Application to MARAD's Port Infrastructure Development Program

Salem Wind Port

Submitted by: City of Salem

May 16, 2022

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INFORMATION PAGE

Field Name	Guidance
Name of Applicant	City of Salem, Massachusetts
Is the applicant applying as the lead applicant with any private entity partners or joint applicants?	Yes. The City has partnered with Crowley Wind Services (CWS) to construct the Project. CWS has a committed tenant: Avangrid Renewables and Copenhagen Infrastructure Partners (CIP)
What is the project name?	Salem Wind Port Project
Project description	The Project will create a new wind services port on the U.S. Atlantic coast by redeveloping a vacant industrial port into a purpose-built offshore wind marshalling port in Salem, Massachusetts. The Project will build a new wharf and deck to load/unload vessels. It will be built to support 6,000 psf loads. Also, 12-inches of dense graded aggregate will be installed in the upland area.
Is this a planning project?	No
Is this a project at a coastal, Great Lakes, or inland river port?	Coastal
Is this application for a small project at a small port?	No
Is this project located in a noncontiguous State or U.S. territory?	No
GIS Coordinates	Interpolated Longitude (X): -70.88256 Interpolated Latitude (Y): 42.525745
Is this project in an urban or rural area?	Urban
Project Zip Code	01970
Is the project located in a Historically Disadvantaged Community or a Community Development Zone?	No
Has the same project been previously submitted for PIDP funding?	No
Is the applicant applying for other discretionary grant programs in 2022 for the same work or related scopes of work?	Yes, CWS will be applying for other federal and state funding as opportunities arise.
Has the applicant previously received TIGER, BUILD, RAISE, FASTLANE, INFRA or PIDP funding?	Yes. $2.4M PIDP funding in 2021. The City of Salem received grant funding for a separate adjacent project.
PIDP Grant Amount Requested	$33,835,953
Total Future Eligible Project costs	$58,944,029
Total Project Cost	$58,944,029
Total Federal Funding	$33,835,953
Total Non-Federal Funding	$25,108,076
Will RRIF or TIFIA funds be used as part of the project financing?	No

1. PROJECT DESCRIPTION

1.1 Overview

The Salem Wind Port Project (the "Project") will meet an immediate critical national need for more U.S. port locations capable of serving the growing offshore wind (OSW) industry on the U.S. Atlantic coast. The nation's existing port capacity is not sufficient to accommodate the pipeline of new OSW power production areas coming into use through 2030 (and beyond) as lease areas are permitted and move into construction.

The Project will construct a new wharf and deck with sufficient space and weight capacity to load and unload vessels, as well as prepare a laydown area to receive and store components. As the Project will serve the OSW industry, both the wharf and deck will be built to handle associated oversized and overweight cargoes. Both the wharf and the deck will be capable of supporting 6,000 pounds per square foot (psf) uniform loads. The upland laydown area will receive 12-inches of dense graded aggregate (dga) to support the materials being offloaded.

When completed, the Project will serve initially as the construction and operations base for both phases of "New England Wind". Phase 1 of New England Wind is "Park City Wind," an OSW farm that will provide 804 megawatts (MW) of green energy to Connecticut.[1] Phase 2 is "Commonwealth Wind," which will provide 1,232 MW of energy to Massachusetts. (See Figure 1.) The Project is an essential link in the developing supply chain for the Northeast OSW industry. The Project directly advances the Biden-Harris Administration's aggressive goals of rapid OSW deployment and union job creation. It invests in U.S. infrastructure and strengthens the maritime supply chain via the use of Marine Highway M-95.

Figure 1: Offshore Wind Is Growing Rapidly Off the U.S. Atlantic Coast

The Project is being developed through a public-private partnership between the City of Salem Massachusetts (the "City") and Crowley Wind Services ("CWS" or "Crowley"). The project partners have created a plan to repurpose a remediated brownfield site that once held a coal-fired power plant, into a modern, purpose-built wind services port. Because coal for that plant had to be delivered by barge, the site has a small industrial port. The limited wharf facilities are

[1] The New England Wind project consists of two phases. Phase 1, also known as the 804-megawatt (MW) Park City Wind project, will be developed immediately southwest of the Vineyard Wind 1 project. Phase 2, called Commonwealth Wind, will deliver 1,232 MWs of power. When constructed, Phase 2 will be southwest of Phase 1 within the OCS 534 Lease Area. For more information about Park City Wind please visit: https://www.parkcitywind.com/ ; for more information about Commonwealth Wind: https, please visit www.commonwealthwind.com/

currently operated by the Salem Harbor Port Authority (the "Port Authority") through a Wharfing Agreement with the power generation facility. The City will also be able to continue their site use for seasonal cruises.

The landside marine infrastructure at the brownfield site is in disrepair and in danger of becoming obsolete. The site's ocean access, by contrast, is among the best in New England. The Salem site offers unimpeded access to the Atlantic Ocean with no vessel size or height restrictions, making it an attractive service hub for many lease areas off the North Atlantic coast. The Project will make focused investments in adapting the existing port facility to the needs of the OSW industry and leverage the port's geographic and physical advantages.

Crowley has negotiated the purchase of 42 acres of the 65-acre site and will develop the wind services port. As successor to an existing Community Benefits Agreement made during the construction of the new power generation facility that replaced the decommissioned coal-fired plant at the site, Crowley will be required to convey title to the wharf and at least 3 acres of upland to the City under a joint management structure. That transfer is anticipated to occur after the redevelopment of the Project site. The existing liquified natural gas (LNG)-fired generation facility will remain operational on the remaining 23 acres of the site within the "donut hole" shown in Figure 3.

This **is not** a "build it and they will come" project. The future wind services port already has committed tenants: Avangrid Renewables and Copenhagen Infrastructure Partners. These firms have signed and executed Power Purchase Agreements (PPAs) for the wind farms they are building on leased ocean parcels from the Bureau of Ocean Energy Management (BOEM). Avangrid Renewables has contracted with Crowley to use the Project for construction and operations of Avangrid's two OSW farms, "Park City Wind" and "Commonwealth Wind," both off the coast of Massachusetts.[2] At the completion of these projects, Copenhagen Infrastructure Partners will use the Project to build out its lease area OCS A-0522. Collectively known as "New England Wind," the Park City and Commonwealth Wind projects will be marshalled from the Project site and deliver more than 2,000 MW of clean, renewable power to the New England Grid. The Project site is well positioned to capture the marshalling scope for Copenhagen Infrastructure Partners' planned projects, which will follow Avangrid's developments and could produce an additional 2,500 MW or more.

The development and operation of the Project will support union job growth in Salem and increase the competitiveness of the U.S. OSW power industry. Simply stated, the nation needs this port to continue progress towards its goal of providing 30 MW of clean OSW power by 2030 as set forth by the current administration and for the future protection of the environment. The nation's existing port capacity is not sufficient to accommodate the pipeline of new wind power projects in development through 2030 (and beyond) as permitted lease areas begin construction.

[2] Collectively known as New England Wind.

1.2 Detailed Project Scope

The Project is the initial operating hub of a larger, phased program of investment. Each phase has independent utility. When completed and in operation, the Project (Phase 1), will allow the construction of the Park City Wind farm to move forward. Subsequent phases will expand the marshalling area's physical footprint to offer greater operational flexibility. This will be needed once Park City Wind is operational and requiring regular operations and maintenance (O&M) support, while the Commonwealth Wind facility is under construction. The coordination of O&M and construction activities requires additional space. Additional berthing area will be created along with additional wharf deck (4,000 psf) to facilitate simultaneous inbound and outbound movement of components. Park City Wind and Commonwealth Wind will use the site for wind turbine generation assembly and staging activities, including the storage and assembly of components (such as blades, nacelles, and tower sections) as they are prepared for offshore installation during construction. In addition, the subsequent phases will provide the City with an improved cruise berth to support its tourism industry.

The Project is shown in Figure 2 as the yellow and grey shaded areas. It comprises approximately 700 linear feet of wharf and bulkhead, constructed to an equivalent 6,000 psf load strength over 52,500 sq ft (700 ft X 75 ft) as the loadout and assembly space (yellow area). Upland improvements to approximately 23 acres, including compaction, grading and dense graded aggregate (DGA) surfacing (grey area) create a laydown area adjacent to the loadout and assembly space. The wharf will support components being staged for loading to feeder barges, heavy transport vessels or wind turbine installation vessels (WTIVs) to lift and place the components onto those vessels. This area can be extended to the south in a later phase to further enhance the loadout and component capabilities of the site and allow for larger vessels to call. The structure will comprise a combi-wall bulkhead with sufficient capacity for future dredging and seabed preparations, with a combination of pipe and H-piles to support a landward reinforced concrete deck topped with dense grade aggregate. The upland yard can also be further improved in subsequent phases to increase its bearing capacity and further improve its utility.

Figure 3 shows the Project in the context of the full buildout of the Salem OSW port program. The Project is shown as Areas 5 (wharf and assembly space) and Area 1 (upland area).

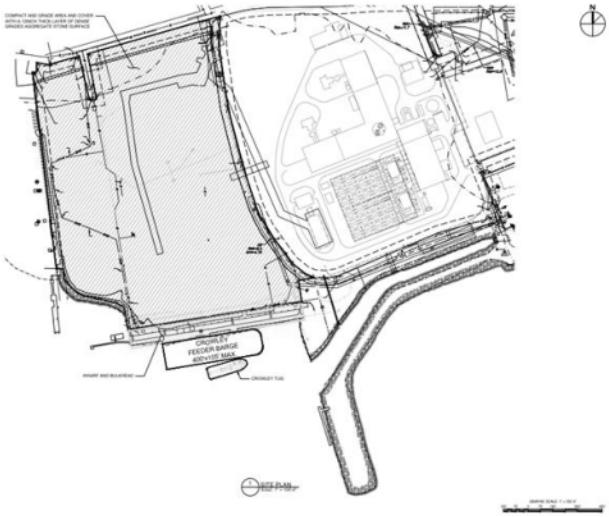
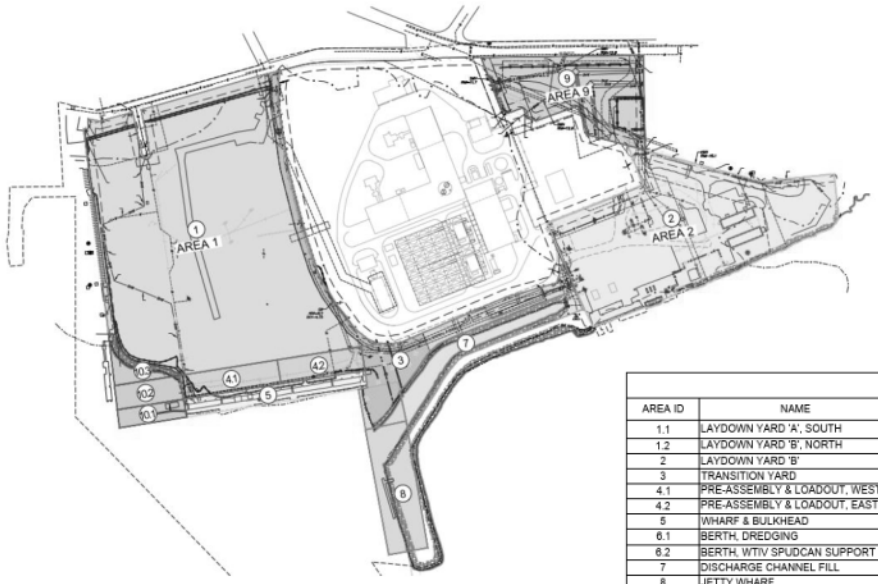


Figure 2 The Project Creates an Initial Operating Hub

Figure 3 Major Components of the Salem Wind Port's Program at Full Buildout



AREA ID	NAME	FUNCTION (PER RFP)
1.1	LAYDOWN YARD 'A', SOUTH	TOWER & NACELLE STORAGE
1.2	LAYDOWN YARD 'B', NORTH	TOWER & NACELLE STORAGE
2	LAYDOWN YARD 'B'	BLADE STORAGE
3	TRANSITION YARD	TRANSIT TO LAYDOWN YARD 'B'
4.1	PRE-ASSEMBLY & LOADOUT, WEST	PRE-ASSEMBLY & LOADOUT
4.2	PRE-ASSEMBLY & LOADOUT, EAST	PRE-ASSEMBLY & LOADOUT
5	WHARF & BULKHEAD	MOORING & LOADOUT
6.1	BERTH, DREDGING	DREDGE DEPTH-32' MLLW + 2' OVERDREDGE
6.2	BERTH, WTIV SPUDCAN SUPPORT	WTIV SUPPORT
7	DISCHARGE CHANNEL FILL	SUPPLEMENT TO AREA 3
8	JETTY WHARF	INBOUND COMPONENT DELIVERY
9	PARKING	PARKING
10.1	ALCOVE FILL, WHARF	SOUTH EXTENSION OF AREA 5
10.2	ALCOVE FILL, PRE-ASSEMBLY	SOUTH EXTENSION OF AREA 4
10.3	ALCOVE FILL, LAYDOWN	SOUTH EXTENSION OF AREA 1

Legend for Figure 3

ID	Name	Quantity	Units	Description
1	Laydown Yard 'A'	23	Acres	Dense graded aggregate; 4,000 pounds per square foot (psf); storage for components, 60-ton axle loading for a self propelled modular transporter (SPMT) used to transport the nacelles
2	Laydown Yard 'B'	9.5	Acres	DGS; 4,000 psf; storage for components, 60-ton axle loading for SPMT
3	Transition Yard	3	Acres	60-ton axle loading for SPMT
4	Pre-Assembly and Loadout	7000	SF	6,000 psf uniform load
5	Wharf and Bulkhead	900	LF	6,000 psf uniform load
6	Berth	900	LF	Depth -32 Mean Lower Low Water (MLLW) with 2' over-dredge allowance
7	Discharge Channel	4	Acres	To be filled, 4,000 psf
8	Jetty Wharf	500	LF	Support of cargo import, 4,000 psf
9	Parking	2.5	Acres	Parking for road vehicles
10	Alcove Fill (Southern Notch)	Overlaps with area 4 and 5.	Acres	To be filled and suitable 6,000 psf uniform loading

Site utilities will include: Stormwater control, high mast lighting, electrical distribution, including site convenience power, shore power, nacelle plug points, water reticulation including fire hydrants.

1.3 Project Partners and Stakeholder Roles

The public-private partnership leading this Project is an experienced team. The City of Salem operates the port currently through its department known as the Salem Harbor Port Authority (the "Port Authority") via a Wharfing Agreement. For more information about the City and its development plans, please visit: https://www.salemma.gov/planning-and-community-development. The City's roles in the Project include:

- Lead applicant for the Project
- Current operator of the site
- Shared owner for the new OSW port facility
- Entity responsible for grant administration and ensuring that the reporting requirements of the grant are met
- Partner with Crowley and the state in marketing and training and apprenticeship program delivery in support of community benefit agreements
- Participant in Avangrid's benefit agreement

Crowley is the City's private partner in delivering this Project. Crowley will develop the OSW port facility. Crowley is the largest U.S. Flag vessel operator and leading employer of U.S. merchant mariners. The company operates marine terminals on the East and West coasts of the U.S. from the Caribbean to Alaska, with the goal of becoming one of the most sustainable maritime and logistics solutions companies in the Americas. For more information about Crowley's OSW activities, please visit: https://www.crowley.com/shipping/offshore/wind/. Crowley's roles in the Project include:

- Private funding partner
- Development project core participant
- Shared owner of the port facility
- Entity responsible for design and construction management of the port
- Entity responsible for maintaining the port in a state of good repair
- Entity responsible for day-to-day operations of the facility

Key stakeholders for the Project include Avangrid Renewables and the Commonwealth of Massachusetts.

Avangrid has partnered with Crowley to support the Project's implementation. Avangrid Renewables (Avangrid), a part of the Iberdola Group, has more than 7,300 MW of owned and controlled wind and solar generation operations in more than 20 states. Avangrid will manage the construction of New England Wind's approximately 2,000 MW of OSW turbines and the

assembly of the major components within the OSW port[3]. Avangrid's roles in the Project include:

- Committed anchor tenant with a 10-year lease of the facility
- Entity whose operational requirements for its lease areas will inform the Project's design specifications

As a stakeholder, the Commonwealth of Massachusetts also plays a role in the Project. It will:

- Set legislative mandates for the amount of OSW purchased by the electric distribution companies (EDCs)
- Continue established programs and support the innovative new programs to foster equitable participation in the construction and operation of this new industry
- Ensure that commitments made in the proposals submitted for negotiation of Power Purchase Agreements with the EDCs are substantively met

A draft Memorandum of Understanding (MOU) signed by the direct project sponsors (the City and Crowley) is provided with this application.

1.4 Transportation Challenges Addressed and Broader Context

There are both local and national aspects to the transportation challenges addressed by this Project.

At the local level, the Project will return the Port of Salem to an active, working waterfront and bring obsolete wharf facilities into a state of good repair. This will result in the development of a modern port designed to serve an emerging 21st century maritime-focused industry.

Since the closure of the site's coal-fired generation plant, Salem's maritime transportation assets have largely languished. The port's main cargoes had traditionally been coal and lignite for the power plant. As those shipments have ended with the power plant's reconstruction and transition to LNG delivered by pipeline, maritime activity in Salem has been reduced to infrequent small coastal cruise calls, six active permitted commercial fishing vessels landing in Salem,[4] the Fast Ferry that provides service to Boston's Long Wharf, and the hosting of approximately 1,600 recreational vessels annually.[5]

The site has degraded landside marine infrastructure that is in disrepair and becoming obsolete. Between 1951 and 2014, a coal and oil-fired power generation facility operated on this 65-acre site, served by a marginal wharf that allowed for coal to be delivered by self-unloading vessels.

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[3] For more information about Avangrid, please visit: https://www.avangridrenewables.com/wps/portal/aren/ourbusiness/offshorewind/

[4] 2018 DMF Permitting and Statistics Data; ACCSP Data Warehouse, as reported in 2021 Massachusetts Commercial Fishing Port Profiles. Accessed: https://www.mass.gov/doc/salem-port-profile-2021/download.

[5] Salem Harbormaster.

Cost pressures led to the plant's decommission in 2014, when it was replaced by a new natural-gas-fed, combined-cycle power generation facility.

Salem's port facilities are underutilized assets that are critical pieces of infrastructure for ocean-based businesses. This new power plant occupies only 23 acres of the original plant's 65-acre footprint, opening up the additional area for modern reuse options. Natural gas is delivered to the new plant via pipeline, eliminating the power plant's need for the wharf and cargo-handling facilities. The modernization of the power plant has freed up 42 acres for new industrial uses. Crowley holds a purchase and sale agreement on the 42 acres and will repurpose the land for a modern OSW marshalling facility. The power generation facility remains operational on 23-acre parcel which has been subdivided from the original 65-acre parcel as shown in Figure 3. The City of Salem and Crowley are completing a Memorandum of Understanding (MOU) that preserves the City's rights and interests created by a wharfing agreement between the City and the owner of the power generation facility.

The 42-acre Project site is the largest parcel in Salem's Designated Port Area (DPA) and was designated for DPA land use and policy by the Massachusetts Office of Coastal Zone Management (CZM). DPAs have the necessary physical and operational features needed to support businesses that require close proximity to the ocean, such as commercial fishing, shipping, and other vessel-related activities associated with water-borne commerce; as well as to support manufacturing, processing, and production activities that require marine transportation or the withdrawal or discharge of large volumes of water. There are only 11 areas with these particular, essential developed infrastructure attributes in Massachusetts, and once converted to a non-industrial character, such areas are unlikely to be reclaimed by water-dependent industries. The state's DPA policy, therefore, seeks to protect these resources from significant conversion to non-industrial or non-water dependent types of development that could be sited on other areas of the coast. The Project is consistent with the region's DPA designation.

Moreover, Salem is one of five Compact Ports in Massachusetts. The goals of Compact Ports are to: 1) increase mobility for people and goods within and through the Commonwealth in a safe, secure, environmentally sustainable, and efficient manner; 2) promote and adopt administrative efficiency and program improvement initiatives between and among transportation agencies, authorities, and municipalities; 3) share best practice techniques for project implementation across the Commonwealth, and 4) better integrate delivery of transportation services and goods across the Commonwealth. All in all, therefore, the Project will help the Port of Salem meet its goals as a Compact Port, is consistent with the state's DPA designation, and repurposes obsolete 20th century legacy maritime assets into the infrastructure foundation for an emerging 21st century industry.

At the national level, the Project represents an incremental gain in closing the gap between the demand for port services created by the growing pipeline of OSW developments, and the supply of available berth facilities. As OSW developments move forward and continue to expand to meet U.S. OSW goals, new purpose-built ports such as this Project will support the success of this industry in the U.S. and its ability to capture the maximum share of the associated supply chain. The Project is ideally located to leapfrog the U.S. into a leadership role in the global OSW industry. Besides playing a crucial role in the development of the first U.S. OSW farms, the facility is ideally positioned to take advantage of the developing floating OSW industry that is

set to dominate in the Gulf of Maine Wind Energy Areas proposed by the Bureau of Ocean and Energy Management (BOEM) and expected to be in development within the next 10 years. If the Project does not come online in time to support the OSW projects noted above, then it is likely that the components used to build those wind farms will be shipped directly to the installation locations from foreign manufacturing locations, and the opportunity to develop the American jobs associated with the marshalling of those wind farms will be missed. The investment in the Project will yield positive developments throughout the port industry and for the effort to create a just and equitable transition to a renewable energy future.

Comparing the projected pipeline of developments with the nation's existing port capacity demonstrates that insufficient port capacity will limit the pace of this industry's expansion in the U.S. according to data from the National Renewable Energy Laboratory (NREL). Figure 4 illustrates the large pipeline of OSW generation capacity under development,.[6] Analysis of the pipeline and its recent growth pattern suggests that it is possible to have 30 GW of OSW energy generation capacity installed by 2030, which would successfully fulfill the national OSW energy target.[7] However, this national goal will not be achievable without port infrastructure investments such as the Project.

