity to the inlet suggests that this would be an optimal location for an O&M port facility.

Figure 37. Shinnecock Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

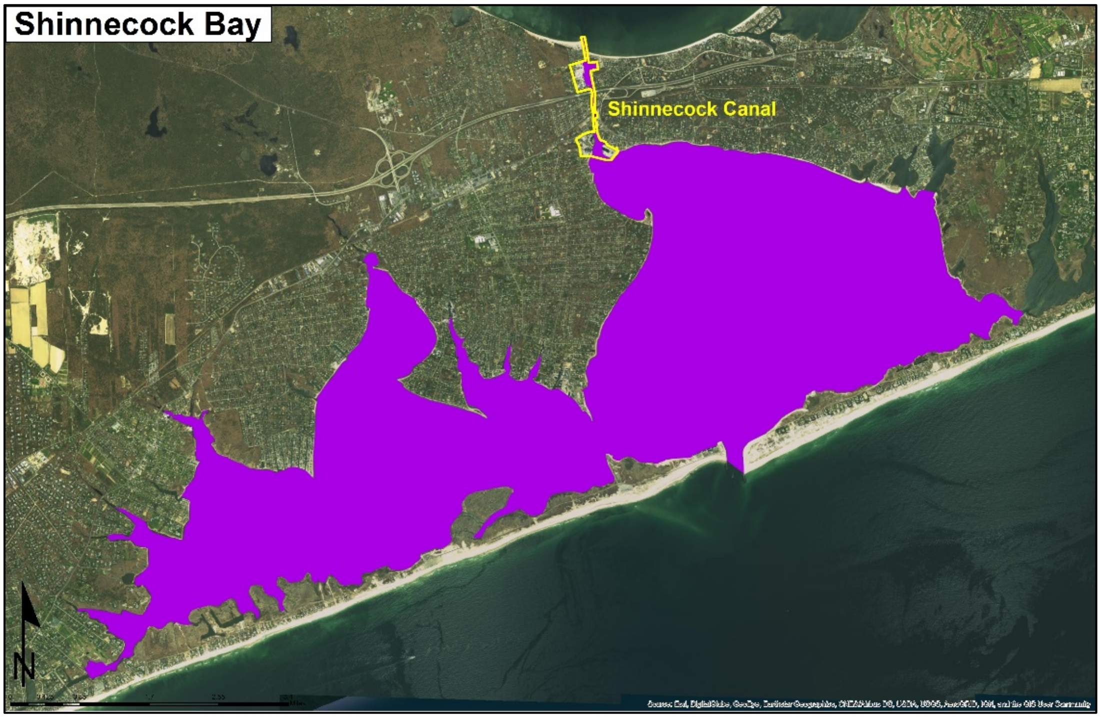
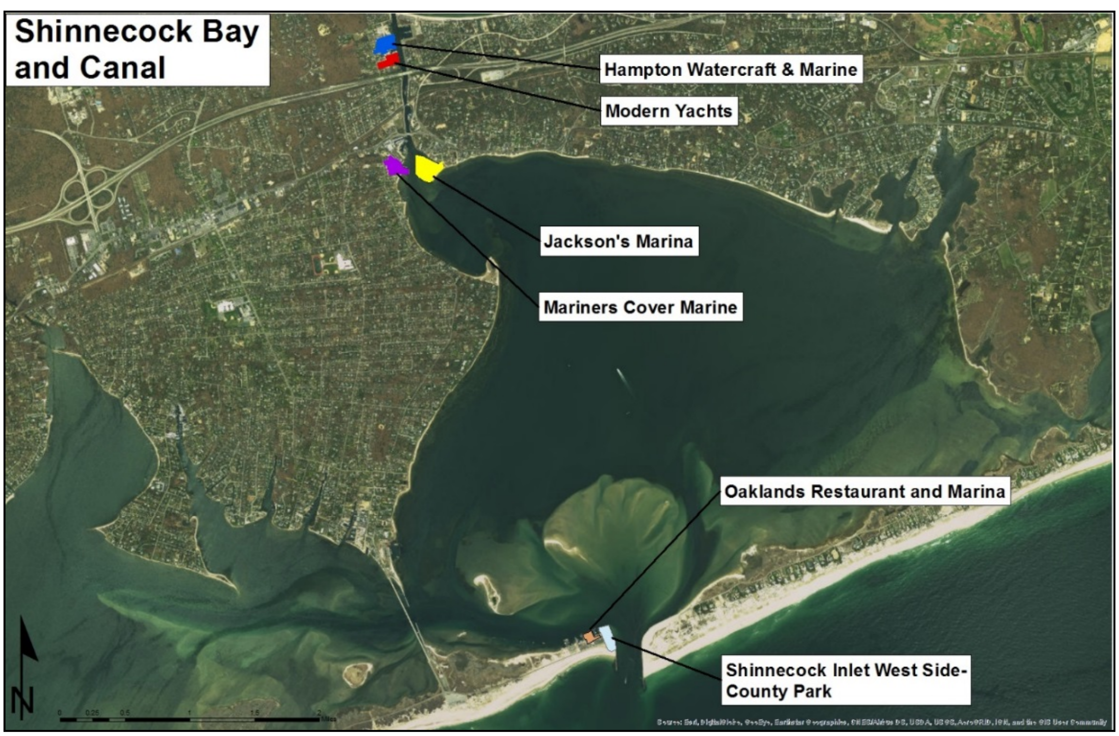


Figure 38. Shinnecock Bay and Canal Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.6 Montauk Harbor and Lake Montauk

Lake Montauk is an approximately 3.6-square-km (1.4-square-mile) saltwater lake located at the eastern extent of the South Fork of Long Island (see Figure 39). The entrance to the inlet faces north into Block Island Sound and is restricted by a navigable width of 45.7m (150 ft.) and navigable depth of 3.7m (12 ft.). There are no published air draft restrictions based upon the NOAA navigation chart; however, the nearby Montauk Airport may affect air draft restrictions if tall components are to be moved in the area. Montauk Harbor occupies the northernmost portion of Lake Montauk, between the main body of the lake and the inlet. Navigable draft in outer parts of Lake Montauk range typically from 3.0m to 4.6m (10 ft. to 18 ft.). Draft in Lake Montauk past Star Island and the Gone Fishing Marina is limited to 1.8m to 2.4m (6 ft. to 8 ft.)

Vessels departing Montauk Harbor have a steaming distance of approximately 170.6 km (106 miles) from the inlet to the New York WEA and 61.2 km (38 miles) to Deepwater Wind's proposed South Fork project.

Montauk Harbor and Lake Montauk are home to multiple yacht clubs, charters, and marinas. The area is an active recreational and commercial fishing location. Private residences occupy the majority of the shoreline of the lake; however, multiple government and commercial properties occupy the shoreline of Montauk Harbor. The lake is active with recreational summer activities in the months of June, July, and August. There are multiple fuel and mechanical facilities in the harbor. The commercial and charter fishing industries remain active in Montauk through early December. During the offseason, the area is mostly empty of recreational vessels.

A total of ten waterfront sites were identified that appear to have some availability to provide mooring for O&M service vessels outside of peak tourist season (see Figure 40). Both East Hampton Town Docks, Montauk Marine Basin, Inlet Seafood, and the 9 Acre Compound likely have the ability to provide mooring for OSW O&M vessels year-round in their existing condition.

Figure 39. Lake Montauk Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

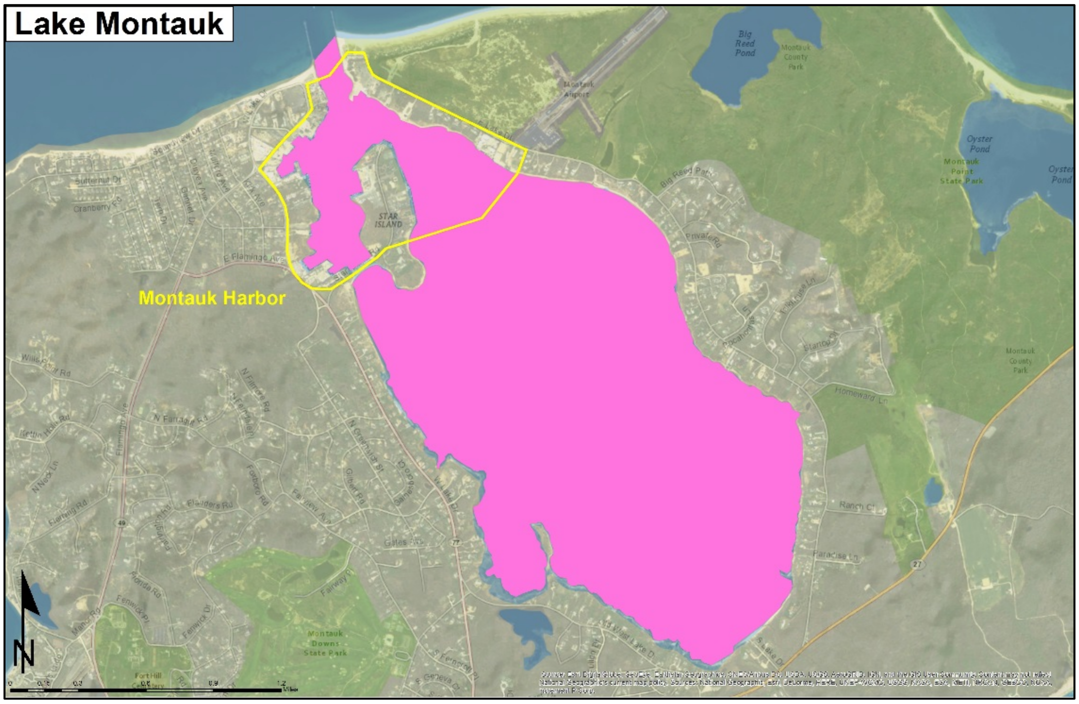
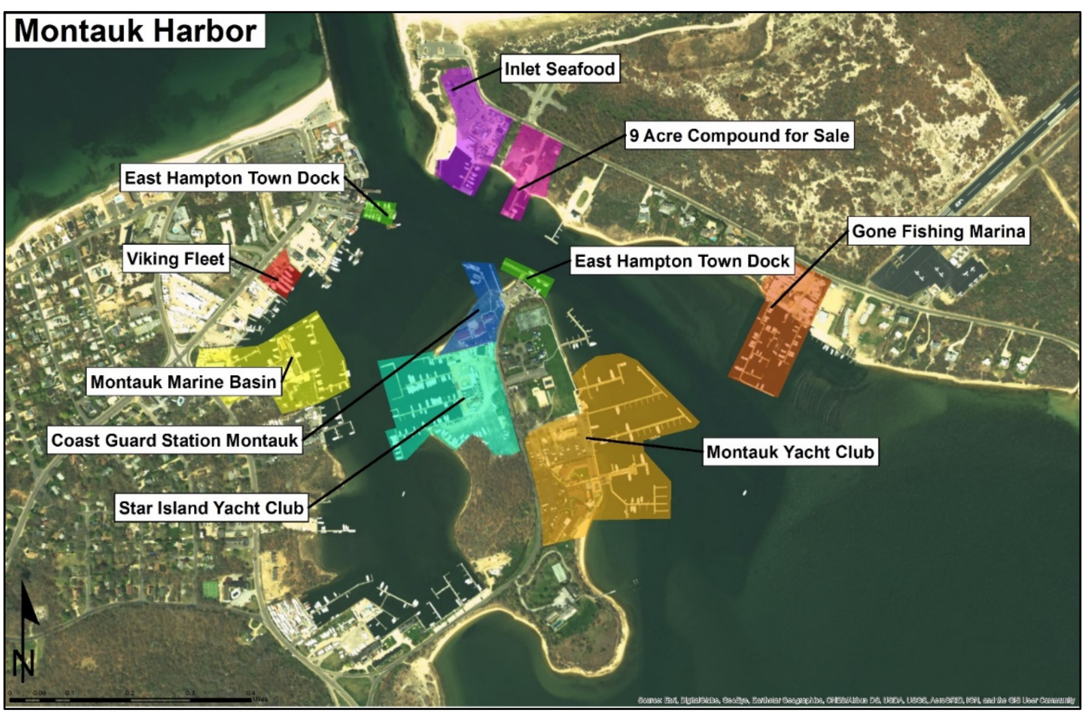


Figure 40. Montauk Harbor Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.7 Three Mile Harbor

Three Mile Harbor is located on the northern coast of the South Fork of Long Island with its entrance facing north into Gardiners Bay (see Figure 41). The channel accessing the harbor has a depth of 1.8m (6 ft.). The East Hampton Cruising Guide describes the channel as "extremely narrow with a strong current." The harbor is located a steaming distance of 198.6 km (123.4 miles) to the New York WEA and 61.2 km (38 miles) to Deepwater Wind's proposed South Fork project. There are no air draft restrictions in this area.

The two facilities identified in Three Mile Harbor, as seen in Figure 42, may not be as well suited as other areas due to their steaming distances to future proposed projects and navigational challenges.

Figure 41. Three Mile Harbor Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

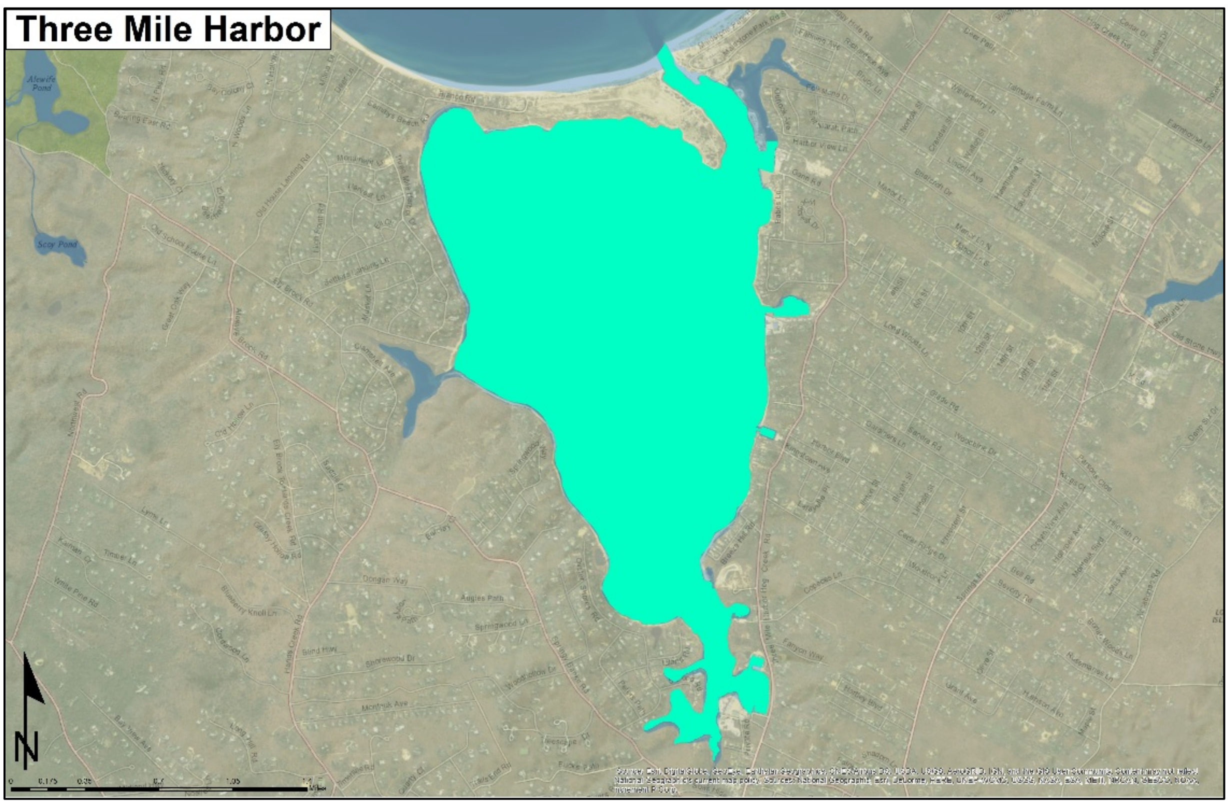


Figure 42. Three Miles Harbor Inlet Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

5.5.8 Sag Harbor

Sag Harbor is located on the north coast of the South Fork of Long Island and includes the adjacent section of the Peconic River in this study (see Figure 43). The entrance to the harbor faces northwest into Gardiners Bay. Vessels departing Sag Harbor have a steaming distance of 200.7 km (124.7 miles) from the entrance of the harbor to the New York WEA and 90.8 km (56.4 miles) from the entrance to Deepwater Wind's proposed South Fork project. Because water depth in the channel leading into the harbor is no longer maintained, current depths are not depicted on NOAA charts; however, as of 1974, the channel had a controlling depth of 2.4m (8 ft.) and 3m (10 ft.) at the center of the channel. There are no air draft restrictions in this area. Significant portions of the shoreline are undeveloped land, including the Northwest Harbor County Park, the Cedar Point County Park, and the Mashomack Preserve, which comprises the northern coastline of the harbor. The remaining portions of the coastline are occupied by residential properties and the Village of Sag Harbor. During the summer, the marinas and yacht clubs in Sag Harbor are home to multiple recreational vessels up to approximately 21.3m (70 ft.) in length. Four potential waterfront sites were identified within the Village of Sag Harbor (see Figure 44).

Figure 43. Sag Harbor Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

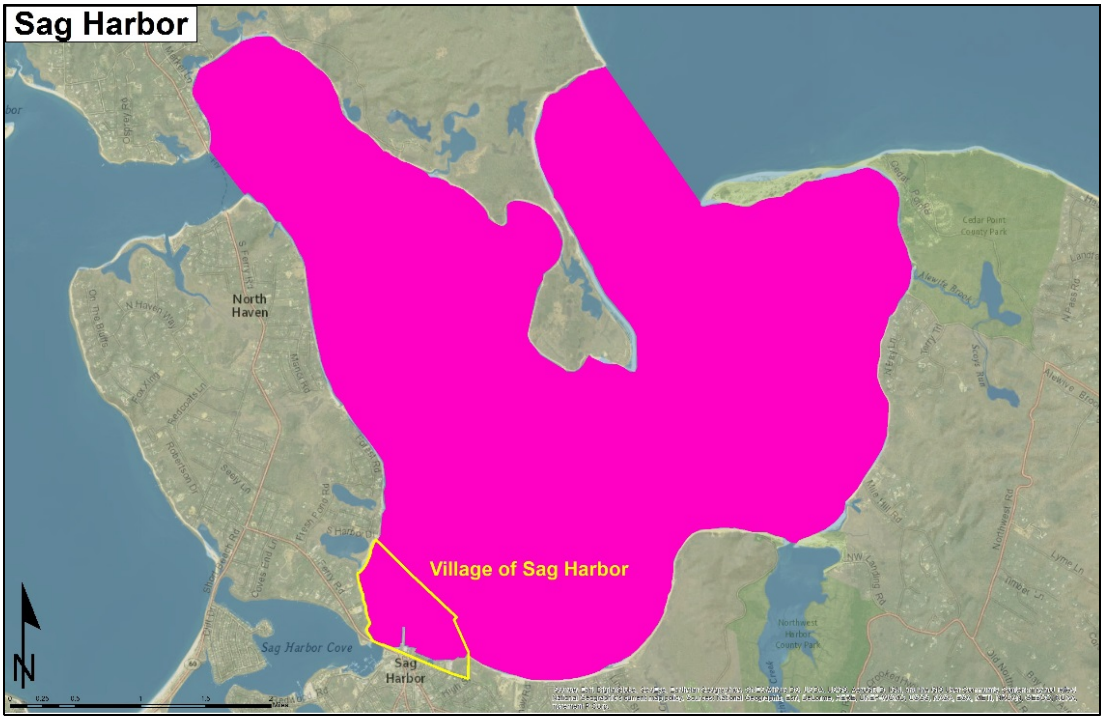
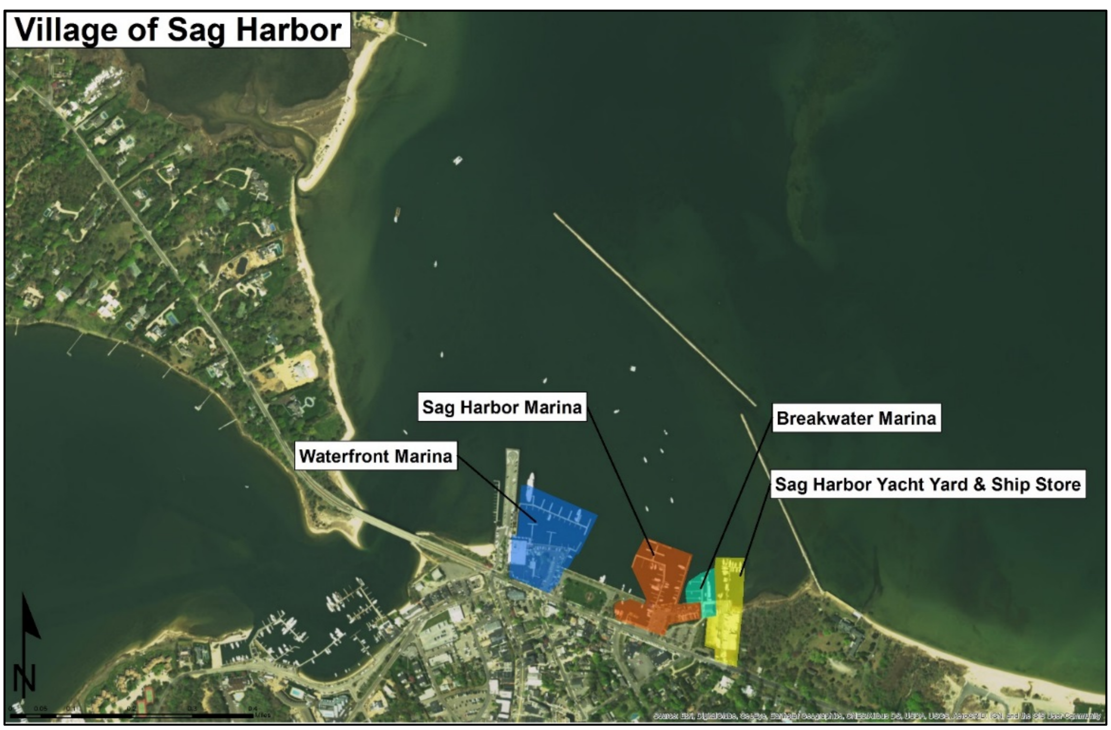


Figure 44. Village of Sag Harbor Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.9 Orient Point

Orient Point occupies the eastern extent of the North Fork of Long Island (see Figure 45). Vessels departing from Orient Point have a steaming distance of 193.8 km (120.4 miles) to the New York WEA and 83.2 km (51.7 miles) to Deepwater Wind's proposed South Fork project. There are no air draft restrictions in this area.

Three waterfront sites were identified that may serve the OSW industry as O&M sites (see Figure 46). The Orient Point Ferry Terminal is located on the south shore of the point, facing into Gardiners Bay, and services the Cross Sound Ferry and the Block Island Express Ferry. The land area surrounding the Orient Point Ferry Terminal and inlets is occupied by residential properties and undeveloped land, including the Orient Point County Park. The two inlets adjacent to the ferry terminal are home to the Orient by the Sea Marina and Restaurant, and the reception office and parking for the Plum Island Animal Disease Center. The Plum Island facility is not anticipated to be available due to ongoing U.S. Government operations.

Figure 45. Orient Point Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

Figure 46. Orient Point Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

5.5.10 Shoreham Inlet

The Shoreham Inlet is located on the north shore of Long Island, opening to the Long Island Sound (see Figure 47). The inlet and jetties were constructed to facilitate the construction and operation of the Shoreham Nuclear Plant in 1984, which was never put into commercial operation. The inlet is a steaming distance of approximately 252 km (156.6 miles) to the New York WEA and 142.2 km (88.5 miles) to the South Fork Project. There are no air draft restrictions in this area. Adjacent to the inlet to the north is a creek and marshlands; residential properties occupy the land to the south and west of the inlet.

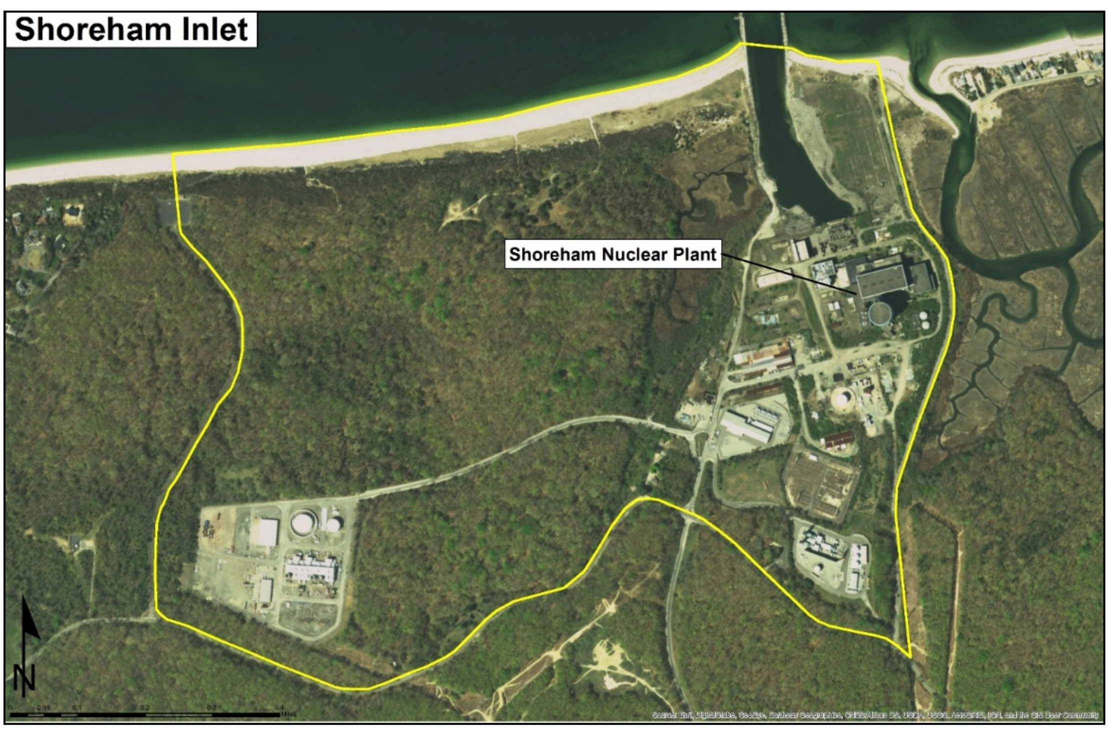
Due to its size, accessibility, and industrial use, the Shoreham Nuclear Plant is the only existing site identified on Long Island that could potentially be used as an OSW manufacturing and fabrication facility, or a staging and installation port (see Figure 48). However, the old power station buildings remain on the property, and the entrance channel would have to be deepened and straightened to accommodate OSW vessel access. Significant upgrades and potential environmental remediation would be required to develop this facility for OSW purposes.

Figure 47. Shoreham Inlet Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

Figure 48. Shoreham Nuclear Plant Site

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



5.5.11 Port Jefferson

Port Jefferson is located on the north shore of Long Island, approximately 80 km (50 miles) east of New York City (see Figure 49). The entrance to the port faces north into Long Island Sound. The Port Jefferson Harbor Channel, which provides passage from the harbor entrance to the town center at the southern extent of the port, is maintained to a project depth of 8m (26 ft.).

The Bridgeport & Port Jefferson Steamboat Company regularly operates a ferry to Bridgeport, Connecticut. The shoreline of Port Jefferson is fully occupied by a number of industrial properties, marinas, private residences, and McAllister County Park at the entrance to the harbor. There are no air draft restrictions in this area. Vessels leaving the Port Jefferson Harbor inlet have a steaming distance of 271.2 km (168.5 miles) to the New York WEA and 162.1 km (100.7 miles) to Deepwater Wind's proposed South Fork project.

Nine waterfront properties were identified in the Port Jefferson inner harbor (see Figure 50). While there are industrial waterfront facilities in the inner harbor, they are smaller, highly utilized facilities that are unlikely to be available for OSW activities.

Figure 49. Port Jefferson Area

Source: COWI 2017;ESRI (ArcGIS, World Imagery Basemap)

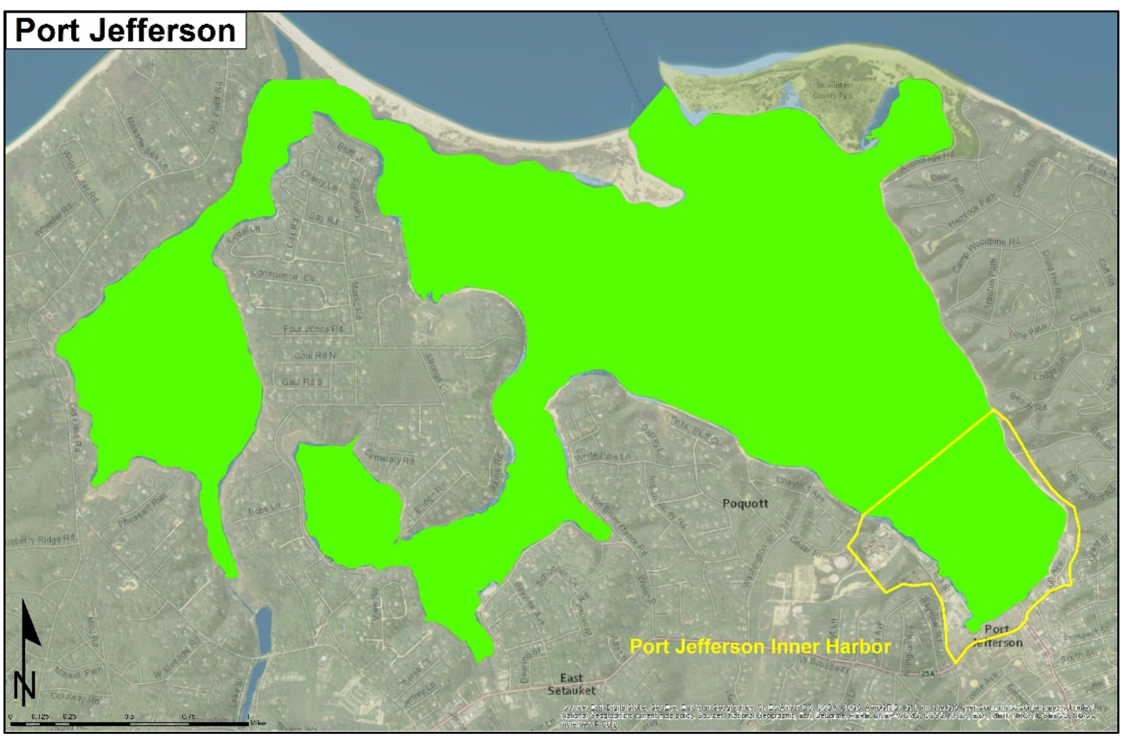
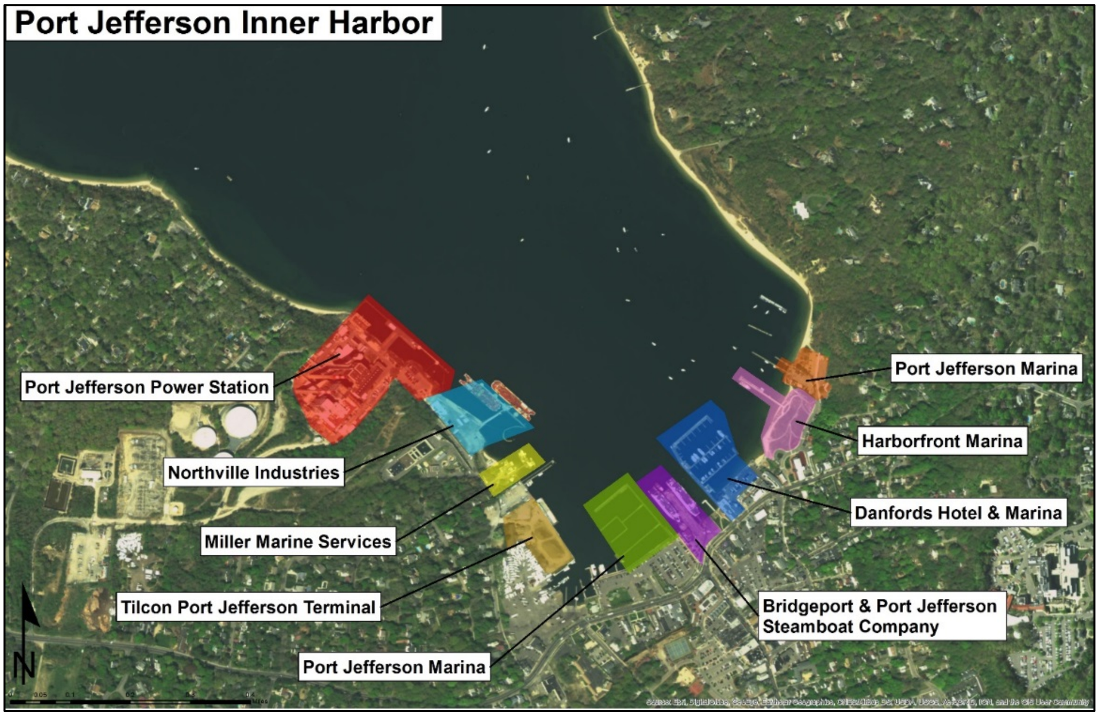


Figure 50. Port Jefferson Inner Harbor Sites

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)



6 Closing

This study identified 54 waterfront facilities along the New York Harbor and Hudson River. Several of these sites show high potential to serve as manufacturing and fabrication facilities that could support future OSW development off of New York State. These sites would require minor to significant upgrades, depending on the purpose of the facility and ability to accommodate the different OSW components. The study identified 11 distinct areas along the Long Island coast, within which a number of the sites show potential to serve as future operations and maintenance facilities with minor upgrades.

This study identified five waterfront facilities that could be used either as staging or installation facilities for future OSW development projects. Similar to many ports on the U.S. East Coast, there are challenges to using these sites for staging and installation of OSW components. Many of the identified sites are located upriver of bridges that impose air draft restrictions, or maximum heights, of the vessels transiting below the bridge. The air draft available at New York's bridges will require some components to be transported horizontally rather than vertically, as is typically preferred in Europe. The air draft of certain bridges may prevent some installation vessels from transiting to the potential upriver sites. The two identified sites without air draft restrictions are not currently operating as waterfront terminals and would require substantial upgrades if they were to be used as OSW ports.

The findings of this study describe the needs of the OSW industry and the capabilities of New York State's existing port infrastructure to support future OSW project construction and maintenance activities. New York's waterfront facilities show great potential to serve as OSW ports in the 2020–2030 timeframe.

7 Bibliography

4C Offshore ltd. n.d. "Global Offshore Wind Farms Database." Accessed 17 October 2017. http://www.4coffshore.com/offshorewind/.

All About Shipping. 2017. "United Wind Logistics Develops and Realises Transport Concept for MHI Vestas' V164 Wind Turbines." Accessed 31 October 2017. http://www.allaboutshipping.co.uk/2017/06/27/united-wind-logistics-develops-and-realises-transport-concept-for-mhi-vestas-v164-wind-turbines/.

Amaral, Brian. "Sayreville Seeks $200,000 in Federal Funds for Chemical Cleanup." *New Jersey On-line*. Accessed 2 May 2017. http://www.nj.com/middlesex/index.ssf/2014/01/sayreville_seeks_200000_in_federal_funds_for_chemical_cleanup.html.

Bard, J., and F. Thalemann. 2012. "Offshore Infrastructure: Ports and Vessels: A Report of the Off-shore Renewable Energy Conversion Platforms – Coordination Action." *WaveEnergy Centre*. ORECCA. Accessed 2017. http://www.orecca.eu/c/document_library/get_file?uuid=6b6500ba-3cc9-4ab0-8bd7-1d8fdd8a697a&groupId=10129.

Belfast Harbour Commissioners. 2017. "Belfast Harbour Renewables." Accessed 16 May 2017. https://www.belfast-harbour.co.uk/port/renewables.

Bellport.com, LLC. 2017. "Marina." Accessed 31 August 2017. https://www.bellport.com/residents/marina.htm.

Bladt Industries. 2017. "Offshore Wind Image." Accessed 2017. https://www.offshorewind.biz/2017/04/07/bladt-reports-good-2016-results-eyes-us-apac-offshore-wind-markets/

BlueSeas. 2017. "The Hudson River Guide." Accessed 14 June 2017. http://www.offshoreblue.com/cruising/hudson-river.php.

Boating Times Long Island. 2014. "Nicoll Bay." Accessed 31 August through 2 September 2017. http://boatingtimesli.com/NY/nicoll-bay/.

Cashman Equipment. "Our Vessels: ABS Deck and & Spud Barges." Accessed 8 November 2017. http://4barges.com/en/vessels/abs-deck-spud-barges.

Chesto, Jon. 2016. "Offshore Wind Developers to Use Largely Empty New Bedford Terminal." *The Boston Globe*. Accessed 1 May 2017. https://www.bostonglobe.com/business/2016/09/06/offshore-wind-developers-sign-agreement-use-state-largely-empty-new-bedford-port/1YtGrrOe3EGOZYGMFemwpJ/story.html.

City of New York. 2017. "NYC DOF Digital Tax Map Interactive Database." Accessed 2 May 2017. http://gis.nyc.gov/taxmap/map.htm.

City of South Amboy. n.d. "Redevelopment Agency (SARA)." Accessed 2 May 2017. http://www.southamboynj.gov/departments/redevelopment-agency-sara.

Cooper, Brent D. and Joseph F. Marrone. 2013. "Port Requirements to Support Offshore Wind Development in North America." *American Society of Civil Engineers*. doi: 10.1061/9780784413067.151.

DanTysk Offshore Wind. n.d. "Ports & Ships." Accessed 29 April 2017. http://www.dantysk.com/technology-ships/ports-ships.html.

DNV GL AS. 2017. "Electrifying the Future." Accessed 16 March through 18 May 2017. https://www.dnvgl.com/technology-innovation/broader-view/electrifying-the-future/third-generation-wind-power.html.

Encyclopedia Britannica, Inc. 2017. "Long Island." Accessed 30 August 2017. https://www.britannica.com/place/Long-Island-New-York.

ESRI. 2010. "*Maps throughout this report were created using ArcGIS® software by ESRI.* ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright ESRI. All rights reserved. For more information about Esri® software, please visit www.esri.com."

European Union. n.d. "Offshore Wind Port Bremerhaven." Accessed 16 May 2017. http://offshore-windport.de/de/startseite/.

Facilitating Offshore Wind in India (FOWIND) and the European Union (EU). 2016. "Supply Chain, Port Infrastructure and Logistics Study for Offshore Wind Farm Development in Gujarat and Tamil Nadu." Accessed 2017. http://www.gwec.net/wp-content/uploads/vip/Fowind-study-report_29-06-2016_pages_JWG-update_v2.pdf.

Ferro, John. 2017. "Dutton Site in Poughkeepsie Poised for Transformation" *Poughkeepsie Journal*. Accessed 12 June 2017. http://www.poughkeepsiejournal.com/story/news/local/central-dutchess/2017/01/20/dutton-lumber-poughkeepsie-waterfront-development/96785622/.

Frost, Mary. 2016. "Critics: Pull the plug on proposed Wallabout Channel Power Barge." *Brooklyn Daily Eagle*. Accessed 2 May 2017. http://www.brooklyneagle.com/articles/2016/5/9/critics-pull-plug-proposed-wallabout-channel-power-barge.

Garad Hassan America, Inc. 2013. "U.S. Offshore Wind Port Readiness." Prepared for the U.S. Department of Energy. Accessed 2017. http://wind.energy.gov/pdfs/wind_offshore_port_readiness.pdf.

__________. 2014. "Assessment of Ports for Offshore Wind Development in the United States." Prepared for the U.S. Department of Energy. Accessed 2017. https://energy.gov/sites/prod/files/2014/03/f14/Assessment%20of%20Ports%20for%20Offshore%20Wind%20Development%20in%20the%20United%20States_1.pdf.

Garcia, Ernie. 2016. "Yonkers Waterfront Projects Face Tough Road." *www.lohud.com*. Accessed 11 January 2017. http://www.lohud.com/story/news/local/westchester/yonkers/2016/01/06/one-point-street/78304590/.

Green Port Hull. n.d. “Homepage.” Accessed 18 May 2017. http://greenporthull.co.uk/.

Groningen Seaports NV. n.d. “Port of Eemshaven.” Accessed 17 May 2017. https://www.portofeemshaven.nl/.

Guillen, Pedro, Nic Wetzler, and Nick Abstoss. 2011. "Analysis of Maryland Port Facilities for Offshore." *Kinetik Partners*. Prepared for State of Maryland, Maryland Energy Administration. Accessed 2017. http://energy.maryland.gov/Documents/AnalysisMarylandPortFacilities_OffshoreWindEnergyServices.pdf.

GustoMSC. 2017. “U.S. Jones Act Compliant Offshore Wind Turbine: A Report for the Roadmap Project for Multi-state Cooperation on Offshore Wind.” Prepared for New York State Energy Research and Development Authority (NYSERDA), Massachusetts Clean Energy Center, Massachusetts Department of Energy Resources, Rhode Island Office of Energy Resources, and Clean Energy States Alliance. Accessed 2017. https://www.winston.com/images/content/1/2/v2/129605/US-Jones-Act-Compliant-Offshore-Wind-Study.pdf.

Haydon, Tom. 2009. "Perth Amboy Steel Plant Shuts After 30 Years." *New Jersey On-line*. Accessed 2 May 2017. http://www.nj.com/news/index.ssf/2009/06/perth_amboy_steel_plant_shuts.html.

Heffner, Jr., Michael. 2017. "Affidavit of Michael Heffner, Jr." *City of Hudson, New York Zoning Board of Appeals*. Affidavit sworn before City of Hudson, New York Zoning Board of Appeals by Michael Heffner, Jr., Vice President of Operations for A. Colarusso & Son, Inc. Accessed 13 June 2017. http://cityofhudson.org/content/Boards/View/11:field=documents;/content/Documents/File/3661.pdf.

Lafarge North America, Inc. n.d. "Green Matters – Buchanan, New York Drywall Plant." Accessed 8 June 2017. http://www.lafarge-na.com/Gypsum_Green_Broch_Buchanan_final.pdf?xtmc=BuchananNY&xtcr=1.

Lisinski, Chris. 2016. "Should the Old Shoreham Nuclear Plant Become a Deep Water Port?" *Riverhead News-Review*. Accessed 18 September 2017. http://riverheadnewsreview.timesreview.com/2016/01/71020/should-the-old-shoreham-nuclear-plant-become-a-deep-water-port/.

Madsen, Krista. 2014. "Sleepy Hollow Mayor Announces Former GM Site Has a Developer." *Tarrytown Patch*. Accessed 12 June 2017. https://patch.com/new-york/tarrytown/sleepy-hollow-mayor-announces-former-gm-site-has-a-developer.

Massachusetts Clean Energy Center. n.d. "New Bedford Marine Commerce Terminal." Accessed 1 May 2017. http://www.masscec.com/new-bedford-marine-commerce-terminal.

Mindat.org and the Hudson Institute of Mineralogy. 2017. "Tomkins Cove Quarry." Accessed 12 June 2017. https://www.mindat.org/loc-13437.html.

Multiple Listing Service (MLS) of Long Island, Inc. 2016. "West Gilgo Beach Real Estate." *Douglas Elliman Real Estate*. Accessed 22 September 2017. https://www.elliman.com/long-island/west-gilgo-beach.

Murtha, D.T. 2015. "Permitting Considerations for Facility Reactivation, Zombie Power Plants." *18th Annual AWMA/NYWEA Joint Seminar*. ERM. February 11, 2015.

National Oceanic and Atmospheric Administration (NOAA), Office of Coast Survey. 2017. "Interactive Chart Viewer." Accessed 2 May 2017. http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml.

__________. n.d. "Booklet Chart Hudson River – New York to Wappinger Creek (Chart 12343)." Accessed 14 June 2017. http://www.charts.noaa.gov/BookletChart/12343_BookletChart.pdf.

New Bedford Harbor Development Commission. 2017. "New Bedford Marine Commerce Terminal" *Port of New Bedford*. Accessed 1 May 2017. http://www.portofnewbedford.org/shipping/operating-areas-marine-terminals/south-port-area.php.

New York Business Journal. 2013. "Castleton Buys Roseton Power Plant from Dynegy." Accessed 16 June 2017. http://www.bizjournals.com/newyork/news/2013/05/01/castleton-buys-roseton-power-plant.html.

New York City Department of City Planning. 2011. "Vision 2020: New York City Comprehensive Waterfront Plan – Neighborhood Strategies." Accessed 2 May 2017. http://www1.nyc.gov/assets/planning/download/pdf/plans-studies/vision-2020-cwp/vision2020/vision2020_nyc_cwp.pdf.

New York State Department of State (DOS). 2013. *Offshore Atlantic Study.* Accessed September 12, 2017. https://docs.dos.ny.gov/communitieswaterfronts/ocean_docs/NYSDOS_Offshore_Atlantic_Ocean_Study.pdf.

New York State. 2017. "GIS Data Set Details." *ITS GIS.* Accessed 2 May 2017. http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1300.

__________. n.d.(a). "The Governor Mario M. Cuomo Bridge." Accessed 12 June 2017. http://www.newnybridge.com/.

__________. n.d.(b). "New York State Parcels." Accessed 12 June 2017. http://gis.ny.gov/parcels/#parcel.

New York State Department of Environmental Conservation. 2005. "Lower Hudson-Long Island Bays Basin." *Comprehensive Wildlife Conservation Strategy for New York*. Accessed 1 September 2017. http://www.dec.ny.gov/docs/wildlife_pdf/lowerhudsontxt.pdf.

__________. 2006. "Environmental Restoration Record of Decision, South Troy Industrial Park Site." Accessed 12 June 2017. http://www.dec.ny.gov/docs/remediation_hudson_pdf/b001634.pdf.

__________. 2016. "Superfund Site Fact Sheet, BASF – Manufacturing Plant." Accessed 16 June 2017. http://www.dec.ny.gov/data/der/factsheet/442027cuprop.pdf.

New York State Energy Research and Development Authority (NYSERDA). 2012. "Offshore Wind Study." *Ocean and Coastal Consultants*. [Unpublished]. December 2012.

__________. 2017. "Clean Energy Standard." Accessed 19 September 2017. https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard.

North American Transmission. 2015. " Amended Initial (Part A) Article VII Application, 10a – 1.24000 Topo Maps, Location of Facilities a1 Exhibit2 NSLPV_3." Accessed 12 June 2017. http://www.nat-ny.com/NAT%20Amended%20Initial%20(Part%20A)%20Application/10a%20-%201.24000%20topo%20maps/Location_of_Facilities_a1_Exhibit2_NSLPV_3.pdf.

OspreyGuide.com. 2005. "Three Mile Cruising Guide: Navigating the Harbor & Important Waterways." *East Hampton Cruising Guide*. Accessed 30 August 2017. http://www.ospreysguide.com/CruiseGuide/cruisegEH/cruiseg3MI/cruisg3MINav.html.

Petroski, Alex. 2017. "LIPA Studies: Repowering Port Jeff Power Plant Doesn't Make Sense." *TBR News*. Accessed 30 August 2017. http://tbrnewsmedia.com/lipa-studies-repowering-port-jeff-power-plant-doesnt-make-sense/.

Porpora, Tracey. 2017. "Exclusive: Developer Trying to Resume LNG Tank Dismantle After Stop Work Order." *Staten Island Live*. Accessed 2 May 2017. http://www.silive.com/southshore/index.ssf/2017/02/developer_trying_to_resume_lng.html.

__________. 2015. "Site of LNG Tanks in Rossville to Be Home to Designer Mall, Movie Theater, Park." *Staten Island Live*. Accessed 2 May 2017. http://www.silive.com/southshore/index.ssf/2015/03/site_of_lng_tanks_in_rossville.html.

Port of Esbjerg. n.d. "Port of Esbjerg." Accessed 17 May 2017. http://portesbjerg.dk/en.

Ports America. n.d. "Contact Port of Davisville, RI." Accessed 10 May 2017. https://www.portsamerica.com/portofdavisville-rhode-island.html.

Quonset Development Corporation. 2014. "Quonset Business Park – Port of Davisville." Accessed 10 May 2017. http://www.quonset.com/.

Rhenus Cuxport. n.d. "About Cuxport." Accessed 16 May 2017. http://www.cuxport.de/.

Ripco Real Estate. "The Pointe at Sayreville." Accessed 2017. http://thepointenj.com/wp-content/uploads/2016/02/SayrevilleNJ_ThePointe_ExclusiveMarketingFlyer_WEB-1.pdf.

Riverkeeper, Inc. 2017. "Houghtaling Island." Accessed 12 June 2017. https://www.riverkeeper.org/campaigns/stop-polluters/pollution-enforcement/houghtaling-island/.

Serreze, M.C. 2016. "Offshore Wind Developers Agree to Use New Bedford Marine Terminal." *MassLive, LLC*. Accessed 1 May 2017. http://www.masslive.com/politics/index.ssf/2016/09/new_bedford_marine_terminal_si.html.

State of New Jersey Transparency Center. n.d. "OGIS State of NJ Tax List Map." Accessed 2 May 2017. http://njgin.state.nj.us/oit/gis/NJ_TaxListSearch/. Accessed May 2, 2017.

State of Rhode Island, Office of Economic Recovery and Reinvestment. 2010. "Press Release: State of Rhode Island Receives $22.3 Million Stimulus Grant to Support Improvements at Quonset Point." *RI.gov*. Accessed 10 May 2017. http://www.ri.gov/press/view/10777.

Surrey Equities, LLC. n.d. "Ceasar's Bay." Accessed 3 October 2017. http://surreyequities.propertycapsule.com/properties/cae-ar--bay/#overview.

The Glosten Associates. 2009. "Vessel Requirements for Offshore Wind Farm Construction and Maintenance: Appendices." Accessed 2017. http://files.masscec.com/research/OffshoreWindPortInfrastructureAnalysisAppendicies.pdf.

The Long Island Index. n.d. "Long Island Index: Interactive Map". Accessed 21 September 2017. http://www.longislandindexmaps.org/.

The Village of Sag Harbor. 2016. "Harbor and Docks." Accessed 1 September 2017. http://sagharborny.gov/departments/harbor-and-docks/.

Town of Babylon, Geographic Information System. n.d. "Real Property GIS Viewer." Accessed 21 September 2017. http://gis.townofbabylon.com:81/orpsviewer/default.aspx.

U.S. Army Corps of Engineers (USACE), Navigation Data Center. 2011. "Ports and Waterways Facilities." Accessed 2 May 2017. http://www.navigationdatacenter.us/ports/ports.htm.

U.S. Army Corps of Engineers (USACE). 1999. "The Ports of New York, NY and NJ and Ports on Long Island, NY." *Port Series, No. 5*. Washington, DC: U.S. Government Printing Office.

__________. 2017. "Issuance and Reissuance of Nationwide Permits." *Federal Register* 82(4):1860-2008. Accessed 17 October 2017. https://www.federalregister.gov/documents/2017/01/06/2016-31355/issuance-and-reissuance-of-nationwide-permits.

__________. n.d. "Controlling Depth Reports and Surveys." Accessed 2 May 2017. http://www.nan.usace.army.mil/Missions/Navigation/Controlling-Depth-Reports/.

U.S. Fish and Wildlife Service, Southern New England New York Bight Coastal Ecosystems Program. 1997. "Significant Habitats and Habitat Complexes of the New York Bight Watershed." *National Conservation Training Center*. Accessed 1 September 2017. https://nctc.fws.gov/pubs5/web_link/text/gsb_form.htm.

U.S. Harbors. 2015. "Threemile Harbor Entrance." Accessed 30 August 2017. http://ny.usharbors.com/harbor-guide/threemile-harbor-entrance.

Wachman, Richard. 2017. "Siemens to Cut Offshore Maintenance Times with Labor-Saving Drones." *New Energy Update*. Accessed 10 May 2017. http://newenergyupdate.com/wind-energy-update/siemens-cut-offshore-maintenance-times-labor-saving-drones.