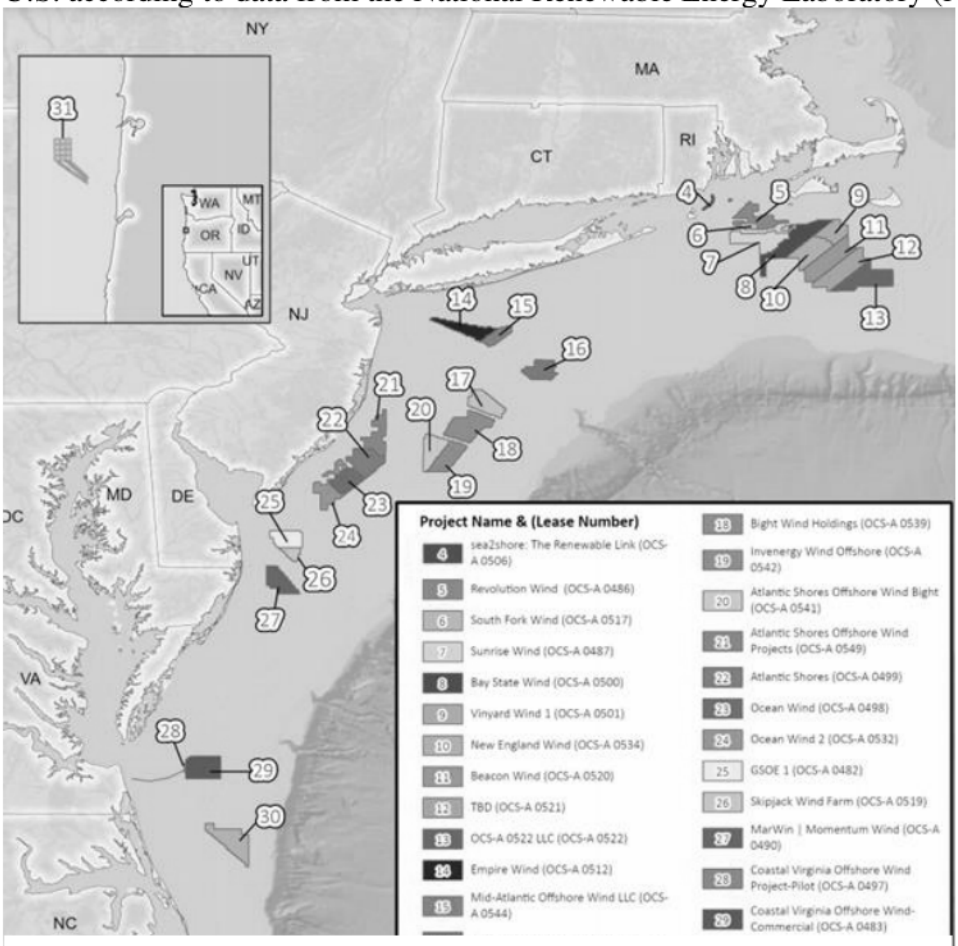

Figure 4: Pipeline of Offshore Wind Developments in the Eastern U.S. as of May 2021

Source: BOEM Outer Continental Shelf Renewable Energy Leases Map Book April 2022

NREL's analysis mentioned above has projected the number of berths it would take to construct the

[6] "Offshore Wind Market Report: 2021 Edition," page 13, Figure 4. Accessed Offshore Wind Market Report: 2021 Edition (energy.gov).
[7] Shields, Matt, Ruth Marsh, Jeremy Stefek, Frank Oteri, Ross Gould, Noé Rouxel, Katherine Diaz, Javier Molinero, Abigayle Moser, Courtney Malvik, and Sam Tirone. "The Demand for a Domestic Offshore Wind Energy Supply Chain." Golden, CO: National Renewable Energy Laboratory. 2022. P. 14. NREL/TP-5000-81602. https://www.nrel.gov/docs/fy22osti/81602.pdf.

wind power pipeline and has concluded that the existing base of ports in the U.S. is not sufficient to deliver the volume of maritime services required to construct enough turbines to realize the industry's pipeline. The berths required to support the import and partial assembly of OSW components need to have extremely high bearing capacities in comparison to the bearing capacities that are needed for onshore wind or other common cargoes. As of today, based on NREL's assessment there are only 4 commercially-available berths existing in the U.S., whether in construction or in advanced permitting, with the bearing capacity to support the deployment of OSW components. In short, port capacity will be a bottleneck for this industry's pace of expansion. The report finds that, "[f]ixed-bottom offshore wind energy activities will require up to 8 dedicated [vessel] berths for several years leading up to 2030, although the demand will fluctuate along with the deployment pipeline. The expansion of floating wind deployment (as opposed to the current practice of fixed bottom assemblies) in the 2030s will lead to a significant growth in demand for appropriate berths because each project effectively requires 3 berths for foundation assembly, wind turbine installation, and anchor/mooring marshalling" (p. 25). Figure 5 illustrates this projected growth.[8] Moreover, this estimate is conservative, as it does not make adjustment for the port capacity needed to simultaneously meet operations and maintenance needs while other offshore facilities are under construction.

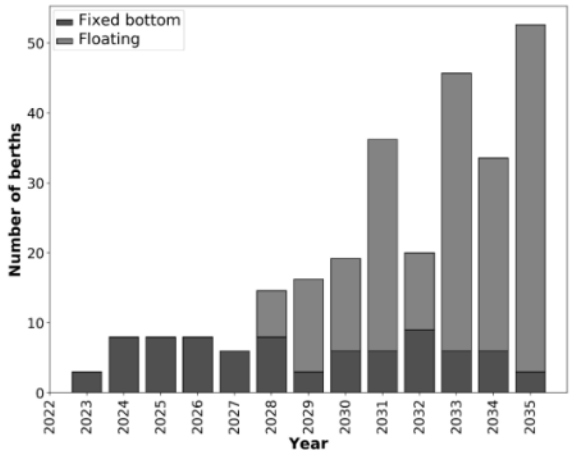

Figure 5 NREL Projections of Annual Demand for Berth Capacity to Constructed Projected Offshore Wind Pipeline

[8] Shields, Matt, Ruth Marsh, Jeremy Stefek, Frank Oteri, Ross Gould, Noé Rouxel, Katherine Diaz, Javier Molinero, Abigayle Moser, Courtney Malvik, and Sam Tirone. 2022. The Demand for a Domestic Offshore Wind Energy Supply Chain. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-81602. https://www.nrel.gov/docs/fy22osti/81602.pdf. See page 25.

2. PROJECT LOCATION

Salem Harbor, located in Salem Massachusetts (MA), offers a protected harbor with unimpeded vessel access to the Atlantic Ocean that is well positioned to support planned and developing clusters of OSW farms along the coast of MA in the nearer term and the Gulf of Maine in the longer term. See Figure 6. Salem Harbor is also located along MARAD-designated Marine Highway M-95.

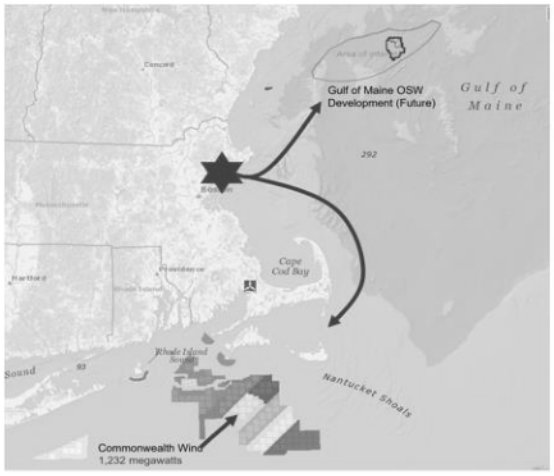

Figure 6 Salem Location Provides Good Access to Massachusetts Cluster of Wind Farms

The Project is located on the site of the Salem Harbor Power Station, situated between Derby Street and Salem Harbor. The site is bounded to the west by residential properties, to the north by the South Essex Sewage District, to the east/southeast by Salem Harbor, and to the southwest by commercial properties including the Salem Ferry port and parking lot.

The Project site is located in Tract 2044, along the same harbor coast as one of Salem's Opportunity Zones: Number: 25009204200 in Census Tract 2042. See Figure 7; the blue area shows Salem's opportunity zones. Tract 2042 is an Area of Persistent Poverty The site is physically adjacent to Tract 2043, also an Area of Persistent Poverty.

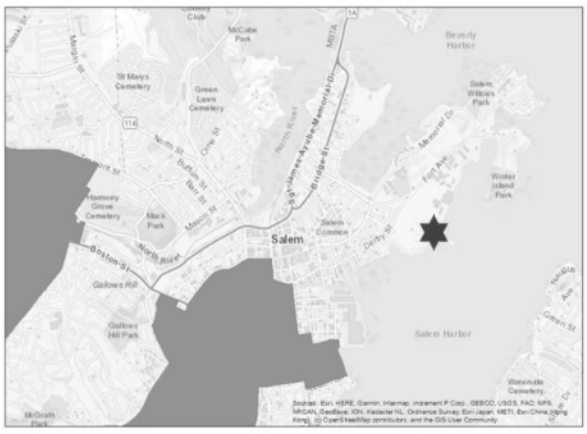

Figure 7 Opportunity Zones in Salem

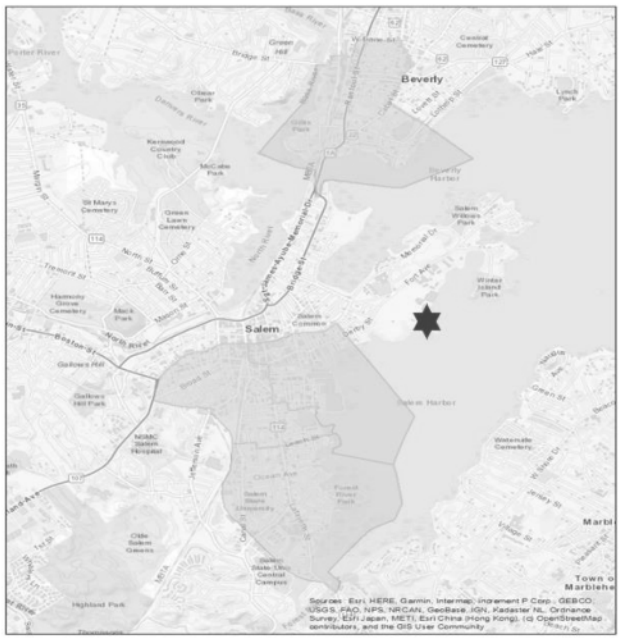

Figure 8 Areas of Persistent Poverty Near the Project

3. GRANT FUNDS, SOURCES AND USES OF PROJECT FUNDS

The estimated cost of the overall Project is $58.9 million (year of expenditure, YOE$). These values will not match the cost estimate used in the benefit-cost analysis, as the cost estimate is discounted to 2020 dollars for the purposes of that assessment. The City is requesting PIDP grant funding of $33.8 million.

This cost estimate is based on structural drawings that are at 30 percent design and associated site plans. The team anticipates being at 60 percent design by October 1, 2022. The design team used cost data from their historical library which was updated during April 2022. The cost estimate considered the following:

1. local craft union wages, fringe benefits and work rules for Essex County, MA including statutory taxes and insurances,

2. current steel prices and other local materials with due conservatism to account for the volatility evident in the current market

3. heavy construction equipment costs based on *Equipment Watch* monthly ownership divided by 176 hours/month PLUS hourly fuel, oil, grease and maintenance, and

4. historical costs for material delivery to the site during the Footprint Power construction and site remediation.

In addition, site specific unit rates were built up based on the engineering designs, material costs and assumed construction methodology for the marine structures to account for geotechnical and other existing conditions. Generic square foot rates were used for common upland infrastructure which were based on a similar recent project outside of MA and adjusted/factored for Essex County, MA plus some escalation of the material components. The overall project cost has been benchmarked against publicly available comparable projects, and it is based on public sources and bids received for port work in New England over the past year.

Additional budget details include:

- Project expenses incurred prior to the assumed October 1, 2022 notice of award are estimated at $1,537,540.
- The Project cost from October 1, 2022 through completion is $58.9 million ($YOE); all parts of the Project are eligible costs.
- The City's partner, Crowley, has committed just over $25.1 million. The Project team would close the funding gap with federal PIDP grant funding of $33.8 million (rounded). Crowley has provided a letter of funding commitment for the $25.1 million of privately-funded non-federal match with this application. This private match represents 43 percent of the required funding for the Project. The letter is in the supplemental materials for this application.
- No federal dollars are applied to this project beyond the $33.8 million requested in PIDP funds. The source of the non-federal match is private funds from Crowley.

If awarded the grant, the City would request approval to spend $1,010,063 (the value shown for 2022 expenses in Table 1) between notice of award and the time of obligation. This will allow the team to maintain the schedule.

Budget Showing Sources and Uses of Funds

The City requests $33.8 million in PIDP funding. This represents 57 percent of the total Project cost in YOE$. **Table 1** summarizes the Project costs by major cost categories. The Project funding sources are allocated across the major project components listed in **Table 2.**

Table 1: Summary of Project Costs by Major Cost Category (in YOE$)

Major Cost Category	2022	2023	2024	Total
Engineering/Design	$815,427	$800,901		$1,616,328
Construction Management / Administration		$1,318,971	$1,758,629	$3,077,600
NEPA and Permitting	$194,636	$219,512		$414,148
Construction				$0
Environmental Controls Allowance		$28,371	$85,112	$113,483
Civil Demolition		$860,512		$860,512
Laydown Area Improvements			$4,023,553	$4,023,553
Site Improvements			$1,745,680	$1,745,680
Water System Allowance			$113,483	$113,483
PAZ Combi-Wall Steel Bulkhead		$5,030,280	$6,148,119	$11,178,399
Foundation Piles - Heavy Lift Platform		$4,718,728	$11,010,366	$15,729,094
Concrete Bulkhead Cap			$4,748,962	$4,748,962
Concrete Heavy Lift Platform			$15,110,007	$15,110,007
Electrical Infrastructure Allowance			$212,780	$212,780
Total	**$1,010,063**	**$12,977,275**	**$44,956,691**	**$58,944,029**

Note: Costs are year of expenditure dollars (YOE$).

For planning purposes, the expected award date is October 1, 2022 and the expected date of federal funding obligation is January 1, 2023 or later. Funds expended in the FY 2022 column of Table 1 are pre-construction funds that will be expended shortly following the award date but before the likely obligation date as outlined above. The Project partners intend to request approval from U.S. DOT to count this spending toward the non-federal cost share pursuant to 46 U.S.C 54301(a)(10)(B).

Table 2 Major Project Components by Funding Source, YOE$

Major Cost Category	State and Local	Private	Federal PIDP	Total
Engineering/Design	$ -	$ 1,616,328		$ 1,616,328
Construction Management / Administration	$ -	$ 3,077,600		$ 3,077,600
NEPA and Permitting	$ -	$ 414,148		$ 414,148
Construction	$ -	$ -		$ -
Environmental Controls Allowance	$ -	$ 113,483		$ 113,483
Civil Demolition	$ -	$ 860,512		$ 860,512
Laydown Area Improvements	$ -	$ 4,023,553		$ 4,023,553
Site Improvements	$ -	$ -	$ 1,745,680	$ 1,745,680
Water System Allowance	$ -	$ -	$ 113,483	$ 113,483
PAZ Combi-Wall Steel Bulkhead	$ -	$ 10,253,490	$ 924,909	$ 11,178,399
Foundation Piles - Heavy Lift Platform	$ -	$ -	$ 15,729,094	$ 15,729,094
Concrete Bulkhead Cap	$ -	$ 4,748,962	$ -	$ 4,748,962
Concrete Heavy Lift Platform	$ -	$ -	$ 15,110,007	$ 15,110,007
Electrical Infrastructure Allowance	$ -	$ -	$ 212,780	$ 212,780
Total	**$ -**	**$ 25,108,076**	**$ 33,835,953**	**$ 58,944,029**
Share of Total (%)	**0%**	**43%**	**57%**	**100%**

4. MERIT CRITERIA

This section describes how the Project aligns with the merit criteria for PIDP funding in the order that they are listed in the Notice of Funding Opportunity. The benefit cost analysis (BCA) technical memorandum contains an appendix that summarizes the status of the most likely alternative locations for a wind services port between Maine and Virginia including their physical characteristics, readiness for wind work, and public information about their market availability. This table provides the data for some of the discussion contained in the Merit Criteria section and the BCA technical memorandum.

4.1 Achieving Safety, Efficiency or Reliability Improvements

The Project transforms an obsolete waterfront property in Salem, MA into a much-needed, modern OSW terminal that enables the safe and efficient onloading and offloading, assembly and storage of very large and heavy OSW components. As outlined in Section 1.4, the growth of the OSW industry in the U.S. and especially on the East Coast, will be restricted by insufficient port capacity. Although East Coast ports are actively making investments to adapt, there is a significant shortage of adequate berth capacity in place to accommodate the projected OSW

installation needs. Moreover, those that could serve as potential candidates, are or will be committed to projects that will absorb a port's capacity for up to 10 years.

4.1.1 Loading and Unloading

All efficiency gains in the Salem Wind Port will come from this Project. Safe and efficient loading and unloading of the large and heavy materials and equipment necessary to install the OSW Turbines is a core element of this project. This includes approximately 110 nacelles (up to 800+ tons each), 330 blades (115m long), and approximately 400 OSW tower sections. Each multi-ton tower section is approximately 35m long. The Project will have the capacity and design to safely facilitate throughput of approximately 40 total WTG (wind turbine generator) assemblies per year based on current technology. Future technology advancements will alter the size and number of OSW components to be managed.

The existing conditions at the Project site limit safe maritime activity of all types as the facility was developed to serve a legacy coal shipping operation and has not been in use for about a decade. The Project will replace this obsolete facility with a safe, purpose-built marine infrastructure that can accommodate the oversize and overweight equipment needed to assemble and install the wind turbines and associated connection infrastructure. Without the Project, Salem cannot support the OSW industry, and the OSW industry in the North Atlantic is denied a favorably sited work location and forced to work from more distant and costly locations. With the Project, the U.S. gains a much-needed wind services port in a high-demand location. The improvements enable support of the Park City Wind and Commonwealth Wind projects in the nearer term and, based on the resiliency improvement from the project, support to the Gulf of Maine floating wind projects in the future. The improvements made at Salem will also support the use of other cargoes and cruise ships.

The design for reconstructing the wharf has taken projections of rising sea levels into account.

4.1.2 Movement of Goods Into, Out of, Around, or Within a Port

The primary purpose of this project is to move materials and equipment into the Port and major assembled components out of the Port for OSW installation via vessel transportation. The large and oversize components required to construct the approximately 100 OSW turbines will be transported into the Port from Europe, Canada and/or other locations in the U.S. by vessel. Highway transportation of heavy and oversized components from other locations in North America, including along I-95, will be avoided by using marine transportation. This is an important inequity mitigation for the Project as it is adjacent to an Area of Persistent Poverty. See Section 2, Location. In addition, data from the EJ Screener indicates that the adjacent tract is in the 95th percentile for traffic proximity. The ability to avoid road traffic by utilizing a marine highway alternative will be an important benefit to the households that live in this area.

Component transportation from the port to the OSW project will be along the M-95 Marine Highway and maritime transportation into the Port from other places along the East Coast of North America will use the same M-95 Marine Highway.

4.1.3 Operational Improvements

Operational improvements include those gained through on-port activities and those gained through use of the port to accomplish OSW construction and operations.

On-Port Improvements. The project will achieve safety, efficiency, and reliability gains through installation of operational improvements that will transform an empty remediated brown field site into a functional wind services port capable of receiving, storing, partial assembly and loading the approximately 100 sets of large wind turbine components needed for a single wind farm aboard vessels. Operational improvements resulting from this project include the ability to safely berth large OSW vessels, load and unload very large and heavy wind turbine components from an improved pier via an adjacent apron, move large components around the terminal and store, assemble and test them in laydown areas. The partially assembled structure is loaded on to a feeder vessel or WTIV for delivery to the wind farm.

Improvements to the terminal will address multiple safety hazards for yard equipment operation and workers including; a lack of markings for safe work areas, terminal pedestrian and surface vehicle and machinery traffic management, the lack of useful lighting on the terminal, unknown surface load bearing capacity throughout the terminal for heavy lift equipment and heavy components and laydown areas, traffic obstructions including legacy wooden power poles and wiring, lack of ready access to electrical power sources thus limiting options to less safe alternatives such as long exposed power extensions, and a lack of water or other methods of firefighting. The project will improve worker access to power, water, and shelter from extreme weather to avoid injury.

Efficiency gains from operational improvements include the ability to on/off load large wind turbine components from a purpose-built pier and heavy-weight bearing concrete apron. The new capability enables the unloading, storage, partial assembly and loading of OSW wind vessels with enough components to construct and install 100 or more completed wind turbines. Alternative methods of on/offloading of OSW vessels from the current unimproved port are not likely achievable. The project implements efficient materials movement within the terminal be designating and marking storage, laydown and traffic control areas. Night lighting in key work areas such as the apron enables safe operation during nighttime thus increasing terminal utilization and worker safety. Operational improvements such as access to additional laydown areas, from project improved areas, and traffic flow management enable the terminal to accommodate changes in capacity and throughput.

The port's resiliency is increased through construction of a permanent bulkhead and adjacent, reinforced concrete apron that inhibits erosion along the pier length. The heavy load supporting structure ensures that the terminal can provide a wide range of vessel loading and unloading operations aside from its immediate purpose as needed. The treatment of the surface within the project scope also limits further erosion and overgrowth. The resiliency and long-range value of the port past its planned service to the City and region is its ability to serve as a key link in the development of other OSW projects including emerging fixed structure wind farms in the Northeast. Its unique location in northern Massachusetts also enables it to directly support the large number of floating wind turbines needed when the Gulf of Maine floating wind industry is

developed in the next decade. The resiliency gains from this Project will allow it to provide decades-long value to the City and the region.

Operational Improvements Afforded to the OSW Industry. While operational improvements for ports are typically landside gains as outlined in the preceding section, the location of the Project affords important transportation savings for construction and operations activities related to the OSW farms located off the Massachusetts and northern New England coast—one of the densest clusters of OSW production areas anticipated on the Atlantic coast given current BOEM plans. In the absence of the Project, construction and operations vessels will have to travel farther than they would if they used Salem as a base of operations. This increases the cost of constructing the project and likely leads vessels supporting the construction and operation of New England Wind projects to work from sub-optimal locations. As described more fully in the benefit cost analysis, as the likely next alternative port is not known, we have taken a weighted average of five possible alternative ports as a "strawman" against which to measure the benefits of a new wind services port at Salem. This strawman adds 164 nautical miles (314-150) to each one-way trip; this is based on an average distance of 314 nautical miles from alternative construction and operations base sites to the offshore construction site, compared to 150 nautical miles from Salem Harbor.

Based on conversations with operators, we estimate the hourly operating cost for a loaded tug and barge at $2,000 per hour and an unloaded barge at $1,500. Once out of port, a speed of 8 nm/hour is estimated on average—translating into about 42 additional hours of sailing time for each round trip. As trips will be loaded one-way and unloaded on the backhaul, the distance penalty translates into over $70,000 penalty per trip. Using the distance between Salem and the New England Wind location as a benchmark, that distance is 150 nautical miles. Thus, the additional distance roughly doubles the transportation time and cost associated with construction and operations. Moreover, in the event that the Salem location is not available and wind farm construction crews must share port facilities elsewhere, this increases the complexity and costs of installation due to limitations of the facilities. As concluded in the NREL 2022 report on the wind power supply chain, "[d]elays and bottlenecks are more likely to accrue for projects staged out of suboptimal ports. Additional factors such as commitments of ports to other industries and additional demand introduced by O&M activities will further constrain the abilities of existing ports to support OSW project construction."[9]

In addition, future investments at Salem will enable the use of a wind turbine installation vessel (WTIV) in addition using feeder barges to carry materials out to sea for installation. As the NREL (2022) study describes, a feeder approach may, reduce costs (p. 30). The construction team based at Salem will use feeder barges until WTIVs are ready. WTIV's may be the future of building the NE OSW leases, and Salem can and will be WTIV capable. This will provide flexibility for the U.S. wind industry to either use a similar building technology as the established European wind services industry, or innovate new operations and methods for constructing wind farms.

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[99] Shields, Matt, Ruth Marsh, Jeremy Stefek, Frank Oteri, Ross Gould, Noé Rouxel, Katherine Diaz, Javier Molinero, Abigayle Moser, Courtney Malvik, and Sam Tirone. 2022. The Demand for a Domestic Offshore Wind Energy Supply Chain. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-81602. https://www.nrel.gov/docs/fy22osti/81602.pdf.. See page 30.

4.1.4 Environmental and Emissions Impacts

Building off the scenario comparison described in Section 4.1.3, the longer trips associated with more distant ports, translates into greater emissions associated with each trip. The emissions are more than double in the scenario developed for this location where construction and service teams share a variety of locations with an average distance of 314 nautical miles from the offshore construction site, compared to 150 nautical miles from Salem Harbor. This distance and the associated emissions released into the atmosphere would be several times larger if the Park City Wind and Commonwealth Wind sites are served by the Port of Argentia for example. A tug engine releases 644 grams of CO2 per kWH of energy expended, and the tugs have engines capable of developing 8,113 kW of power. Over the period of analysis, the Project avoids the release 250,000 metric tons of CO2, 3,700 metric tons of NOx, 123 metric tons of PM2.5, and 13 metric tons of SO2 related to the construction of OSW turbines. These savings will increase as turbine operations and maintenance support vessels begin operating from Salem Harbor. Moreover, larger vessel transit times at sea, increase the risk of environmental impact including from the vessel itself, proximity to other vessels, navigational dangers and moving vessel effects on marine life.

Electrical power infrastructure will be installed in subsequent phases. The design is implementing shore power for vessels to charge when they are in port. The site will also have future capabilities for WTIV's and other vessels, as well as be prepared to support the seasonal cruise ships. The design takes every possible opportunity to use electric shore power in lieu of running generators and will be capable of providing power as the shipping industry transitions to hybrid and electric vessels.