Whitney, III, Payson R., Stephanie J.K. Wilson, Stephanie Chaston, Chris Elkinton, and Alex Uriate. 2016. "The Identification of Port Modifications and the Environmental and Socioeconomic Consequences." *ESS Group*. Prepared in Association with DNV GL and ICF Jones & Stokes, Inc. for Bureau of Ocean Energy Management (BOEM). Accessed 2 May 2017. https://www.boem.gov/ESPIS/5/5508.pdf.

Wikipedia. 2017. "Shoreham Nuclear Power Plant." *Wikipedia*. Accessed 18 September 2017. https://en.wikipedia.org/wiki/Shoreham_Nuclear_Power_Plant.

Wind Europe. 2017. "The European Offshore Wind Industry – Key Trends and Statistics 2016." Accessed 12 May 2017. https://windeurope.org/about-wind/statistics/offshore/european-offshore-wind-industry-key-trends-and-statistics-2016/.

Yee, V., and P. McGeehan. 2017. "Indian Point Nuclear Power Plant Could Close by 2021." New York Times. Accessed 16 June 2017. https://www.nytimes.com/2017/01/06/nyregion/indian-point-nuclear-power-plant-shutdown.html

Appendix A. New York Harbor Data Sheets

Figure A-1. New York Waterway Areas

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

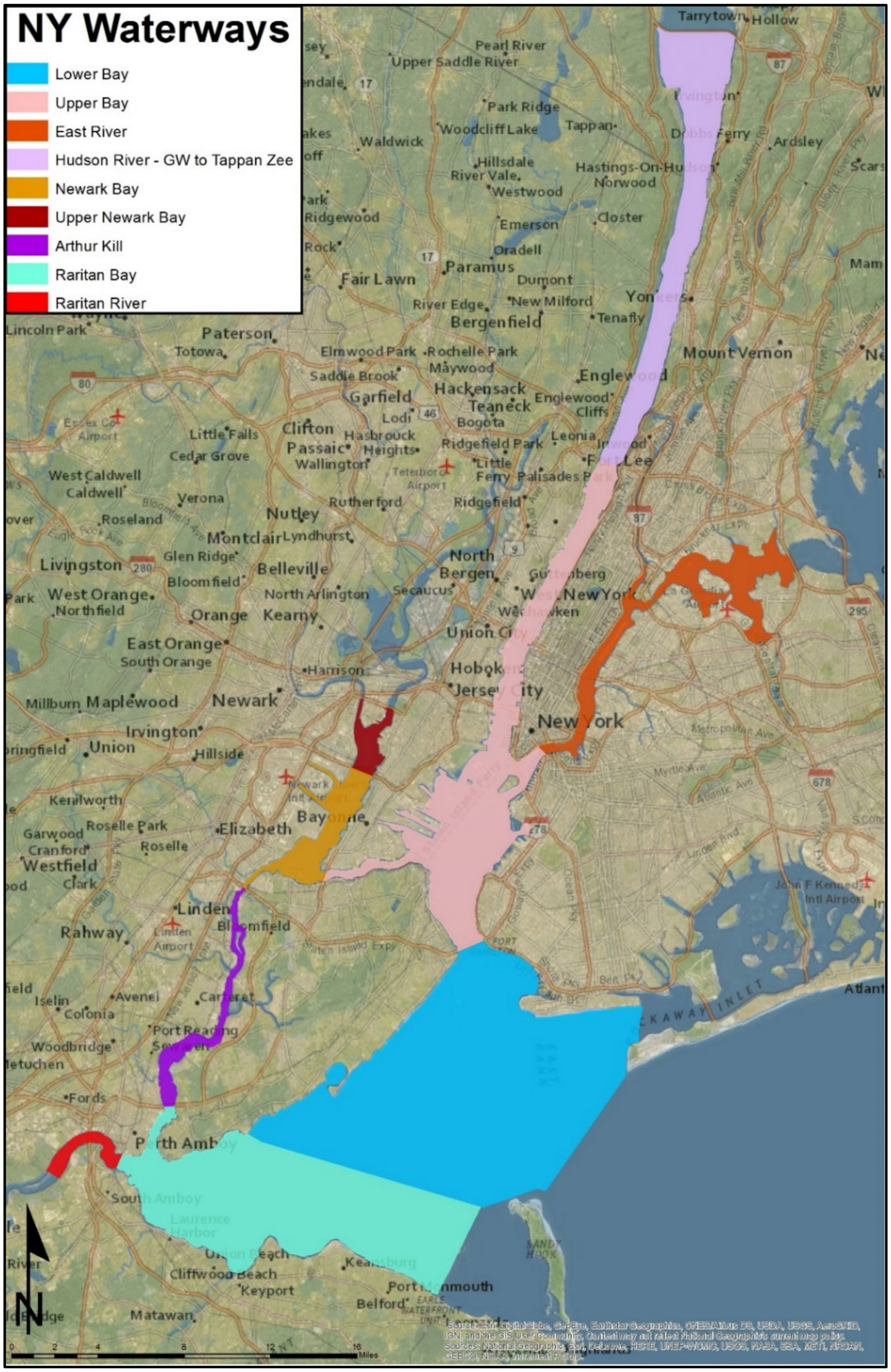


Figure A-2. New York Lower Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

Table A-1. Ceasar's Bay Shopping Center Site Summary

Ceasar's Bay Shopping Center

Site Location	Address: 8949 Bay Pkwy, Brooklyn, NY 11214 Latitude: 40º35'36" N Longitude:74º00'00" W
Owner	Sal Tru Associates (718) 373-7341
Significant Tenants	Toys-R-Us: (718) 372-4646 Modell's Sporting Goods (718) 373-1955 Kohl's: (718) 266-6357 Best Buy: (718) 265-6950
Distance to NY Wind Energy Area (WEA)	74 km (46.1 miles)
Upland Area	6.3 hectares (15.6 acres)
Water Frontage	391.1m (1,283 feet [ft.])
Minimum Wharf Length(s)	None Existing
Wharf Live Load Capacity	Not Applicable
Navigable Depth	Channel – 16.1m (53 ft.) → Lower Bay Berth - 4.8m (16 ft.) Along bulkhead
Limiting Air Draft Restriction	Unlimited

Table A-1 continued

Ceasar's Bay Shopping Center	
Intermodal Connections	Adjacent to Belt Parkway / Leif Ericson Drive 4 km (2.5 miles) to Interstate I-278 Industrial rail access not available
Surrounding Land Use	Recreational (parks), commercial
Comments	Recently renovated shopping center, no functioning pier on site.

Figure A-3. New York Upper Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

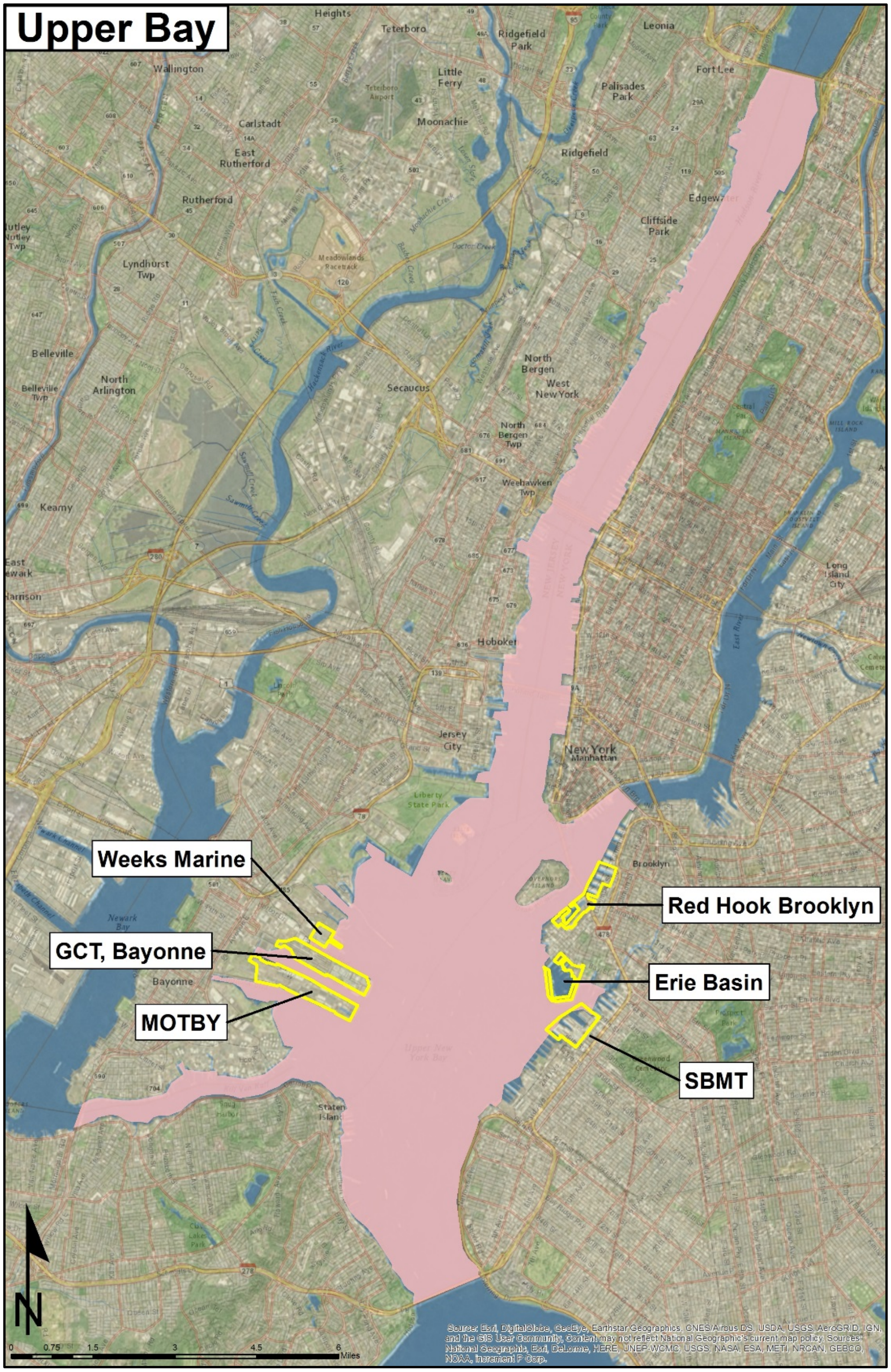
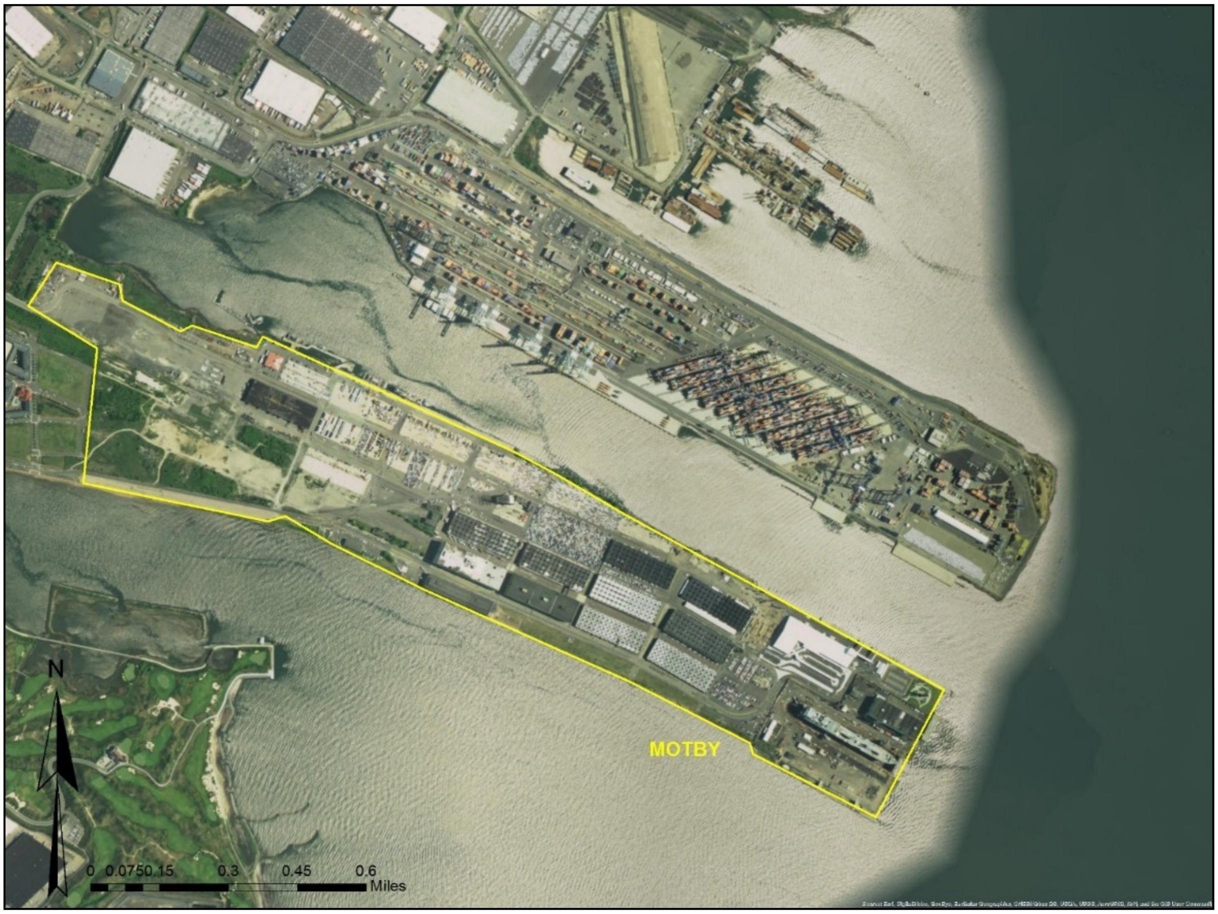


Table A-2. Military Ocean Terminal at Bayonne Site Summary

Military Ocean Terminal at Bayonne



Location	Address: 100 Military Ocean Term St., Bayonne, NJ 07002 Latitude: 40º39'47" N Longitude:74º04'20" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	GMD Shipyard: (718) 260-9200 http://GMDshipyard.com Cape Liberty Cruise Port: (201) 436-2080 http://www.cruiseliberty.com
Distance to NY WEA	84.8 km (52.7 miles)
Water Frontage	6,294.1m (20,650 ft.)
Upland Area	21 hectares (52 acres)
Minimum Wharf Length(s)	Berth A: 68.6m (225 ft.); Berth B & C: 106.1m (348 ft. total); L-Shaped Pier: 36.6+30.5+33.5+27.4m (120+100+110+90 ft.)
Wharf Live Load Capacity	Not Identified

Table A-2 continued

Military Ocean Terminal at Bayonne	
Navigable Depth	Channel - 16.1m (53 ft.) → Upper Bay Berth - 14.6m (48 ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	4 km (2.5 miles) to Interstate I-78 4.8 km (3 miles) to existing railway
Surrounding Land Use	Industrial and commercial
Comments	Portions of the peninsula are occupied by various businesses (e.g., GMD Shipyard and Cape Liberty Cruise Port). GMD Shipyard operates a graving dock at the east end of the pier. Remainder of peninsula is occupied by derelict and unused warehouses.

Table A-3. Global Container Terminal, Bayonne Site Summary

Global Container Terminal, Bayonne

Location	Address: 302 Port Jersey Blvd., Jersey City, NJ 07305 Latitude: 40º39'47" N Longitude:74º04'20" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Global Container Terminals: (201) 706-4000 http://globalterminalsbayonne.com
Distance to NY WEA	85.1 km (52.9 miles)
Upland Area	67.6 hectares (167 acres)
Water Frontage	4,640m (15,223 ft.)
Minimum Wharf Length(s)	823m (2,700 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel - 16.1m (53 ft.) → Upper Bay Berth - 14.6m (48 ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-3 continued

Global Container Terminal, Bayonne	
Intermodal Connections	4 km (2.5 miles) to Interstate I-78 4.8 km (3 miles) to existing railway
Surrounding Land Use	Industrial and commercial
Comments	Busy container terminal. Unlikely to interrupt business for offshore wind (OSW) purposes; therefore, not considered for further study.

Table A-4. Weeks Marine, Inc. Site Summary

Weeks Marine, Inc.

Location	Address: Foot of Colony Rd., Jersey City, NJ 07305 Latitude: 40º40'38" N Longitude:74º04'33" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Weeks Marine, Inc.: (201) 435-0804 http://weeksmarine.com
Distance to NY WEA	87.4 km (54.3 miles)
Upland Area	17.8 hectares (43 acres)
Water Frontage	1,359.4m (4,460 ft.)
Minimum Wharf Length(s)	(2) each x 300m (1,000 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel - 16.1m (53 ft.) → Upper Bay Not Identified at Berth
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-4 continued

Weeks Marine, Inc.	
Intermodal Connections	2.4 km (1.5 miles) to Interstate I-78 Industrial Rail present at adjacent property
Surrounding Land Use	Industrial
Comments	Staging yard for marine contractor. Unlikely that Weeks will re-purpose facility on a long-term basis but may be available on a project-specific basis. Weeks Marine is an active OSW stakeholder. Upland area estimated on Google Earth.

Table A-5. Erie Basin Site Summary

Erie Basin	
	
Location	Address: 700 Columbia St., Brooklyn, NY 11231 Latitude: 40º40'03" N Longitude:74º00'53" W
Owner	Erie Basin: 800-357-7744 www.eriebasinbargeport.com
Significant Tenants	Same as Owner
Distance to NY WEA	83 km (51.6 miles)
Upland Area	12 hectares (30 acres)
Water Frontage	4,088m (13,412 ft.)

Table A-5 continued

Erie Basin	
Minimum Wharf Length(s)	West Arm Wharf: 663.2m (2,176 ft.) South Arm Wharf: 304.8m (1,000 ft.) East Arm Wharf: 343.8m (1,128 ft.) Pier 5: 328.6m (1,078 ft.) Pier 4 South: 202.7m (665 ft.) Pier 4 North: 211.5m (694 ft.) Pier 3 South: 176.8m (580 ft.) Pier 3 North: 130.8m (429 ft.) Pier 2 South: 100.6m (330 ft.) Pier 2 North: 167.6m (550 ft.) Pier 1 South: 173.1m (568 ft.) Pier 1 North: 342.9m (1,125 ft.)
Wharf Live Load Capacity	Total Capacity - 25 tons (unconfirmed)
Navigable Depth	Channel - 16.1m (53 ft.) → Upper Bay, Red Hook Channel Berth - 6m (20 ft.) within basin
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	1.6 km (1.0 mile) to Interstate I-278 / I-478 Rail access not available
Surrounding Land Use	Industrial and commercial
Comments	Existing use: private berthing facility for tugs and barges; 185m² (200,000 sq. ft.) of warehouse space, loading berth for crane service 280 Richards St. (rectangular property on north end) stated goal of development compatible with adjacent water dependent industry and explore public access opportunities. Upland area obtained from Erie Basin Website.

Table A-6. South Brooklyn Marine Terminal (SBMT) Site Summary

South Brooklyn Marine Terminal (SBMT)

Location	Address: 551 Second Avenue., Brooklyn, NY 11232 Latitude: 40º39'37" N Longitude:74º00'49" W
Owner	NYC EDC: 888-692-0100 https://www.nycedc.com www.nycedc.com/project/south-brooklyn-marine-terminal
Significant Tenants	Same as Owner
Distance to NY WEA	85.6 km (53.2 miles)
Upland Area	35.6 hectares (88 acres)
Water Frontage	2,859m (9,380 ft.)
Minimum Wharf Length(s)	39th Street (southern) Pier: Face: 216.1m (709 ft.); Lower Side: 306.3m (1,005 ft.); Upper Side: 167.6+185.9m (550+610 ft.)
Wharf Live Load Capacity	500 PSF (unconfirmed)
Navigable Depth	Channel – 16.1m (53 ft.) → Upper Bay, Bay Ridge Channel Berth - Varies 0 to 10.9m (0 to 36 ft.)

Table A-6 continued

South Brooklyn Marine Terminal (SBMT)	
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-278 New on-dock rail facility
Surrounding Land Use	Industrial, commercial, and parkland
Comments	North 35th pier is a solid fill structure (more readily upgradeable to high load rating). Recently released new RFP for long-term leases. Upland area obtained from NYC EDC website.

Table A-7. Red Hook Brooklyn Site Summary

Red Hook Brooklyn	
	
Location	Address:70 Hamilton Ave, Brooklyn, NY 11231 Latitude: 40º41'07" N Longitude:74º00'35" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Red Hook Terminals: (973) 522-0999 www.redhookterminal.com
Distance to NY WEA	89.8 km (55.8 miles)
Upland Area	32 hectares (80 acres)
Water Frontage	4,876.8m (16,000 ft.)

Table A-7 continued

Red Hook Brooklyn	
Minimum Wharf Length(s)	Pier 12 North: 97.5m (320 ft.); Pier 12 West: 277.4m (910 ft.); Pier 12 East: 213.4m (700 ft.); Pier 11 Face: (1,400 ft.); Berths 1 & 2 Face: 411.5m (1,350 ft.); Berths 1 & 2 Rear of Face: 106.7+198.1m (350+650 ft.); Pier 9B Face: 97.5m (320 ft.); Pier 9B South: 198.1m (650 ft.); Pier 9B North: 213.4m (700 ft.); Pier 9A Face: 97.5m (320 ft.); Pier 9A South: 192m (630 ft.); Pier 9A North: 228.6m (750 ft.); Pier 8 Face: 97.5m (320 ft.); Pier 8 South: 207.3m (680 ft.); Pier 8 North: 304.8m (1,000 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel - 11.5-12.8m (38-42 ft.) Berth - 12.8m (42 ft.) MLW
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-278 Rail access not available
Surrounding Land Use	Industrial and commercial
Comments	Underutilized terminal. South end is shared with cruise terminal. Site included in Vision 2020 NYC Comprehensive Waterfront Plan, complimentary goals with OSW.

Figure A-4. East River Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

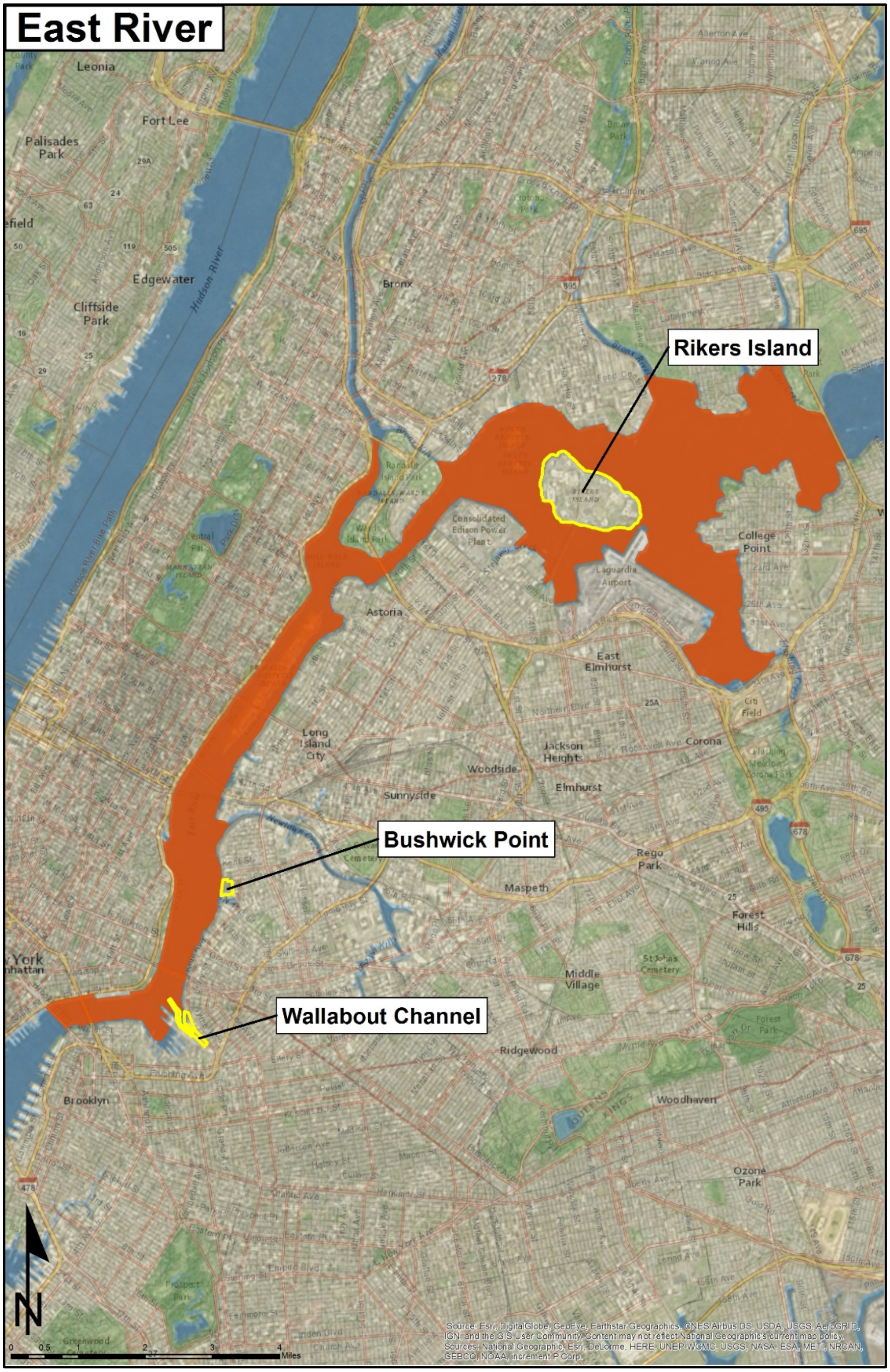


Table A-8. East River Air Draft Site Summary

East River Air Draft	
Bridge	Vertical Clearance above Mean High Water
Brooklyn Bridge (Entrance to Upper Bay - South end)	38.7m (127 ft.)
Manhattan Bridge	40.8m (134 ft.)
Williamsburg Bridge	40.5m (133 ft.)
Queensboro Bridge	West Span: 39.9m (131 ft.) East Span: 40.5m (133 ft.) and Roosevelt Island Lift Bridge 12.2m down / 30m up (40 ft. down/ 99 ft. up)
Robert F. Kennedy Bridge	42.0m (138 ft.)
Hell Gate Rail Bridge	40.8m (134 ft.)
I-678 Bronx Whitestone Bridge	40.5m (130 ft.) 41.1m (135 ft.) at center
I-295 Throgs Neck Bridge (Entrance to Long Island Sound – North end)	42.0m (138 ft.) main span 37.5m (123 ft.) north span

Table A-9. Wallabout Channel Site Summary

Wallabout Channel

Location	Address: Kay Ave, Brooklyn, NY 11249 Latitude: 40º42'24" N Longitude:73º58'11" W
Owner	Brooklyn Navy Yard: (718) 907-5900 http://brooklynnavyyard.org
Significant Tenants	Same as Owner
Distance to NY WEA	89 km (55.3 miles)
Upland Area	11.1 hectares (27.5 acres)
Water Frontage	1,706m (5,597 ft.)
Minimum Wharf Length(s)	Face: 45.7m (150 ft.); South Side: 152.4+106.7m (500+350 ft.); North Side: 243.8m (800 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel - 35 ft. →East River Berth – 7.62m (25 ft.); 15.2m (50 ft.) on face of pier.
Limiting Air Draft Restriction	Brooklyn Bridge- 39m (127 ft.)
Intermodal Connections	0.7 km (0.4 miles) miles to Interstate I-278 Industrial rail at adjacent facility

Table A-9 continued

Wallabout Channel	
Surrounding Land Use	Brooklyn Navy Yard, Steiner Studios, NYC Auto Auction
Comments	Underused section on the northern extent of the Brooklyn Navy Yard. NYC Energy LLC/SEF Industries wants to build a floating power generator along Pier K. Upland residential developments proposed. Upland area estimated on Google Earth. The Brooklyn Navy Yard website states the area of the entire asset as 121.4 hectares (300 acres).

Table A-10. Bushwick Point Site Summary

Bushwick Point

Location	Address: 2741 West St, Brooklyn, NY 11222 Latitude: 40º43'34" N Longitude:73º57'41" W
Owner	M&H Realty LLC: (718) 239-1623
Significant Tenants	One Stop L.I.C., LLC: (646) 325-4821
Distance to NY WEA	91.1 km (56.6 miles)
Upland Area	2 hectares (4.9 acres)
Water Frontage	250.6m (822 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 10.7m (35 ft.) → East River, between Williamsburg Bridge and Roosevelt Island Berth – N/A
Limiting Air Draft Restriction	Brooklyn Bridge- 39m (127 ft.)
Intermodal Connections	1.9 km (1.2 miles) miles to Interstate I-278 Rail access not available

Table A-10 continued

Bushwick Point	
Surrounding Land Use	Commercial, Industrial
Comments	Unused industrial space, including a parking lot advertising space for rent. Owner unconfirmed. Ownership information determined from a posted phone number (One Stop LLC) and NYC Tax Parcel data (M&H Realty LLC).

Table A-11. Rikers Island Site Summary

Rikers Island	
	
Location	Address: 60 Hazen St., East Elmhurst, NY 11370 (Technically part of The Bronx) Latitude: 40º47'27" N Longitude:73º52'60" W
Owner	New York City Department of Corrections: (718) 546-1500 http://www1.nyc.gov/site/doc/index.page
Significant Tenants	Same as Owner
Distance to NY WEA	102.4 km (63.6 miles)
Upland Area	168 hectares (415 acres)
Water Frontage	5,307.8m (17,414 ft.)
Minimum Wharf Length(s)	Rikers Island Oil Dock: 68.6m (225 ft.); Rikers Island Patrol Boat Dock: 12.2m (40 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel 35 ft. – East River, Rikers Island Channel Berth – N/A

Table A-11 continued

Rikers Island	
Limiting Air Draft Restriction	Brooklyn Bridge- 39m (127 ft.) LaGuardia Airport will have significant additional restrictions depending on location on the island.
Intermodal Connections	2.6 km (1.6 miles) to Interstate I-278 Rail access not available.
Surrounding Land Use	NYC Correctional Facilities, LaGuardia Airport
Comments	The city hopes to close the correctional facilities on the island over the course of the next decade. No published plans for the remaining space. The island is adjacent to LaGuardia Airport, so significant air draft restrictions are to be expected.

Figure A-5. Newark Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

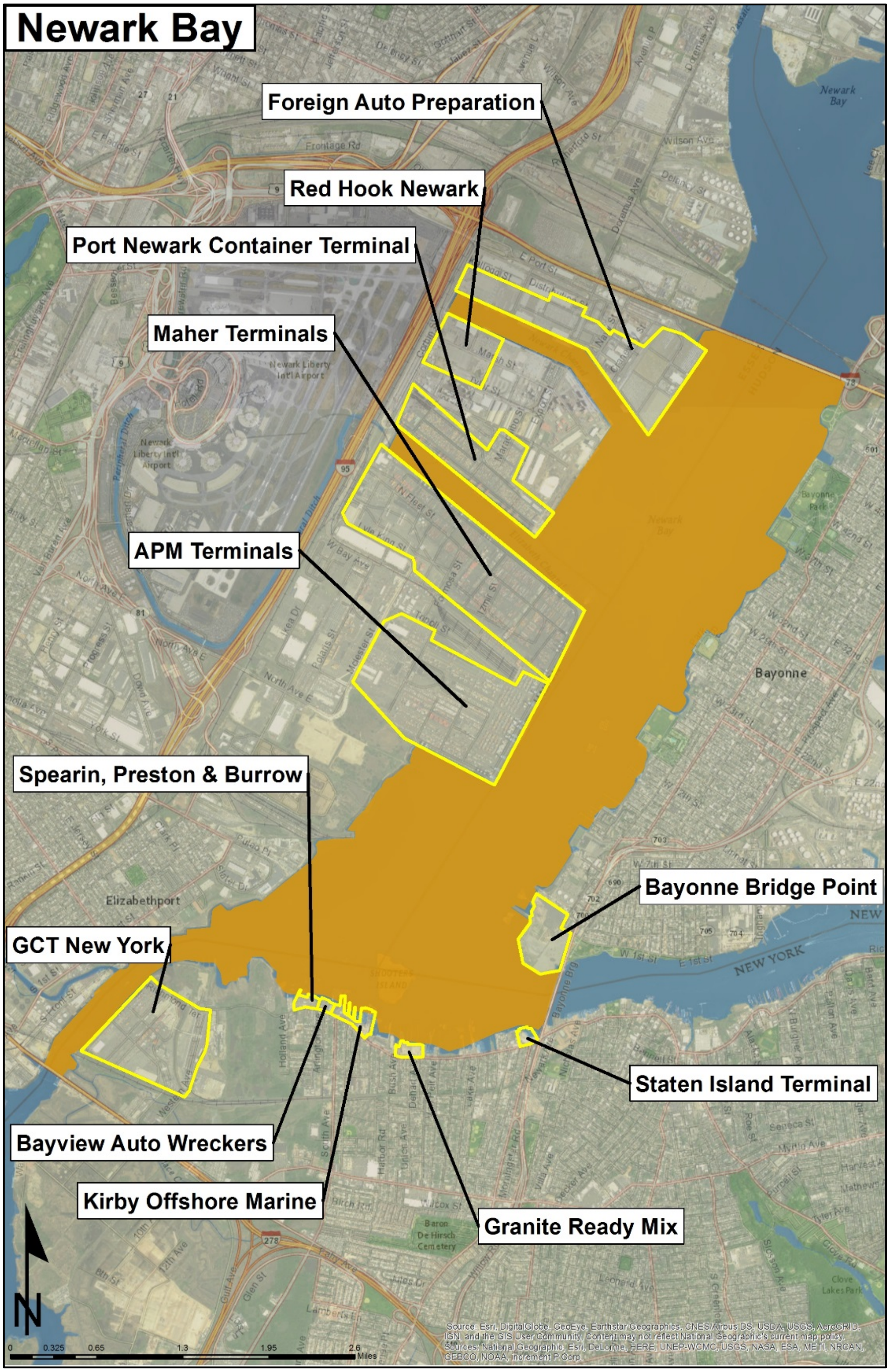


Table A-12. GCT New York, Staten Island Site Summary

GCT New York, Staten Island

Location	Address: 300 Western Ave, Staten Island, NY 10303 Latitude: 40º38'25" N Longitude:74º11'23" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Global Container Terminal: (718) 568-1700 http://www.globalterminalsnewyork.com
Distance to NY WEA	90.4 km (56.2 miles)
Upland Area	58 hectares (187 acres)
Water Frontage	972m (3,189 ft.)
Minimum Wharf Length(s)	765.7m (2,512 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 15m (50 ft.) → Arthur Kill, Elizabethport Reach Berth – 11.3 - 13.7m (37-45 ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-12 continued

GCT New York, Staten Island	
Intermodal Connections	Adjacent to Interstate I-278 On-Site rail access
Surrounding Land Use	Industrial / Commercial
Comments	Busy container terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study. Storage area to the north of the terminal owned by the Port Authority and used by GCT.

Table A-13. Spearin, Preston & Burrow, Inc. Site Summary

Spearin, Preston & Burrows Inc.

Location	Address: 3365 Richmond Terrace, Staten Island, NY 10303 Latitude: 40º38'31" N Longitude:74º10'08" W
Owner	Spearin, Preston & Burrows Inc.: (718) 889-3080
Significant Tenants	Same as Owner
Distance to NY WEA	88 km (54.7 miles)
Upland Area	2.4 hectares (6 acres)
Water Frontage	286.8m (941 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel 9.1m (30 ft.) → Newark Bay, South of Shooter's Island Reach Berth – Not Identified
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	5.1 km (3.2 miles) to Interstate I-278 Rail access not available

Table A-13 continued

Spearin, Preston & Burrows Inc.	
Surrounding Land Use	Commercial, Residential
Comments	Property is in the Mariners Harbor neighborhood with multiple sites nearby. Owner is a heavy construction company. www.nyc1.gov lists plans for area: • Use publicly owned land at Van Pelt/Van Name Ave. to provide open space with views of Shooters Island. • Facilitate maritime expansion on underutilized sites. • Recruit industrial users and maritime training facility to historic industrial buildings. • Permit and recruit commercial amenities along Richmond Terrace frontage and in reused historic buildings.

Table A-14. Bayview Auto Wreckers Site Summary

Bayview Auto Wreckers

Location	Address: 3333 Richmond Terrace, Staten Island, NY 10303 Latitude: 40º38'29" N Longitude:74º10'00" W
Owner	Bayview Auto Wreckers: (718) 273-6060; (718) 981-5757; (917) 468-7774 → after hours http://bayviewautowreckers.com
Significant Tenants	Same as owner
Distance to NY WEA	87.96 km (54.6 miles)
Upland Area	1.4 hectares (3.3 acres)
Water Frontage	167.9m (551 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel 9.1m (30 ft.) → Newark Bay, South of Shooter's Island Reach Berth – N/A
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-14 continued

Bayview Auto Wreckers	
Intermodal Connections	5.0 km (3.1 miles) to Interstate I-278 Rail access not available
Surrounding Land Use	Kirby Offshore Marine, Residential
Comments	Property is in the Mariners Harbor neighborhood with multiple sites nearby. www.nyc1.gov lists plans for area: Use publicly owned land at Van Pelt/Van Name Ave. to provide open space with views of Shooters Island. Facilitate maritime expansion on underutilized sites. Recruit industrial users and maritime training facility to historic industrial buildings. Permit and recruit commercial amenities along Richmond Terrace frontage and in reused historic buildings. Facility appears to be in use. Unlikely to interrupt business for OSW purposes; therefore not considered for further study.

Table A-15. Kirby Offshore Marine & Clean Water of New York Site Summary

Kirby Offshore Marine & Clean Water of New York	
	
Location	Address: 3245 & 3249 Richmond Terrace, Staten Island, NY 10303 Latitude: 40º38'27" N Longitude:74º09'45" W
Owner	Kirby Offshore Marine & Clean Water of New York: (718) 720-7207 & (718) 981-4600 http://kirbycorp.com
Significant Tenants	Same as Owner
Distance to NY WEA	87.5 km (54.4 miles)
Upland Area	4.9 hectares (12.2 acres)
Water Frontage	794.6m (2,607 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel 9.1m (30 ft.) → Newark Bay, South of Shooter's Island Reach Berth – N/A
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-15 continued

Kirby Offshore Marine & Clean Water of New York	
Intermodal Connections	3 miles to Interstate I-278 Rail access not available
Surrounding Land Use	Commercial, Residential
Comments	Two companies share the lot, unclear where the property line is from initial survey. Property is in the Mariners Harbor neighborhood with multiple sites nearby. www.nyc1.gov lists plans for area: Use publicly owned land at Van Pelt/Van Name Ave. to provide open space with views of Shooters Island. Facilitate maritime expansion on underutilized sites. Recruit industrial users and maritime training facility to historic industrial buildings. Permit and recruit commercial amenities along Richmond Terrace frontage and in reused historic buildings. Facility appears to be in use. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-16. Granite Ready Mix, Inc. Site Summary

Granite Ready Mix Inc.	
	
Location	Address: 2945 Richmond Terrace, Staten Island, NY 10303 Latitude: 40°38'16" N Longitude:74°09'27" W
Owner	Granite Ready Mix Inc.: (718-447-1755)
Significant Tenants	Same as Owner
Distance to NY WEA	87.2 km (54.2 miles)
Upland Area	3 hectares (7.3 acres)
Water Frontage	318.2m (1,044 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel 30 ft. →Newark Bay, South of Shooter's Island Reach Berth – N/A
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	2.6 miles to Interstate I-278 Rail access not available
Surrounding Land Use	Industrial, Residential

Table A-16 continued

Granite Ready Mix Inc.	
Comments	Two companies share the lot, unclear where the property line is from initial survey. Property is in the Mariners Harbor neighborhood with multiple sites nearby. www.nyc1.gov lists plans for area: Use publicly owned land at Van Pelt/Van Name Ave. to provide open space with views of Shooters Island. Facilitate maritime expansion on underutilized sites. Recruit industrial users and maritime training facility to historic industrial buildings. Permit and recruit commercial amenities along Richmond Terrace frontage and in reused historic buildings. Facility appears to be in use. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-17. Staten Island Terminal LLC Site Summary

Staten Island Terminal LLC

Location	Address: 2541 Richmond Terrace, Staten Island, NY 10303 Latitude: 40º38'21" N Longitude:74º08'44" W
Owner	Staten Island Terminal LLC: (718)-420-0400 http://www.siterminal.com
Significant Tenants	Same as Owner
Distance to NY WEA	86.1 km (53.5 Miles)
Upland Area	2.2 hectares (5.5 acres)
Water Frontage	192.9m (633 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 15.2m (50 ft.) → Newark Bay, Bergen Point West Reach Berth – N/A
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-17 continued

Staten Island Terminal LLC	
Intermodal Connections	1.8 miles to Interstate I-278 Rail access not available
Surrounding Land Use	Industrial, Residential
Comments	The facility website states that the area is slated to be a deepwater cement and aggregate processing terminal.

Table A-18. APM Terminals Site Summary

APM Terminals	
	
Location	Address: 5080 McLester St, Elizabeth, NJ 07201 Latitude: 40º39'41" N Longitude:74º08'51" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	APM Terminals: (908) 558-6000 http://www.apmterminals.com
Distance to NY WEA	88.8 km (55.2 miles)
Upland Area	142 hectares (350 acres)
Water Frontage	1838.3m (6,031 ft.)
Minimum Wharf Length(s)	East Face: 615.4m (2,019 ft.); South Face: 762m (2,500 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 15.2m (50 ft.) → Newark Bay, Middle Newark Reach Berth - 13.7-15.2m (45-50ft.) MLW

Table A-18 continued

APM Terminals	
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-95 On-site rail connection
Surrounding Land Use	Industrial
Comments	Busy international terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-19. Maher Terminals Site Summary

Maher Terminals

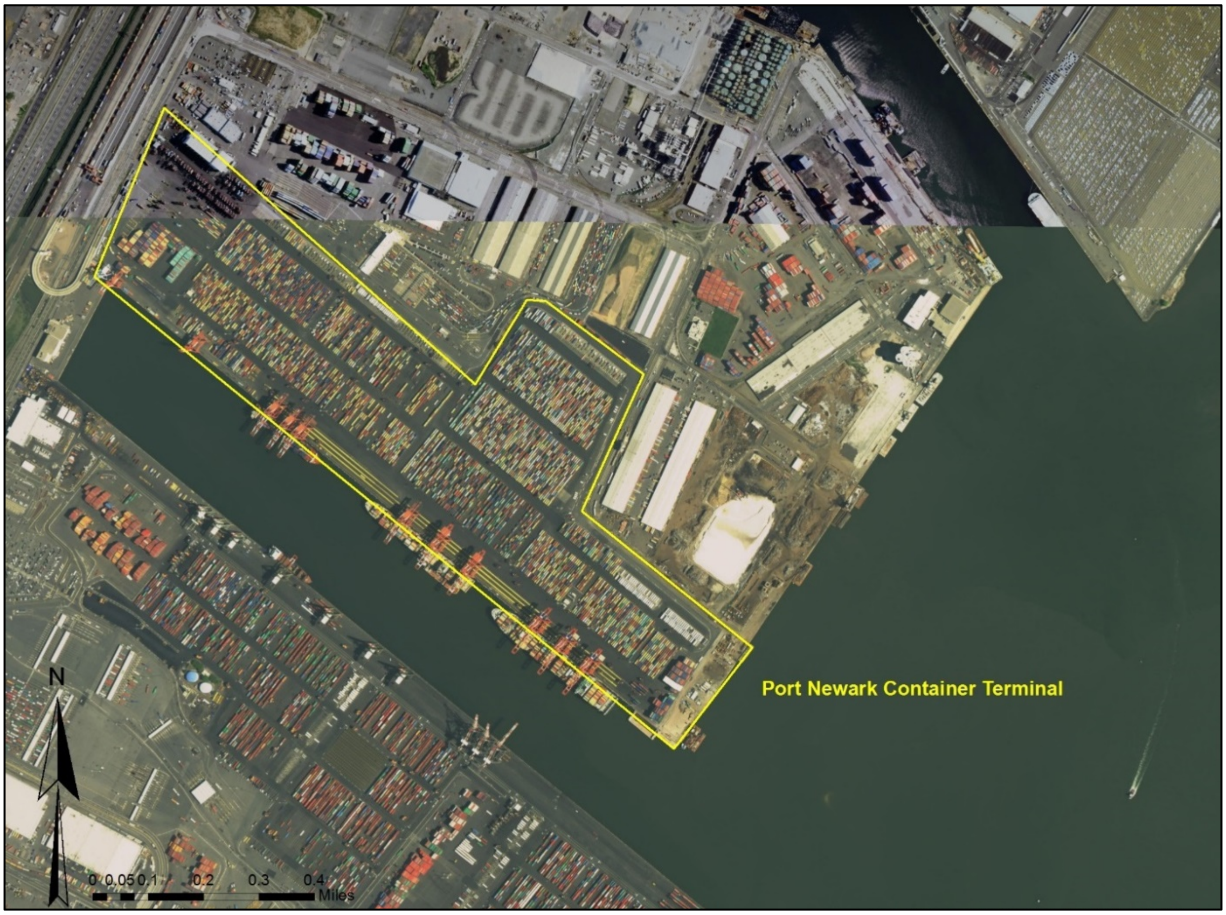
Location	Address: 1210 Corbin St, Elizabeth, NJ 07201 Latitude: 40º40'20" N Longitude:74º08'24" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Maher Terminals: (908) 527-8200 http://www.maherterminals.com
Distance to NY WEA	90.8 km (56.4 miles)
Upland Area	184 hectares (445 acres)
Water Frontage	3,096.2m (10,158 ft.)
Minimum Wharf Length(s)	Berths 52, 54, 56, 58, & 60: 876.3m (2,875 ft.) Berths 62, 64, 66, & 68: 914.4m (3,000 ft.) Berth 70: 280.4m (920 ft.) Berths 72 & 74: 272.8m (895 ft.) Berth 76: 228.6m (750 ft.) Berths 78, 80, 82, 84, & 86: 960.1m (3,150 ft.)
Wharf Live Load Capacity	Not Identified

Table A-19 continued

Maher Terminals	
Navigable Depth	Channel – 15.2m (50 ft.) →Newark Bay, Middle Newark Reach Berth - 13.7-15.2m (45-50ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-95 On-site rail connection
Surrounding Land Use	Industrial
Comments	Busy international terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-20. Port Newark Container Terminal Site Summary

Port Newark Container Terminal



Location	Address: 241 Calcutta St., Newark, NJ 07114 Latitude: 40º40'57" N Longitude:74º08'55" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Port Newark Container Terminal (operated by Ports America): (973) 522-2200 https://www.pnct.net
Distance to NY WEA	91.4 km (56.8 miles)
Upland Area	108 hectares (267 acres)
Water Frontage	1,918.7m (6,295 ft.)
Minimum Wharf Length(s)	Berth 36: 213.4m (700 ft.) Berth 63: 267m (876 ft.) Berth 61: 185.9m (610 ft.) Berths 59, 57, 55, & 53: 932.1m (3,058 ft.) Berth 51: 232.9m (764 ft.)
Wharf Live Load Capacity	Not Identified

Table A-20 continued

Port Newark Container Terminal	
Navigable Depth	Channel - 15.2m (50 ft.) →Newark Bay, Middle Newark Reach Berth - 12.2-15.2m (40-50 ft.) MLW
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-95 On-site rail connection
Surrounding Land Use	Industrial
Comments	Busy international terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-21. Foreign Auto Preparation Site Summary

Foreign Auto Preparation

Location	Address: 371 Craneway St., Newark, NJ 07114 Latitude: 40º41'25" N Longitude:74º08'03" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	FAPS, Inc.: (973)-589-5656 http://www.fapsinc.com
Distance to NY WEA	92.4 km (57.4 miles)
Upland Area	48.5 hectares (120 acres)
Water Frontage	3,483.6m (11,429 ft.)
Minimum Wharf Length(s)	Berths 25 & 23 Face: 426.7m (1,400 ft.); Berth 21 Face: 213.4m (700 ft.); Berth 19: 210.3m (690 ft.); Berth 17: 178m (584 ft.); Berth 15: 183.8m (603 ft.); Berth 13: 183.8m (603 ft.); Berth 11 & 9: 345.3m (1,133 ft.); Berths 7 & 5: 418.8m (1,374 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 12.2m (40 ft.) → Newark Bay, Port Newark Inshore Reach Berth - 9.8-12.2m (32-40 ft.) MLW (unconfirmed)

Table A-21 continued

Foreign Auto Preparation	
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline
Intermodal Connections	Adjacent to Interstate I-95 On-site rail connection
Surrounding Land Use	Industrial, Port Authority NY/NJ
Comments	Busy international roll on/roll off "RoRo" terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-22. Red Hook Newark Site Summary

Red Hook Newark	
	
Location	Address: 138 Marsh St., Newark, NJ 07114 Latitude: 40º41'48" N Longitude:74º08'55" W
Owner	Port Authority of NY & NJ (212) 435-3008 http://www.panynj.gov
Significant Tenants	Red Hook Container Terminals: (973) 522-0999 http://www.redhookterminal.com
Distance to NY WEA	94.1 km (58.5 miles)
Upland Area	12.1 hectares (30 acres)
Water Frontage	581m (1,906 ft.)
Minimum Wharf Length(s)	Berth 4: 211.8m (695 ft.); Berth 6: 182.9m (600 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 12.m (40 ft.) → Newark Bay, Port Newark Inshore Reach Berth – 10.9m (36 ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-22 continued

Red Hook Newark	
Intermodal Connections	Adjacent to Interstate I-95 On-site rail connection
Surrounding Land Use	Industrial
Comments	Busy container terminal. Unlikely to interrupt business for OSW purposes; therefore, not considered for further study.

Table A-23. Bayonne Bridge Point Summary

Bayonne Bridge Point

Location	Address: Avenue A & West 1st Street, Bayonne, NJ 07002 Latitude: 40º38'44" N Longitude:74º08'39" W
Owner	Texaco Downstream Properties, Inc., managed by Kaplan Companies
Significant Tenants	Kaplan Companies: (954) 515-3993 https://www.thinkkaplan.com
Distance to NY WEA	86.1 km (53.5 miles)
Upland Area	15 hectares (37 acres)
Water Frontage	1,120.4m (3,676 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel ft. →Kill Van Kull, Bergen Point West Reach Berth Not dredged, 0.6m (2 ft.) - 1m (3 ft.)
Limiting Air Draft Restriction	Verrazano-Narrows Bridge: 60m (198 ft.) for the center 610m (2,000 ft.) 65.5m (215 ft.) maximum at the centerline

Table A-23 continued

Bayonne Bridge Point	
Intermodal Connections	Adjacent to NJ Route 440 6.4 km (6 miles) to Interstate I-78
Surrounding Land Use	Commercial, Residential
Comments	Adjacent properties owned by Vertellus Specialties, White Glove Moving, and Starting Point Bar & Grill. 2007 redevelopment agreement between Bayonne Local Redevelopment Authority (BLRA) and Kaplan Companies to remediate site and develop mixed-use plans for residential and parkland. BLRA dissolved in 2013, Kaplan continuing with redevelopment plans.

Figure A-6. Upper Newark Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

Table A-24. Bayfront Site Summary

Bayfront	
	
Location	Address: 60 Kellogg St, Jersey City, NJ 07305 Latitude: 40º42'51" N Longitude:74º06'22" W
Owner	The City of Jersey City: (201) 547-5000 http://www.cityofjerseycity.com Honeywell: (877) 841-2840 http://www.bayfrontjerseycity.com
Significant Tenants	Same as Owner
Distance to NY WEA	95.4 km (59.3 miles)
Upland Area	29.2 hectares (72.2 acres)
Water Frontage	690.1m (2,264 ft.)
Minimum Wharf Length(s)	Droyer's Point Wharf: 152.4m (500 ft.); Broadway Wharf: 61m (200 ft.)
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel - 9.1m (30 ft.) – Newark Bay, Droyer's Reach Berth – N/A
Limiting Air Draft Restriction	I-78 Newark Bay Bridge 41.1m (135 ft.)

Table A-24 continued

Bayfront	
Intermodal Connections	2.9 km (1.8 miles) to Interstate I-95 Rail access not available
Surrounding Land Use	Residential, Commercial
Comments	Former brownfield slated for multi-purpose residential area. Unlikely to convert for industrial use; therefore, not considered further for this study.