To the degree that insufficient or suboptimal port facilities delay the completion of the Park City and Commonwealth lease areas (or other OSW farms), that power generation would continue to be fueled by non-renewable sources such as—LNG, oil, or a coal fired plant. The delay contributes to additional carbon and emissions released into the atmosphere as well.

4.2 Supporting Economic Vitality at the Regional or National Level

The Project allows the densest cluster and most promising area for OSW in the U.S., a very large renewable energy source, to move forward without delay and in the most efficient manner possible by returning a declining port facility to a state of good repair. The Project eliminates the need to utilize more distant ports for construction and operations. There is a demonstrated shortage of ports capable of handling OSW turbine components on the East Coast of the U.S. New modern terminals like the Project must be constructed to expand capacity and meet state and federal targets for wind-generated electricity, supporting U.S. job creation.

A distinguishing feature of the OSW terminal redevelopment Project is that there is already a committed tenant with approved BOEM wind generation lease areas ready to use the Project for construction and operations as soon as the existing port is repurposed and becomes available. Without the Project, at least two large generation areas (Park City and Commonwealth) are put

on hold and the U.S. wind industry's growth will be delayed. This puts the U.S. goal of generating 30 GW by 2030 is put at risk.

However, it's not just the schedule for two OSW farms that are at risk. As Figure 4 makes clear, there are many wind generation areas slated to come online in the same general physical area off the south coast of Massachusetts. The demand to construct and operate them far exceeds the capacity of nearby ports, particularly when the industry moves to floating platforms that are estimated to require 3 berths (see Section 1.3) for partial assembly. Multiple wind generation areas in this region of the ocean will need to rely on more distant ports without the Project in Salem. In short, one the most favorable areas for the growth of this new industry will be constrained by insufficient supporting infrastructure. It is as if the growth of the U.S. distribution industry was constrained by a fragmented highway system, or the growth of internet industries was constrained by an insufficient power supply. The domestic OSW industry provides cleaner and lower cost power. Growth of the domestic wind generation capacity creates local demand for equipment. Given the density of developments off the coast of south Massachusetts, this is one of the best areas in the U.S. for creating sustained demand of sufficient volume to attract manufacturers to the U.S. market—extending the wind industry supply chain in the U.S.

But beyond the direct impact of the Project on the speed with which the wind farms come into use, there is also an anticipated beneficial impact on energy prices in the region. A U.S. Department of Energy study has concluded that increased electrification across all sectors of the economy, but especially transportation, will boost electricity consumption by nearly 40 percent by 2050[10]. Massachusetts, where the power is likely to connect into the grid, already pays a higher-than-average cost for electricity. See Table 3

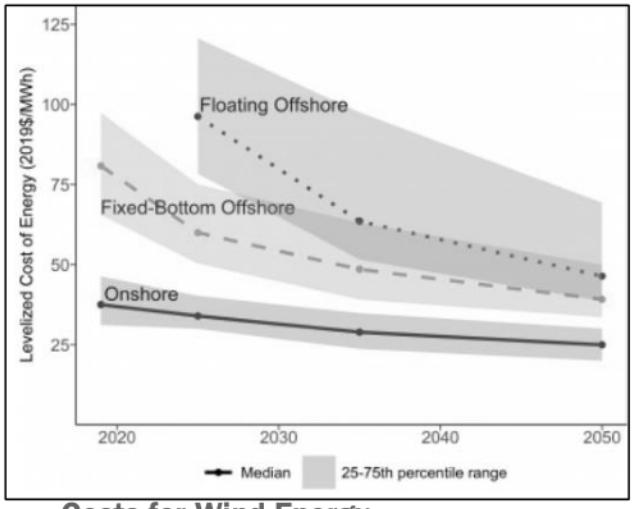
Table 3 Electricity Prices in Massachusetts, January

Electricity	Massachusetts	U.S. Average
Residential	25.28 cents/kWh	13.72 cents/kWh
Commercial	19.59 cents/kWh	11.36 cents/ kWh
Industrial	17.49 cents/kWh	7.30 cents/ kWh

Source: EIA, Massachusetts State Energy Profile

Electricity from OSW, as the industry matures, will offer a lower cost production method. Figure 9 illustrates how the levelized cost of OSW is projected to fall over time[11]. One of the largest drivers of the cost reduction is the expected transition of the industry to use of larger turbines. Investments in the ports that handle this equipment, such as the Project described here, are essential to supporting the industry in realizing this productivity gain.

[10] Brown, Alex. 2020."Electric Cars Will Challenge State Power Grids," Stateline. Accessed: https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2020/01/09/electric-cars-will-challenge-state-power-grids.
[11] LCOE is the cost per unit of energy of generating electricity during an assumed project design life that allows for the recovery of all project expenses and meets investor return expectations. The LCOE is reported here as a proxy for what energy purchasers might pay once the OSW industry is more developed.



Costs for Wind Energy

Source: Dept. of Energy, Wind Technologies Office, "Experts Predict 50% Lower Wind Costs Than They Did in 2015," June 2021. [1]

An independent study by North Carolina State University researchers came to the same conclusion. The researchers found that OSW power could help reduce wholesale electricity prices for six New England states.[12]

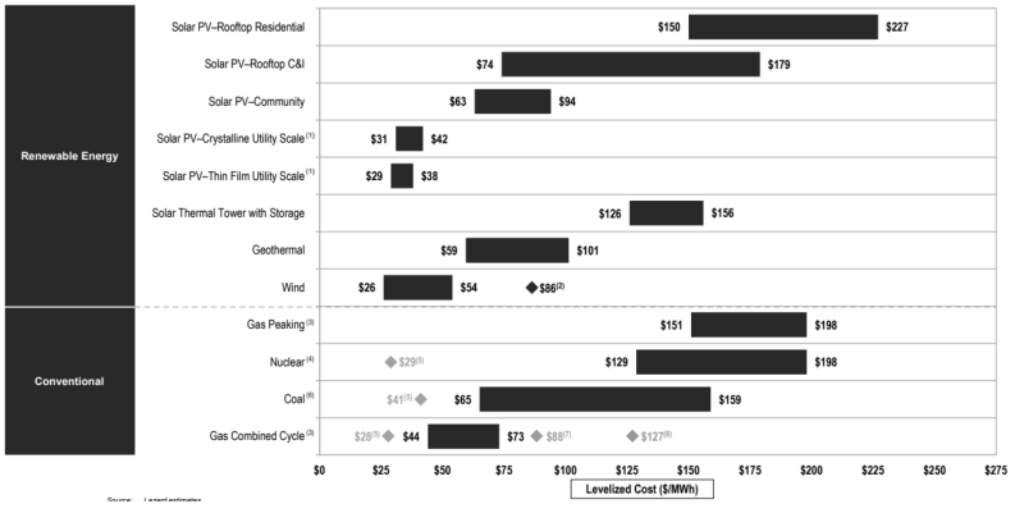
Compared with conventional sources of electricity production, OSW offers a favorable cost reduction. In Figure 10, which is based on 2020 estimates, OSW is estimated at $86/MWh, well within the range of coal with a range of $65/MWh to $159/MWh. Gas combined cycle technologies offer a more competitive range of $44/MWh to $73/MWh which beats the current estimate for OSW but is well within the projected range shown in Figure 9.

Using bid information from early lease procurements, the Massachusetts Department of Energy Resources concluded that an "additional procurement for 1,600 MW of offshore wind is projected to save ratepayers $670 million to $1.27 billion over the 20-year life of the contract versus purchasing the same amount of clean energy in the markets (energy plus RECs/CESs)".[13] That same report concluded that "[d]uring severe winter storm events, OSW energy has particular benefit of lowering energy prices and reducing greenhouse gas emissions by minimizing reliance on oil and coal fired generation units because of its higher winter capacity factor than other renewable resources."

[12] Kerem ZiyaAkdemir[a] Jordan D.Kern[a] Jonathan Lamontagne[b], "Assessing risks for New England's wholesale electricity market from wind power losses during extreme winter storms," Energy, Volume 251, 15 July 2022, 123886 and Oleniacz, Laura. " Study Finds Offshore Wind Could Drive Down Energy Costs in New England," April 21, 2022. Accessed: https://news.ncsu.edu/2022/04/study-finds-offshore-wind-could-drive-down-energy-costs-in-new-england/

[13] Massachusetts Department of Energy Resources, Offshore Wind Study, May 2019, pages 5 and 6.. Accessed: https://www.mass.gov/doc/offshore-wind-study/download.

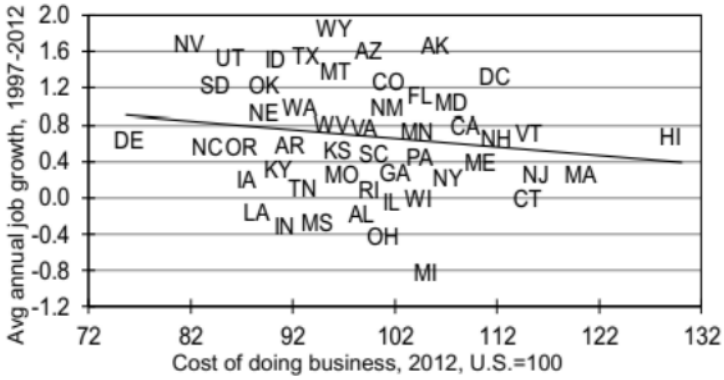
Figure 10 Levelized Cost of Energy Comparison—Unsubsidized Analysis



Source: Lazard's Levelized Cost of Energy Analysis — Version 14.0. Accessed: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Ultimately, business costs influence the pace of economic growth. Figure 11 shows the relationship between long-term job growth and the cost of doing business if the 50 states. Business costs are measured as a mix of unit labor costs, energy costs, and tax burdens at the state level. To the degree that OSW maintains electricity costs in the presence of growing demand from electric cars and other new users, OR contributes to a reduction in energy costs, the industry will help high-cost states such as Massachusetts and Connecticut become more economically competitive. This helps all residents and makes the U.S. overall more competitive globally.

Figure 11 Business Costs Influence Economic Growth and Vitality



Source: Moody's Analytics, Regional Cost of Doing Business

4.2.1 Findings from the Benefit-Cost Analysis

A benefit-cost analysis (BCA) was conducted to determine the cost-effectiveness of the Project. The BCA followed methods set by the Office of Management and Budget (OMB) Circular A-94 and the USDOT 2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. As described in the Benefit-Cost Analysis Technical Memorandum attached as part of this application, the benefits and costs are provided in 2020 dollars, with a 2020 base year, and discounted using a 7 percent discount rate. Following a two-year construction process, the benefits of the Project were estimated over a 20-year analysis period beginning in 2025.

Due to the unprecedent expansion of OSW, other ports in the region that have (or are planned to have) the facilities to support OSW (e.g., New Bedford, MA, New London, CT, New Jersey Wind Port, NJ, etc.) are already engaged/contracted with other developers and will be operating at full capacity for years to come. Because OSW developers without port contracts have already made significant investments in obtaining lease areas and are under pressure from stakeholders and electricity companies to become operational and produce electricity, it is anticipated that developers will move forward with installation of turbines using facilities that are available, even if it requires using ports that are outside of the region or have inherent constraints. See the Appendix to the BCA Technical Memorandum, Alternative Port Locations.

Upon completion of the Project, Salem Harbor will serve as a regional marshaling port for the installation of OSW turbines, with tugs and barge vessels supplying the wind turbine installation vessels (WTIVs) operating in the lease areas. Salem Harbor is significantly closer to the lease areas than other ports that may have availability to support OSW. Therefore, the BCA focused on the reduced distance (and resulting emissions) of transporting OSW components from the marshalling areas to the installation site.

The results of the BCA estimated the Project would provide $104.8 in net benefits and have a benefit/cost ratio (BCR) of 3.5. The BCA indicated that the Project is cost effective and would return $3.5 for every $1 invested.

4.3 Addressing Climate Change and Environmental Justice Impacts

Few other projects more directly support the President's greenhouse gas reduction goals, promote energy efficiency, and increase the climate resiliency of port infrastructure. The Project not only supports the development of the OSW industry to the economic benefit of the region, but it also provides a cleaner source of electricity for all consumers connected to the New England Grid, **including all overburdened or disadvantaged households in the service area**. The history of the property will show its transformation from a coal-fired power plant adjacent to an area of persistent poverty into a clean OSW energy enabler that will provide good paying union jobs to the same area.

But for this Project, the expansion of wind power generation capacity will be held back, leading to additional carbon released into the environment. Research conducted by the National

Renewable Energy Laboratory is shown in Figure 12[14]. The scientists reviewed and harmonized life cycle assessments (LCAs) of electricity generation technologies to reduce uncertainty around estimates for environmental impacts. Two metrics were reported: the published study values, and a "harmonized" value that adjusted the estimates to a consistent set of methods and assumptions specific to each technology to provide an apples-to-applies comparison. The key takeaway from the figure is that every kWH produced by OSW compared with conventional technologies using natural gas or coal, reduces carbon emissions by over 98 percent.

But beyond the cleaner energy provided by the OSW enabled by the Project, it also allows the wind farms to be constructed with a smaller carbon footprint. The closer the host port is to the wind farm that it supports, the fewer vessel miles needed to transport supplies out for construction and maintenance. Moreover, it minimizes the negative impact of construction activity on the adjacent disadvantaged neighborhood. The construction plans include bringing in aggregate by barge to reduce the impact that these large trucks will have on the local streets and neighborhoods. Data from the EJ Screener indicates that the adjacent tract is in the 95th percentile for traffic proximity. The ability to avoid road traffic by utilizing a marine highway alternative will be an important benefit to the households that live in this area.

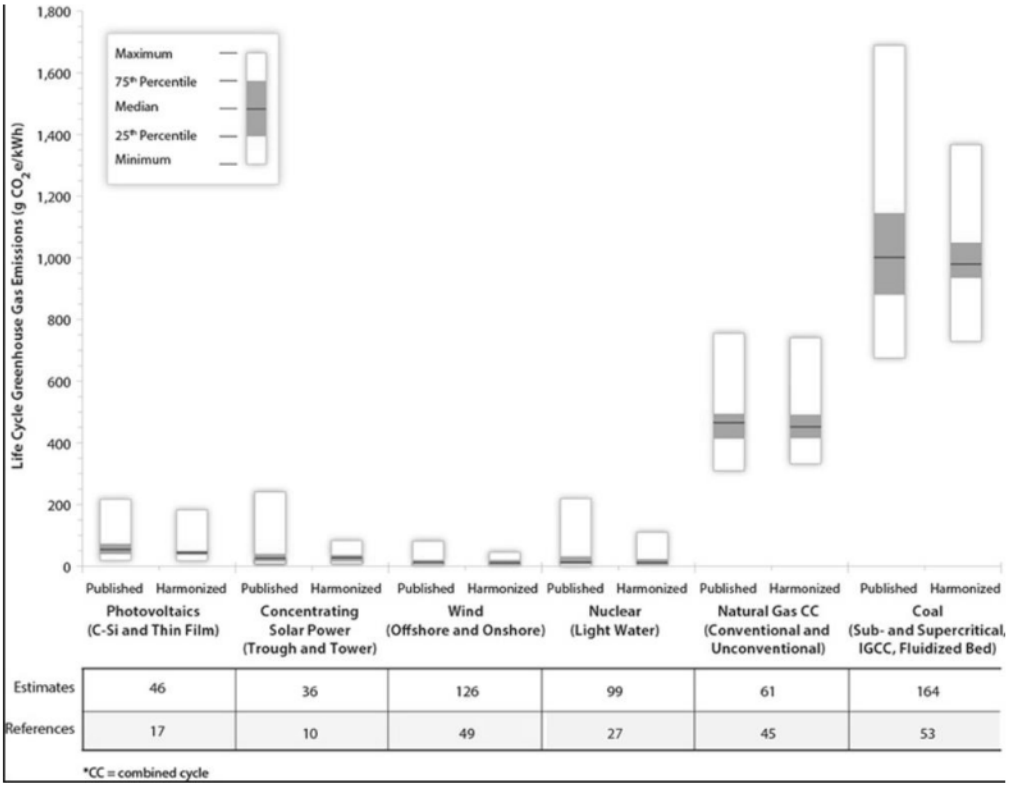


Figure 12 Comparison of Life Cycle Greenhouse Gas Emission Estimates for Selected Electricity Generation Technologies

[14] Life Cycle Assessment Harmonization. Accessed: https://www.nrel.gov/analysis/life-cycle-assessment.html

The effort to redevelop the Project and associated OSW is consistent with the state's climate change and decarbonization report shown in Figure 13. The report highlights the cost, emissions, and value of OSW in responding to fluctuations in electricity demand. It finds that "[t]he development of OSW not only provides an affordable, clean energy resource for the Commonwealth, but also the region more broadly. OSW development at the scale forecasted by the *Energy Pathways Report* will allow Massachusetts to become an energy exporter during many high-generation hours of the year.

This is particularly valuable for neighboring states and provinces, which may not have as direct access to or the ability to actively develop large OSW resources. Further, the ability to export OSW power to Quebec can enable the optimal use of hydropower and OSW resources across the broader Northeastern region, with Canadian hydropower serving effectively as a regional storage resource for hours when wind is less abundant in New England. This sharing of resources has an added benefit of reducing costs for ratepayers in the Commonwealth and across the Northeast."[15] The report's development entailed significant public engagement conducted in multiple languages to be inclusive. It was guided by a Technical Steering Committee of local academic experts, community organizations, Environmental Justice organizations and communities, regional planning authorities, and other stakeholders. Public engagement included multiple opportunities for public input including web forms that can be submitted at any time, in-person meeting until the pandemic began, and public webinars after the pandemic, some with over 200 attendees.

Building on this work, in March 2021 Governor Charlie Baker signed a new bill into law: "An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy" (colloquially known as the "2050 Roadmap Bill"). The primary goal of the bill is to create a net-zero greenhouse gas emission limit in Massachusetts by 2050. However, the bill goes further and includes an environmental justice amendment that outlines and defines certain precepts of environmental justice principles for the state. The amendment creates new standards for public participation in the decision-making process and establishes an environmental justice advisory council. It also changes how the state calculates environmental impacts. In the past, agencies assessed a project's potential for air, water, or soil pollution separately; now impact will be considered cumulatively.

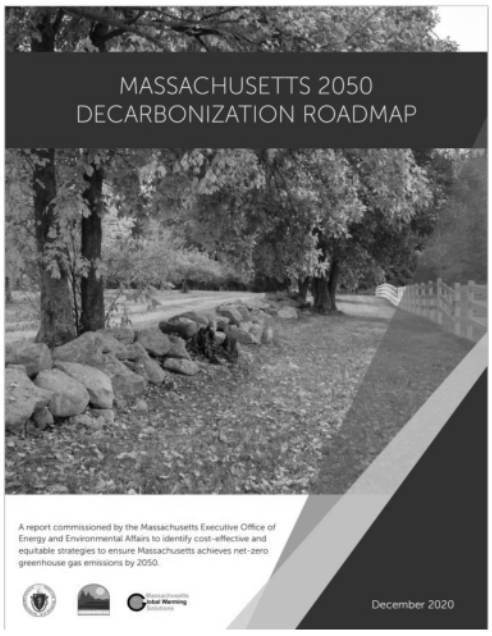


Figure 13 Massachusetts Climate Change and Decarbonization Plan

[15] Massachusetts Executive Office of Energy and Environmental Affairs, Massachusetts 2050 Decarbonization Roadmap. December 2020, page 65. Accessed https://www.mass.gov/doc/ma-2050-decarbonization-roadmap/download

4.4 Advancing Equity and Opportunity for All

Analysis of the Project's economic impact concludes that it will create about 400 full-time-equivalent (FTE) job years (about 200 jobs for two years). The wind marshalling operation will create another 400 FTE job years over the rest of the decade[16]. These jobs align with the industrial legacy of Salem and the surrounding area and offer workers displaced by past maritime industry losses who may be underemployed in other occupations new opportunities. These jobs are also good opportunities for new market entrants.

The Project partners will be negotiating a Project Labor Agreement with representatives of the Union Building Trades and the City. The Project partners will use union labor to construct the Project. In addition, the Project partners will be able to build on initiatives in the region that support ongoing developments. For example, the Massachusetts Maritime Academy, where Crowley recruits many new employees, is offering courses through its Center for Responsible Energy. Classes include specialized safety and navigation training such as Global Wind Organization Sea Survival Training and exercises that simulate routine work procedures at sea, as well as emergency evacuation techniques. The Academy is offering Offshore Wind 101 to a pre-apprenticeship program in Southeastern Massachusetts, Building Pathways South, to prepare young adults for opportunities available today as well as down the road, including in the growing U.S. OSW industry. Both Crowley and Avangrid are in partnerships for similar development with area colleges and universities. Crowley has a recognized record of outreach for hiring veterans through its "Military to Mariners" Program. The industry will also promote the OSW industry to local high schools and elementary schools to educate and promote OSW. An extensive community outreach program is being established per the Project plan and will be executed with assistance from a dedicated consulting team.

As part of the partnership with the City, Commonwealth Wind will be part of a $15 million investment in workforce training and supply chain development. There is also a plan to invest $20 million in education, innovation, and environmental initiatives to benefit local communities[17].

The City of Salem and Crowley have already begun to reach out to the local community and discuss the project and socialize the benefits the project will have for the community. The outreach effort will also listen and take into consideration the comments and concerns the public may have in relation to what the new terminal would bring. All neighborhoods, especially those that are typically underrepresented or underprivileged, will be included in the outreach. It has been noted there is a strong Spanish speaking population in Salem. The outreach team has already identified that flyers and written materials will need to be in both English and Spanish.

The project partners are working with local elementary, high school, trade school, colleges, and universities to promote education and opportunity in the OSW industry. Crowley will use local union labor to operate the port and terminal. The local ILA (longshoreman's union) has been contacted and supports the creation of the jobs this Project is going to create to support

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[16] Salem Alliance for the Environment, "Avangrid Renewables Lays Out Future of Salem Harbor Wind Port," February 22, 2022. Accessed at: https://salemsafe.org/2022/02/14/avangrid-renewables-lays-out-future-at-salem-harbor/
[17] The plan is described at (https://www.iberdrola.com/press-room/news/detail/iberdrola-awarded-ppa-commonwealth-wind)

hardworking local families. When construction begins, construction crews will also be local union members.

Stakeholder engagement has been formally integrated into the Project. The project partners have engaged a dedicated Community Outreach consultant to develop a stakeholder engagement plan to assist with strategy, direction, and support Crowley and the City of Salem. The Project team already has project-related community outreach meetings scheduled for the months of May and June 2022 to continue socializing the Project and receive input from the local community, particularly from representatives of the nearby disadvantaged communities (see Section 2: Location).

Crowley and the City of Salem are working on a revised Memorandum of Understanding (MOU) and Community Benefits Agreement (CBA). The City of Salem currently has a CBA with the previous owner, but both parties are working towards a separate agreement to benefit the City now and in the future.

4.5 Leveraging Federal Funding to Attract Non-Federal Sources of Infrastructure Investment

The Project is requesting $33,835,953 in federal funding for this $58,944,029 investment; this represents 57 percent of the total project cost. As a result, the non-federal **private** share is 43 percent. These non-federal match funds are private sources as outlined in Section III: Grant Funds, Sources and Uses of Project Funds.

5. PROJECT READINESS

5.1 Technical Capacity.

The public Project partner, City of Salem, has the technical capacity to manage this grant and has collaborated with all government and private stakeholders on this Project over the past year. The City also has PID Project experience. The Project design is managed by the private Project partner, Crowley, who has developed and currently operates several similar marine terminal projects ranging from the Caribbean to Alaska. Moreover, the design team is consulting with Avangrid, a key stakeholder and an experienced partner for understanding the requirements for wind services ports. The Project delivery team has been assembled and includes:

1. City of Salem representatives, including Planning and Community Development and PIDP grant administration
2. Dedicated project manager (Crowley)
3. Terminal operations, port operations, match funding, and other specialists (Crowley)
4. End user representative (Avangrid Renewables and Copenhagen Infrastructure Partners)
5. Engineering and design consultant
6. Permitting consultant
7. Dedicated Community Outreach team and consultant

A description of engineering status and cost data used to develop the Project's budget is provided in Section 3 and not repeated here given the page limitation for applications.