Table A-25. Veckridge Chemical Co. Site Summary

Veckridge Chemical Co.

Location	Address: 60 Central Ave, Kearney, NJ 07032 Latitude: 40º43'08" N Longitude:74º07'01" W
Owner	Town of Kearney: (201) 955-7400 http://www.kearnynj.org HP Real Estate, LLC: (914) 694-4200 http://hprealestate.com
Significant Tenants	Veckridge Chemical Co.: (973) 344–1818 http://www.veckridgechemical.com
Distance to NY WEA	95.4 km (59.3 miles)
Upland Area	9.2 hectares (22.8 acres)
Water Frontage	576.1m (1,890 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel - 9.1m (30 ft.) – Newark Bay, Kearney Point Reach Berth – N/A

Table A-25 continued

Veckridge Chemical Co.	
Limiting Air Draft Restriction	I-78 Newark Bay Bridge 41.1m (135 ft.)
Intermodal Connections	1.4 miles to Interstate I-95 On-Site rail access
Surrounding Land Use	Commercial, wastewater treatment
Comments	Apparently underused industrial space formerly occupied by Veckridge Chemical Co. Adjacent to a wastewater treatment plant.

Figure A-7. Arthur Kill Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

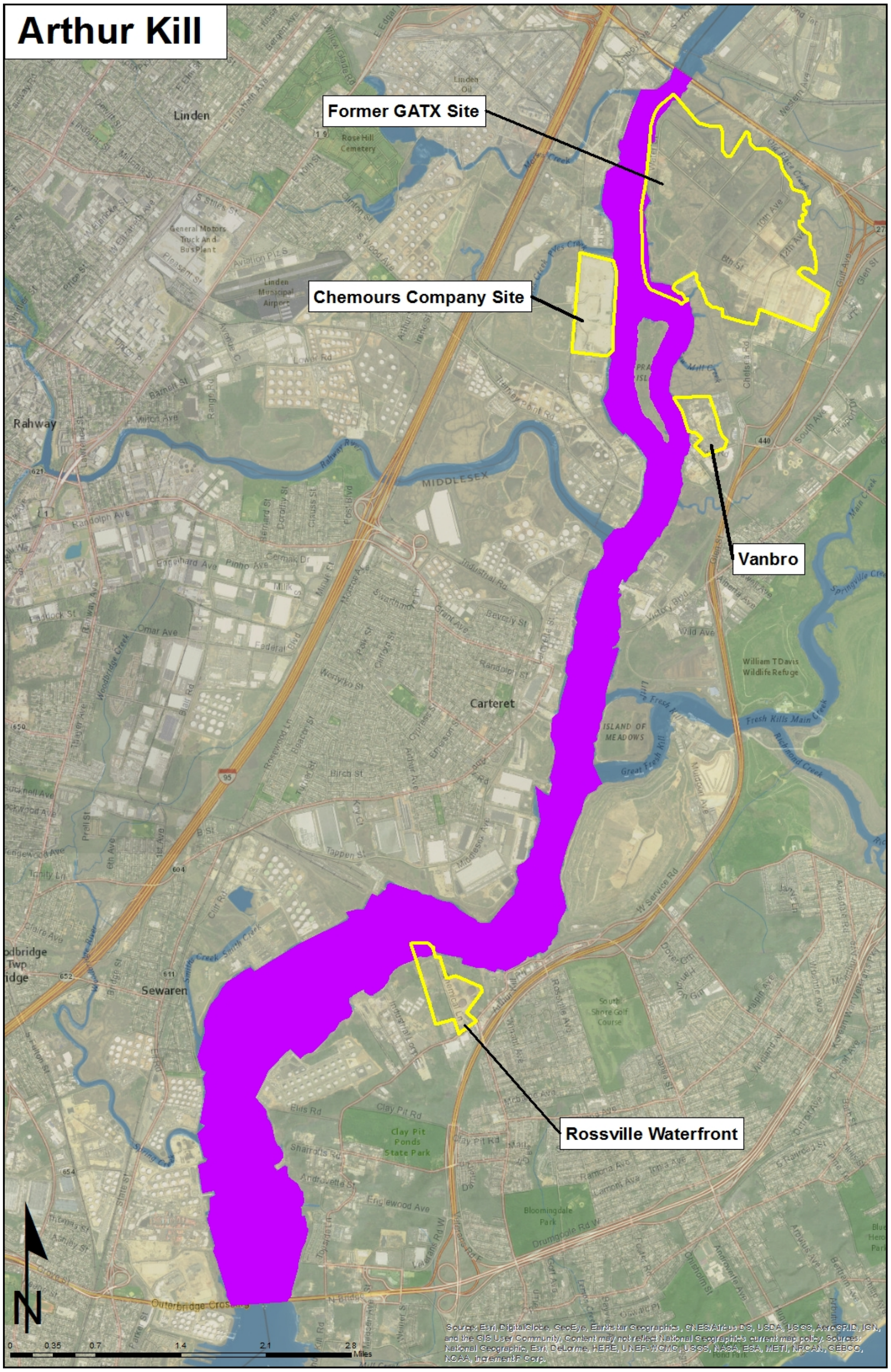


Table A-26. Rossville Waterfront Site Summary

Rossville Waterfront	
	
Location	Address: Chemical Lane, Staten Island, NY 10309 Latitude: 40º33'21" N Longitude:74º13'26" W
Owner	Chaim Babad of Babad Management: (718) 633-7586 https://www.babadmanagement.com
Significant Tenants	Same as Owner
Distance to NY WEA	96.1 km (59.7 miles)
Upland Area	32.37 hectares (80 acres)
Water Frontage	280.4m (920 ft.)
Minimum Wharf Length(s)	304.8m (1,000 ft.) with dolphins
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel 10.7m (35 ft.) →Arthur Kill, Port Reading Reach Berth
Limiting Air Draft Restriction	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Outerbridge Crossing to the south: 43.6m (143 ft.)

Table A-26 continued

Rossville Waterfront	
Intermodal Connections	6 miles to Interstate I-278 Rail access not available
Surrounding Land Use	Commercial
Comments	Largely unused industrial land with derelict pier in place. Some of the waterfront is owned by the city New York City Department of Environmental Conservation issued stop work order in 2016 for developer dismantling old LNG tanks. Owner "announced in 2015 plans for a factory outlet center" NYC.gov lists plans for site: Explore feasibility of improving municipal pier and recruiting maritime user. Support redevelopment that includes a mix of maritime, retail and commercial uses. Improve public waterfront access, incorporating Blazing Star Cemetery with an eventual link to Fresh Kills Park.

Table A-27. Former GATX Site Summary

Former GATX Site

Location	Address: Gulf Ave, Bloomfield, Staten Island, NY 10304 Latitude: 40º37'29" N Longitude:74º11'59" W
Owner	Staten Island Marine Development: (718) 477-2719 www.simd.com
Significant Tenants	Same as Owner
Distance to NY WEA	92.2 km (57.3 miles)
Upland Area	273.6 hectares (676 acres)
Water Frontage	1,996.4m (6,550 ft.)
Minimum Wharf Length(s)	Berths 3, 5, 6, & 7: 335.3m (1,100 ft.); Berth 2: 64m (210 ft.) with dolphins; Berth 1: 109.7m (360 ft.)
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel 10.7m (35 ft.) →Arthur Kill, Gulfport Reach Berth – N/A
Limiting Air Draft Restriction	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Outerbridge Crossing to the south: 43.6m (143 ft.)

Table A-27 continued

Former GATX Site	
Intermodal Connections	1.6 miles to Interstate I-278 On-site Rail Access
Surrounding Land Use	Commercial
Comments	Largely unused industrial land with derelict pier in place. NYC.gov plans for the area: Reutilize industrial sites with modern distribution, maritime, and commercial facilities that utilize the waterfront for goods movement, with sensitivity to existing wetlands.

Table A-28. Vanbro Site Summary

Vanbro	
	
Location	Address: 1900 South Avenue, Staten Island, NY 10314 Latitude: 40º37'29" N Longitude:74º11'59" W
Owner	Vanbro Corporation: Robert Vanderbilt (917) 553-4695 Neil Vanderbilt (718) 698-1100 www.vanbrodevelopment.com
Significant Tenants	Same as Owner
Distance to NY WEA	95.4 km (59.3 miles)
Upland Area	21.4 hectares (53 acres)
Water Frontage	216.4m (710 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 10.7m (35 ft.) → Arthur Kill, Tremley Point Reach Berth – N/A

Table A-28 continued

Vanbro	
Limiting Air Draft Restriction	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Or Outerbridge Crossing to the south: 43.6m (143 ft.)
Intermodal Connections	2.6 km (1.6 miles) to Interstate I-278 On-Site Rail Access
Surrounding Land Use	Commercial
Comments	Site contains functioning berth with deep water per NYC EDC. Rail connections with 100-car capacity, waterfront steel bulkhead dock, and direct access to Rte. 440.

Table A-29. Chemours Company Site Summary

Chemours Company FC LLC	
	
Location	Address: South Wood Avenue, Linden, NJ 07036 Latitude: 40º36'51" N Longitude:74º12'21" W
Owner	Chemours Company FC LLC (302) 773-2280 http://www.chemourssurplus.com
Significant Tenants	Same as Owner
Distance to NY WEA	93.6 km (58.2 miles)
Upland Area	37 hectares (92 acres)
Water Frontage	968m (3,176 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Channel Navigable Depth	Channel – 10.7m (35 ft.) → Arthur Kill, Pralls Island Reach Berth - N/A
Limiting Air Draft Restriction	Arthur Kill Railroad Bridge to the north: 41.1m (135 ft.) Outerbridge Crossing to the south: 43.6m (143 ft.)

Table A-29 continued

Chemours Company FC LLC	
Intermodal Connections	0.8 km (0.5 miles) to Interstate I-95 On-Site Rail Access
Surrounding Land Use	Industrial, Commercial
Comments	Linden Roselle Sewerage Authority, Phillips 66 Company, and Citgo are located south of the site. The site appears to be unused. Additional information was not readily available. Owner information was obtained using the New Jersey Transportation Planning Authority interactive map.

Figure A-8. Raritan Bay Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

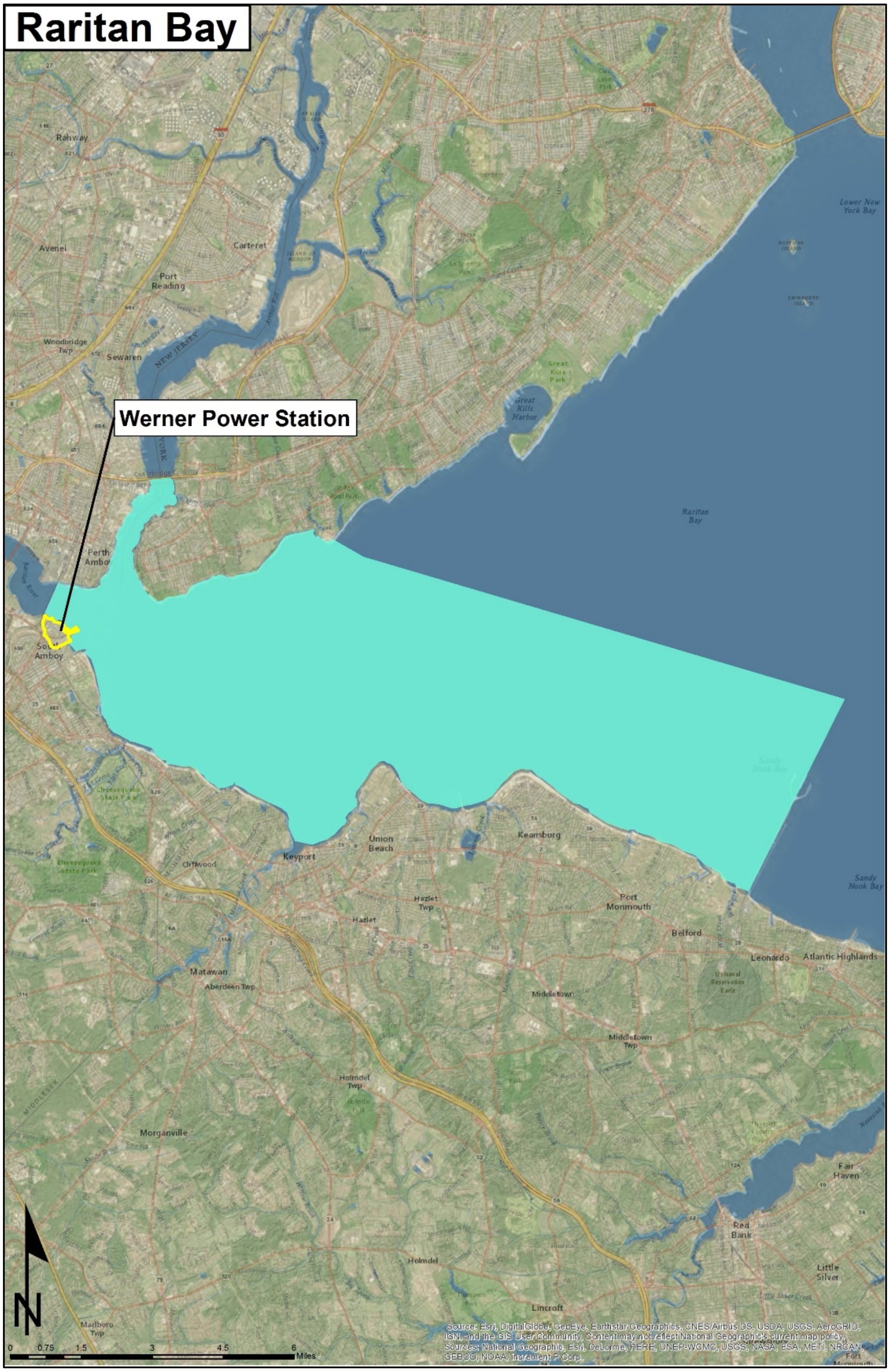


Table A-30. Werner Power Station Site Summary

Werner Power Station	
	
Location	Address: 106 Pupek Rd, South Amboy, NJ 08879 Latitude: 40º36'51" N Longitude:74º12'21" W
Street Address	106 Pupek Rd
Owner	South Amboy Redevelopment Agency: (732) 727-4600 www.southamboynj.gov/south-amboy-redevelopment-agency-sara The City of South Amboy: (732) 727-4600 http://www.southamboynj.gov
Significant Tenants	Same as Owner
Distance to NY WEA	86.9 km (54 miles)
Upland Area	36.3 hectares (89.8 acres)
Water Frontage	1,868.4m (6,130 ft.)
Minimum Wharf Length(s)	35m (115 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 7.6m (25 ft.) →Raritan River, Great Beds Reach Berth – 6.4m (21 ft.)
Limiting Air Draft Restriction	Unrestricted

Table A-30 continued

Werner Power Station	
Intermodal Connections	7.2 km (4.5) miles to Interstate I-95 On-site Rail Access
Surrounding Land Use	Residential, Raritan Pointe Developers
Comments	Decommissioned Reliant Power Plant (E.H. Werner Power Station). Plans were to sell the property to Manhattan Beach Club, LLC and begin redevelopment into residential area. Unclear at what stage of this process the project currently is.

Figure A-9. Raritan River Area

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

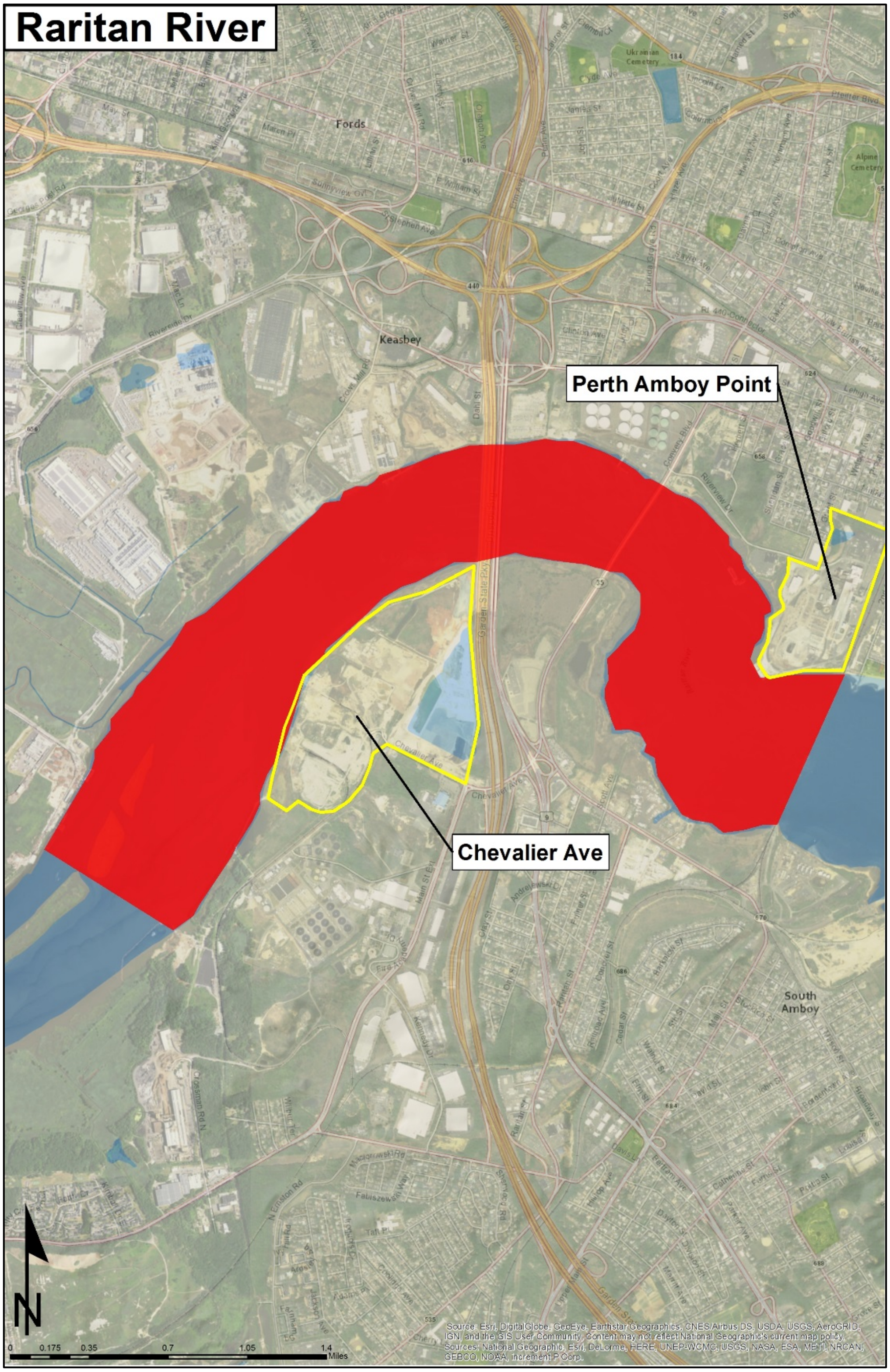


Table A-31. Perth Amboy Point Site Summary

Perth Amboy Point	
	
Location	Address: Foot of Elm Street, Perth Amboy, NJ 08861 Gerdau building at 333 Riverview Drive, Building 51 Latitude: 40º30'03" N Longitude:74º17'00" W
Owner	RR Steel: (920) 739-6521, (800) 331-6521 http://www.rrsteelconstruction.com Gerdau Ameristeel (Co-Owner): (732) 651-7822 https://www.gerdau.com/northamerica/en
Significant Tenants	Same as Owner
Distance to NY WEA	88.3 km (54.9 miles)
Upland Area	34.4 hectares (85 acres)
Water Frontage	929.6m (3,050 ft.)
Minimum Wharf Length(s)	Not Identified
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 7.6m (25 ft.) →Raritan River, Great Beds Reach Berth – 5.2m (17 ft.)

Table A-31 continued

Perth Amboy Point	
Limiting Air Draft Restriction	Overhead power cables: 42.7m (140 ft.) Raritan River Railroad [Swing] Bridge: Horizontal clearance of 37.8m (124 ft.)
Intermodal Connections	5.8 km (3.6 miles) to Interstate I-95 On-site Rail Access
Surrounding Land Use	Cornucopia Cruise Lines, Company Steel Raritan, Perth Amboy Autobody Repair
Comments	Steel plant closed in 2009.

Table A-32. Chevalier Avenue Brownfield Site Summary

Chevalier Avenue Brownfield	
	
Location	Address: Chevalier Ave, Sayreville, NJ 08872 Latitude: 40º30'07" N Longitude:74º18'40" W
Owner	Sayreville Economic & Redevelopment Agency: (732) 390-7010 www.sayreville.com/Cit-e-Access/webpage.cfm?TID=87&TPID=8706
Significant Tenants	Same as the Owner
Distance to NY WEA	92.1 km (57.2 miles)
Upland Area	94.7 hectares (234 acres)
Water Frontage	1,801.4m (5,910 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 7.6m (25 ft.) →Raritan River, Great Beds Reach Berth – Not applicable
Limiting Air Draft Restriction	New Jersey Route 35 Victory Bridge: 33.5m (110 ft.) and Edison Fixed Bridges: 33.5m (110 ft.)

Table A-32 continued

Chevalier Ave Brownfield	
Intermodal Connections	Adjacent to Garden State Parkway On-site Rail Access
Surrounding Land Use	Faith Fellowship Ministries, Middlesex County Fire Department
Comments	In 2014, SERA was seeking funding for chemical cleanup at 1000 Chevalier Ave., possibly with the goal to develop into "The Pointe" retail power and entertainment center.

Appendix B. Hudson River Waterways Data Sheets

Figure B-10. Hudson River Waterways

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

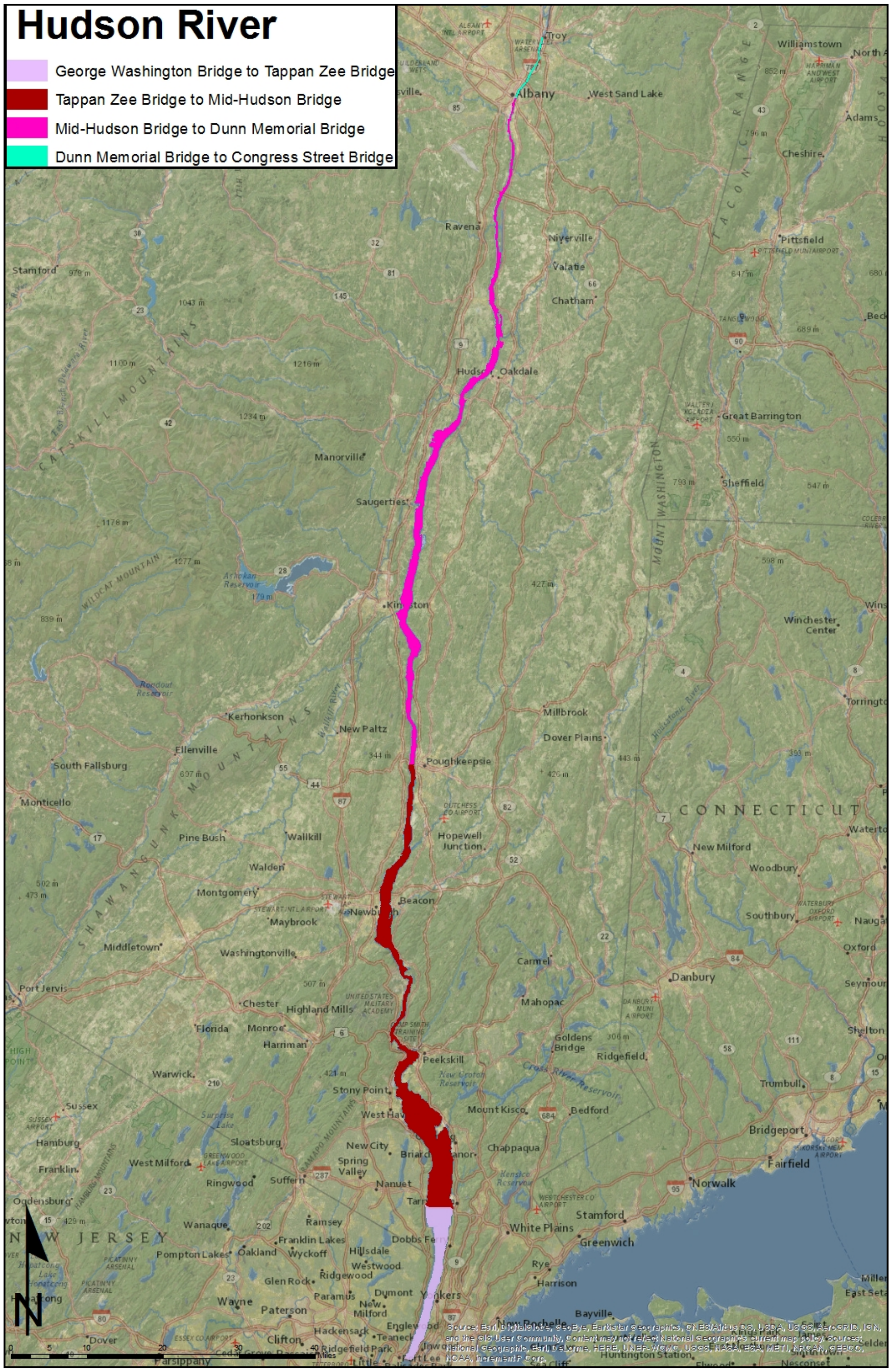


Figure B-11. Hudson River - George Washington Bridge to Tappan Zee Bridge

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

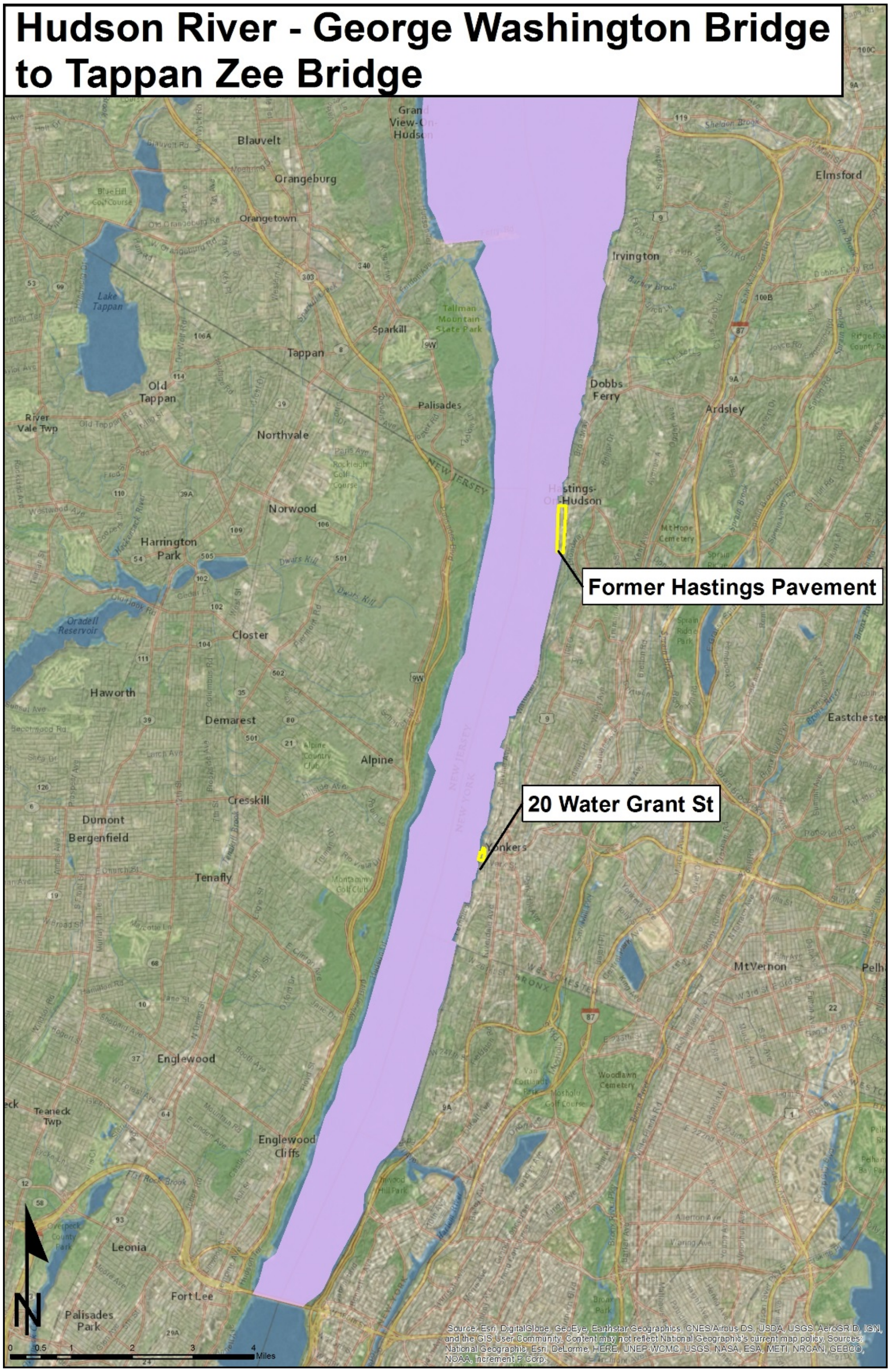


Table B-33. 20 Water Grant Street Site Summary

20 Water Grant St

Location	Address: 20 Water Grant St., Yonkers, NY 10701 Latitude: 40º55'52" N Longitude:73º54'18" W
Owner	Extell Development Co. (212) 712-6000 http://extell.com/
Significant Tenants	Same as Owner
Distance to NY Wind Energy Area (WEA)	113.6 km (70.6 miles)
Upland Area	2.5 hectares (6.1 acres)
Water Frontage	289.9m (951 feet [ft.])
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel - 9.7m (32 ft.) Berth - N/A
Limiting Air Draft Restriction	George Washington Bridge – 65m (213 ft.)
Intermodal Connections	2.0 miles to Interstate I-87 Adjacent to Metro-North Rail. No industrial rail access.

Table B-1 continued

20 Water Grant St	
Surrounding Land Use	Residential, Domino Sugar Yonkers
Comments	1395 unit apartment complex consisting of 6 buildings under development. Site unavailable.

Table B-34. Former Hastings Pavement & Anaconda Copper Company Industrial Area Summary

Former Hastings Pavement & Anaconda Copper Company Industrial Area

Location	Address: One River Street, Hastings-on-Hudson, NY 10706 Latitude: 40º59'24" N Longitude:73º53'10" W
Owner	Atlantic Richfield Company: http://oneriverstreet.com/site/index.php
Significant Tenants	Hastings-On-Hudson, NY 10706
Distance to NY WEA	119.1 km (74 miles)
Upland Area	11.3 hectares (28 acres)
Water Frontage	1060.1m (3,478 ft.)
Minimum Wharf Length(s)	None existing, 3,600 linear ft. frontage on Hudson River
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel - 9.7m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	George Washington Bridge – 65m (213 ft.)
Intermodal Connections	2.0 miles to Interstate I-87 Adjacent to Metro-North Rail. No industrial rail access.

Table B-2 continued

Former Hastings Pavement & Anaconda Copper Company Industrial Area	
Surrounding Land Use	Railway right-of-way Light commercial
Comments	New York State Superfund Site. Remedial design investigations in process.

Figure B-12. Tappan Zee Bridge to Mid-Hudson Bridge

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

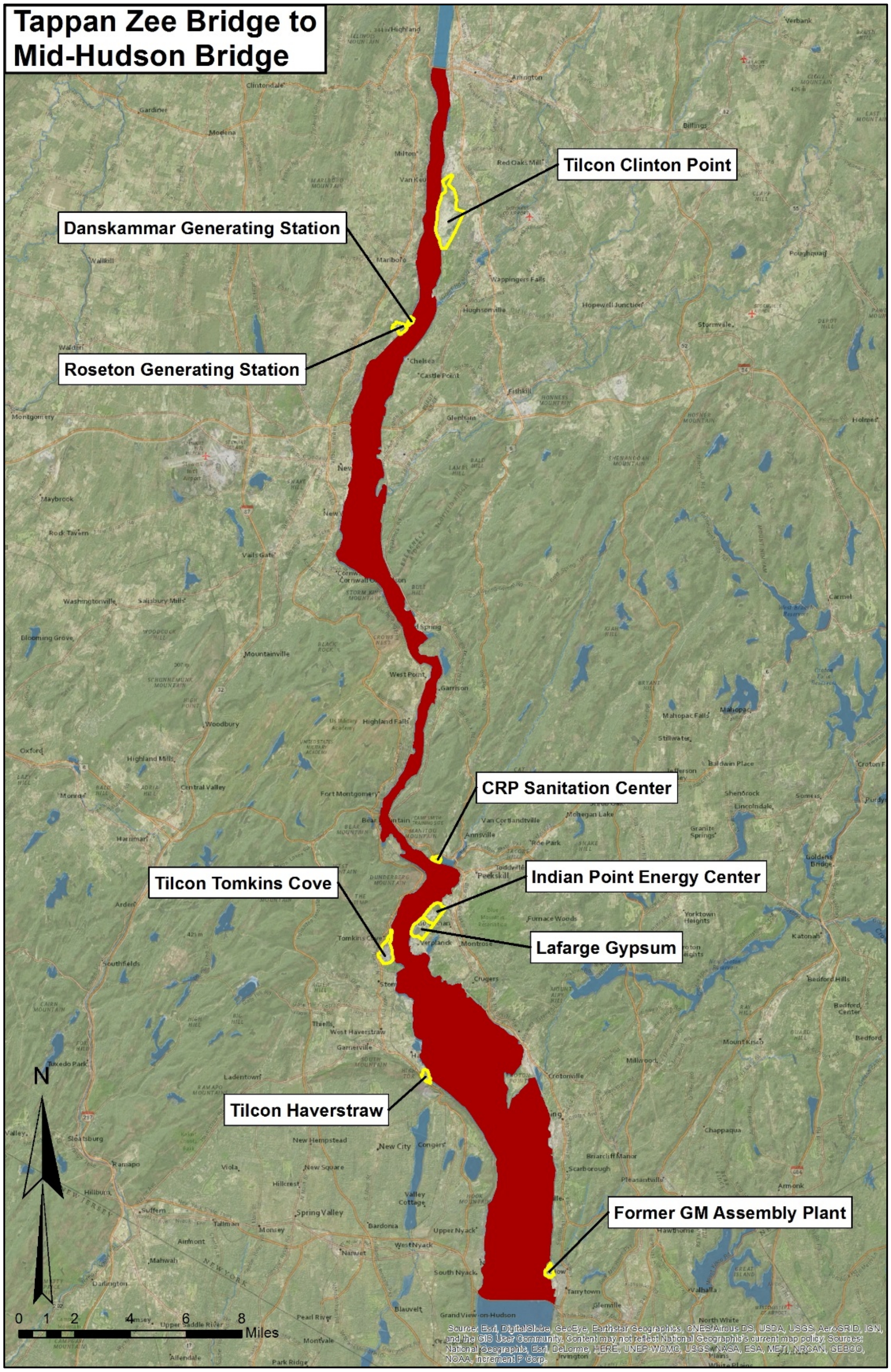


Table B-35. Former GM Assembly Plant Summary

Former GM Assembly Plant

Location	Address: 199 Beekman Ave, Sleepy Hollow, NY 10591 Latitude:41o04'57" N Longitude: 73o52'23" W
Owner	General Motors, site being developed by Diversified Realty Advisors and SunCal https://www.gm.com/
Significant Tenants	Diversified Realty Advisors: (908) 273-2400 http://www.diversifiedra.com/ SunCal: (212) 554-2975 http://suncal.com/
Distance to NY WEA	129.6 km (80.5 miles)
Upland Area	38.8 hectares (96 acres)
Water Frontage	676.1m (2,218 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)

Table B-3 continued

Former GM Assembly Plant	
Intermodal Connections	3.3 km (2.1 miles) to Interstate I-87 Adjacent to existing railway
Surrounding Land Use	Residential, Parks
Comments	Site under redevelopment for residential purposes. Not recommended for further investigation.

Table B-36. Tilcon Haverstraw Quarry Summary

Tilcon Haverstraw Quarry

Location	Address: 59 Riverside Ave, Haverstraw, NY 10927 Latitude:41o11'03" N Longitude: 73o57'08" W
Owner	Tilcon NY, Inc. 1-800-872-7762 http://www.tilconny.com/
Significant Tenants	Same as the Owner
Distance to NY WEA	142.9 km (88.8 miles)
Upland Area	22.1 hectares (54.5 acres)
Water Frontage	836.7m (2,745 ft.)
Minimum Wharf Length(s)	141m (463 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	10 km (6.2 miles) to Interstate I-87 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Residential, Undeveloped

Table B-4 continued

Tilcon Haverstraw Quarry	
Comments	Identified site is the portion of the Tilcon Haverstraw Quarry located adjacent to the Hudson River East of NY 9W and existing railway. Site is currently used for stockpiling aggregate and loading bulk material vessels. Aggregate source is an approximately 70 hectare (175 acre) active quarry located west of NY 9W and existing railway.

Table B-37. Tilcon Tomkins Cover Summary

Tilcon Tomkins Cove

Location	Address: 48 Elm Ave, Stony Point, NY 10986 Latitude:41°15'24" N Longitude: 73°58'41" W
Owner	Tilcon NY, Inc.: 1-800-872-7762 http://www.tilconny.com/
Significant Tenants	Same as the Owner
Distance to NY WEA	150.3 km (93.4 miles)
Upland Area	93.5 hectares (231 acres)
Water Frontage	1716.6m (5,632 ft.)
Minimum Wharf Length(s)	"Island" type berth for bulk handling
Wharf Live Load Capacity	Not Applicable – "Island" type berth
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	6.2 km (3.9 miles) to the Palisades Interstate Parkway 21.7 km (13.5 miles) to Interstate I-87 Adjacent to existing railway, no existing spur.

Table B-5 continued

Tilcon Tomkins Cove	
Surrounding Land Use	Residential, Quarry
Comments	Latest reference source dated 2013, site no longer appears on Tilcon website.

Table B-38. Lafarge Gypsum Summary

Lafarge Gypsum

Location	Address: 350 Broadway, Buchanan, NY 10511 Latitude:41º15'51" N Longitude: 73º57'43" W
Owner	Lafarge Gypsum: (773) 372-1000 http://www.lafarge-na.com/wps/portal/na
Significant Tenants	Same as the Owner
Distance to NY WEA	152.1 km (94.5 miles)
Upland Area	88 hectares (217.5 acres) including a 10.9 hectare (26.9 acres) pond
Water Frontage	1270.1m (4,167 ft.)
Minimum Wharf Length(s)	"Island" type berth for bulk handling
Wharf Live Load Capacity	Not Applicable – "Island" type berth
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	Adjacent to NY-9A 28.9 km (18 miles) to Interstate I-684 No railway connection on site.
Surrounding Land Use	Residential, Industrial

Table B-6 continued

Lafarge Gypsum	
Comments	Gypsum drywall manufacturing plant for an international construction company. Here Lafarge reports using "synthetic gypsum from neighboring power plants to produce environmentally-friendly drywall."

Table B-39. Indian Point Energy Center Summary

Indian Point Energy Center	
	
Location	Address: Broadway, Buchanan, NY 10511 Latitude:41º16'12" N Longitude: 73º57'12" W
Owner	Entergy: (914) 736-8000 safesecurevital.com
Significant Tenants	Same as the Owner
Distance to NY WEA	152.9 km (95 miles)
Upland Area	78 hectares (192.8 acres)
Water Frontage	1962.9m (6,440 ft.)
Minimum Wharf Length(s)	74m (244 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	Adjacent to NY-9A 29.1 km (18.1 miles) to Interstate I-684 No railway connection on site
Surrounding Land Use	Residential, Industrial

Table B-7 continued

Indian Point Energy Center	
Comments	Nuclear energy plant. January, 2017 agreement with New York State to close one reactor by April 2020 and remaining reactor a year later.

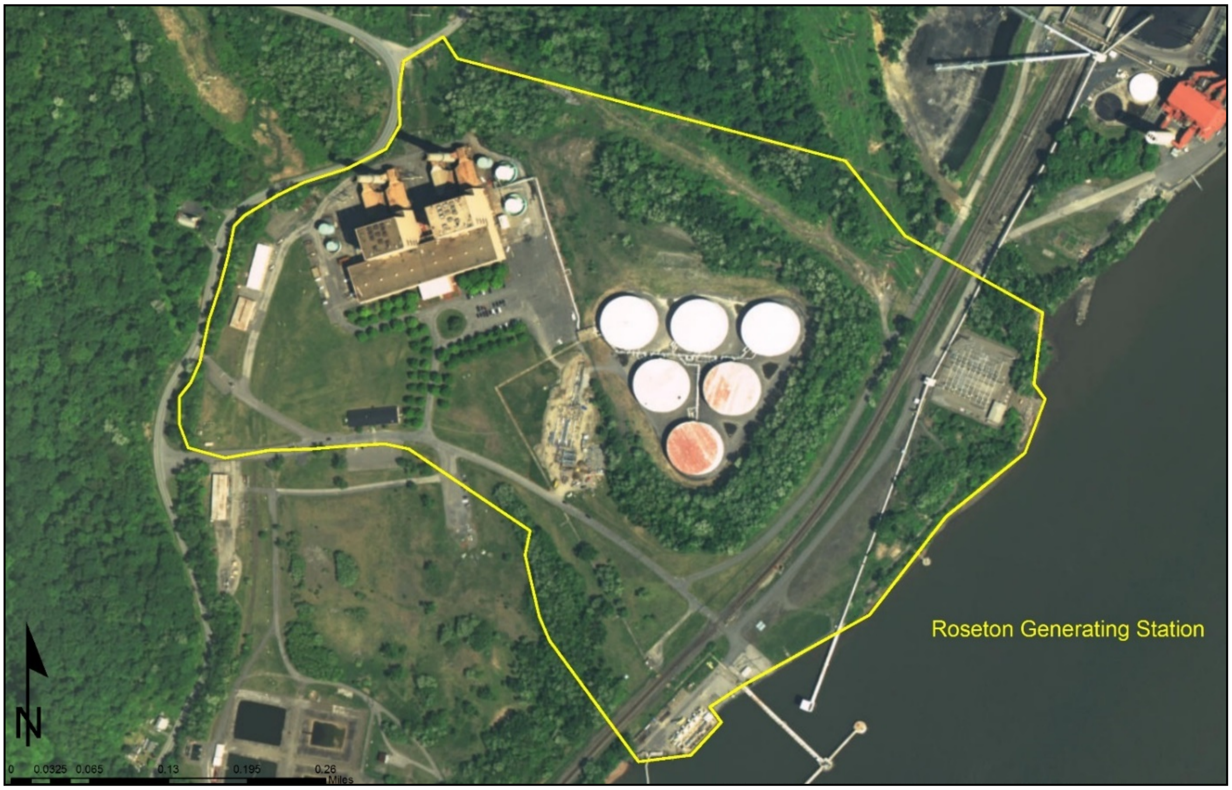
Table B-40. CRP Sanitation Plant Summary

CRP Sanitation Plant

Location	Address: 2 Bayview Rd, Cortlandt, NY 10567 Latitude:41o17'44" N Longitude: 73o56'44" W
Owner	CRP Sanitation: (914) 592-4129 http://www.crpsanitation.com/
Significant Tenants	Same as the Owner
Distance to NY WEA	155.6 km (96.7 miles)
Upland Area	11.9 hectares (29.6 acres)
Water Frontage	393.5m (1,291 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	28.4 km (17.6 miles) to Interstate I-684 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Industrial, Undeveloped
Comments	Recycling center.

Table B-41. Roseton Generating Season Summary

Roseton Generating Season



Location	Address: 992 River Rd, Newburgh, NY 12550 Latitude:41o34'00" N Longitude: 73o58'18" W
Owner	Castleton Commodities International LLC: (203) 564-8100 (Stamford office) http://www.cci.com/assets/power
Significant Tenants	Same as the Owner
Distance to NY WEA	190.5 km (118.4 miles)
Upland Area	46.1 hectares (114 acres)
Water Frontage	685.5m (2,249 ft.)
Minimum Wharf Length(s)	"Island" type berth for bulk handling
Wharf Live Load Capacity	Not Applicable – "Island" type berth
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	7.9 km (4.9 miles) to Interstate I-84 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Industrial, Residential, Church
Comments	Active natural gas and fuel oil power plant. Purchased from Dynegy Inc. in 2013.

Table B-42. Danskammar Generating Station

Danskammar Generating Station

Location	Address: 99 Old Post Rd, Newburgh, NY 12550 Latitude:41º34'20" N Longitude: 73º57'55" W
Owner	Helios Power Capital: (732) 362-8282
Significant Tenants	Same as Owner
Distance to NY WEA	190.9 km (118.6 miles)
Upland Area	21 hectares (52 acres)
Water Frontage	893.7m (2,932 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	7.9 km (4.9 miles) to Interstate I-84 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Industrial, Residential, Church

Table B-10 continued

Danskammar Generating Station	
Comments	Dynegy Inc. sold the coal plant to Helios in 2013. Helios planned to decommission the plant; however due to pressure to stabilize electric power prices, Helios worked with the NY Public Service Commission to reopen the facility in 2014 using only natural gas (and fuel oil as a backup). Not recommended for further investigation.

Table B-43. Tilcon Point Quarry Summary

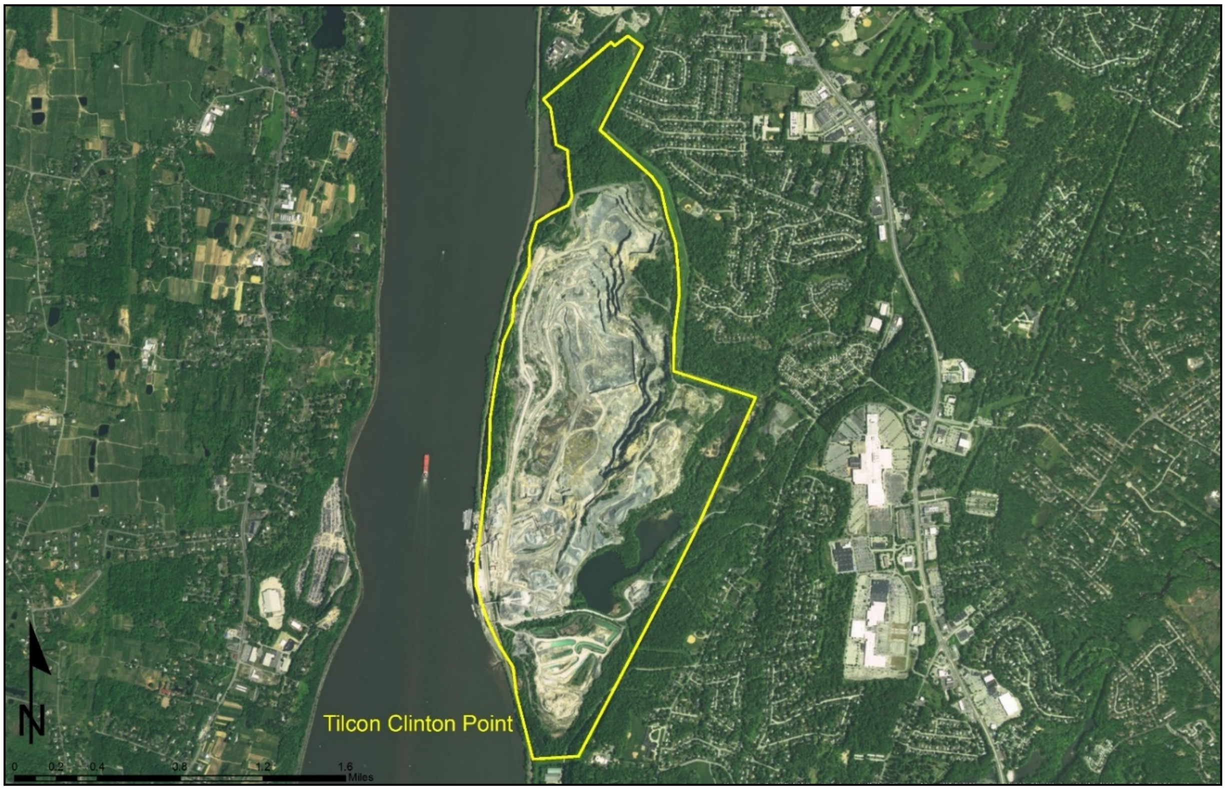
Tilcon Clinton Point Quarry	
	
Location	Address: 461 Sheafe Rd, Wappingers Falls, NY 12590 Latitude:41º37'11" N Longitude: 73º56'55" W
Owner	Tilcon NY, Inc.: (800) 872-7762 tilconny.com
Significant Tenants	Same as the Owner
Distance to NY WEA	195.2 km (121.3 miles)
Upland Area	361.3 hectares (892.9 acres)
Water Frontage	3,532.9m (11,591 ft.)
Minimum Wharf Length(s)	Barge loading along bulkhead. No wharf for breakbulk project cargo.
Wharf Live Load Capacity	N/A
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Tappan Zee Bridge: Center Span: 42.4m (139 ft.) East and West spans: 37.5m (123 ft.)
Intermodal Connections	13.9 km (8.6 miles) to Interstate I-84 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Residential, Commercial
Comments	Aggregate, paving, and construction materials company. Formerly owned by New York Trap Rock.

Figure B-13. Mid-Hudson Bridge to Dunn Memorial Bridge

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

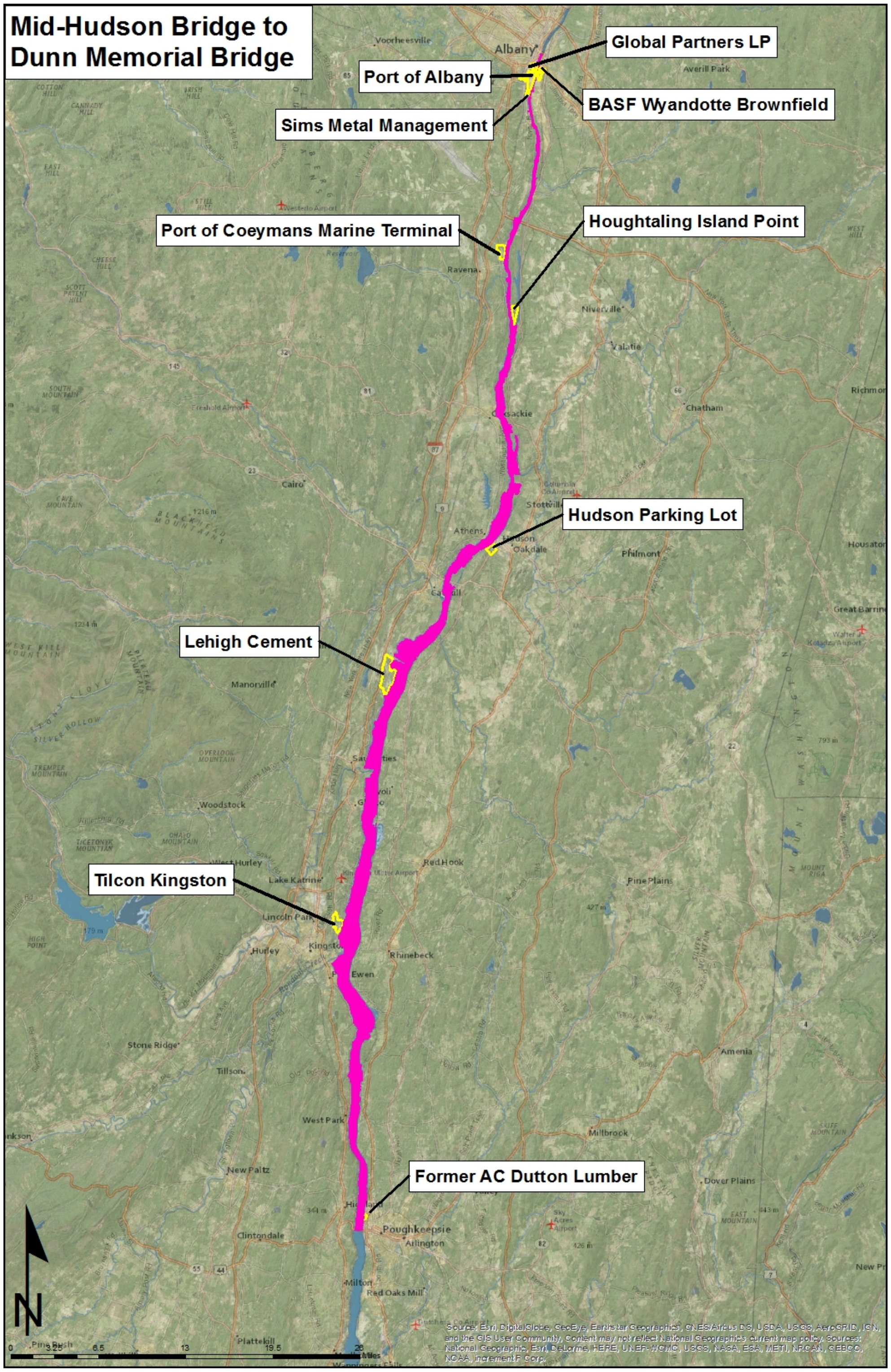


Table B-44. Former A.C. Dutton Lumber Site Summary

Former A.C. Dutton Lumber Site

Location	Address: 1 Dutchess Ave, Poughkeepsie, NY 12601 Latitude:41°42'47" N Longitude: 73°56'22" W
Owner	The O'Neill Group-Dutton LLC: (719) 445-5050 http://www.theoneilgroupco.com/
Significant Tenants	Same as the Owner
Distance to NY WEA	207.3 km (128.8 miles)
Upland Area	4.5 hectares (11 acres)
Water Frontage	424.9m (1,394 ft.)
Minimum Wharf Length(s)	Not existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	16.5 km (10.3 miles) to Interstate I-87 Adjacent to existing railway, possible existing spur.
Surrounding Land Use	Residential
Comments	Development has begun on luxury apartments. Not recommended for further investigation.