Design and permitting activities are underway and are due to complete during quarter 2 of 2023. It is anticipated that all permits will be in hand to allow the construction works to commence in quarter 3 of 2023. Construction works are planned to complete by quarter 4 of 2024 to allow the opening of the facility in January 2025. **Figure 14** illustrates the project schedule.

Existing environmental and geotechnical investigations previously completed for the brownfield rehabilitation were leveraged to begin additional design and permitting works without incurring delays while waiting for the site investigation works. Members of the professional team have prior experience with the site having been involved in the demolition of the coal power plant, the site remediation and the construction of the new gas fired power plant.

Figure 14: Project Schedule

5.2 Environmental Risk

It is anticipated that the class of action will be an NEPA Environmental Assessment, given that no acquisitions are required, though this will be determined by the federal agency. As the site was used for maritime activity before, there is no change in use. In addition, the site has undergone substantial environmental remediation, so the area has been well documented in terms of contaminants. There are no threatened or endangered species on the site. The permitting effort has begun.

A key consideration in the construction of the site is minimizing the impact it will have on local traffic. Landside access to the site is primarily by two arterials, one of which is also the main tourist corridor in downtown Salem. To mitigate this, the construction plans include bringing in aggregate by barge to reduce the impact that these large trucks will have on the local streets and neighborhoods. This is an important mitigation for the Project as it is adjacent to an Area of Persistent Poverty. See Section 2, Location. In addition, data from the EJ Screener indicates that the adjacent tract is in the 95th percentile for traffic proximity. The ability to avoid road traffic by utilizing a marine highway alternative will be an important benefit to the households that live in this area.

Permitting is a critical factor to achieving the project build out and construction completion goals. The permitting scope of the Project has begun but is not complete. We are in the first stage of the permitting effort. Some of the permits required:

- Massachusetts Environmental Policy Act (MEPA),
- Massachusetts Department of Environmental Protection (MassDEP) Chapter 91, MassDEP 401 Water Quality Certification,
- Consistency Review by the office of Coastal Zone Management (CZM),
- Salem Conservation Commission,
- Salem Planning and Zoning,
- and EPA National Pollution Discharge Elimination System (NPDES).

A USACE permit is not anticipated to advance the Project described in this application, but will be needed to move forward with subsequent parts of the full program scope for the Salem site.

NEPA requirements will be considered simultaneously to the MEPA process and added if not captured already under the MEPA process. Permits and Authority Having Jurisdiction (AHJ) reviews for utility infrastructure and connections such as electrical, potable water, sewer, fire protection, etc. will also be considered for coordination with the Design consultant.

Permitting will also consist of preparation of environmental reports, studies, and plans including, but not limited to, those related to MEPA/NEPA compliance, dredge material management, Coastal Zone Management (CZM) consistency, water quality monitoring, etc. Planning, procurement, and administration of field activities such as soil and sediment sampling and characterization efforts. Performance of site field investigations such as wetland, shoreline, and habitat delineation will occur, as well as ACM and LBP surveys of existing infrastructure. A Permit Acquisition Plan will be developed and a permitting delivery schedule.

The goal is to have the permits required to begin construction in April 2023. We understand that is an aggressive goal, but we will do everything we can to achieve it and planning on how to achieve that goal has begun. Additional agency contacts will be made during this effort. The experienced Permitting and Environmental consultant hired to assist in this effort has the expertise and contacts required to make this goal attainable. The permitting consultant is also involved with the design of the project as is working closely with the design consultant, Crowley, and the City of Salem to make sure the design presented is permittable.

5.3 Risk Mitigation

The primary risks to Project delivery are related to schedule. Project partner Crowley has significant experience delivering large capital marine construction projects with public partners. and the Project can draw from Avangrid's experience with similar wind service port development projects elsewhere to inform the technical aspects of the Project delivery.

Risk Identification	Description	Mitigation
Permit Issuance Delay - Environmental Review	EIS instead of EA would require scoping, public hearing and analysis of alternatives.	Early coordination with public agencies at state level has kept relevant agencies informed on project developments.
Permit Issuance Delay - Permitting	Timeframe for agency review of permit application and permit issuance; resolution of mitigation.	The City is one of the Project sponsors, helping to guide the best approach to local permits. Early state coordination has made agencies aware of the Project and informed the team's permitting strategy.
End User Directed Changes	End user change to requirements substantially altering the terms and/or scope of work. These changes could result from changes to budget, changes to the end-user operational plan, or other non-technical changes.	The City and Crowley are involving Avangrid in the design process to avoid scope changes later in the process.

6. DOMESTIC PREFERENCE

The Project partners are committed to following the domestic reference requirements outlined in the Build America, Buy America Act, as well as the policy guidance provided in Executive Order 14005, *Ensuring the Future is Made in All of America by All of America's Workers*. The Project design manager, Crowley, is a leading maritime industry supporter of Buy America requirements.

The team understands that content requirements are rising over the time period that this Project will be in final design. The team is already working through its procurement approach as the design progresses. Highlights of the procurement approach include:

1. For fendering systems and bollards, Prosertek USA offers a team of professionals specialized in the design, manufacture and assembly of harbor equipment based in Houston
2. American suppliers for steel pipe and sheets piles are being investigated for cost effective and timely delivery of the heavy sections required
3. Reinforcing steel for the concrete pile caps and decks will be locally sourced
4. Concrete will be locally sourced
5. Electrical components (transformers and switchgear) will be locally sourced
6. Aggregate needed for construction will be sourced from U.S. producers and barged to the site to avoid truck traffic disrupting nearby communities.

There is also a case for ensuring that the U.S. captures the maximum share possible of this emerging North American industry. By investing and constructing this Project that will expand

U.S. wind services port capacity, it removes the incentive for wind farm operators along the U.S. coast to purchase wind port services from Canada.

7. DETERMINATIONS

1. **The Project improves the safety, efficiency, or reliability of the movement of goods through a port or intermodal connection to the port.**

There is a demonstrated shortage of ports capable of handling OSW turbine components on the East Coast of the U.S. New modern terminals like the Project must be constructed to expand capacity and meet state and federal targets for wind-generated electricity. The Project allows the densest cluster and most promising area for OSW in the U.S. to move forward without delay and in the most efficient manner possible by refurbishing a facility that eliminates the need to utilize more distant ports for construction and operations. The Project transforms an obsolete waterfront property in Salem, MA into a modern OSW terminal that facilities loading, assembly and storage of large and heavy OSW components.

2. **The Project is cost effective.**

The results of the BCA estimated the Project would provide $104.8 in net benefits and have a benefit/cost ratio (BCR) of 3.5:1, indicating that the Project is cost effective and would return $3.5 for every $1 invested.

3. **The eligible applicant has the authority to carry out the project.**

Crowley will own the property and the City of Salem is a partner in the reuse of the brownfield site who will help secure the necessary local construction permits. The City negotiated an MOU with Crowley for right of way access to sections of the property for City use. The Project is an eligible use for the state designated DPA zone. The remaining considerations is clearing the environmental process.

4. **The eligible applicant has sufficient funding available to meet the matching requirement.**

Yes, the private partners have provided letters of financial commitment attesting to the amount of match funding to be provided upon notice of award. There are no restrictions on the use of private funds and the partners are prepared to financially support the project through completion.

Private funds and effort have already been dedicated to developing this project and this support will continue while waiting to hear about federal funding award. Consulting firms have been contracted and added to the team to provide services and expertise to the buildout of the project.

5. **The Project will be completed without unreasonable delay.**

The Project partners are advancing their design ready and will be ready to move into construction by mid-2023. Significant technical work has been undertaken at the site and Crowley routinely manages construction similar projects of similar scale. The match funding is secured, and the Project partners already have a committed tenant for the Project upon completion. The team will continue design and have it completed towards the end of 2022 and into 2023. The project is scheduled to start construction in Q3 2023. The project is slated to be complete and operational by 1/1/2025.

6. **The Project cannot be easily and efficiently completed without Federal funding or financial assistance available to the project sponsor.**

Without funding to construct the port facility at Salem, one of two scenarios will likely occur. In the first scenario, project partners complete a small part of the overall project. As a result, the port is not as efficient as it would be at full Project buildout, and it will not have the same throughput. It is a compromised facility in an area of the coast that needs multiple modern ports supporting the construction and operation of the wind generation facilities.

The other possibility is that the wind farm developers will work from a more distant port. This will add cost, logistical complexity, emissions, and additional time to the delivery of the OSW power generation facilities.

8. LIST OF SUPPLEMENTAL MATERIALS PROVIDED WITH THIS APPLICATION

Aside from this Narrative, the following materials were provided with this application:

1. Attachment Forms
2. BCA Narrative
3. BCA Workbook
4. Funding Commitment Letter
5. MOU
6. Engineering Drawings
7. Project Cost Information
8. Letters of Support

CROWLEY

AVANGRID
RENEWABLES

Salem OSW Terminal Risk Register: 10%

Rev 00 05.10.2022

AECOM

Risk Identification			
Risk No.	**Risk Name**	**Risk Description**	**Risk if Unmitigated**
01	**Finance & Funding**		
1.1	**Funding**		
1.1.01	**Magnitude of / Delays relevant to Grant Funding**	The magnitude of the Grant funding may vary from what is expected and further delays to the receipt of Grant funding (e.g., union labor) may result in schedule delays.	Underfunding of the project, shortfalls delaying contractor NTP.
1.1.02	**Requirements of Grant Funding**	Grant funding may come with development requirements that go above and beyond typical development requirements such as MWBE reqs, sustainability reqs, etc..	Additional costs and delays if Grant Funder development requirements are not adequately planned for.
1.1.02	**Other Grant Funding**	This is an opportunity. Other sources of funds may be availible.	Missed funding opportunities.
1.1.03	**Grant Funding**	Mismatch between Grant Funding and Development Objectives	Grant funding packages may not match with the development objectives leading to abortive works and unnecessary costs.
02	**Program Operations / Soft Costs**		
2.1	**Program Management**		
2.1.01	**Project Governance - Executive Decision Making Delays**	Given the complex structure of the development team (multiple developers, multiple stakeholders), executive decision making may be complicated or poorly defined.	Delays to executive decision making resulting in project delays
03	**Development**		
3.1	**Planning, Permitting, and Preliminary Engineering**		
3.1.01	**Stakeholder opposition**	Controversy can lengthen schedule and contributes to level of environmental review (EA/EIS) decision.	Increased cost, permit issuance delay, potential construction start delay
3.1.02	**Stakeholder acceptance**	Community acceptance of the project through positive messaging, provision/upgrade of public facilties, improved screening, etc could mitigate any isolated objections	Opportunity
3.1.03	**Permit Issuance Delay - Environmental Review**	EIS instead of EA would require scoping, public hearing and analysis of alternatives.	Increased cost, permit issuance delay, potential construction start delay
3.1.04	**Permit Issuance Delay - Permitting**	Timeframe for agency review of permit application and permit issuance; resolution of mitigation.	Increased cost, permit issuance delay, potential construction start delay

3.1.05	**Permit Issuance Delay - Permitting**	Some elements of the project may be simpler and quicker to secure permits than othres. Delays in receiving key permits (i.e. in water work, channel filling, notch filling) may delay the overall project and planned go-live for operations.	
3.1.06	**Excessive Sustainability and Resiliency Requirements**	Due to the coastal nature of the project, and MA's sustainability and resiliency initiatives, stakeholders may require development to include sustainable and resilient elements beyond the required scope of the project.	Scope creep, increased costs, delays.

3.1.07	**Reliance on Outside Stakeholders**	The dredging and maintenance of the Federal Channel is outside of the projects control. The Port is under the control of the City of Salem.	Unable to safety bring in planned vessel. Opposition from Ferry operations, Port Pilots, Community, Environmental Groups, etc
3.1.08	**Adjacent Site Developments**	Footprint Power and the Sewer Plant are the immediate neighbors. Development plans may not be aligned leading to community/regulatory issues.	Delays to construction NTP.
3.2	**Procurement**		
3.2.01	**Unclear Bid Scoring/Criteria**	Bid scoring is unclear, resulting in non-communication of owner's priorities to bidders. This will result in bids that may not address core issues due to budget constraints.	Low quality bids requiring rebidding or extensive negotiations once a bidder is selected. May also lead to a bid protest. This will delay NTP.
3.2.02	**Market Risk**	Specialized aquatic and port work may limit the quantity of qualified bidders. Availiblity of specialised contractors capable of driving the required pipe pile sizes.	Non-competitive bidding, resulting in increase bid prices.
3.2.03	**Contingency/Allowance Fund Sizing and Communication**	The Salem Wind Port will have considerable unknowns to apportion contingencies/allowances for. These items include: - Unforeseen site conditions (particularly structural) - Excessive hazardous materials removal and disposal.	Delays to development while additional funding is secured/approved.
3.2.04	**Bids exceeding budgetted amounts**	Market uncertainty and supply chain disruptions may lead to bids beng recevied in excess of budgets.	Cost overruns and delays.
3.2.05	**Long lead items**	Crowley could elect to procure long lead items ahead of the appointment of a Contractor or Construction Manager.	Opportunity to reduce schedule.
3.3	**Design (Pre-Bid Contingency)**		
3.3.01	**Owner's Directed Changes - Design**	Owner's changes to requirements substantially altering the terms and/or scope of work.` These changes could result from changes to budget, changes to the end-user operational plan, or other non-technical changes.	Delays to the program.
3.3.02	**End User Directed Changes**	End user (OEM, T&I Contractor) to requirements substantially altering the terms and/or scope of work. Could include equipment sizes and weights (i.e. next gen equipment), handling and transportation operations, etc. These changes could result from changes to budget, changes to the end-user operational plan, or other non-technical changes.	Delays to the program. Cost overruns.
3.3.03	**Delayed Decision Making**	Owner or End User delays in key decisions or changes in decisions made	Delays to the program. Cost overruns.

3.3.04	**Unclear Development Requirements**	Development requirements in terms of equipment, phasing, loads, etc not understood or developed	Delays to the program. Cost overruns.
3.3.05	**Challenging Design**	Design may be challenging due to existing site condition and unique requirements of the complexes, such as the remnants of the coal fired power plant, existing masonary wall, sheet piles and timber wharf, etc. Design of Stormwater sewer may be compounded by City requirements.	Delays to design or need for substantial redesign as part of the project could delay the project.

3.3.06	**Coordination with Utility Providers - Design**	Delays to project development as a result of coordination with utility providers. For example, electrical design requires of information on power requirements, and existing infrastructure and conditions of such, e.g., substations, feeders and duck banks. The project is using different voltage and frequency. To not impair the efficiency of equipment, and ensure all equipment functions properly.	Delays to the program.
3.3.07	**Change in Codes, Guidelines, Standards, and Sustainability Requirements**	If codes, guidelines, and standards change prior to construction, redesign efforts may be triggered. These codes and standards include, but are not limited to flood zone remapping, new waterfront code, and climate change & resiliency relevant guidelines.	Delays to the program.
3.3.08	**Design Coordination Delays**	The project requires interface of various engineering design disciplines (structural, marine, electrical, etc.) and with the permitting consultant.	Delays to the program, increased soft costs.
3.3.09	**Complex Design Elements and Required Sequencing**	Complex design elements, may require complex installation sequencing that must be conveyed to the contractor without specifying means and methods.	Increased bid prices.
3.3.10	**Condition of Existing Critical Infrastructure - Marine**	Condition of existing marine infrastructure, such as bulkheads, may trigger additional design work or project costs.	Delays to the program, increase soft costs.
3.3.11	**Condition of Existing Critical Infrastructure - Geotech**	Existing geotechnical conditions, such as pavements may trigger additional design work or project costs. Unknown buried power station remants may impact design.	Delays to the program, increase soft costs.
3.3.12	**Condition of Existing Critical Infrastructure - Civil**	Condition of existing civil infrastructure including, but not limited to, stormwater outfalls may trigger additional design work or project costs.	Delays to the program, increase soft costs.
3.3.13	**Condition of Existing Critical Infrastructure - Electrical**	Condition of existing electrical infrastructure may trigger additional design work or project costs.	Delays to the program, increase soft costs.
3.3.14	**European Electrical Voltage Transformation**	Sustainable energy components to be staged at the site are fabricated in Europe. Therefore due diligence must be undertaken to ensure that components are compatible with US electrical standards.	Design may require additional electrical infrastructure / considerations to accommodate European equipment. This may delay the project and cost additional money.

3.4	**Construction (Post Bid Contingency)**		
3.4.01	**Preservation of Existing Site Operations and Adjacent Operations**	Additional traffic during construction may lead to communiy objections.	Delays to the program, increase construction costs
3.4.02	**Coordination with Utility Providers - Construction**	Delays to construction work as a result of required coordination with utility providers. Specifically, the program has concerns with timely coordination with the electical utility.	Schedule delays from coordination with utility providers, and work schedule coordination
3.4.03	**Unforeseen Site Conditions - Construction**	Site conditions unforeseen or unable to be examined by preliminary site testing and examination, e.g., unusable outfalls and bulkheads, soil condition, environmental condition, archeological remains, existence of protected wildlife, structural items such as tie-backs and bulkheads that involves redesign process and/or must be mitigated by applicable law.	Additional cost and schedule delays from redesign, input from engineers of record, increase of project scope, and further review and permitting process. Significant unforeseen site conditions may have impacts to the whole environmental assessment.
3.4.04	**Owner's Directed Changes - Construction**	Changes to the scope by the owner which will require redesign or demolition & reconstruction.	Redesign or rework resulting in additional cost or delay.
3.4.05	**Excessive Removal and Disposal of Hazardous Materials**	The site has been remediated, however contaminated materials may be discovered during the works. Not only can materials be present beyond the expected volumes, but market prices of removal and disposal fluctuate significantly.	Increase project costs and schedule delays
3.4.06	**Contractor Damage of Existing Infrastructure for which the Design substantially relies upon**	Contractor accidently damages existing infrastructure for which the design substantially replies upon, such as retention system, and bulkheads.	Increase project costs and schedule delays
3.4.07	**Ground Settlement**	Unexpected ground settlement/movement during construction may impact the work limits of the project, adjacent infrastructure such as footprint power and the selected construction means and methods.	Schedule delays resulting from work stoppages, additional cost resulting from additional repair scope.
3.4.08	**Obstructions during piling**	There is a risk that obstructions are encountered during the piling operations leading to rework.	Schedule delays resulting from work stopages, additional costs resulting from rework.
3.4.09	**Safe working at/near gas lines**	The exsting gas pipeline to Footprint power is located on the project site. Special considerations are required when working in proximity to this.	
4	**Health, Safety, and Environment**		
4.1.01	**Safety Practice**	This may be due to contractor being unaware of necessary safety requirements for the site.	Schedule delays
4.1.02	**Injuries to Personnel at Construction Site**	Construction accidents at the site	Schedule delays

Scale		Probability/ Likelihood	Impact	Probability		Cost (1000's)		Schedule	
				Min	Max	Min	Max	Min	Max
Very Low	1	Unlikely to occur	Negligible impact	0%	10%	$ -	$ 100	0	30
Low	2	Low probability to occur	Minor impact on schedule, cost	10%	25%	$ 101	$ 250	31	40
Medium	3	Medium probability of occurance	Notable impact on schedule, cost	25%	40%	$ 251	$ 450	41	90
High	4	high probability to occur	Substantial impact on schedule, cost	40%	50%	$ 451	$ 1,000	91	120
Very High	5	greater than 50% chance to occur	Threatens success of the project	50%	100%	$ 1,001		121	

Heat Map

Probability						
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
			Cost/Schedule			

Date: May 16, 2022

Subject: Salem Wind Port Project: Benefit-Cost Analysis Technical Memorandum

Table of Contents

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Acronyms and Abbreviations

BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
OSW	Offshore Wind
O&M	Operations and Maintenance
PIDP	Port Infrastructure Development Program
SOGR	State of Good Repair
WTIV	Wind Turbine Installation Vessel
USDOT	United States Department of Transportation

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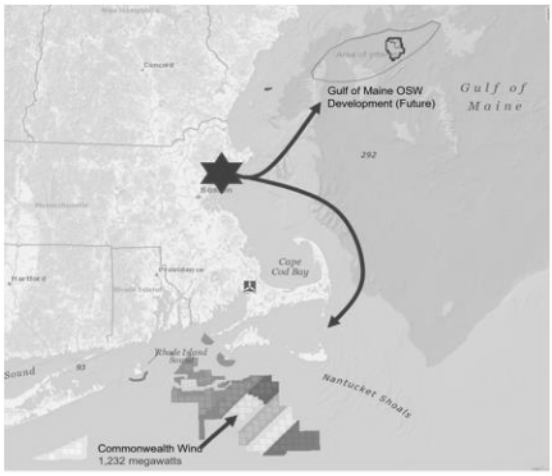
1. INTRODUCTION

This technical memorandum presents the long-term benefits and costs associated with the development of the Salem Wind Port Project (the Project) in Salem, Massachusetts. The terminal is uniquely located to serve as a regional marshalling port for the installation of offshore wind (OSW) turbines. The proposed investment will upgrade the port infrastructure to support the import, staging, pre-assembly, and load-out of large OSW components. A benefit-cost analysis (BCA) was conducted to support the City of Salem's grant application for the U.S. Department of Transportation's (USDOT) 2022 Port Infrastructure Development Program (PIDP).

The Project is being developed through a public-private partnership between the City of Salem and Crowley Wind Services (Crowley). The project partners have created a plan to repurpose a remediated brownfield site that once held a coal-fired power plant, into a modern, purpose-built wind services port. The Project will construct a new wharf and deck with sufficient space and weight capacity to load and unload vessels, as well as prepare a laydown area to receive and store components. As the Project will serve the OSW industry, both the wharf and deck will be built to handle associated oversized and overweight cargoes.

The Project will be able to support the extensive OSW development occurring off of the coasts of Massachusetts and Rhode Island, as well as anticipated development in the Gulf of Maine (Figure 1). The Project will initially support Avangrid Renewables in the development of the Park City Wind and Commonwealth Wind lease areas off the coast of Massachusetts.

Figure 1. Salem location in Relation to OSW Development



2. REVIEW OF POTENTIAL PORTS

Due to the unique characteristics needed to support the OSW industry, very few ports are currently available or are actively being redeveloped to support OSW. Potential ports were reviewed to identify alternative ports that could support development of the Park City Wind and Commonwealth Wind lease areas. Table 1 summarizes the characteristics of alternative ports.

Table 1. Review of Port Characteristics

Port Name	State	Distance to Commonwealth (nm)	Laydown Area (acres)	Quayside Length (m)	Number of Berths	Berth Depth (m)	Channel Depth (m)	Bearing Capacity (t/m2)	Air Draft Limit	Readiness for WTIV	Readiness for Feeders	Availability/ Comments
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
Searsport	ME	278	70	270	2	12.2	11	5	no	no 2,3	no 2,3	Needs redevelopment; more distant from North Atlantic wind farm cluster than Salem
Brayton Point	MA	55	140	210	2	10.5	10.2	9.8	41.2	no 1,2,3	no 1,2,3	Committed 47-acre cable production facility
New Bedford	MA	51	29	366	3	9.1	9.1	20t/m 2	no	no 1,3	yes	Committed
Boston Autoport	MA	190	81	332	4	11.9	11.1	9,8t/m 2	41	no 2,3 airdraft	no 2,3	Committed – automobiles
Providence S. Quay	RI	55	20	1280	3	11.5	10.7		62.8	no 1,2 laydow n airdraft	no 2 laydow n	Unimproved, needs redevelopment, air draft restriction
Quonset Point	RI	45	60	1400	4	9.8	9.8		62.8	no 1,2 airdraft	possibl e2	Committed – automobiles
New London State Pier	CT	85	30	1244	4	12.2	10	Assum e >15	no	no 1	yes	Committed
Port of Bridgeport	CT	125	18.3	375	3	9.8	8.5		no	no 1,2,3 laydow n	no 2,3 laydow n	Committed—in redevelopment
All ports below are more distant from the Commonwealth Wind and nearby cluster of wind farms than the Salem location.												