Table B-45. Tilcon Kingston Summary

Tilcon Kingston

Location	Address: 290 John St, Kingston, NY 12401 Latitude:41º56'52" N Longitude: 73º57'48" W
Owner	Tilcon, NY and KGN Landings Dev LLC: 1-800-872-7762 tilconny.com
Significant Tenants	Same as the Owner
Distance to NY WEA	234 km (145.4 miles)
Upland Area	129.5 hectares (320 acres)
Water Frontage	762.9m (2,503 ft.)
Minimum Wharf Length(s)	64m (210 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	4.9 km (3 miles) to Interstate I-587 2.3 km (1.4 miles) to railway connection
Surrounding Land Use	Residential, Waste Management

Table B-13 continued

Tilcon Kingston	
Comments	Address estimated, facility not listed on Tilcon website. Site includes multiple parcels owned by KGN Landings, for which no online information was found, the mailing address is listed at: 1 Executive Blvd, Yonkers, NY 10701 Significant elevation rise. Lower portions of the site closer to Hudson River may be appropriate for offshore wind (OSW) development.

Table B-46. Lehigh Cement Summary

Lehigh Cement

Location	Address: 120 Alpha Blvd, Catskill, NY 12414 Latitude:42°08'24" N Longitude: 73°54'35" W
Owner	Lehigh Cement Co: (518) 943-5940 lehighhanson.com
Significant Tenants	Same as the Owner
Distance to NY WEA	255.9 km (159 miles)
Upland Area	278.7 hectares (688.8 acres)
Water Frontage	2,475.9m (8,123 ft.)
Minimum Wharf Length(s)	Two (2) wharves, barges are loaded at bulkheads South - 78m (256 ft.), North – 82.4m (270.3 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	Adjacent to NY-9W 9.3 km (5.8 miles) to Interstate I-87 On-site railway connection
Surrounding Land Use	Residential, Undeveloped
Comments	Active cement facility for a national construction materials company.

Table B-47. Hudson Parking Lot Summary

Hudson Parking Lot

Location	Address: 175 South Front St, Hudson, NY 12534 Latitude:42°15'12" N Longitude: 73°48'05" W
Owner	Unknown (see comments below)
Significant Tenants	Not Applicable
Distance to NY WEA	272.3 km (169.2 miles)
Upland Area	43.4 hectares (107.3 acres)
Water Frontage	867.2m (2,845 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	10.5 km (6.5 miles) to Interstate I-87 Adjacent to existing railway, possible existing spur.
Surrounding Land Use	Residential, Undeveloped

Table B-15 continued

Hudson Parking Lot	
Comments	Seemingly unused space including marshland. Unclear how much land is protected/able to be developed. Owner unknown; not listed on Columbia County tax site. SWIS: 100600, Tax ID: 109.15-1-1. Applications were submitted to the City of Hudson by A. Colarusso and Son Inc. over the past few years to stabilize the shoreline with rip-rap and a bulkhead.

Table B-48. Houghtaling Island Point Summary

Houghtaling Island Point

Location	Address: Hudson River, New Baltimore, NY Latitude:42o26'00" N Longitude: 73o46'42" W
Owner	New York State Parks: (518) 474-0456 https://parks.ny.gov/
Significant Tenants	Same as the Owner
Distance to NY WEA	292.4 km (181.7 miles)
Upland Area	51.2 hectares (126.6 acres)
Water Frontage	3,500.3m (11,484 ft.)
Minimum Wharf Length(s)	None Existing
Wharf Live Load Capacity	Not Applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	No existing rail or road connection.
Surrounding Land Use	Undeveloped
Comments	State Park. Army Corps has used the island for dumping of dredged soil (sometimes contaminated). Not considered further by this study.

Table B-49. Port of Coeymans Marine Terminal Summary

Port of Coeymans Marine Terminal

Location	Address: 2170 River Rd, Coeymans, NY 12045 Latitude:42°28'53" N Longitude: 73°47'18" W
Owner	Port of Coeymans: (518) 756-2164 http://portofcoeymans.com/about-us/
Significant Tenants	Same as the Owner
Distance to NY WEA	298.5 km (185.5 miles)
Upland Area	161.8 hectares (400 acres)
Water Frontage	993.6m (3,260 ft.)
Minimum Wharf Length(s)	*See comments below
Wharf Live Load Capacity	Undetermined
Navigable Depth	Channel – 9.8m (32 ft.) Berth – 9.1m (30 ft.)
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	Adjacent to Interstate I-87 1.0 km (0.6 miles) to railway connection
Surrounding Land Use	Undeveloped

Table B-17 continued

Port of Coeymans Marine Terminal	
Comments	The terminal is currently supporting the New NY Bridge (Tappan Zee Bridge) project. Website states ability to accommodate vessels up to 228.5m (750 ft.) in length and a "Heavy Load Capacity" at the berth, actual length of existing wharf not identified.

Table B-50. Sims Metal Management Summary

Sims Metal Management

Sims Metal Management	
Location	Address: 140 Port Road South, Albany, NY 12202 Latitude:42º36'41" N Longitude: 73º45'45" W
Owner	Port Albany Ventures LLC: (518) 432-4276
Significant Tenants	Sims Metal Management: (518) 465-2288 simsmm.com
Distance to NY WEA	313.3 km (194.7 miles)
Upland Area	11.4 hectares (28.1 acres)
Water Frontage	420m (1,378 ft.)
Minimum Wharf Length(s)	91m (298 ft.)
Wharf Live Load Capacity	Undetermined
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	2.6km (1.6 miles) to Interstate I-87 On-site railway connection
Surrounding Land Use	Commercial, Port of Albany.
Comments	Per Albany tax parcel information, site is owned by Port Albany Ventures and currently operated by Sims Metal Management, which is a metal scrap yard.

Table B-51. Port of Albany-Rensselaer

Port of Albany-Rensselaer

Location	Address: 106 Smith Blvd, Albany, NY 12202 Latitude:42o37'26" N Longitude: 73o45'25" W
Owner	Albany Port District Commission: (518) 463-8763 http://www.portofalbany.us/
Significant Tenants	Federal Marine Terminal: 518.463.0237 http://www.fmtcargo.com/locations/albany/index.html Ben Weitsman: (518) 462-4444 Ardent Mills: (518) 447-1735 Westway Terminal Co: (518) 463-5917
Distance to NY WEA	314.1 km (195.2 miles)
Upland Area	107.6 hectares (266 acres). The website advertises 8.1 hectares (20 acres) of available open storage space.
Water Frontage	2,398.8m (7,870 ft.)
Minimum Wharf Length(s)	Albany side (west): 1,280m (4,200 ft.) Rensselaer side (east): 335.3m (1,100 ft.)
Wharf Live Load Capacity	Not Identified
Navigable Depth	Channel – 9.8m (32 ft.) Berth – Not Identified
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)

Table B-19 continued

Port of Albany-Rensselaer	
Intermodal Connections	1.0 km (0.6 miles)to Interstate I-787 On-site railway connection
Surrounding Land Use	Industrial
Comments	Per the Port of Albany Website: four transit sheds and two backup warehouses totaling 300,000 square feet (27,870 square meters) of storage. Heavy lift on-dock rail capability.

Table B-52. BASF Wyandotte Summary

BASF Wyandotte Brownfield	
 	
Location	Address: 36 Riverside Ave, Rensselaer, NY 12144 Latitude:42o37'26" N Longitude: 73o45'25" W
Owner	BASF Corporation: (973) 245-6000 https://www.basf.com/us/en.html
Significant Tenants	Same as the Owner
Distance to NY WEA	315.1 km (195.8 miles)
Upland Area	18.3 hectares (45.3 acres)
Water Frontage	398.7m (1,308 ft.)
Minimum Wharf Length(s)	None Existing
Wharf Live Load Capacity	Not Applicable
Navigable Depth	Channel – 9.8m (32 ft.) Berth – N/A
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	6.2 km (3.9 miles) to Interstate I-90 On-site railway connection
Surrounding Land Use	Industrial
Comments	The New York State Department of Environmental Conservation Superfund site, former chemical manufacturing plant. Per the New York State Department of Environmental Conservation website 2016 - BASF is performing a site cleanup

Table B-53. Global Partners LP

Global Partners LP

Location	Address: 346 Church Street, Albany, NY 12202 Latitude:42º37'53" N Longitude: 73º45'16" W
Owner	Global Partners LP: (518) 445-1300 http://www.globalp.com/terminals/terminal.cfm?terminalID=3135
Significant Tenants	Federal Marine Terminals: (518) 463-0237 http://www.fmtcargo.com/
Distance to NY WEA	315.7 km (196.2 miles)
Upland Area	8.1 hectares (20 acres)
Water Frontage	584m (1,916 ft.)
Minimum Wharf Length(s)	5 Berths, length not publically available
Wharf Live Load Capacity	Undetermined
Navigable Depth	Channel – 9.8m (32 ft.) Berth – 9.4m (31 ft.)
Limiting Air Draft Restriction	Mid-Hudson Bridge: 40.8m (134 ft.)
Intermodal Connections	0.5 km (0.3 miles) to Interstate I-787 On-site railway connection
Surrounding Land Use	Industrial

Table B-21 continued

Global Partners LP	
Comments	Federal Marine Terminals is operating on part of the site. The land is owned by Global Partners LP, per Albany tax parcel GIS data. Two (2) cranes with capacities up to 110 mt, Barge-mounted cranes with lift capabilities up to 1,000 metric tonnes on request Much of the area is occupied by petroleum infrastructure. Some areas may be repurposed for OSW.

Figure B-14. Dunn Memorial Bridge to Congress Street Bridge

Source: COWI 2017
ESRI (ArcGIS, World Imagery Basemap)

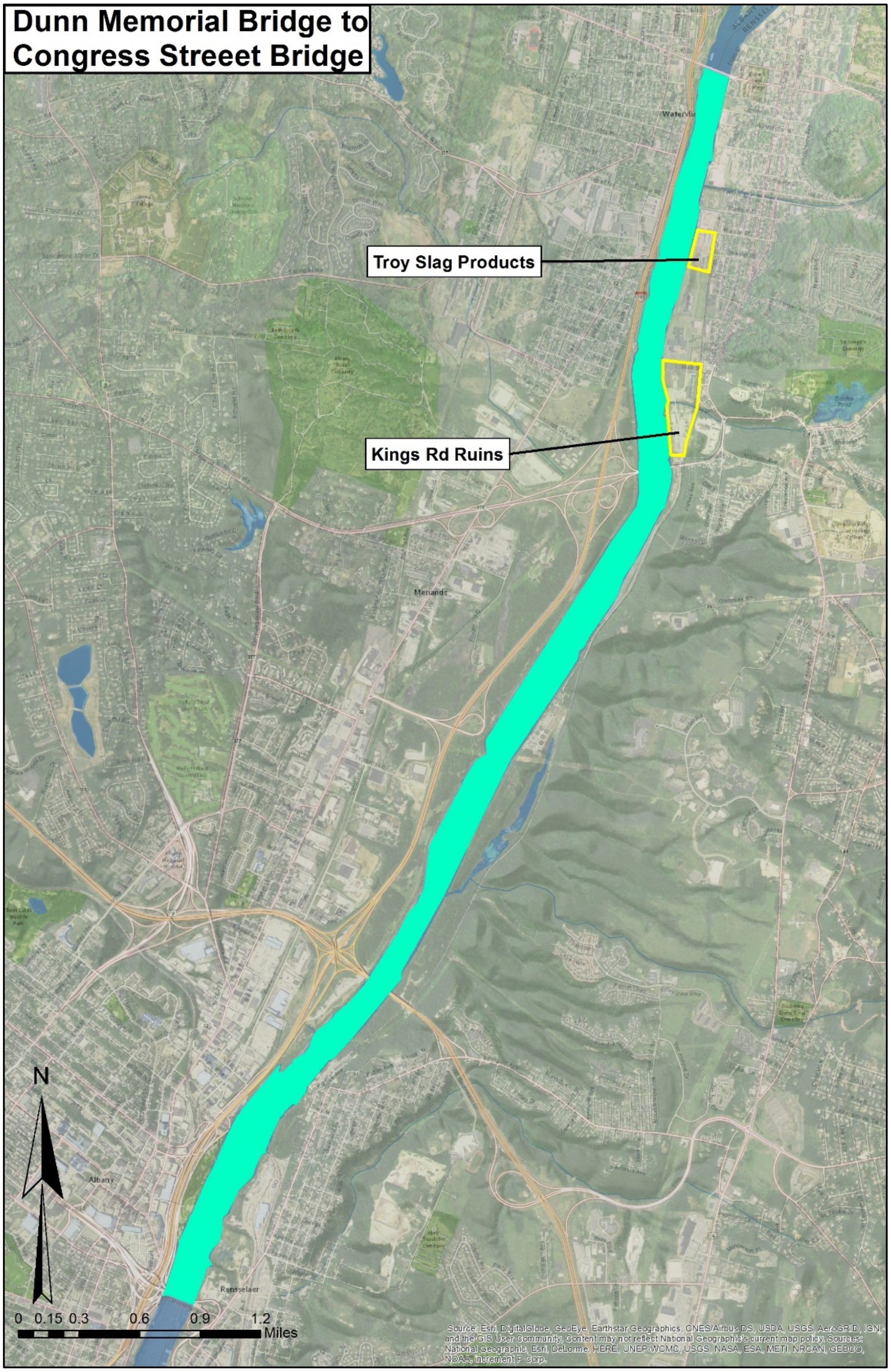


Table B-54. King Rd Ruins Summary

Kings Rd Ruins	
	
Owner	Address: Kings Rd, Troy, NY 12180 Latitude:42º42'12" N Longitude: 73º42'04" W
Owner	Rensselaer County Industrial Development Agency: (518) 465-1693 http://www.rensselaerny.gov/departments/PlanningBuilding/IndustrialDevelopmentAgency.aspx
Significant Tenants	Troy Local Development Co.: (518) 279-7412 http://www.troyny.gov/Departments/EconomicDevelopment/TroyTLDC.aspx
Distance to NY WEA	324.8 km (201.8 miles)
Upland Area	14.5 hectares (35.8 acres)
Water Frontage	746.8m (2,450 ft.)
Minimum Wharf Length(s)	None Existing
Wharf Live Load Capacity	Not Applicable
Navigable Depth	Channel – 4.3m (14 ft.) Berth – N/A
Limiting Air Draft Restriction	Dunn Memorial Bridge: 18.3m (60 ft.)
Intermodal Connections	1.8 km (1.1 miles) to Interstate I-787 Adjacent to existing railway, no existing spur.

Table B-22 continued

Kings Rd Ruins	
Surrounding Land Use	Residential, Sheriff Department
Comments	Multiple adjacent tax parcels encompassing derelict buildings and unused land. Documents released 2006 state plans for site remediation.

Table B-55. Troy Slag Products Summary

Troy Slag Products	
	
Location	Address: 3 Monroe St, Troy, NY 12180 Latitude:42º42'59" N Longitude: 73º41'58" W
Owner	Troy Slag Products Co: (518) 272-0831 http://www.quicktransportsolutions.com/truckingcompany/newyork/troy-slag-products-co-inc-usdot-450945.php
Significant Tenants	Same as Owner
Distance to NY WEA	326.1 km (202.6 miles)
Upland Area	4.6 hectares (11.3 acres)
Water Frontage	304.8m (1,000 ft.)
Minimum Wharf Length(s)	None existing
Wharf Live Load Capacity	Not applicable
Navigable Depth	Channel – 4.3m (14 ft.) Berth – N/A
Limiting Air Draft Restriction	Dunn Memorial Bridge: 18.3m (60 ft.)
Intermodal Connections	3.0 km (1.9 miles) to Interstate I-787 Adjacent to existing railway, no existing spur.
Surrounding Land Use	Residential, Sheriff Department
Comments	Trucking company distribution warehouse and equipment yard.

Appendix C. Long Island Waterways Data Sheets

Figure C-15. Long Island Waterways

Source: COWI 2017; ESRI (ArcGIS, World Imagery Basemap)

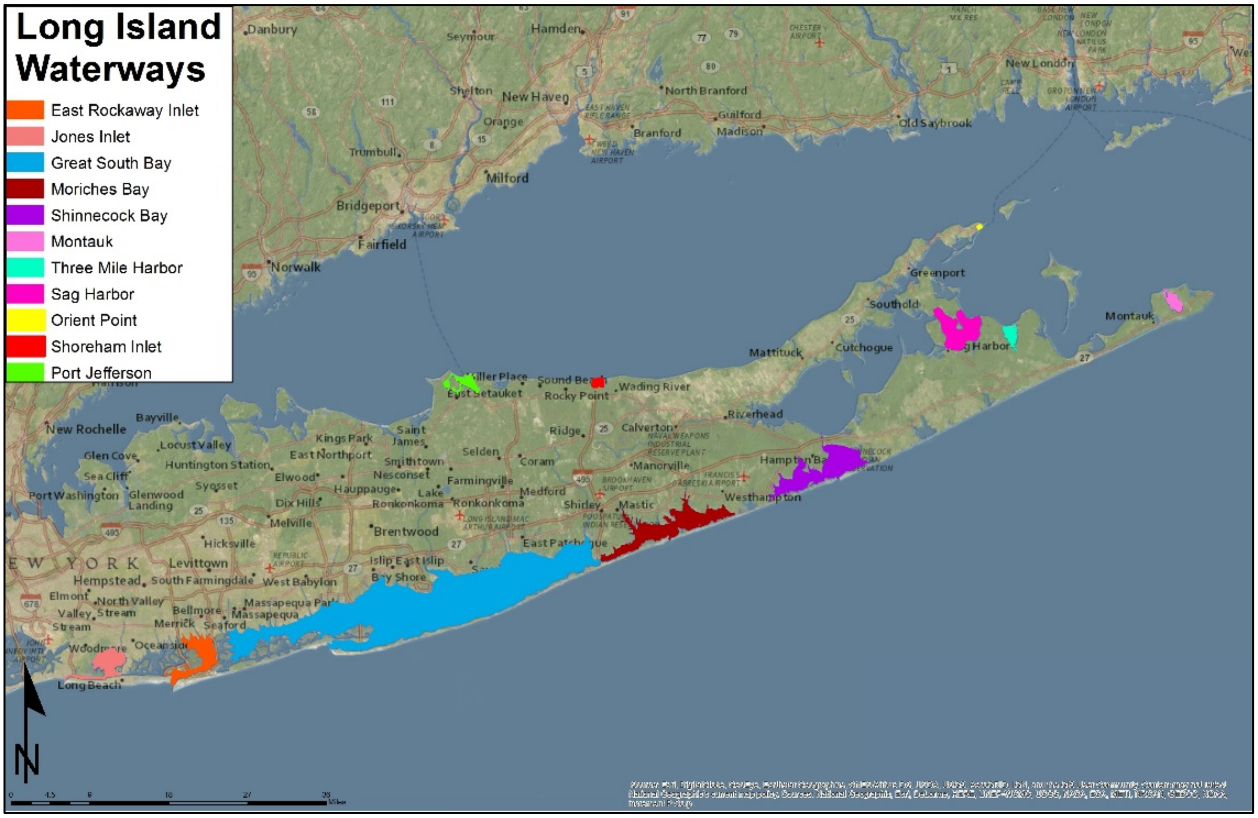


Table C-56. East Rockaway Inlet Summary

East Rockaway Inlet

Location	Latitude: 40º35'20" N Longitude: 73º45'10" W
Significant Tenants	Apache Yacht Club & Marina: (516) 431-7533 http://apacheyachtclub.com/ Bailey's Marina: (516) 764-9682 Bay Park Yacht Harbor: (516) 766-4112 Woodmere Bay Yacht Club: (516) 599-9783 http://woodmerebayyc.com/ Hewlett Point Yacht Club (516) 599-9877 http://www.hpyachtclub.org/ Keystone Yacht Club: (516) 295-4142 http://www.keystoneyachtclub.com/ Crow's Nest Marina (516) 766-2020 http://crowsnestmarina.com/ Cedarhurst Yacht Club (516) 239-9702 http://www.cycny.com

Table C-1 continued

East Rockaway Inlet	
Distance to Wind Energy Areas (WEAs) (From mouth of Harbor)	221.6 km (137.7 miles) to South Fork Project (Bureau of Ocean Energy Management [BOEM] commercial lease outer continental shelf [OCS]-A 0486) 49.9 km (31 miles) to NY WEA
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 feet [ft.])
Navigable Depth	Channel – 3.7m (12 ft.)
Limiting Air Draft Restriction	None. Atlantic Beach Bascule Bridge: Horizontal Clearance of 38m (125 ft.)
Intermodal Connections	Varies
Surrounding Land Use	Residential, light industrial and commercial, golf courses and uninhabited marshland.
Comments	Navigation in the western half of the bay may be constrained due to the area being populated with salt marsh islands.

Table C-57. Jones Inlet and East Hampton Bay Summary

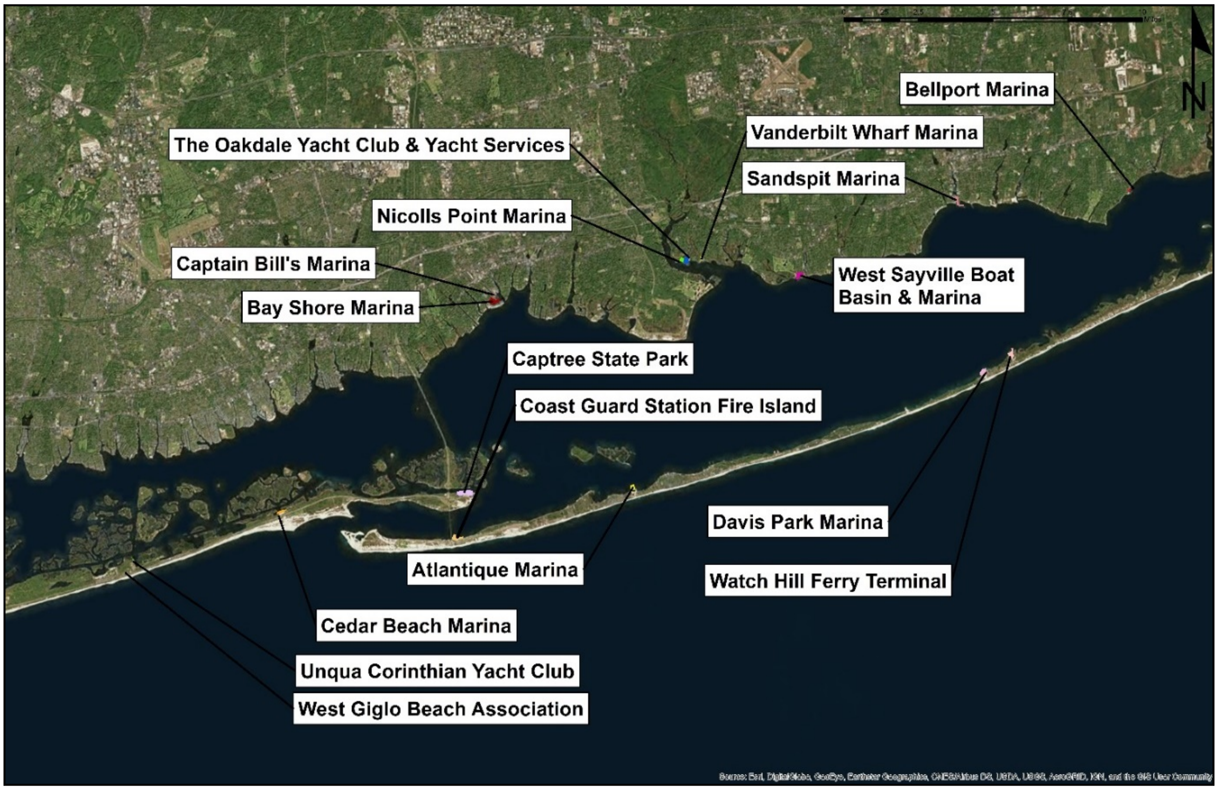
Jones Inlet and East Hempstead Bay	
	
Location	Latitude: 40º35'05" N Longitude: 73º34'25" W
Significant Tenants	Field 10 Fishing Station: (631) 559-5938 http://jonesbeach.com/index.php?option=com_wrapper&view=wrapper&Itemid=100082 Whaleneck Marina Center: (516) 378-8025 Blue Water Yacht Club: (516) 623-5757 http://www.bluewateryachtclub.com/ Open Bay Marina: (516) 771-6736 http://www.openbaymarina.com/ Sunrise Yacht Club: (516) 378-9481 Captain Al's Fishing East Marina (516) 361-9275 Boat Basin West End- Jones Beach State Park (516) 785-1600 https://parks.ny.gov/parks/jonesbeach/ Coast Guard Station Jones Beach http://www.atlanticarea.uscg.mil/Our-Organization/District-1/stajonesbeach/ (516) 785-2995

Table C-2 continued

Jones Inlet and East Hempstead Bay	
Distance to WEAs (From mouth of Harbor)	206.5 km (128.3 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 39.3 km (24.4 miles) to NY WEA
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 ft.)
Navigable Depth	Channel – As per National Oceanic and Atmospheric Administration Chart 12352: "The buoys and soundings in this inlet are not charted because of continual change."
Limiting Air Draft Restriction	None at inlet. Meadowbrook State Parkway Bascule Bridge: Horizontal restriction of 15.2m (50 ft.)
Intermodal Connections	Varies
Surrounding Land Use	Primarily residential
Comments	The National Oceanic and Atmospheric Administration encourages procurement of local knowledge before navigating the area due to frequently changing bottom conditions.