Port Name	State	Distance to Commonwealth (nm)	Laydown Area (acres)	Quayside Length (m)	Number of Berths	Berth Depth (m)	Channel Depth (m)	Bearing Capacity (t/m2)	Air Draft Limit	Readiness for WTIV	Readiness for Feeders	Availability/ Comments
Port of Coeymans	NY	325	125	1067	3	9.2	9.2	19.5 t/m2	41.2	no plan 4	yes	Needs redevelopment but not feasible as planned for mfg
Port of Albany	NY	325	300	1798	3	9.2	9.2	5 t/ m2 & 10 t/m2	40.2	no plan 4	yes	Committed—in redevelopment but planned for mfg
South Brooklyn Marine Terminal	NY	200	88	417	2	10.7	12.2	30	60	no 1,3 airdraft	3	Committed—in redevelopment
Arthur Kill Terminal	NY	184	32	411	2	10.7	10.7	30	no	no 1,3	3	Unknown but more distant than Salem
New Jersey Wind Port	NJ	300	180	854	4	10.8	10.8	Assum e >15	no	no 1	yes	In redevelopment - committed
Port of Paulsboro	NJ	356	195	260	3	12.2	13.7		53	no 2,3 airdraft	no 2,3	Committed
Tradepoint Atlantic	MD	560	3300	1021	2	11.0	11.0		no	no 1,2,5	yes	Committed
Portsmouth	VA	425	287	1079	3	13.1	13.1	Assum e >15 t/m2	no	yes	yes	Committed
Newport News	VA	418	165	1061	4	12.2	12.2		yes	no 2 airdraft	no 2	Dedicated to VPA military and non-container commercial trade

Notes: (1) indicates concern about channel depth; (2) indicates concern about bearing capacity; (3) indicates concern about quayside length; (4) Ports of Coeymans and Albany are planned as manufacturing ports and do not plan to support WTIVs; (5) Tradepoint has invested in bearing capacity but the resulting metrics are not known publicly so bearing capacity is listed as a possible concern although the port is committed.

Source: Shields, Matt, Ruth Marsh, Jeremy Stefek, Frank Oteri, Ross Gould, Noé Rouxel, Katherine Diaz, Javier Molinero, Abigayle Moser, Courtney Malvik, and Sam Tirone. 2022. The Demand for a Domestic Offshore Wind Energy Supply Chain. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-81602. https://www.nrel.gov/docs/fy22osti/81602.pdf.. See Appendix A, Project Team analysis, and industry articles on status of individual ports Items c and m from Project Team analysis and press reports. All other columns from NREL, 2022.

3. WITH-PROJECT AND WITHOUT-PROJECT CONDITIONS

The following describe the with-project (i.e., Project) condition and without-project (i.e., baseline) condition, which determines the impacts of the Project and the resulting benefits and costs.

3.1 With-Project Condition

Upon completion of the Project, the infrastructure upgrades would remake Salem Harbor into a modern, heavy-lift capable port that is able to meet the facility requirements of the OSW industry and to support other bulk handling. Salem Harbor would serve as a regional marshaling port for the installation of offshore wind turbines, with feedering vessels supplying the wind turbine installation vessels (WTIVs) operating in the lease areas. It would be one of the few facilities in the region with no air draft restrictions. As such, the port would allow for the use of purpose-built feedering vessels that can carry pre-assembled towers (which, if loaded vertically on the deck of a barge or vessel, will be over 300 feet tall) and all other turbine components in a single trip.

During development of the Park City Wind and the Commonwealth Wind lease areas and the other lease areas in the Massachusetts-Rhode Island area, Salem Harbor is the closest port with available capacity. It is 150 nm from the lease areas, which is considerably closer than the Port of Argentia (830 nm) and other ports that may have capacity after 2030.

Salem Harbor will also be well positioned to support the development of new OSW areas that are anticipated to be leased and developed, including floating OSW development that is expected to occur in the Gulf of Maine.

In addition to OSW installation activities, Salem Harbor would function as a staging port for operations and maintenance activities for the OSW fields and would be available for heavy lift and bulk imports/exports for other industries. Because Salem Harbor is being designed to have a 50-year life span, the port would have the requirements to support "repowering" of the wind turbines that reach the end of their design life.

3.2 Without-Project Condition

Salem Harbor currently has limited capabilities to support the shipping needs of the region and no capabilities to support the development of OSW. Because the facility cannot support heavy-lift capabilities, OSW wind developers will need to use other ports for marshalling of OSW components (nacelle, tower, blades) if the Project is not implemented. Due to the unprecedented expansion of OSW, other ports in the region that have (or are planned to have) the facilities to support OSW (e.g., New

Bedford, MA, New London, CT, New Jersey Wind Port, NJ, etc.) are already engaged/contracted with other developers and will be operating at full capacity for years to come. Because OSW developers without port contracts have already made significant investments in obtaining lease areas and are under pressure from stakeholders and electricity companies to become operational and produce electricity, it is anticipated that developers would move forward with installation of turbines using facilities that are available, even if that requires using ports that are outside of the region and/or country.

The Project will initially support Avangrid Renewables in the development of the Park City Wind and Commonwealth Wind lease areas off the coast of Massachusetts. The closest port anticipated to have capacity to support development of these lease areas is the Port of Argentia in Newfoundland, Canada, which is 830 nautical miles (nm) from the lease areas. The Port of Argentia, which is a heavy industry seaport at the site of a former American naval base, has experience with wind power and is currently being considered by developers to support U.S. OSW while construction of U.S. ports is completed. Therefore, it is anticipated that Avangrid and other developers will use the Port of Argentia as a marshalling area for OSW components until port capacity closer to their lease areas is available.

Although other ports in the region are under 20-year lease contracts with OSW developers, capacity to support the Park City Wind and Commonwealth Wind lease areas may be available after 2030 through sub-leases. However, it is uncertain which port, if any, would have capacity. If sufficient port capacity was available, it is anticipated that the developers would relocate marshalling operations to reduce the transit cost from the port to their lease areas. Due to the uncertainty of where capacity could be available, the without-project conditions assume that there is an equal chance of performing marshalling operations from the following ports after 2030:

- Brooklyn, New York (200 nm from lease areas)
- New Bedford, Massachusetts (51 nm)
- New Jersey Wind Port, New Jersey (300 nm)
- New London, Connecticut (85 nm)
- Newport News, Virginia (418 nm)
- Port of Argentia, Newfoundland (830 nm)

4. ANALYSIS FRAMEWORK

The parameters of the benefits analysis follow the protocols set by the Office of Management and Budget (OMB) Circular A-94 and the USDOT 2022 *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* document[1] (BCA Guidance). Generally, standard factors and values accepted by

[1] USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs, March 18, 2022 (https://www.transportation.gov/office-policy/transportation-policy/benefit-cost-analysis-guidance-discretionary-grant-programs-0)

Federal agencies were used for the benefits calculation except in cases where more project-specific values or prices were available. In all such cases, modifications are noted, and references are provided for data sources. The analysis follows a conservative estimation of the benefits. By adhering to a strict standard of what could be included in the benefits analysis, actual total benefits may be greater than depicted in the results.

The with-project conditions (Project) were compared to the without-project conditions (baseline) to identify the impacts and measure the benefits and costs. A custom model was developed to estimate the future benefits for the Project. Benefits were estimated over a 20-year period of analysis beginning when construction ends and concluding after 20 years of operations. The construction period is planned to begin in 2023 and be complete in 2024, with operations beginning in 2025. Thus, the period of analysis was from 2025 through 2044.

The benefits are expressed in constant 2020 dollars, which avoids forecasting future inflation and escalating future values for benefits and costs accordingly. The BCA Guidance deflator and gross domestic product chained price index from the OMB were used to adjust past cost estimates or price values to a 2020 price level. The use of constant dollar values requires the use of a real discount rate for discounting to the present value. The results are the discounted streams of anticipated benefits and costs using a base year of 2020 and a 7 percent discount rate.

5. ANALYSIS ASSUMPTIONS

A list of assumptions used to complete the BCA for the Project is provided in Table 2 as well as in the BCA workbook (see "Inputs" tab in the file Salem Wind Port-BCA Workbook.xlsx).

Table 2. BCA Calculation Inputs

Input	Value	Source
General		
Dollar Year	2020	2022 BCA Guidance for Discretionary Grant Programs
Discount Rate	7.0%	
Discount Rate (CO2)	3.0%	
Discount Year	2020	
Period of Analysis (years)	20	
Construction Begins	2023	Crowley
Operations Begin	2025	Crowley
Annual O&M Cost	$1,200,000	Crowley
Economic Competitiveness		
Distance to Lease Area	Nautical Miles	

Input	Value	Source
Salem, MA	150	Crowley
Brooklyn, NY	200	Crowley
New Bedford, Ma	51	Crowley
New London, CT	85	Crowley
Newport News, VA	418	Crowley
New Jersey Wind Port, NJ	300	Crowley
Port of Argentia, Canada	830	Crowley
Turbines assembled per year - Phase 1	40	Crowley
Turbines per barge	1	Crowley (barges can carry 2 turbines, but limited to 1 by Jones Act)
Transit speed - outgoing (loaded)	8	Crowley
Transit speed - inbound (unloaded)	8	Crowley
Tug and barge - hourly operating cost (loaded)	$2,000	Crowley
Tug and barge - hourly operating cost (unloaded)	$1,500	Crowley
Engine Loading Factor - outbound (loaded)	80%	Crowley
Engine Loading Factor - inbound (unloaded)	70%	Crowley
Engine Fuel consumption rate (g/kw-h)	185	BOEM Offshore Wind Energy Facilities Emission Estimating Tool Technical Documentation https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Wind-Power-Technical-Documentation_2017_079-%281%29.pdf
Environmental Sustainability		
Conversion rate for grams per metric ton	1,000,000	https://www.metric-conversions.org/weight/grams-to-metric-tons.htm
Conversion rate for kg per metric ton	1,000	https://www.metric-conversions.org/weight/grams-to-metric-tons.htm
Emissions rates per vessel		See "Emission Reduction - Transit" worksheet
Social Cost of Emissions		
Social Cost of CO2	2020$ per Metric Ton	2022 BCA Guidance for Discretionary Grant Programs

Input	Value	Source
2021	$52	
2022	$53	
2023	$54	
2024	$55	
2025	$56	
2026	$57	
2027	$58	
2028	$60	
2029	$61	
2030	$62	
2031	$63	
2032	$64	
2033	$65	
2034	$66	
2035	$67	
2036	$69	
2037	$70	
2038	$71	
2039	$72	
2040	$73	
2041	$74	
2042	$75	
2043	$77	
2044	$78	
2045	$79	
2046	$80	
2047	$81	
2048	$82	
2049	$83	
2050	$85	
Social Cost of NOx	2020$ per Metric Ton	2022 BCA Guidance for Discretionary Grant Programs
2021	$15,600	

Input	Value	Source
2022	$15,800	
2023	$16,000	
2024	$16,200	
2025	$16,500	
2026	$16,800	
2027	$17,100	
2028	$17,400	
2029	$17,700	
2030	$18,100	
2031	$18,100	
2032	$18,100	
2033	$18,100	
2034	$18,100	
2035	$18,100	
2036	$18,100	
2037	$18,100	
2038	$18,100	
2039	$18,100	
2040	$18,100	
2041	$18,100	
2042	$18,100	
2043	$18,100	
2044	$18,100	
2045	$18,100	
2046	$18,100	
2047	$18,100	
2048	$18,100	
2049	$18,100	
2050	$18,100	
Social Cost of PM2.5	2020$ per Metric Ton	2022 BCA Guidance for Discretionary Grant Programs
2021	$748,600	
2022	$761,600	

Input	Value	Source
2023	$774,700	
2024	$788,100	
2025	$801,700	
2026	$814,500	
2027	$827,400	
2028	$840,600	
2029	$854,000	
2030	$867,600	
2031	$867,600	
2032	$867,600	
2033	$867,600	
2034	$867,600	
2035	$867,600	
2036	$867,600	
2037	$867,600	
2038	$867,600	
2039	$867,600	
2040	$867,600	
2041	$867,600	
2042	$867,600	
2043	$867,600	
2044	$867,600	
2045	$867,600	
2046	$867,600	
2047	$867,600	
2048	$867,600	
2049	$867,600	
2050	$867,600	
Social Cost of SOx	2020$ per Metric Ton	2022 BCA Guidance for Discretionary Grant Programs
2021	$41,500	
2022	$42,300	
2023	$43,100	

Input	Value	Source
2024	$44,000	
2025	$44,900	
2026	$45,700	
2027	$46,500	
2028	$47,300	
2029	$47,200	
2030	$49,100	
2031	$49,100	
2032	$49,100	
2033	$49,100	
2034	$49,100	
2035	$49,100	
2036	$49,100	
2037	$49,100	
2038	$49,100	
2039	$49,100	
2040	$49,100	
2041	$49,100	
2042	$49,100	
2043	$49,100	
2044	$49,100	
2045	$49,100	
2046	$49,100	
2047	$49,100	
2048	$49,100	
2049	$49,100	
2050	$49,100	

6. BENEFITS ANALYSIS

The BCA focused on the reduced distance of transporting the OSW components from the marshalling port to the installation site related to the Project, primarily vessel operating cost savings and emissions reductions. Activities at the installation site would be the same no matter which port is used. Since operation and maintenance activities of the wind turbines are anticipated to be the same following installation, these activities were not evaluated separately as part of the BCA. In addition, any electricity generation benefits associated with OSW compared to traditional electricity generation were not evaluated. The methods used to estimate the benefits of the Project are described in the following sections based on the desired outcomes listed in the Notice of Funding Opportunity (NOFO).

The Project will provide other benefits to the nation that were not quantified for the BCA, including:

- safety benefits from less time operating at sea;
- ability to fully assemble the wind turbine tower at the Project site, saving assembly time at sea;
- the cost-avoided benefit of developing other ports to serve OSW (appropriate facilities do not currently exist at other ports);
- ability to support other vessels needed for the operation of an OSW farm, such as maintenance vessels;
- ability to use the port for heavy-lift bulk items (not OSW related); and
- support for seasonal cruise ships that visit Salem.

6.1 Vessel Operating Cost Savings

Because Salem Harbor is closer to the lease areas than other available ports, significant vessel operating cost savings can be achieved with the Project relative to the without-project condition (baseline). The savings are assessed based on the maximum capacity for marshalling OSW turbines at the Project site and are comprised of vessel hourly operation and maintenance costs, including crew wages and fuel.

It is planned that an ocean-going tug and barge will be used to transport OSW components from the marshalling port to a WTIV in the lease area (referred to as feedering) in both the baseline and with-project conditions. Feedering with a tug and barge will save the time and expense of having the WTIV transiting to the marshalling port to load the OSW components. Although a tug and barge can carry components for two complete OSW turbines, Jones Act restrictions limit the tug to carrying only the components for one turbine per trip. The tug and barge will travel at a speed of 8 knots while transiting between the marshalling port and the WTIV. While an unloaded tug and barge can travel faster than 8 knots, there are vessel speed restrictions associated with right whales.

Given the active turbine installation season is expected to run from April 1 through October 31, it is anticipated that the Project will be able to support the marshalling and installation of 40 turbines per year. The active campaign season could be extended into March and November, but this potential season extension was not factored into the BCA.

As described in Section 2, there are a limited number of ports that are available (or will be available) to support OSW development in the lease area offshore of Massachusetts and Rhode Island. If the Project is not implemented, it is anticipated that the OSW developer would use the next closest port for marshalling the OSW components. The closest port anticipated to have capacity to support development of these lease areas is the Port of Argentia in Newfoundland, Canada, which is 830 nautical miles (nm) from the lease areas. Although other ports in the region are under 20-year lease contracts with OSW developers, capacity to support the Park City Wind and Commonwealth Wind lease areas may be available after 2030 through sub-leases. However, it is uncertain which port, if any, would have capacity. If sufficient port capacity was available, it is anticipated that the developers would relocate marshalling operations to reduce the transit cost from the port to the lease areas. Due to the uncertainty of where capacity could be available, the without-project condition assumes that there is an equal chance of staging marshalling operations from the following ports after 2030:

- Brooklyn, New York (200 nm from lease areas)
- New Bedford, Massachusetts (51 nm)
- New Jersey Wind Port, New Jersey (300 nm)
- New London, Connecticut (85 nm)
- Newport News, Virginia (418 nm)
- Port of Argentia, Newfoundland (830 nm)

To estimate the transit distance from marshalling port to installation area for the without-project conditions, the Port of Argentia was used from 2025 through 2030, then the distance of the six potential ports was averaged to estimate the transit distance from 2031 through 2044. Table 3 summarizes the percent of use and estimated transit distances for selected years over the 20-year period of analysis.

Table 3. Estimated Transit Distances For the Without-Project Condition

Port	Distance (nm)	2025	2030	2031	2035	2040	2044
Brooklyn, NY	200	0%	0%	16.7%	16.7%	16.7%	16.7%
New Bedford, Ma	51	0%	0%	16.7%	16.7%	16.7%	16.7%
New Jersey Wind Port, NJ	300	0%	0%	16.7%	16.7%	16.7%	16.7%
New London, CT	85	0%	0%	16.7%	16.7%	16.7%	16.7%
Newport News, VA	300	0%	0%	16.7%	16.7%	16.7%	16.7%
Port of Argentia, Canada	830	100%	100%	16.7%	16.7%	16.7%	16.7%
Average Distance (nm)		**830**	**830**	**294**	**294**	**294**	**294**

Salem Harbor is 150 nm from the lease areas. Implementation of the Project will result in a significant savings in transit time from the marshalling port to the WTIV in the lease area compared to the without-project conditions. As mentioned earlier, an ocean-going tug and barge can travel at a speed of 8 knots while transiting between the marshalling port and the WTIV. Table 4 presents the hours of transit time saved for selected years for each leg of a round trip from the marshalling port to the lease area and back again.

Table 4. Hours of Transit Time Saved

Category	2025	2030	2031	2035	2040	2044
Distance saved for each leg of trip (nm)	680	680	164	164	164	164
Transit time savings (hours) - outbound	85	85	21	21	21	21
Transit time savings (hours) - inbound	85	85	21	21	21	21

The estimated hourly operating expenses for ocean tug and barge while in transit were estimated based on the use of similar tug and barge configurations. It was estimated that the hourly operating cost is $2,000[2] for loaded barges transiting to the lease area and $1,500 for empty barges transiting to port. The hourly operating cost includes fuel, labor, maintenance, and other indirect costs (e.g., insurance). Table 5 presents the annual distance saved and annual operating savings.

Table 5. Annual Operating Savings

Category	2025	2030	2031	2035	2040	2044
Transit Savings (nm)	54,400	54,400	13,100	13,100	13,100	13,100
Operating Hours Saved	6,800	6,800	1,600	1,600	1,600	1,600
Operating Savings	**$11,900,000**	**$11,900,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**

The annual operating savings for each year were discounted at 7 percent to a base year of 2020. **The total vessel operating cost savings of the Project amount to $56.0 million.**

6.2 Emissions Reductions

The Project would result in emissions reductions through reductions in total transit distances traveled between the marshalling port and the lease area. Vessel emission rates based on the U.S. Bureau of Ocean Energy Management (BOEM)'s Offshore Wind Energy Facilities Emission Estimating Tool[3] for nitrogen oxide (NO_x), particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2) and carbon dioxide (CO_2) were applied to the annual energy consumption reductions. The analysis applies the following equation to

[2] Crowley

[3] BOEM, 2014. Offshore Wind Energy Facilities Emission Estimating Tool: Technical Documentation. https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Wind-Power-Technical-Documentation_2017_079-%281%29.pdf

derive total annual emissions per type of vessel to derive emissions saved by the Project relative to the without-project condition.

The general equation for calculating the emissions from a vessel:

Vessel Emissions (tons) = [**Main** Engine Power Rating (kW) x Loading Factor x Activity Hours (hours) x Emission Factor (g/kW-hour) x (1 lb /454 g) x (1 ton / 2000 lb) x (# of Sources)] + [**Auxiliary** Engine Power Rating (kW) x Loading Factor x Activity Hours (hours) x Emission Factor (g/kW hour) x (1 lb /454 g) x (1 ton / 2000 lb) x (# of Sources)]

Source: BOEM, 2014. Offshore Wind Energy Facilities Emission Estimating Tool: Technical Documentation. https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Wind-Power-Technical-Documentation_2017_079-%281%29.pdf

The analysis applies BOEM's suggested energy consumption rates to the annual vessel transit time to determine total kilowatt hour (kW-h) consumed by tugs for the main engines. Table 6 presents the vessels emission rates in grams per kW-h. The emission rates were multiplied by the engine power rating of the tug (8,113 kWs) and loading factor when transiting (80 percent when loaded, 70 percent when unloaded) to calculate the grams per hour. The grams per hour were multiplied by the reduced transit time per trip, the number of trips per year (40), and a gram-to-ton conversion factor to estimate the annual metric tons of emissions saved. The resulting tons were multiplied by the social costs of the emissions provided in the BCA Guidance.

Table 6. Marine Vessel Emission Factors (grams per kW-h)

Engine	Type	NOX	PM2.5	SO2	CO2
Main	Anchor Handling Tugs	9.26	0.330	0.07870	636.0
Main	Barge	13.6	0.420	0.36200	589.0
Main	Crew	9.15	0.300	0.00624	648.0
Main	Jackup	10.00	0.298	0.01270	647.0
Main	Tug	9.52	0.316	0.03330	644.0
Main	Shuttle Tanker	9.05	0.420	0.36200	589.0
Auxiliary	Anchor Handling Tugs	9.88	0.310	0.006	648.0
Auxiliary	Barge	12.60	0.310	0.006	648.0
Auxiliary	Crew	10.40	0.310	0.006	648.0
Auxiliary	Jackup	11.50	0.310	0.006	648.0
Auxiliary	Tug	10.10	0.310	0.006	648.0
Auxiliary	Shuttle Tanker	9.80	0.310	0.006	648.0

Source: Jacobs, 2019. South Fork Wind Farm and South Fork Export Cable Air Emissions Inventory - Calculations and Methodology. Prepared using the BOEM emissions estimating tool. https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/App-L_SFWF_AirEmissionsInventory_2019_05_17.pdf

Table 7 provides the results of the emissions analysis. The annual emissions savings were discounted at 7 percent, except for CO_2 which was discounted at 3 percent, to a base year of 2020. **The total emissions savings of the Project amount to $95.6 million.**

Table 7. Emissions Saving

Port	2025	2030	2031	2035	2040	2044
CO2 Savings per Year (metric tons)	26,646	26,646	6,426	6,426	6,426	6,426
NOx Savings per Year (metric tons)	394	394	95	95	95	95
PM2.5 Savings per Year (metric tons)	13	13	3	3	3	3
SO2 Savings per Year (metric tons)	1	1	0	0	0	0
Total Value	**$18,540,000**	**$20,190,000**	**$4,880,000**	**$4,900,000**	**$4,940,000**	**$4,970,000**

6.3 Residual Value

Some Project elements would have a residual value at the end of the analysis period because their useful lives are longer than 20 years. These long-lasting/durable infrastructure elements have service/design lives of 50 years and were separated out from the engineering cost estimate.

The residual value of the infrastructure at the end of the 20-year analysis period was summed and discounted. The present value of the residual value of the Project at the end of a 20-year period of analysis is $5.2 million, discounted at 7 percent.

7. COSTS ANALYSIS

Costs include capital costs of the Project and operation and maintenance (O&M) costs.

7.1 Capital Costs

Capital costs for the Project include design/planning/permitting/closeout activities, pier upgrade activities, grading, and utility activities. While some design work will be completed in 2022, the capital costs for the Project will be expended over the 2-year construction period beginning in 2023 and ending in 2024. The costs for 2023 and 2024 were adjusted to a 2022 price level to account for a 4.5 percent inflation factor that was applied to the engineering estimate to arrive at a year of expenditure estimate.

The costs were then deflated to 2020 dollars (Table 8) using the deflator provided in the BCA Guidance. It should be noted that the costs include some engineering and design efforts that are not included in the costs for the grant application. While they are Project related costs, and therefore should be included in the total costs for the BCA, they will have been expended prior to award of PIDP funding. A 7 percent discount rate was applied to all costs. **The capital costs for the Project total $54.3 million in 2020 dollars. When discounted to 2020 using a 7 percent discount rate, the total is $42.3 million.**

Table 8. Project Costs (2020$)

Major Cost Category	2022	2023	2024	Total
Engineering/Design	$2,274,941*	$740,998	$0	$3,015,938
Construction Management / Administration	$0	$1,220,318	$1,557,026	$2,777,344
NEPA and Permitting	$188,182	$203,094	$0	$391,275
Environmental Controls Allowance	$0	$26,249	$75,355	$101,604
Civil Demolition	$0	$796,150	$0	$796,150
Laydown Area Improvements	$0	$0	$3,562,307	$3,562,307
Site Improvements	$0	$0	$1,545,561	$1,545,561
Water System Allowance	$0	$0	$100,474	$100,474
PAZ Combi-Wall Steel Bulkhead	$0	$4,654,039	$5,443,321	$10,097,360
Foundation Piles - Heavy Lift Platform	$0	$4,365,790	$9,748,176	$14,113,967
Concrete Bulkhead Cap	$0	$0	$4,204,558	$4,204,558
Concrete Heavy Lift Platform	$0	$0	$13,377,849	$13,377,849
Electrical Infrastructure Allowance	$0	$0	$188,388	$188,388
Total	**$2,463,122**	**$12,006,638**	**$39,803,015**	**$54,272,775**

Note: includes costs spent prior to notice of award

7.2 Operation and Maintenance

In bringing the Salem Harbor to a state of good repair, the Project would increase required annual O&M. Based on existing port infrastructure on similar nature, it is estimated that annual O&M costs at Salem Harbor would be $1,200,000[4]. **The total cost of the O&M discounted at 7 percent over the 20-year period of analysis is $9.7 million.** Per BCA Guidance, the O&M costs were included in the benefit portion of the BCA (i.e., O&M was considered a negative benefit as opposed to a cost).

[4] Crowley

8. BCA RESULTS

The BCA results in a benefit-cost ratio (BCR) of 3.4 and net present value of $103.3 million when discounted at a rate of 7 percent. The results of the BCA are summarized in Table 9.

Table 9. Benefit-Cost Analysis Summary

Category	Project Total ($millions)
Costs	
Capital Costs	$42.3
Benefits	
Operating Savings	$56.0
Emissions Reduction	$95.6
Residual Value	$5.2
Operating and Maintenance Costs	-$9.7
Total Benefits	*$147.1*
Net Benefits	**$104.8**
Benefit/Cost Ratio	**3.5**

Value of Benefits & Costs (2020$ M)	
Costs	**Value**
Capital Costs	$42.3
Benefits	
Economic Competitiveness	
Operating Savings-Transit	$56.0
State of Good Repair	
Residual Value	$5.2
Environmental Sustainability	
Emissions Reduction-Transit	$95.6
Operating and Maintenance Costs	-$9.7
Total Benefits	**$147.1**
Results	
Net Benefits	**$104.8**
BCR	***3.5***

Notes:

- 2020 price level
- discount rate of 7%
- 2020 base year
- 20-year period of analysis

Input	Value	Source
General		
Dollar Year	2020	2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Discount Rate	7.0%	
Discount Rate (CO2)	3.0%	
Discount Year	2020	
Period of Analysis	20	
Construction Begins	2023	Crowley
Operations Begin	2025	Crowley
Annual O&M Cost	$1,200,000	Crowley
Economic Competitiveness		
Distance to Lease Area (nautical miles)		
Salem, MA	150	Crowley
Brooklyn, NY	200	Crowley
New Bedford, MA	51	Crowley
New London, CT	85	Crowley
Newport News, VA	418	Crowley
New Jersey Wind Port, NJ	300	Crowley
Port of Argentia, Canada	830	Crowley
Turbines assembled per year - Phase 1	40	Crowley
Turbines per barge	1	Crowley (barges can carry 2 turbines, but limited to 1 by Jones Act)
Transit speed - outgoing (loaded)	8	Crowley
Transit speed - inbound (unloaded)	8	Crowley
Tug and barge - hourly operating cost (loaded)	$2,000	Crowley
Tug and barge - hourly operating cost (unloaded)	$1,500	Crowley
Engine Loading Factor - outbound (loaded)	80%	Crowley
Engine Loading Factor - inbound (unloaded)	70%	Crowley
Engine Fuel consumption rate (g/kw-h)	185	BOEM Offshore Wind Energy Facilities Emission Estimating Tool Technical Documentation https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Wind-Power-Technical-Documentation_2017_079-%281%29.pdf
Evironmental Sustainability		
Conversion rate for short-ton per gram	0.000001102	2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Conversion rate for grams per metric ton	1,000,000	https://www.metric-conversions.org/weight/grams-to-metric-tons.htm
Conversion rate for kg per metric ton	1,000	
Conversion rate for lbs. per short ton	2,000	
Conversion rate for grams per gallon	3225.6	https://www.convertunits.com/from/gallon/to/ton
Conversion rate for gallons per metric ton	264	
Miles per hour per knot	1.151	MARAD, 2019. A Guide to Fuel, Lubricant, and Engine Concerns Relative to the IMO 2020 Fuel Oil Sulfur Reduction Mandate https://www.maritime.dot.gov/sites/marad.dot.gov/files/docs/innovation/meta/12166/maradprimerornl-draft-12122019final-v1-003.pdf
Emissions rates per vessel		See "Emission Reduction - Transit" worksheet
Social Cost of Carbon		
Social Cost of CO2	2020$ per Metric Ton	2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
2021	$52	
2022	$53	
2023	$54	
2024	$55	
2025	$56	
2026	$57	
2027	$58	
2028	$60	
2029	$61	
2030	$62	
2031	$63	
2032	$64	
2033	$65	
2034	$66	
2035	$67	
2036	$69	
2037	$70	
2038	$71	
2039	$72	
2040	$73	
2041	$74	
2042	$75	
2043	$77	
2044	$78	
2045	$79	
2046	$80	
2047	$81	
2048	$82	
2049	$83	
2050	$85	
Social Cost of NOx	2020$ per Metric Ton	2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
2021	$15,600	
2022	$15,800	
2023	$16,000	
2024	$16,200	
2025	$16,500	
2026	$16,800	
2027	$17,100	
2028	$17,400	
2029	$17,700	
2030	$18,100	
2031	$18,100	
2032	$18,100	
2033	$18,100	
2034	$18,100	
2035	$18,100	
2036	$18,100	

2037	$18,100
2038	$18,100
2039	$18,100
2040	$18,100
2041	$18,100
2042	$18,100
2043	$18,100
2044	$18,100
2045	$18,100
2046	$18,100
2047	$18,100
2048	$18,100
2049	$18,100
2050	$18,100
Social Cost of PM2.5	2020$ per Metric Ton
2021	$748,600
2022	$761,600
2023	$774,700
2024	$788,100
2025	$801,700
2026	$814,500
2027	$827,400
2028	$840,600
2029	$854,000
2030	$867,600
2031	$867,600
2032	$867,600
2033	$867,600
2034	$867,600
2035	$867,600
2036	$867,600
2037	$867,600
2038	$867,600
2039	$867,600
2040	$867,600
2041	$867,600
2042	$867,600
2043	$867,600
2044	$867,600
2045	$867,600
2046	$867,600
2047	$867,600
2048	$867,600
2049	$867,600
2050	$867,600
Social Cost of SOx	2020$ per Metric Ton
2021	$41,500
2022	$42,300
2023	$43,100
2024	$44,000
2025	$44,900
2026	$45,700
2027	$46,500
2028	$47,300
2029	$47,200
2030	$49,100
2031	$49,100
2032	$49,100
2033	$49,100
2034	$49,100
2035	$49,100
2036	$49,100
2037	$49,100
2038	$49,100
2039	$49,100
2040	$49,100
2041	$49,100
2042	$49,100
2043	$49,100
2044	$49,100
2045	$49,100
2046	$49,100
2047	$49,100
2048	$49,100
2049	$49,100
2050	$49,100

2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs

2022 Benefit-Cost Analysis Guidance for Discretionary Grant Programs

Current Status/Baseline & Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts	Affected Population	Economic Benefit ($2018 M, 7% Discount Rate)	Page Reference in BCA
Planned wind turbine generation (WTG) off the East Coast require available port area for the import, staging, and loadout of large offshore wind components. Developers are seeking ports that have direct access to a federally maintained deep-water channel, with 25 acres of upland space and heavy-lift capacity. Moreover, for the installation of the wind turbines, the industry relies on purpose-built wind turbine installation vessels (TIV) that can carry up to six pre-assembled towers, nacelles and blades per campaign. TIVs require air draft of at least 330 ft to accommodate the standing towers on deck. The port of New London, Connecticut is the sole facility in the Northeast Atlantic region that possesses these essential characteristics. The closest port that meet the requirements is the Port of Davisville, RI. However, air draft restrictions to access the open sea from Davisville requires a more traditional installation strategy, which relies on the use of a jack-up vessel, a supply barge to carry the components, a crew transfer vessel, two tugboats and a tanker for the installation of one turbine per campaign.	This project seeks to retrofit the existing Admiral Shear State Pier complex (State Pier) in New London so that it can serve as a regional WTG offshore wind staging port for the import, staging, preassembly, and loadout of large offshore wind components onto TIVs. Upgrades to the existing uplands, electrical system and marine infrastructure are required for New London to serve as the desired regional WTG staging port. The main benefits from this investment are the operational efficiencies that can be achieved by using a sole vessel to install six turbines per campaign relative to the more traditional installation strategy, the reduced fuel consumption and the reduced emissions. Moreover, offshore wind installation is a challenge due to the operation in the open ocean, frequently in harsh weather conditions leaving a narrow window for safe installation. Pre-installation at the harbour not only saves time offshore, but it also reduces exposure of crew during offshore operations, which is likely to reduce safety outcomes.	**Economic Competitiveness**			
		Operational efficiencies	Rate-paying public within the utiliy service area	$56.0	OpsEfficiencies
		#REF!	All residents of Rhode Island	#REF!	CapEx Saved
		State of Good Repair			
		Residual Value	Taxpayers	$5.2	Residual
		Environmental Sustainability			
		Emissions Savings (vessels)	All residents and non-residents	$95.60	Reduced Emissions

Capital and O&M Costs

Inputs

Dollar Year	2020
Discount Rate	7%
Discount Year	2020
Period of Analysis	20

Year	Capital Costs	O&M	Total Costs	PV of Capex	PV of O&M
2022	$2,463,122		$2,463,122	$2,151,386	
2023	$12,006,638		$12,006,638	$9,800,993	$0
2024	$39,803,015		$39,803,015	$30,365,530	$0
2025		$1,200,000	$1,200,000	$0	$855,583
2026		$1,200,000	$1,200,000	$0	$799,611
2027		$1,200,000	$1,200,000	$0	$747,300
2028		$1,200,000	$1,200,000	$0	$698,411
2029		$1,200,000	$1,200,000	$0	$652,720
2030		$1,200,000	$1,200,000	$0	$610,019
2031		$1,200,000	$1,200,000	$0	$570,111
2032		$1,200,000	$1,200,000	$0	$532,814
2033		$1,200,000	$1,200,000	$0	$497,957
2034		$1,200,000	$1,200,000	$0	$465,381
2035		$1,200,000	$1,200,000	$0	$434,935
2036		$1,200,000	$1,200,000	$0	$406,482
2037		$1,200,000	$1,200,000	$0	$379,889
2038		$1,200,000	$1,200,000	$0	$355,037
2039		$1,200,000	$1,200,000	$0	$331,810
2040		$1,200,000	$1,200,000	$0	$310,103
2041		$1,200,000	$1,200,000	$0	$289,816
2042		$1,200,000	$1,200,000	$0	$270,856
2043		$1,200,000	$1,200,000	$0	$253,136
2044		$1,200,000	$1,200,000	$0	$236,576
Total	**$51,809,653**	**$24,000,000**	**$75,809,653**	**$42,317,909**	**$9,698,547**

Major Cost Category	2022	2023	2024	Total
Engineering/Design	$2,352,967	$800,901		$3,153,868
Construction Management / Administration		$1,318,971	$1,758,629	$3,077,600
NEPA and Permitting	$194,636	$219,512		$414,148
Construction				$0
Environmental Controls Allowance		$28,371	$85,112	$113,483
Civil Demolition		$860,512		$860,512
Laydown Area Improvements			$4,023,553	$4,023,553
Site Improvements			$1,745,680	$1,745,680
Water System Allowance			$113,483	$113,483
PAZ Combi-Wall Steel Bulkhead		$5,030,280	$6,148,119	$11,178,399
Foundation Piles - Heavy Lift Platform		$4,718,728	$11,010,366	$15,729,094
Concrete Bulkhead Cap			$4,748,962	$4,748,962
Concrete Heavy Lift Platform			$15,110,007	$15,110,007
Electrical Infrastructure Allowance			$212,780	$212,780
Total				$60,481,569
	Includes cost spent prior to notice of award			

Applied inflation 4.5%

Remove inflation to 2022 dollars

Major Cost Category	2022	2023	2024	Total
Engineering/Design	$2,352,967	$766,412	$0	$3,119,379
Construction Management / Administration	$0	$1,262,173	$1,610,429	$2,872,602
NEPA and Permitting	$194,636	$210,059	$0	$404,695
Construction	$0	$0	$0	$0
Environmental Controls Allowance	$0	$27,149	$77,940	$105,089
Civil Demolition	$0	$823,456	$0	$823,456
Laydown Area Improvements	$0	$0	$3,684,488	$3,684,488
Site Improvements	$0	$0	$1,598,571	$1,598,571
Water System Allowance	$0	$0	$103,920	$103,920
PAZ Combi-Wall Steel Bulkhead	$0	$4,813,665	$5,630,017	$10,443,682
Foundation Piles - Heavy Lift Platform	$0	$4,515,529	$10,082,522	$14,598,051
Concrete Bulkhead Cap	$0	$0	$4,348,767	$4,348,767
Concrete Heavy Lift Platform	$0	$0	$13,836,686	$13,836,686
Electrical Infrastructure Allowance	$0	$0	$194,849	$194,849
Total				$56,134,236

Delfate to 2020$

Major Cost Category	2022	2023	2024	Total	Include in Residual Value
Engineering/Design	$2,274,941	$740,998	$0	$3,015,938	
Construction Management / Administration	$0	$1,220,318	$1,557,026	$2,777,344	
NEPA and Permitting	$188,182	$203,094	$0	$391,275	
Construction					
Environmental Controls Allowance	$0	$26,249	$75,355	$101,604	
Civil Demolition	$0	$796,150	$0	$796,150	
Laydown Area Improvements	$0	$0	$3,562,307	$3,562,307	$3,562,307
Site Improvements	$0	$0	$1,545,561	$1,545,561	$1,545,561
Water System Allowance	$0	$0	$100,474	$100,474	$100,474
PAZ Combi-Wall Steel Bulkhead	$0	$4,654,039	$5,443,321	$10,097,360	$10,097,360
Foundation Piles - Heavy Lift Platform	$0	$4,365,790	$9,748,176	$14,113,967	$14,113,967
Concrete Bulkhead Cap	$0	$0	$4,204,558	$4,204,558	$4,204,558
Concrete Heavy Lift Platform	$0	$0	$13,377,849	$13,377,849	$13,377,849
Electrical Infrastructure Allowance	$0	$0	$188,388	$188,388	$188,388
Total	$2,463,122	$12,006,638	$39,803,015	$54,272,775	$47,190,464

Residual Value

Inputs	
Dollar Year	2020
Discount Rate	7%
Discount Year	2020
Period of Analysis	20
Operations Begin	2025

Type of Asset	Service Life (years)	
Civil Infratructure and Utilities	60	a
Port Infrastructure	50	b

Sources:

a. BEA Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories
http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm

Impacts of Climate Change on Seaports: a survey of knowledge, perceptions and planning efforts amongst port administrators [cited in OECD, 2014. The Competitiveness of Global Port-Cities]
http://aquaticcommons.org/3883/1/Becker_papers.pdf

Remaining Value	2045	
Port Infrastructure	$	28,314,278
Total Value Remaining	$	28,314,278
Discounted @ 7%	$	5,216,882

Residual Summary	Total	
Total (2020$)	$	28,314,278
Discounted @ 7%	$	5,216,882

Inputs

Dollar Year	2020
Discount Rate	7%
Discount Year	2020
Period of Analysis	20
Distance to Lease Area (nautical miles)	
Salem, MA	150
Brooklyn, NY	200
New Bedford, MA	51
New London, CT	85
Newport News, VA	418
New Jersey Wind Port, NJ	300
Port of Argentia, Canada	830
Turbines per barge	1
Transit speed - outgoing (loaded)	8
Transit speed - inbound (unloaded)	8
Tug and barge - hourly operating cost (loaded)	$2,000
Tug and barge - hourly operating cost (unloaded)	$1,500
Turbines assembled per year - Phase 1	40

Without-Project

Distance to Lease Area	**Distance (nm)**
	Salem
Brooklyn, NY	200
New Bedford, MA	51
New Jersey Wind Port, NJ	300
New London, CT	85
Newport News, VA	418
Port of Argentia, Canada	830

Percent Used

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Brooklyn, NY							16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
New Bedford, MA							16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
New Jersey Wind Port, NJ							16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
New London, CT							16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Newport News, VA							16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Port of Argentia, Canada	100%	100%	100%	100%	100%	100%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%
Average (nm)	830	830	830	830	830	830	314	314	314	314	314	314	314	314	314	314	314	314	314	314

With-Project

	Distance (nm)	**Percent Used**
Salem, MA	150	100%

Impacts

		Notes
Trips per year	40	Number of barge and tug trip to deliver turbines to WTIV given assembly capacity of Salem Harbor Phase I

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Transit Savings per Year (nm)	27,200	27,200	27,200	27,200	27,200	27,200	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560	6,560
Distance saved for each leg of trip (nm)	680	680	680	680	680	680	164	164	164	164	164	164	164	164	164	164	164	164	164	164
Transit time savings (hrs) - outbound	85	85	85	85	85	85	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Transit time savings (hrs) - inbound	85	85	85	85	85	85	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Operating Savings per trip	$297,500	$297,500	$297,500	$297,500	$297,500	$297,500	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750	$71,750
Annual Operating Hours Saved	6,800	6,800	6,800	6,800	6,800	6,800	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640
Annual Operating Savings	**$11,900,000**	**$11,900,000**	**$11,900,000**	**$11,900,000**	**$11,900,000**	**$11,900,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**	**$2,870,000**
Discounted Operating Savings	$8,484,536	$7,929,472	$7,410,722	$6,925,908	$6,472,812	$6,049,357	$1,363,516	$1,274,314	$1,190,948	$1,113,035	$1,040,220	$972,168	$908,569	$849,129	$793,579	$741,663	$693,143	$647,797	$605,418	$565,811
PV of Operating Savings	**$56,032,116**																			

Inputs

Operations Begin	2025
Discount Rate	7%
Discount Rate (CO2)	3%
Discount Year	2020

Tug Characteristics

Type	Ocean Class DP1 and DP2	
Main engine (kW)	8,113	Crowley (https://www.crowley.com/wp-content/uploads/2018/10/Crowley-Tug-Ocean-Class-Spec-Sheet_1.pdf
Engine Loading Factor - outbo	80%	
Engine Loading Factor - inbou	70%	
G to Mtons	0.000001	

The general equation for calculating the emissions from a vessel:

Vessel Emissions (tons) = [**Main** Engine Power Rating (**kW**) x Loading Factor x Activity Hours (hours) x Emission Factor (**g**/kW-hour) x (1 lb /454 **g**) x (1 ton / 2000 lb) x (**#** of Sources)]
+ [**Auxiliary** Engine Power Rating (**kW**) x Loading Factor x Activity Hours (hours) x Emission Factor (**g**/kW hour) x (1 lb /454 **g**) x (1 ton / 2000 lb) x (**#** of Sources)]

Vessel Emissions - Transit (Emission Factors from BOEM Tool)

category	Engine	Type	Units	Emission Factors										
				CO2	CH4	N2O	Black Carbon	CO	NOX	PM10	PM2.5	SO2	Lead	VOC
FACILITY	Main	Anchor Handling Tugs	g_per_kW-hr	636.0	0.00400	0.03100	0.25400	2.16000	9.26000	0.34400	0.33000	0.07870	0.00004	0.23900
FACILITY	Main	Barge	g_per_kW-hr	589.0	0.00400	0.03100	0.32300	1.40000	13.60000	0.45000	0.42000	0.36200	0.00001	0.63000
FACILITY	Main	Crew	g_per_kW-hr	648.0	0.00400	0.03100	0.23100	2.30000	9.15000	0.31000	0.30000	0.00624	0.00005	0.13700
FACILITY	Main	Jackup	g_per_kW-hr	647.0	0.00400	0.03100	0.22900	2.30000	10.00000	0.30800	0.29800	0.01270	0.00005	0.14400
FACILITY	Main	Research/Survey	g_per_kW-hr	638.0	0.00400	0.03100	0.25100	2.25000	9.86000	0.33900	0.32600	0.06570	0.00004	0.22100
FACILITY	Main	Tug	g_per_kW-hr	644.0	0.00400	0.03100	0.24300	2.29000	9.52000	0.32700	0.31600	0.03330	0.00004	0.17700
FACILITY	Main	Cable Laying	g_per_kW-hr	635.0	0.00400	0.03100	0.25200	2.20000	9.49000	0.34100	0.32700	0.08510	0.00004	0.24600
FACILITY	Main	Dredging	g_per_kW-hr	631.0	0.00400	0.03100	0.26300	2.13000	9.60000	0.35700	0.34100	0.11200	0.00004	0.28500
FACILITY	Main	Shuttle Tanker	g_per_kW-hr	589.0	0.00400	0.03100	0.32300	1.40000	9.05000	0.45000	0.42000	0.36200	0.00001	0.63000
FACILITY	Main	Supply Ship	g_per_kW-hr	645.0	0.00400	0.03100	0.23800	2.29000	9.44000	0.32000	0.30900	0.02770	0.00004	0.16700
FACILITY	Main	Ice Breaker	g_per_kW-hr	611.0	0.00400	0.03100	0.29000	1.78000	9.92000	0.39900	0.37700	0.23000	0.00002	0.44800

Source: South Fork Wind Farm and South Fork Export Cable Air Emissions Inventory - Calculations and Methodology, May 2019, Prepared using the BOEM estimating tool
https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/App-L_SFWF_AirEmissionsInventory_2019_05_17.pdf