Table C-58. Great South Bay Summary

Great South Bay



Location	Latitude: 40°41'20" N Longitude: 73°07'00" W
Significant Tenants	Atlantique Marina: (631) 583-8610 http://www.theislips.com/atlantique.php#.WbK0kbJ95EZ Davis Park Marina: (631) 597-9090 http://www.davisparkmarina.com/ Watch Hill Ferry Terminal: (631) 475-1665 http://www.davisparkferry.com/watch-hill-ferry-schedule.htm Sandspit Marina: (631) 475-1592 http://www.brookhavenny.gov/Departments/Parks-Recreation/Boating-and-Fishing/Sandspit-Marina West Sayville Boat Basin & Marina: (631) 589-4141 http://www.boatbasin.com/ Vanderbilt Wharf Marina: (631) 567-1231 The Oakdale Yacht Club and Yacht Services: (631) 589-1087 http://www.oakdaleyacht.com/

Table C-3 continued

Great South Bay	
	Nicolls Point Marina: (631) 589-8282 http://www.nicollspointmarina.com/ Captain Bill's Marina: (631) 666-4407 Bay Shore Marina: (631) 224-5404 Unqua Corinthian Yacht Club – Dock Property off of Gilgo Beach Road (631) 691-6570 http://www.unquaclub.com/ West Gilgo Beach Association – beach Property below Unqua Dock Property (631) 785-6191 Captree State Park (631) 669-0449 https://parks.ny.gov/parks/65/details.aspx Bellport Marina https://www.bellport.com/residents/marina.htm Cedar Beach Marina (631) 669-5949 http://secure.townofbabylon.com/parksportal/marinas.html Coast Guard Station Fire Island (631) 661-9100 https://www.uscg.mil/
Distance to WEAs (From mouth of Harbor)	From Fire Island Inlet: 182.8 km (113.6 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 37 km (23 miles) to NY WEA
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 ft.)
Navigable Depth	Channel – Varies: 1.5m (5 ft.) Bellport Bay Reach and Long Island Intracoastal Waterway
Limiting Air Draft Restriction	Robert Moses Causeway Bridge: 19.8m (65 ft.) for the middle 141m (646 ft.) of the center span
Intermodal Connections	Varies
Surrounding Land Use	Residential, light commercial, park, recreational, undeveloped, wildlife refuge
Comments	Severe shoaling is frequently reported in the Great South Bay. Vessel navigation is not recommended through Bellport Inlet.

Table C-59. Moriches Bay Summary

Moriches Bay

Location	Latitude: 40º46'45" N Longitude: 72º46'00" W
Significant Tenants	Remsenburg Marina: (631) 325-1677 http://www.remsenburgmarina.com/ Windswept Marina: (631) 878-2100 http://www.windsweptmarina.net/ Center Yacht Club: (631) 874-2200 http://www.centeryachtclub.com/ Moriches Bay Marina: (631) 281-2017 Silly Lily Fishing Station Marina (631) 878-0247 https://www.sillylily.com/marina
Distance to WEAs (From mouth of Harbor)	Western route (Fire Island Inlet): 182.8 km (113.6 miles) to South Fork Project(BOEM commercial lease OCS-A 0486) 37 km (23 miles) to NY WEA Eastern route (Shinnecock Inlet): 107.8 km (67 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 93.2 km (57.9 miles) to NY WEA

Table C-4 Continued

Moriches Bay	
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 ft.)
Navigable Depth	Channel – 1.5m (5 ft.) from Bellport Bay to the south end of the Shinnecock Canal, 1.8m (6 ft.) Shinnecock Canal
Limiting Air Draft Restriction	From the west: Robert Moses Bridge: 19.8m (65 ft.) for the middle 141m (646 ft.) of the center span Smith Point Bascule Bridge: Vertical clearance: unlimited when open. Horizontal restriction of 16.8m (55 ft.) From the east: Ponquogue Bridge : 16.8m (55 ft.) Quogue (Post Lane) Bascule Bridge and Beach Lane Bascule Bridge: Horizontal restriction of 15.2m (50 ft.)
Intermodal Connections	Varies
Surrounding Land Use	Residential, light commercial, parks
Comments	The Moriches Inlet is not traversable. To access Moriches Bay from the Atlantic Ocean, vessels must pass through either Great South Bay to the west, or Shinnecock Bay to the east.

Table C-60. Shinnecock Bay and Canal Summary

Shinnecock Bay and Canal	

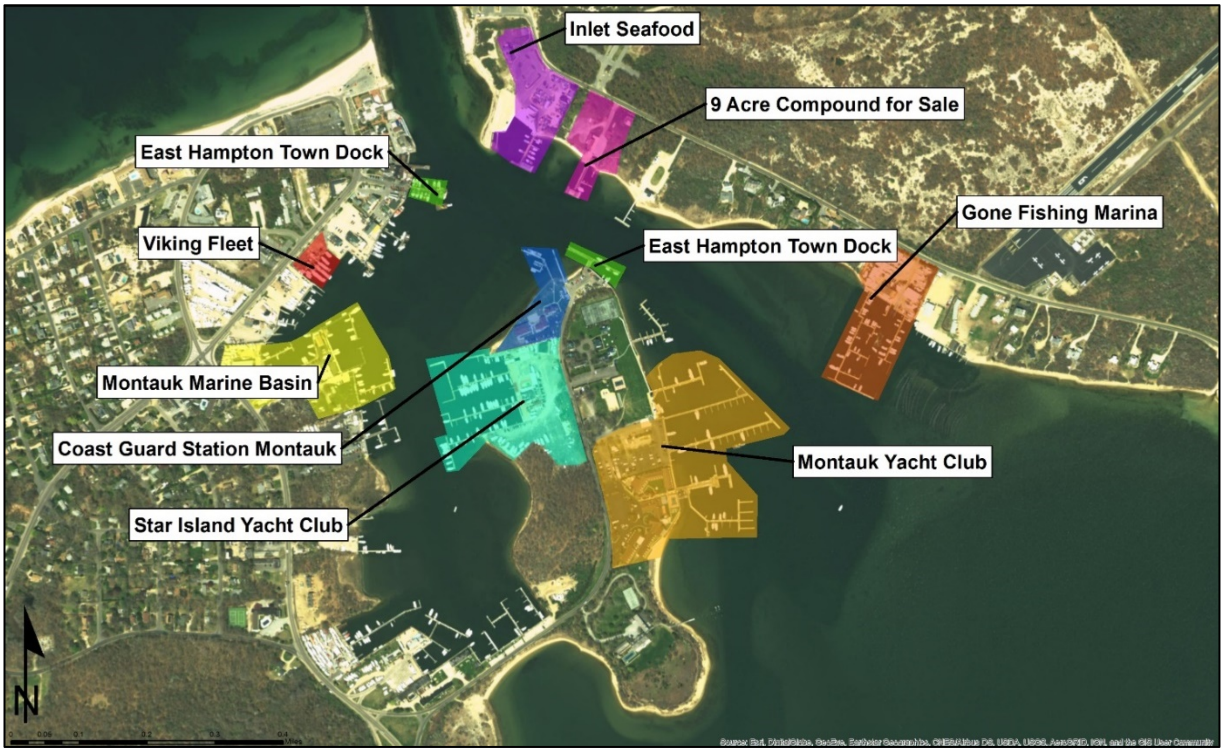
Location	Latitude: 41º53'31" N Longitude: 72º30'06" W
Significant Tenants	Jackson's Marina: (631) 728-4220 http://www.primemarina.com/southampton/ Mariner's Cove Marine: (631) 728-0286 https://marinerscovemarine.com/ Modern Yachts: (631) 728-2266 http://www.modernyachtsny.com/pages/services.aspx Hampton Watercraft & Marine: (631) 728-8200 http://www.hamptonwatercraft.com/ Oaklands Restaurant and Marina (631) 495-7314 http://www.oaklandsmarina.com/home.html Shinnecock Inlet West Side – County Park (631) 852-8899
Distance to WEAs (From mouth of Harbor)	107.8 km (67 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 93.2 km (57.9 miles) to NY WEA
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 ft.)

Table C-5 continued

Shinnecock Bay and Canal	
Navigable Depth	Channel – 1.8m (6 ft.) as of 1978
Limiting Air Draft Restriction	Shinnecock Railway Bridge (located approximately halfway through the canal): 6.7m (22 ft.)
Intermodal Connections	3.3 km (2 miles) to existing railway
Surrounding Land Use	Residential, light commercial, parks
Comments	Due to frequent changes in channel conditions, vessel operators should obtain local knowledge before navigating through the inlet

Table C-61. Montauk Harbor Summary

Montauk Harbor



Location	Latitude: 41º04'20" N Longitude: 73º56'15" W
Significant Tenants	East Hampton Town Dock: (631) 537-7575 http://ehamptonny.gov/191/Marine-Patrol Viking Fleet (Ferry Terminal): (631) 668-6668 https://vikingfleet.com/ Montauk Marine Basin: (516) 835-4910 http://www.marinebasin.com/ Star Island Yacht Club (631) 668-5052 http://www.starislandyc.com/ Coast Guard Station Montauk: (631) 668-2773 http://uscg.mil/ Montauk Yacht Club (631) 668-3100 http://www.montaukyachtclub.com/ Gone Fishing Marina (631) 668-3232 http://www.gonefishingmarina78.com/gonefishingmarina/Welcome.html

Table C-6 continued

Montauk Harbor	
	9 Acre Compound (516) 380-0538 Inlet Seafood (631) 668-4272 http://inletseafood.com/
Distance to WEAs (From mouth of Harbor)	61.1 km (38 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 170.6 km (106 miles) to NY WEA
Maximum Tenable Vessel Length	Approximately 67m (220 ft.)
Navigable Depth	Channel – Reach A (east): 3.7m (12 ft.); Reach B (west, boat basin): 3m (10 ft.)
Limiting Air Draft Restriction	Montauk Airport
Intermodal Connections	3 km (1.9 miles) to existing railway
Surrounding Land Use	Residential, commercial, marinas, government
Comments	Montauk Harbor comprises the area at the northern extent of Lake Montauk including the inlet and Channel Reaches A and B.

Table C-62. Three Mile Harbor Inlet Summary

Three Mile Harbor Inlet

Location	Latitude: 41º01'41" N Longitude: 72º10'54" W
Significant Tenants	Harbor Marina of East Hampton: (631) 324-5666 http://www.harbormarina.com/ East Hampton Harbormaster (631) 329-3078
Distance to WEAs (From mouth of Harbor)	88.7 km (55.1 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 198.6 km (123.4 miles) to NY WEA
Maximum Tenable Vessel Length	Small vessels only, approximately 20m (65 ft.)
Navigable Depth	Channel – 1.8m (6 ft.)
Limiting Air Draft Restriction	None
Intermodal Connections	8.2 km (5.1 miles) to existing railway
Surrounding Land Use	Varies: Residential and undeveloped land
Comments	Shallow navigable draft through the inlet suggest Three Mile Harbor is not well suited to support offshore wind (OSW).

Table C-63. Village of Sag Harbor Summary

Village of Sag Harbor

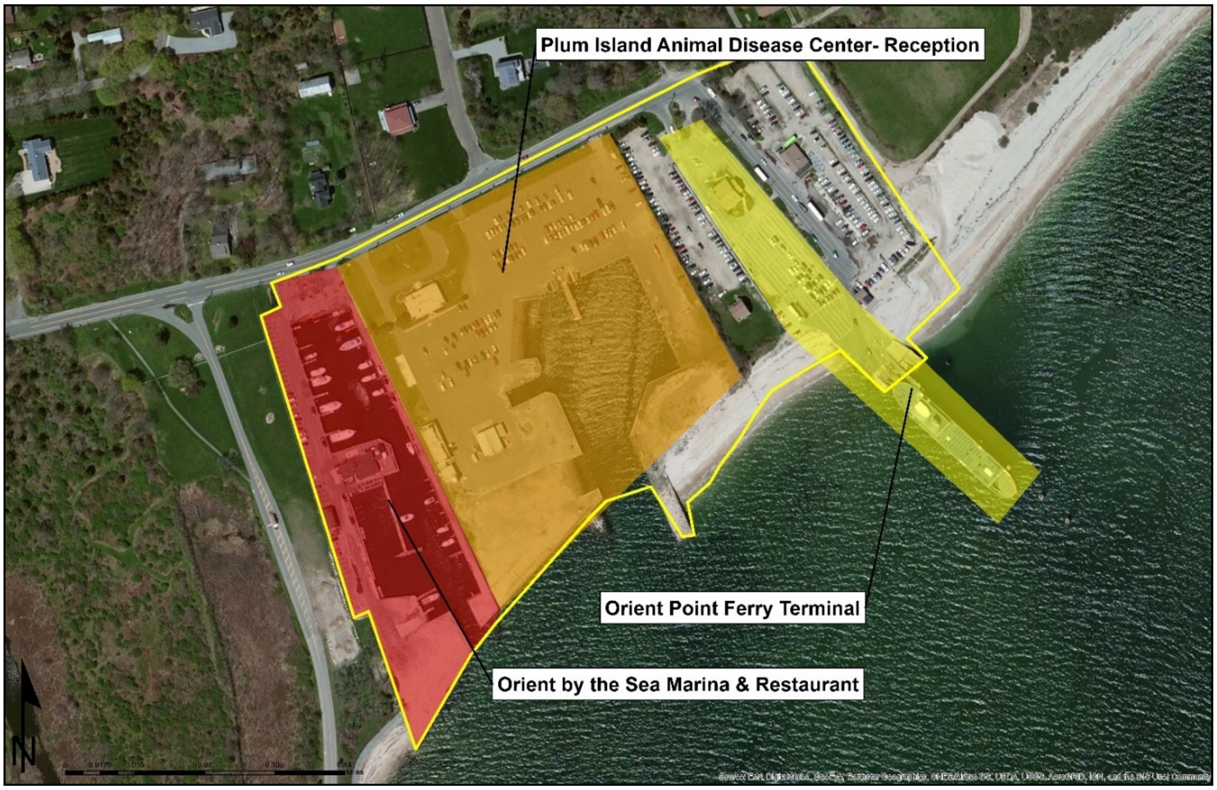
Location	Latitude: 41°00'18" N Longitude: 72°17'41" W
Significant Tenants	Sag Harbor Yacht Club: (631) 725-0567 http://www.sagharboryc.com/ Waterfront Marina: (631) 725-3886 Sag Harbor Yacht Yard & Ship Store (631) 725.3838 http://www.sagharboryachtyard.com/ Breakwater Yacht Club: (631) 725-4604 http://breakwateryc.org/
Distance to WEAs (From mouth of Harbor)	90.8 km (56.4 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 200.7 km (124.7 miles) to NY WEA
Maximum Tenable Vessel Length	21m (70 ft.)
Navigable Depth	Channel – 2.4m (8 ft.) as of 1974
Limiting Air Draft Restriction	None
Intermodal Connections	8.7 km (5.4 miles) to existing railway

Table C-8 continued

Village of Sag Harbor	
Surrounding Land Use	Undeveloped, park, residential, government.
Comments	During the summer, the marinas and yacht clubs of Sag Harbor host multiple recreational vessels exceeding 21.3m (70 ft.) in length.

Table C-64. Orient Point Summary

Orient Point



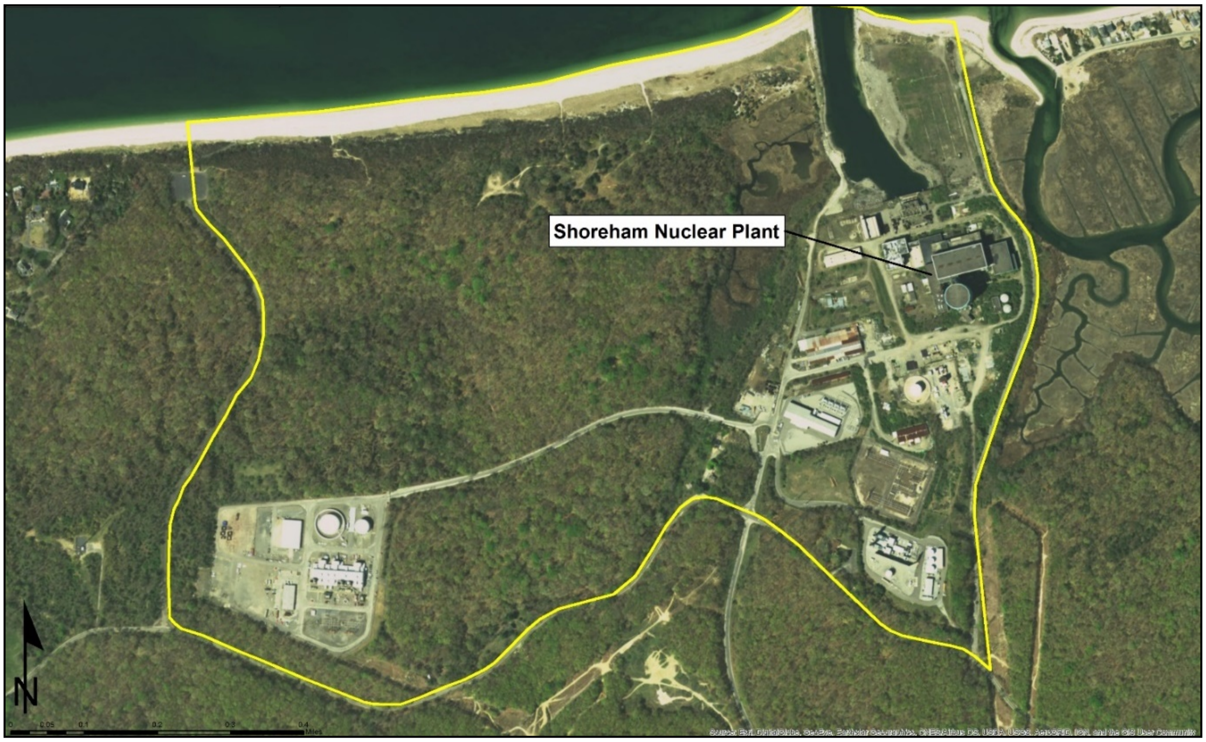
Location	Latitude: 41o09'11" N Longitude: 72o14'30" W
Significant Tenants	Orient Point Ferry Terminal: (631) 323-2525 https://www.longislandferry.com/ Plumb Island Animal Disease Center – Reception: (631) 323-3200 https://www.ars.usda.gov/northeast-area/orient-point-ny/plum-island-animal-disease-center/ Orient by the Sea Marina & Restaurant: (631) 323-2424 http://www.orientbythesea.com/
Distance to WEAs (From mouth of Harbor)	83.2 km (51.7 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 193.8 km (120.4 miles) to NY WEA
Maximum Tenable Vessel Length	At marina facilities: small vessels only, approximately 20m (65 ft.) Bridgeport-Orient Point ferry is approximately 73m (240 ft.)
Navigable Depth	Channel – 2.1m (7 ft.) Berth – N/A
Limiting Air Draft Restriction	None
Intermodal Connections	15.2 km (9.4 miles) to existing railway

Table C-9 continued

Orient Point	
Surrounding Land Use	Residential, park
Comments	The entrance to the Orient by the Sea Marina is approximately 12m (40 ft.) wide. Outside the marina and ferry terminal, the surrounding land is occupied by residential properties and Orient Point County Park.

Table C-65. Shoreham Inlet Summary

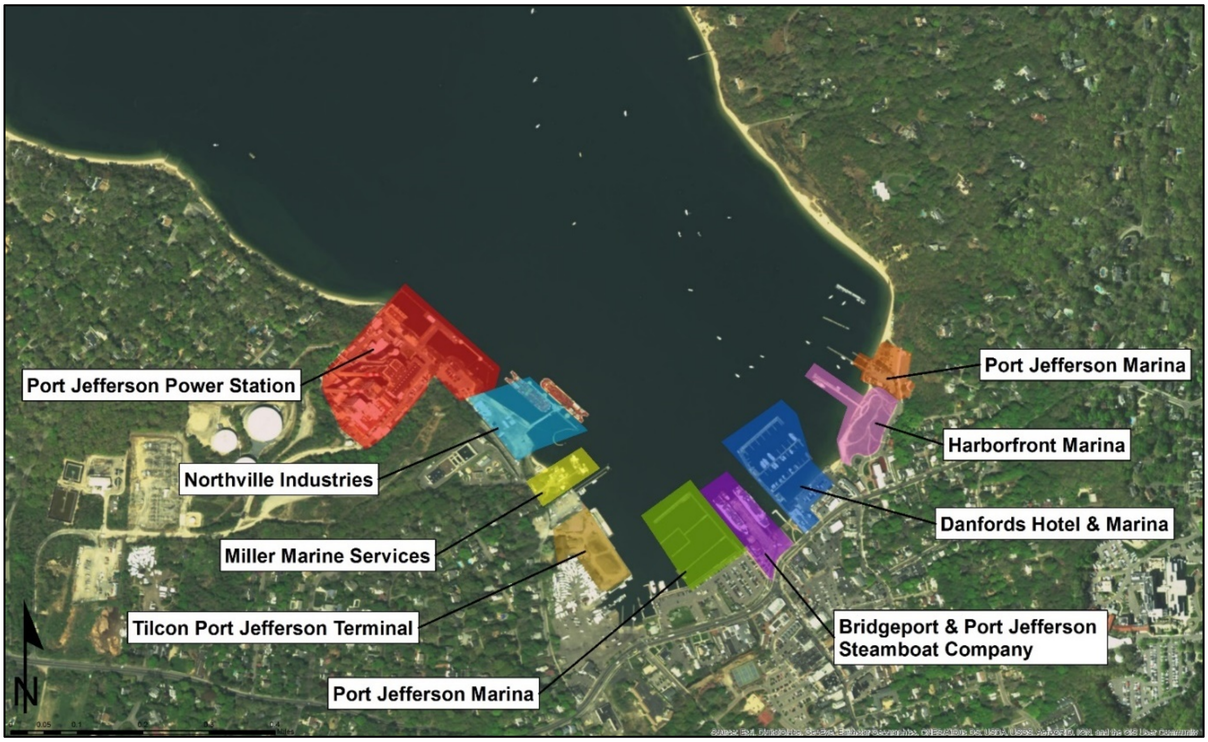
Shoreham Inlet



Location	Latitude: 40o57'50" N Longitude: 72o52'00" W
Significant Tenants	Shoreham Nuclear Plant (Owned by LIPA) (516) 222-7700 http://www.lipower.org/
Distance to WEAs (From mouth of Harbor)	142.4 km (88.5 miles) km to South Fork Project (BOEM commercial lease OCS-A 0486) 252 km (156.6 miles) to NY WEA
Maximum Tenable Vessel Length	30m (100 ft.) (existing condition) Improvements to the existing channel could allow larger vessels.
Navigable Depth	Channel – Not Determined
Limiting Air Draft Restriction	None
Intermodal Connections	18.6 km (11.5 miles) to existing railway
Surrounding Land Use	Residential, undeveloped
Comments	The Long Island Lighting Company (LILCO) built the Shoreham Nuclear Plant between 1973 and 1984. In 1989, due to safety concerns associated with emergency evacuation procedures, LILCO reached a settlement with the State of New York that the plant would not be put into operation. The facility was sold to the Long Island Power Authority in 1992. The plant was fully decommissioned in 1994. Since it has been decommissioned, it has served as a small peak power station, used sparingly during high-energy times of the year. In 2002, a 100 megawatts (MW) Gas Turbine Power Plant was commissioned on the site. In 2004, LIPA installed 2 50kW wind turbines.

Table C-66. Port Jefferson Inner Harbor Summary

Port Jefferson Inner Harbor



Location	Latitude: 40º57'00" N Longitude: 73º04'20" W
Significant Tenants	Port Jefferson Power Station: (516) 222-7700 http://www.lipower.org/ Northville Industries: (631) 928-1584 Miller Marine Services: (631) 331-5336 http://www.millermarineservices.com/ Tilcon Port Jefferson Terminal: 800-872-7762 http://www.tilconny.com/location.htm?Stone-Quarry-Port-Jefferson-New-York-Suffolk-County-NY-9 Port Jefferson Yacht Club: (631) 473-9650 http://portjeffersonyachtclub.com/ The Bridgeport & Port Jefferson Steamboat Company: (888) 443-3779 https://www.88844ferry.com/Default.aspx Danfords Hotel & Marina: (631) 928-5200 http://www.danfords.com/ Harborfront Park: http://portjeff.com/harborfront-park/

Table C-11 continued

Port Jefferson Inner Harbor	
	Port Jefferson Marina: (631) 331-3567 http://www.brookhavenny.gov/Departments/Parks-Recreation/ThingsToDoInYourTown/MarinasDocks
Distance to WEAs (From mouth of Harbor)	162.1 km (100.7 miles) to South Fork Project (BOEM commercial lease OCS-A 0486) 271.2 km (168.5 miles) to NY WEA
Maximum Tenable Vessel Length	Approximately 88m (289 ft.)
Navigable Depth	Channel – 8m (26 ft.)
Limiting Air Draft Restriction	None
Intermodal Connections	2 km (1.3 miles) to existing railway
Surrounding Land Use	Industrial, commercial, residential, park
Comments	Port Jefferson Inner Harbor is located at the southern extent of Port Jefferson Harbor.

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