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	
Transit time savings (hrs) - outbound	85.00	85.00	85.00	85.00	85.00	85.00	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	
Transit time savings (hrs) - inbound	85.00	85.00	85.00	85.00	85.00	85.00	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	
CO2 Savings per Trip (Mtons)	666	666	666	666	666	666	161	161	161	161	161	161	161	161	161	161	161	161	161	161	
NOx Savings per Trip (Mtons)	9.8	9.8	9.8	9.8	9.8	9.8	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
PM2.5 Savings per Trip (Mtons)	0.33	0.33	0.33	0.33	0.33	0.33	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	
SO2 Savings per Trip (Mtons)	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
																					Total Emissions
CO2 Savings per Year (Mtons)	26,646	26,646	26,646	26,646	26,646	26,646	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	6,426	249,849
NOx Savings per Year (Mtons)	394	394	394	394	394	394	95	95	95	95	95	95	95	95	95	95	95	95	95	95	3,693
PM2.5 Savings per Year (Mtons)	13.1	13.1	13.1	13.1	13.1	13.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	123
SO2 Savings per Year (Mtons)	1.4	1.4	1.4	1.4	1.4	1.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	13
CO2 Value (Mtons)	$56	$57	$58	$60	$61	$62	$63	$64	$65	$66	$67	$69	$70	$71	$72	$73	$74	$75	$77	$78	
Nox Value (Mtons)	$16,500	$16,800	$17,100	$17,400	$17,700	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	$18,100	
PM2.5 Value (Mtons)	$801,700	$814,500	$827,400	$840,600	$854,000	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	$867,600	
SO2 Value (Mtons)	$44,900	$45,700	$46,500	$47,300	$47,200	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	$49,100	
Total Annual	$18,535,605	$18,848,883	$19,163,469	$19,508,623	$19,828,506	$20,193,150	$4,876,539	$4,882,966	$4,889,392	$4,895,819	$4,902,245	$4,915,098	$4,921,524	$4,927,951	$4,934,377	$4,940,804	$4,947,230	$4,953,657	$4,966,510	$4,972,936	
Discount 3%	$1,287,180	$1,272,006	$1,256,623	$1,262,092	$1,245,754	$1,229,297	$292,485	$288,473	$284,447	$280,411	$276,369	$276,329	$272,168	$268,016	$263,875	$259,747	$255,636	$251,544	$250,730	$246,589	
Discount 7%	$12,151,716	$11,547,738	$10,971,593	$10,423,692	$9,901,269	$9,425,343	$2,124,459	$1,985,476	$1,855,585	$1,734,191	$1,620,740	$1,514,710	$1,415,617	$1,323,006	$1,236,454	$1,155,565	$1,079,967	$1,009,315	$943,285	$881,575	
Discounted (2020)	$13,438,896	$12,819,744	$12,228,216	$11,685,783	$11,147,023	$10,654,641	$2,416,944	$2,273,949	$2,140,032	$2,014,602	$1,897,108	$1,791,039	$1,687,785	$1,591,022	$1,500,329	$1,415,312	$1,335,603	$1,260,860	$1,194,016	$1,128,164	
PV of Emissions	**$95,621,069**																				

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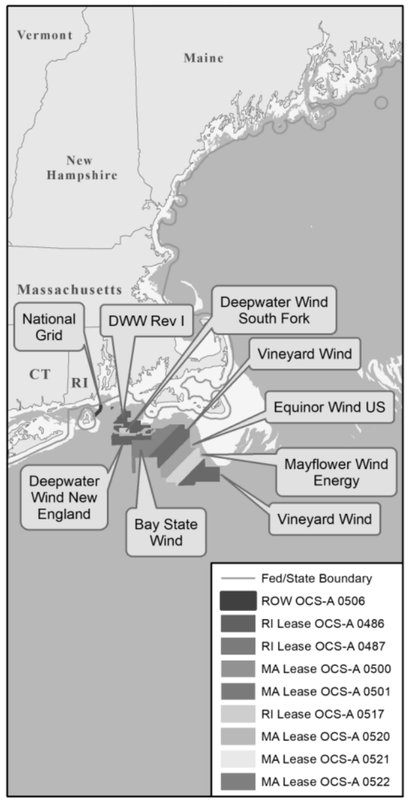
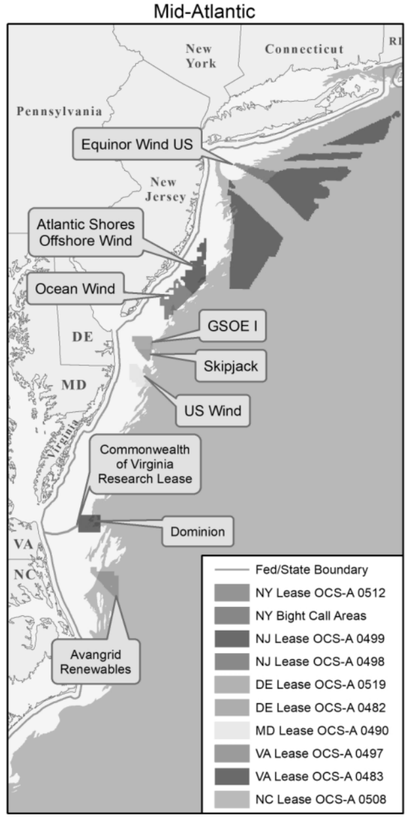
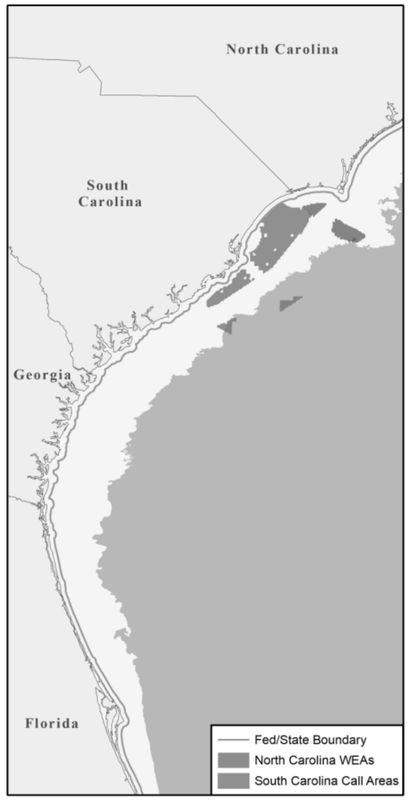
Northeast



Mid-Atlantic



Southeast



Bathymetry

- Up to 30 meters
- More than 30 meters

0 50 100 150 200 250
Nautical Miles

Map Date: 3/30/2020

Map ID: ERB-2017-1004

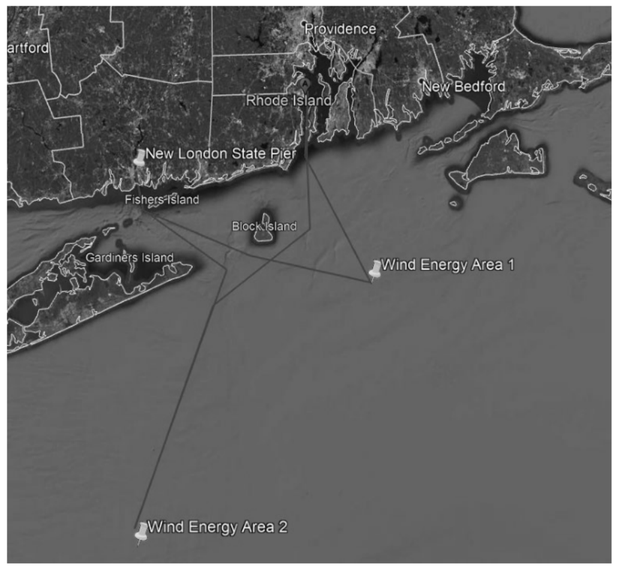


Table 10.1 - GROSS DOMESTIC PRODUCT AND DEFLATORS USED IN THE HISTORICAL TABLES: 1940 - 2026

(Fiscal Year 2020 = 1.000)

Fiscal Year	GDP (in billions of dollars)	GDP (Chained) Price Index	Composite Outlay Deflators												
			Total	Total Defense	Total Nondefense	Payment for Individuals			Other Grants	Net Interest	Undis-tributed Offsetting Receipts	All Other	Addendum: Direct Capital		
						Total	Direct	Grants					Total	Defense	Nondefense
1940	98.200	0.068	0.058	0.056	0.059	0.067	0.067	0.067	0.040	0.068	0.038	0.054	0.129	0.135	0.124
1941	116.200	0.070	0.064	0.069	0.062	0.069	0.069	0.069	0.036	0.070	0.038	0.055	0.140	0.143	0.130
1942	147.700	0.075	0.073	0.084	0.056	0.075	0.075	0.075	0.035	0.076	0.040	0.048	0.146	0.147	0.140
1943	184.600	0.080	0.081	0.090	0.056	0.083	0.083	0.083	0.037	0.080	0.044	0.047	0.143	0.144	0.143
1944	213.800	0.083	0.075	0.079	0.060	0.090	0.090	0.090	0.039	0.083	0.049	0.050	0.139	0.140	0.149
1945	226.400	0.085	0.070	0.072	0.069	0.094	0.094	0.094	0.040	0.085	0.051	0.053	0.130	0.131	0.155
1946	228.000	0.092	0.071	0.068	0.085	0.099	0.099	0.099	0.044	0.092	0.053	0.057	0.132	0.132	0.146
1947	238.900	0.102	0.080	0.074	0.085	0.107	0.107	0.107	0.106	0.102	0.057	0.059	0.147	0.147	0.145
1948	261.900	0.111	0.083	0.069	0.092	0.117	0.117	0.117	0.060	0.111	0.061	0.065	0.163	0.162	0.168
1949	276.500	0.115	0.080	0.069	0.088	0.120	0.120	0.120	0.063	0.115	0.059	0.063	0.171	0.170	0.172
1950	278.700	0.114	0.084	0.070	0.094	0.118	0.118	0.118	0.060	0.114	0.063	0.068	0.169	0.170	0.167
1951	327.100	0.120	0.084	0.074	0.102	0.125	0.125	0.124	0.071	0.120	0.062	0.069	0.181	0.183	0.174
1952	357.100	0.124	0.084	0.077	0.112	0.130	0.130	0.129	0.072	0.125	0.066	0.075	0.190	0.191	0.185
1953	382.100	0.127	0.090	0.085	0.113	0.132	0.132	0.131	0.075	0.127	0.070	0.079	0.192	0.193	0.191
1954	387.200	0.128	0.093	0.086	0.121	0.134	0.134	0.133	0.072	0.128	0.073	0.085	0.190	0.191	0.190
1955	406.300	0.129	0.096	0.089	0.116	0.133	0.133	0.133	0.073	0.129	0.075	0.082	0.196	0.197	0.186
1956	438.300	0.132	0.101	0.094	0.116	0.135	0.135	0.135	0.074	0.133	0.076	0.082	0.206	0.208	0.193
1957	463.400	0.137	0.106	0.099	0.120	0.139	0.139	0.139	0.081	0.138	0.077	0.085	0.217	0.220	0.202
1958	473.500	0.141	0.112	0.104	0.128	0.143	0.143	0.143	0.090	0.142	0.083	0.092	0.224	0.227	0.209
1959	504.600	0.144	0.116	0.111	0.126	0.145	0.145	0.145	0.096	0.144	0.087	0.095	0.228	0.231	0.212
1960	534.300	0.146	0.118	0.110	0.132	0.148	0.148	0.147	0.097	0.146	0.086	0.098	0.230	0.233	0.215
1961	546.600	0.148	0.121	0.112	0.135	0.150	0.150	0.150	0.095	0.148	0.090	0.104	0.231	0.234	0.216
1962	585.700	0.149	0.121	0.112	0.134	0.151	0.151	0.151	0.095	0.149	0.092	0.105	0.233	0.236	0.218
1963	618.200	0.151	0.126	0.117	0.139	0.153	0.153	0.153	0.099	0.151	0.095	0.112	0.237	0.240	0.220
1964	661.700	0.153	0.128	0.119	0.140	0.155	0.155	0.155	0.100	0.153	0.098	0.117	0.237	0.240	0.224
1965	709.300	0.155	0.130	0.118	0.143	0.157	0.157	0.157	0.103	0.156	0.104	0.122	0.238	0.241	0.226
1966	780.500	0.159	0.134	0.124	0.144	0.160	0.160	0.160	0.100	0.159	0.107	0.126	0.240	0.243	0.227
1967	836.500	0.164	0.137	0.128	0.147	0.164	0.164	0.164	0.102	0.164	0.110	0.128	0.243	0.246	0.230
1968	897.600	0.169	0.142	0.134	0.151	0.169	0.169	0.169	0.105	0.170	0.114	0.130	0.249	0.251	0.236
1969	980.300	0.177	0.151	0.141	0.161	0.177	0.177	0.176	0.111	0.177	0.122	0.140	0.258	0.261	0.245
1970	1,046.700	0.186	0.159	0.149	0.169	0.185	0.185	0.185	0.119	0.187	0.132	0.149	0.271	0.274	0.258
1971	1,116.600	0.196	0.170	0.158	0.180	0.193	0.193	0.193	0.127	0.196	0.146	0.163	0.288	0.291	0.275
1972	1,216.300	0.205	0.181	0.173	0.187	0.201	0.201	0.200	0.133	0.206	0.157	0.174	0.310	0.315	0.288
1973	1,352.700	0.214	0.189	0.185	0.192	0.208	0.208	0.208	0.136	0.214	0.166	0.184	0.330	0.338	0.300
1974	1,482.900	0.229	0.205	0.198	0.210	0.225	0.225	0.225	0.149	0.230	0.176	0.194	0.350	0.357	0.323
1975	1,606.900	0.253	0.225	0.215	0.230	0.248	0.248	0.248	0.165	0.253	0.189	0.207	0.380	0.386	0.359
1976	1,786.100	0.271	0.241	0.229	0.246	0.264	0.264	0.264	0.178	0.271	0.205	0.226	0.404	0.411	0.381
TQ	471.700	0.279	0.247	0.233	0.253	0.273	0.273	0.272	0.185	0.279	0.211	0.230	0.417	0.426	0.391
1977	2,024.300	0.290	0.259	0.247	0.264	0.284	0.284	0.284	0.191	0.291	0.221	0.242	0.435	0.444	0.403
1978	2,273.500	0.310	0.275	0.264	0.279	0.303	0.303	0.303	0.203	0.310	0.235	0.256	0.462	0.474	0.424
1979	2,565.600	0.335	0.299	0.286	0.304	0.328	0.328	0.328	0.222	0.335	0.250	0.276	0.494	0.506	0.452
1980	2,791.900	0.364	0.331	0.316	0.336	0.363	0.363	0.363	0.247	0.365	0.271	0.296	0.531	0.541	0.493
1981	3,133.200	0.400	0.367	0.350	0.374	0.399	0.399	0.398	0.276	0.400	0.296	0.323	0.578	0.589	0.537
1982	3,313.400	0.428	0.395	0.382	0.402	0.423	0.423	0.423	0.301	0.428	0.311	0.339	0.623	0.634	0.576
1983	3,536.000	0.446	0.415	0.401	0.422	0.443	0.443	0.442	0.316	0.447	0.321	0.348	0.660	0.673	0.595
1984	3,949.200	0.462	0.435	0.421	0.442	0.460	0.460	0.459	0.333	0.463	0.330	0.368	0.687	0.702	0.612
1985	4,265.100	0.478	0.451	0.438	0.458	0.476	0.476	0.475	0.347	0.478	0.344	0.384	0.693	0.707	0.625
1986	4,526.300	0.489	0.460	0.447	0.467	0.488	0.488	0.488	0.359	0.489	0.348	0.384	0.688	0.699	0.633
1987	4,767.700	0.499	0.473	0.454	0.484	0.500	0.501	0.500	0.377	0.500	0.350	0.392	0.682	0.690	0.642
1988	5,138.600	0.516	0.490	0.466	0.502	0.520	0.520	0.519	0.392	0.516	0.361	0.407	0.683	0.689	0.660
1989	5,554.700	0.536	0.509	0.483	0.521	0.543	0.543	0.542	0.408	0.537	0.370	0.414	0.698	0.704	0.682
1990	5,898.800	0.556	0.524	0.500	0.533	0.565	0.565	0.563	0.428	0.557	0.380	0.415	0.711	0.715	0.699
1991	6,093.200	0.576	0.547	0.525	0.555	0.587	0.587	0.586	0.446	0.577	0.403	0.437	0.728	0.732	0.717
1992	6,416.300	0.590	0.569	0.533	0.582	0.603	0.603	0.601	0.459	0.591	0.417	0.475	0.739	0.744	0.723
1993	6,775.300	0.604	0.586	0.539	0.602	0.618	0.618	0.616	0.473	0.605	0.439	0.512	0.757	0.763	0.735
1994	7,176.900	0.617	0.597	0.544	0.612	0.631	0.631	0.628	0.486	0.618	0.459	0.518	0.775	0.783	0.748
1995	7,560.400	0.631	0.614	0.554	0.631	0.645	0.645	0.642	0.502	0.631	0.473	0.553	0.795	0.802	0.769
1996	7,951.300	0.642	0.627	0.566	0.643	0.658	0.658	0.655	0.517	0.643	0.496	0.569	0.805	0.814	0.775
1997	8,451.000	0.654	0.640	0.575	0.657	0.671	0.671	0.668	0.527	0.655	0.508	0.582	0.803	0.811	0.777
1998	8,930.800	0.662	0.646	0.586	0.660	0.677	0.678	0.675	0.534	0.663	0.518	0.570	0.804	0.811	0.778
1999	9,479.400	0.670	0.654	0.597	0.667	0.685	0.686	0.683	0.547	0.671	0.534	0.586	0.812	0.821	0.783
2000	10,117.500	0.684	0.670	0.619	0.683	0.701	0.702	0.699	0.567	0.685	0.562	0.608	0.823	0.831	0.798
2001	10,526.500	0.700	0.688	0.640	0.699	0.717	0.717	0.715	0.586	0.701	0.574	0.628	0.827	0.833	0.807
2002	10,833.700	0.712	0.698	0.661	0.708	0.725	0.726	0.723	0.597	0.713	0.607	0.650	0.823	0.827	0.806
2003	11,283.800	0.725	0.718	0.703	0.723	0.740	0.740	0.738	0.614	0.726	0.640	0.678	0.829	0.835	0.810
2004	12,025.500	0.746	0.737	0.730	0.740	0.756	0.756	0.754	0.637	0.743	0.670	0.700	0.841	0.846	0.821
2005	12,834.200	0.769	0.762	0.765	0.763	0.777	0.777	0.776	0.674	0.766	0.702	0.725	0.856	0.862	0.837
2006	13,638.400	0.794	0.789	0.797	0.788	0.801	0.801	0.800	0.709	0.790	0.728	0.749	0.870	0.877	0.848
2007	14,290.800	0.813	0.810	0.823	0.809	0.818	0.818	0.818	0.747	0.812	0.754	0.776	0.882	0.890	0.858
2008	14,743.300	0.833	0.838	0.855	0.836	0.847	0.847	0.847	0.784	0.828	0.778	0.795	0.899	0.906	0.874
2009	14,431.800	0.833	0.838	0.853	0.837	0.846	0.846	0.846	0.796	0.838	0.794	0.803	0.906	0.914	0.879
2010	14,838.900	0.847	0.853	0.869	0.851	0.861	0.861	0.861	0.809	0.845	0.817	0.828	0.911	0.918	0.887
2011	15,403.700	0.862	0.873	0.894	0.870	0.880	0.880	0.879	0.832	0.862	0.846	0.848	0.929	0.936	0.907
2012	16,056.500	0.877	0.891	0.907	0.889	0.898	0.898	0.898	0.854	0.878	0.856	0.859	0.939	0.946	0.915
2013	16,603.800	0.893	0.903	0.913	0.903	0.912	0.912	0.911	0.876	0.895	0.863	0.870	0.943	0.949	0.921
2014	17,335.600	0.909	0.918	0.928	0.917	0.925	0.925	0.925	0.897	0.912	0.892	0.888	0.956	0.962	0.936
2015	18,106.100	0.917	0.922	0.932	0.921	0.929	0.929	0.929	0.905	0.922	0.903	0.901	0.959	0.964	0.939
2016	18,581.700	0.935	0.928	0.935	0.928	0.936	0.936	0.936	0.909	0.930	0.914	0.908	0.957	0.962	0.937
2017	19,316.600	0.952	0.944	0.948	0.944	0.952	0.952	0.952	0.925	0.947	0.939	0.927	0.963	0.968	0.950
2018	20,368.900	0.971	0.965	0.975	0.965	0.972	0.972	0.972	0.956	0.968	0.976	0.958	0.976	0.979	0.970
2019	21,223.900	0.990	0.983	0.996	0.981	0.988	0.988	0.988	0.983	0.988	1.010	0.985	0.991	0.994	0.990
2020	20,999.700	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2021 estimate	22,030.000	1.016	1.019	1.018	1.018	1.020	1.020	1.020	1.023	1.017	1.017	1.015	1.020	1.017	1.017
2022 estimate	23,499.700	1.034	1.037	1.037	1.038	1.041	1.041	1.041	1.052	1.036	1.036	1.030	1.038	1.036	1.036
2023 estimate	24,563.300	1.054	1.059	1.057	1.060	1.064	1.063	1.065	1.083	1.056	1.056	1.050	1.057	1.056	1.056
2024 estimate	25,536.500	1.075	1.083	1.078	1.084	1.087	1.087	1.089	1.115	1.077	1.077	1.071	1.078	1.077	1.077
2025 estimate	26,516.000	1.097	1.107	1.100	1.108	1.112	1.111	1.113	1.149	1.098	1.098	1.092	1.098	1.098	1.098
2026 estimate	27,533.200	1.119	1.131	1.122	1.133	1.137	1.137	1.138	1.183	1.120	1.120	1.114	1.120	1.120	1.120
2027 estimate	28,014.860	1.138	1.151	1.141	1.153	1.157	1.156	1.158	1.204	1.140	1.140	1.133	1.140	1.140	1.140
2028 estimate	28,524.788	1.159	1.172	1.162	1.174	1.178	1.177	1.179	1.225	1.161	1.161	1.154	1.161	1.161	1.161
2029 estimate	29,034.716	1.180	1.193	1.183	1.195	1.199	1.199	1.200	1.247	1.181	1.181	1.175	1.181	1.181	1.181
2030 estimate	29,544.643	1.201	1.214	1.204	1.216	1.220	1.220	1.221	1.269	1.202	1.202	1.195	1.202	1.202	1.202

Tables used on in the BCA Technical Memorandum

Table ??. Estimated Transit Distances For the Without-Project Conditions

Port	Distance (nm)	2025	2030	2031	2035	2040	2044
Brooklyn, NY	200	0%	0%	16.7%	16.7%	16.7%	16.7%
New Bedford, MA	51	0%	0%	16.7%	16.7%	16.7%	16.7%
New Jersey Wind Port, NJ	300	0%	0%	16.7%	16.7%	16.7%	16.7%
New London, CT	85	0%	0%	16.7%	16.7%	16.7%	16.7%
Newport News, VA	418	0%	0%	16.7%	16.7%	16.7%	16.7%
Port of Argentia, Canada	830	100%	100%	16.7%	16.7%	16.7%	16.7%
Average Distance		830	830	314	314	314	314

Table ??. Hours of Transit Time Saved

Category	2025	2030	2031	2035	2040	2044
Distance saved for each leg of trip (nm)	680	680	164	164	164	164
Transit time savings (hrs) - outbound	85	85	21	21	21	21
Transit time savings (hrs) - inbound	85	85	21	21	21	21

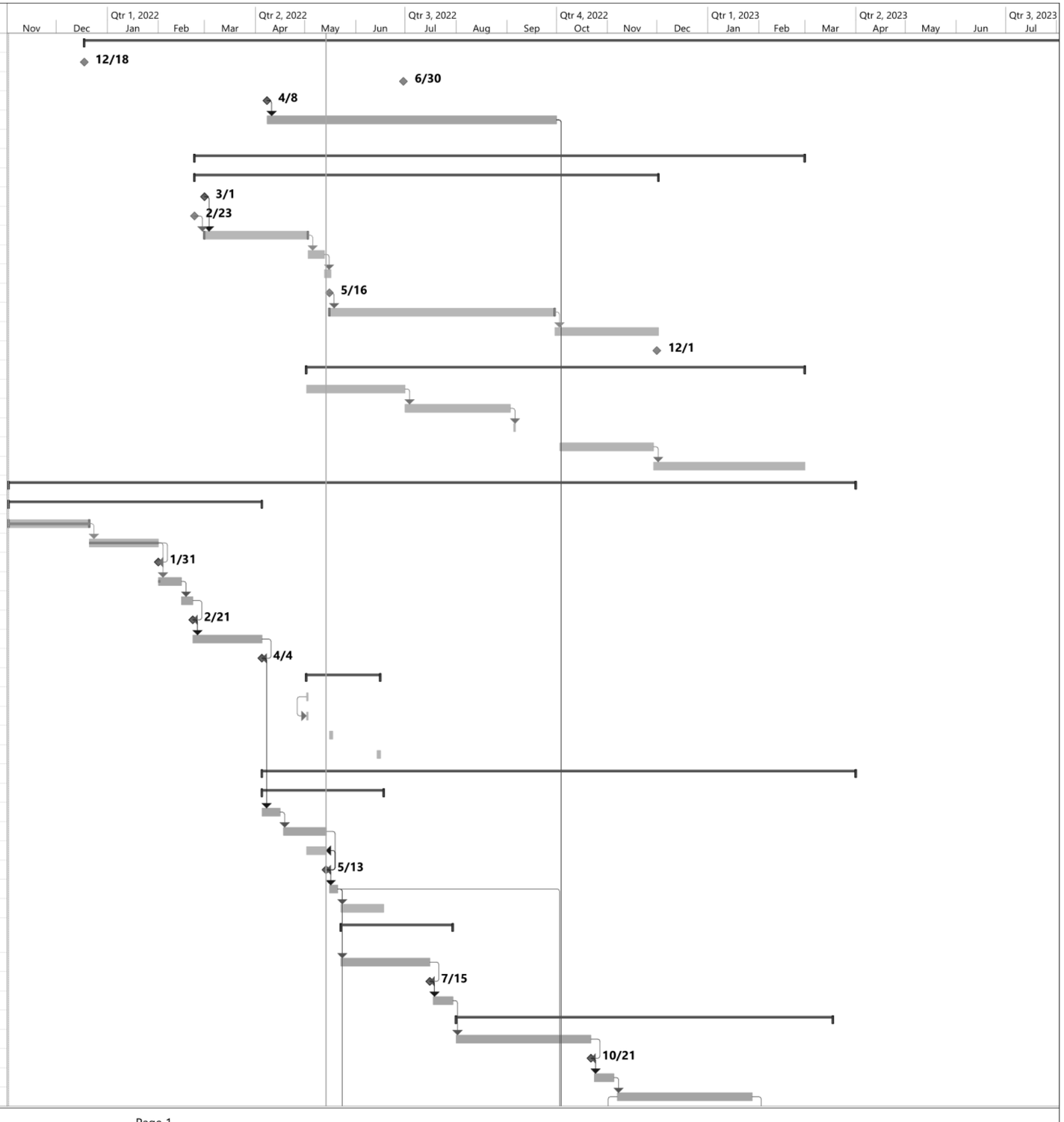
Table ??. Annual Operating Savings

Category	2025	2030	2031	2035	2040	2044
Transit Savings per Year (nm)	54,400	54,400	13,100	13,100	13,100	13,100
Annual Operating Hours Saved	6,800	6,800	1,600	1,600	1,600	1,600
Annual Operating Savings	$11,900,000	$11,900,000	$2,870,000	$2,870,000	$2,870,000	$2,870,000

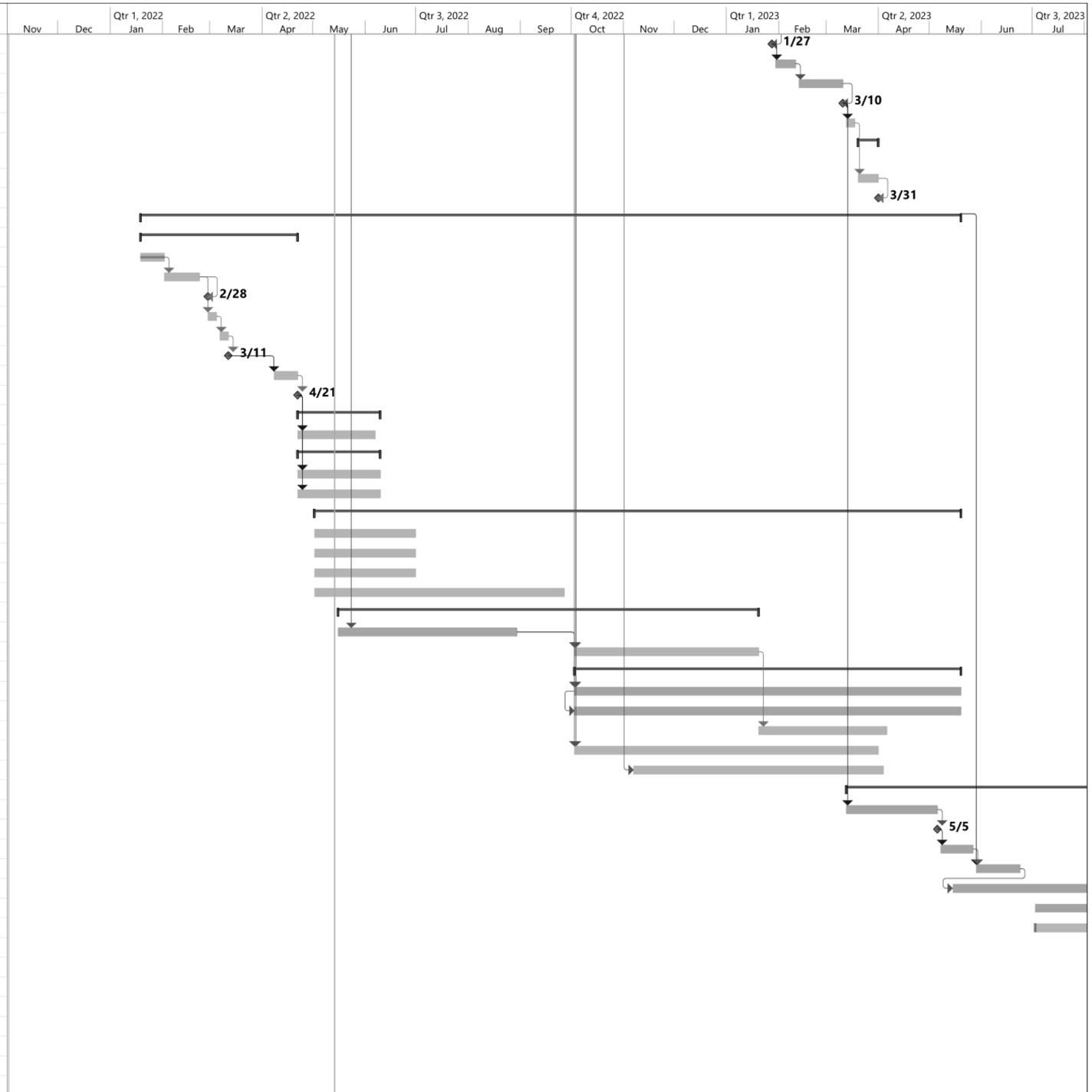
Table ?? Annual Ton o Emissions Reduced

Category	2025	2030	2031	2035	2040	2044
CO2 Savings per Year (Mtons)	26,646	26,646	6,426	6,426	6,426	6,426
NOx Savings per Year (Mtons)	394	394	95	95	95	95
PM2.5 Savings per Year (Mtons	13	13	3	3	3	3
SO2 Savings per Year (Mtons)	1	1	0	0	0	0
Total Annual	$18,535,605	$20,193,150	$4,876,539	$4,902,245	$4,940,804	$4,972,936

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Project Administration**	**792 days?**	**Sat 12/18/21**	**Wed 1/1/25**	
2		Vinyard Wind Notice of Award	0 days	Sat 12/18/21	Sat 12/18/21	
3		Avangrid PPA Execution	0 days	Thu 6/30/22	Thu 6/30/22	
4		Footprint PSA - Signed	0 days	Fri 4/8/22	Fri 4/8/22	
5		Property Closing	126 days?	Fri 4/8/22	Fri 9/30/22	4
6		Terminal Go-Live	0 days	Wed 1/1/25	Wed 1/1/25	
7		**Grant Funding**	**265 days?**	**Wed 2/23/22**	**Tue 2/28/23**	
8		**PIDP-1 Grant**	**202 days?**	**Wed 2/23/22**	**Thu 12/1/22**	
9		PIDP Consultant NTP	0 days	Tue 3/1/22	Tue 3/1/22	
10		PIDP Grant NOFO	0 days	Wed 2/23/22	Wed 2/23/22	
11		Application Peparation	45 days	Tue 3/1/22	Mon 5/2/22	10,9
12		Review Period for Submission	8 days?	Tue 5/3/22	Thu 5/12/22	11
13		Submit to City of Salem	2 days?	Fri 5/13/22	Mon 5/16/22	12
14		Application Due	0 days	Mon 5/16/22	Mon 5/16/22	
15		Review Period	99 days	Mon 5/16/22	Thu 9/29/22	14
16		Notice of Award	45 days?	Fri 9/30/22	Thu 12/1/22	15
17		Receive Funds	0 days	Thu 12/1/22	Thu 12/1/22	
18		**Mass CEC**	**217 days?**	**Mon 5/2/22**	**Tue 2/28/23**	
19		Issue Solicitation	44 days?	Mon 5/2/22	Thu 6/30/22	
20		Application Draft	46 days?	Fri 7/1/22	Fri 9/2/22	19
21		Application Due	1 day	Mon 9/5/22	Mon 9/5/22	20
22		Award	41 days	Mon 10/3/22	Mon 11/28/22	
23		Contracting	66 days?	Tue 11/29/22	Tue 2/28/23	22
24		**Design & Engineering**	**369 days**	**Tue 11/2/21**	**Fri 3/31/23**	
25		**Bidding and Award**	**110 days**	**Tue 11/2/21**	**Mon 4/4/22**	
26		Draft RFP Engineering Services	7 wks	Tue 11/2/21	Mon 12/20/21	
27		Tender RFP Engineering Services	6 wks	Tue 12/21/21	Mon 1/31/22	26
28		RFP Respone Due	0 days	Mon 1/31/22	Mon 1/31/22	27FF
29		Crowley RFP Response Review	2 wks	Tue 2/1/22	Mon 2/14/22	27
30		Engineering Services Interviews	1 wk	Tue 2/15/22	Mon 2/21/22	29
31		Notice of Intent to Award	0 days	Mon 2/21/22	Mon 2/21/22	30FF
32		Contract Negotiation	6 wks	Tue 2/22/22	Mon 4/4/22	31
33		Engineering NTP	0 days	Mon 4/4/22	Mon 4/4/22	32FF
34		**Design Support**	**33 days**	**Mon 5/2/22**	**Wed 6/15/22**	
35		ALTA Survey	1 day	Mon 5/2/22	Mon 5/2/22	
36		Site Topo Survey	1 day	Mon 5/2/22	Mon 5/2/22	35SS
37		GPR & Utility Survey	2 days	Mon 5/16/22	Tue 5/17/22	
38		Bathymetric & Sidescan Survey	2 days	Tue 6/14/22	Wed 6/15/22	
39		**Design**	**259 days**	**Tue 4/5/22**	**Fri 3/31/23**	
40		**PH.I-Project Initiation & Conceptual Desi**	**54 days**	**Tue 4/5/22**	**Fri 6/17/22**	
41		Project Familiarization	9 days	Tue 4/5/22	Fri 4/15/22	33
42		10% Conceptual Design	1 mon	Mon 4/18/22	Fri 5/13/22	41
43		Site Investigation SOW	2 wks	Mon 5/2/22	Fri 5/13/22	44FF
44		10% Concept Design Submittal	0 days	Fri 5/13/22	Fri 5/13/22	42FF
45		Crowley 10% Submittal Review	1 wk	Mon 5/16/22	Fri 5/20/22	44
46		Site Investigation	1 mon	Mon 5/23/22	Fri 6/17/22	45
47		**PH.II-Prelim Design Develop. & Constr. Delivery Planning**	**50 days**	**Mon 5/23/22**	**Fri 7/29/22**	
48		30% Design	2 mons	Mon 5/23/22	Fri 7/15/22	45
49		30% Design Submittal	0 days	Fri 7/15/22	Fri 7/15/22	48FF
50		Crowley 30% Submittal Review	2 wks	Mon 7/18/22	Fri 7/29/22	49
51		**PH.III-Final Design Development**	**165 days**	**Mon 8/1/22**	**Fri 3/17/23**	
52		60% Design	3 mons	Mon 8/1/22	Fri 10/21/22	50
53		60% Design Submittal	0 days	Fri 10/21/22	Fri 10/21/22	52FF
54		Crowley 60% Design Review	2 wks	Mon 10/24/22	Fri 11/4/22	53
55		90% Design	3 mons	Mon 11/7/22	Fri 1/27/23	54



ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
56		90% Design Submittal	0 days	Fri 1/27/23	Fri 1/27/23	55FF
57		Crowley 90% Design Review	2 wks	Mon 1/30/23	Fri 2/10/23	56
58		100% Design	1 mon	Mon 2/13/23	Fri 3/10/23	57
59		100% Design Submittal	0 days	Fri 3/10/23	Fri 3/10/23	58FF
60		Crowley 100% Design Review	1 wk	Mon 3/13/23	Fri 3/17/23	59
61		**PH.IV-Construction Documents & Bidding Support**	**10 days**	**Mon 3/20/23**	**Fri 3/31/23**	
62		IFC Project Manual	2 wks	Mon 3/20/23	Fri 3/31/23	60
63		IFC Submittal	0 days	Fri 3/31/23	Fri 3/31/23	62FF
64		**Permitting**	**348 days**	**Wed 1/19/22**	**Fri 5/19/23**	
65		**Bidding & Award**	**67 days**	**Wed 1/19/22**	**Thu 4/21/22**	
66	✓	Draft RFP Permitting Services	2 wks	Wed 1/19/22	Tue 2/1/22	
67		Tender RFP Permitting Services	3 wks	Wed 2/2/22	Tue 2/22/22	66
68		RFP Respone Due	0 days	Mon 2/28/22	Mon 2/28/22	67FF
69		Crowley RFP Response Review	1 wk	Mon 2/28/22	Fri 3/4/22	67
70		Permitting Services Interviews	1 wk	Mon 3/7/22	Fri 3/11/22	69
71		Notice of Intent to Award	0 days	Fri 3/11/22	Fri 3/11/22	70
72		Contract Negotiation	2 wks	Fri 4/8/22	Thu 4/21/22	71
73		Permitting NTP	0 days	Thu 4/21/22	Thu 4/21/22	72
74		**Permitting-Phase I**	**35 days**	**Fri 4/22/22**	**Thu 6/9/22**	
75		Permit Acquisition Plan	32 days	Fri 4/22/22	Mon 6/6/22	73
76		**Stakeholder Engagement**	**35 days**	**Fri 4/22/22**	**Thu 6/9/22**	
77		Engagement Approach Planning	35 days	Fri 4/22/22	Thu 6/9/22	73
78		Site Investigations Scope of Work	35 days	Fri 4/22/22	Thu 6/9/22	73
79		**Permitting-Phase II**	**275 days**	**Mon 5/2/22**	**Fri 5/19/23**	
80		Site Investigations & Field Studies	44 days	Mon 5/2/22	Thu 6/30/22	
81		Agency Review Meetings	44 days	Mon 5/2/22	Thu 6/30/22	
82		Environmental Studies	44 days	Mon 5/2/22	Thu 6/30/22	
83		Mass Historical Commission	106 days	Mon 5/2/22	Mon 9/26/22	
84		**MEPA**	**179 days**	**Mon 5/16/22**	**Thu 1/19/23**	
85		Expanded ENF	76 days	Mon 5/16/22	Mon 8/29/22	45FS-5 days
86		Single EIR	79 days	Mon 10/3/22	Thu 1/19/23	85,5
87		**Mass DEP Permits**	**165 days**	**Mon 10/3/22**	**Fri 5/19/23**	
88		DEP - Chapter 91	165 days	Mon 10/3/22	Fri 5/19/23	85,5
89		DEP - Water Quality	165 days	Mon 10/3/22	Fri 5/19/23	88SS
90		Salem Conservation Commission NOI	54 days	Fri 1/20/23	Wed 4/5/23	86
91		USACE-10/404 Permit	130 days	Mon 10/3/22	Fri 3/31/23	45,5
92		Local Planning & Zoning, & Special	106 days	Mon 11/7/22	Mon 4/3/23	55SS
93		**Construction**	**473 days?**	**Mon 3/13/23**	**Wed 1/1/25**	
94		Bidding & Award	2 mons	Mon 3/13/23	Fri 5/5/23	59
95		NTP	0 days	Fri 5/5/23	Fri 5/5/23	94
96		Pre Construction Submittals	3 wks	Mon 5/8/23	Fri 5/26/23	95
97		Mobilization	4 wks	Mon 5/29/23	Fri 6/23/23	96,64
98		Construction	428 days	Mon 5/15/23	Wed 1/1/25	97
99		Environmental Controls	393 days	Mon 7/3/23	Wed 1/1/25	
100		Civil Demolition	130 days	Mon 7/3/23	Fri 12/29/23	
101		Laydown Area A Improvement	130 days	Mon 4/1/24	Fri 9/27/24	
102		Site Improvements	130 days	Mon 7/1/24	Fri 12/27/24	
103		Water System	130 days	Mon 7/1/24	Fri 12/27/24	
104		PAZ Combi-Wall Steel Bulkhead	180 days	Mon 10/2/23	Fri 6/7/24	
105		Foundation Piles - Heavy Lift Platform	180 days	Tue 1/2/24	Mon 9/9/24	
106		Concrete Bulkhead Cap	180 days	Tue 1/2/24	Mon 9/9/24	
107		Concrete Heavy Lift Platform	180 days	Mon 4/1/24	Fri 12/6/24	
108		Electrical Infrastructure	130 days?	Mon 7/1/24	Fri 12/27/24	



CROWLEY

May 16, 2022

The Honorable Pete Buttigieg
Secretary of Transportation
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Re: Crowley New Energy, Inc. match funding for a Salem Offshore Wind Port Infrastructure Development Grant award.

Dear Secretary Buttigieg:

Crowley has joined with the Salem Massachusetts Port Authority to develop the state's newest offshore wind port. When completed, the terminal's operations and jobs will enable over 1,200 MW of clean and affordable energy, enough to power 750,000 homes in Massachusetts. The project is a critical link in the green power supply chain that will create over 11,000 full-time equivalent (FTE) jobs, catalyze hundreds of millions of dollars in investments in offshore wind infrastructure, and deliver substantial commitments to environmental justice communities.

Crowley has committed to fully developing the Salem Wind Port with our partners, the City of Salem and Avangrid Renewables, to reach aggressive carbon emission goals, and with assistance from the Department of Transportation we can both reach them even sooner. The City of Salem is requesting $33,835,953 from the PID Grant Program to develop the project.

Please consider this letter as a commitment from Crowley to provide $25,108,076 (43%) as matching funds for the total Project cost of $58,944,029.

If you have any questions, please feel free to contact me at (904-523-3420)

Respectfully,

DocuSigned by:
3832392F632B4AC...

Name: Ray Fitzgerald

Title: Chief Operating Officer

9487 Regency Square Blvd. +1 904 727 2200
Jacksonville, FL 32225 crowley.com

COMMUNITY BENEFITS AGREEMENT

This AGREEMENT is made this 16th day of December, 2014, by and among FOOTPRINT POWER SALEM HARBOR REAL ESTATE LP, a Delaware limited partnership having its principal offices at 1140 Route 22 East, Suite 303, Bridgewater, New Jersey 08807, FOOTPRINT POWER SALEM HARBOR DEVELOPMENT LP, a Delaware limited partnership having its principal offices at 1140 Route 22 East, Suite 303, Bridgewater, New Jersey 08807 ("Footprint"); and THE CITY OF SALEM, MASSACHUSETTS, a municipality having its principal offices at 93 Washington Street, Salem, Massachusetts 01970 (the "City").

WHEREAS, Footprint is developing, and proposes to construct and operate on a parcel of land located within the City, known as 24 Fort Avenue, as shown on City of Salem Assessor's Map 41, Lot 271 (the "Site"), a state of the art Combined Cycle Gas fired electric generation facility ("CCG Facility") (including a natural gas pipeline, an electric transmission line, and all other ancillary and appurtenant facilities, the "Plant"); and

WHEREAS, the City and Footprint agree and acknowledge that the construction and operation of the Plant has and will provide benefits to the City, including the entry by Footprint into a Payment in Lieu of Taxes Agreement, dated as of December 16, 2014 incorporating a schedule of payments as set forth on Attachment A hereto (the "Tax Agreement") and a commitment by Footprint to employ union labor during construction of the Plant;

WHEREAS Footprint RealCo currently owns the Site as well as the adjacent parcel as shown on City of Salem Assessor's Map 41, Lot 339 ("Lot 2") which together with the Site comprises the entire 65 acre site of the existing Salem Harbor Station; and

WHEREAS, Footprint has applied and will continue to apply for numerous licenses, permits, and approvals necessary for the development and construction of the Plant, including approval by the Massachusetts Energy Facilities Siting Board (the "Siting Board") in proceedings docketed as: In the Matter of the Petition of Footprint Power Salem Harbor Development LP for Approval to Construct a Bulk Generating Facility in the City of Salem, Massachusetts, EFSB Docket No. 12-2 (the "Siting Board Proceeding") and In the Matter of the Initial Petition and Application of Footprint Power Salem Harbor Development LP for a Certificate of Environmental Impact and Public Interest, EFSB Docket No. 13-1which incorporates all required state and local permits (the "Certificate Proceeding");

WHEREAS, the Mayor of Salem convened a City of Salem Power Plant Stakeholders Group, comprised of over a dozen community leaders and chaired by the Mayor, which Group met on numerous occasions over several months with the purpose of helping to formulate and assist in the terms, conditions and provisions of this Agreement on behalf of the community;

WHEREAS, the City and Footprint agree and acknowledge that the City has identified certain concerns with respect to the impact of the construction and operation of the Plant on the City; and

WHEREAS, the City and Footprint agree and acknowledge that the performance by Footprint and Footprint RealCo of their respective obligations as set forth herein will address such concerns to the City's satisfaction.

Now, THEREFORE, in consideration of the covenants set forth herein and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Footprint and the City hereby agree as follows.

I. Non-Opposition and Other Consideration to be Provided by the City

A. From the date of this Agreement, neither the City nor any of its agents or representatives will take any action, either directly or indirectly, publicly or privately, in any forum, to oppose or to assist any party in the opposition of the development, construction, or operation of the Plant, except as provided below.

B. The City shall work cooperatively with Footprint and Footprint RealCo to achieve a mutually-agreeable plan for the future development or utilization of the land owned by Footprint RealCo that surrounds the Site.

C. Nothing contained herein shall prevent the City from pursuing any claim for physical harm suffered by it, or for injuries or property damage suffered by it or any persons or property lawfully upon its premises arising out of the actual operation of the Plant or Footprint's actions or omissions in connection with the same. Nothing contained herein shall prevent the City or any of its permitting boards, commissions, or officials from legally exercising its or their own legal regulatory authority.

D. Nothing contained herein shall prevent the City from seeking to participate, and Footprint agrees not to oppose the City's seeking to participate, in any adjudicatory proceeding before the Siting Board or other federal or state agency or court in which is being considered significant new information regarding, or a significant change to, the Plant proposal that is not consistent with the filings made in any pending federal, state or municipal proceedings involving the Plant as of the date of this Agreement, if the City and Footprint agree after good-faith consultation that such new information demonstrates, or that such change may cause, significant public health, safety, or environmental impacts to the City that are materially greater and more adverse than those that have been presented in such proceedings as of the date of this Agreement.

II. Consideration to be Provided by Footprint and Footprint RealCo

A. Tax Agreement

Footprint and the City have entered into the Tax Agreement for the annual tax payment for the Site.

B. Port Development

Footprint RealCo and the City have agreed to work collaborative to ensure the mutually beneficial ongoing development of Salem's Port and related infrastructure. In particular,

Footprint RealCo has entered into a separate agreement with the City that provides long term access and shared use of the current power plant pier for visiting cruise ship vessels, tall ships and the like. ("Wharfing Agreement"). Additionally, Footprint RealCo and the City shall work cooperatively to create a Port Authority or a similar third party independent entity on terms, including ongoing economic terms, that are mutually agreeable to hold title to the land on and around the Wharf (approximately 3-5 acres) to be deeded by Footprint RealCo to said Port Authority at no charge, for the purpose of managing the pier/Wharf and maritime activities related thereto. The Port Authority or similar third party independent entity shall have a Managing Board comprised of representatives appointed by both Footprint and the City. The parties shall work diligently to establish said Port Authority or similar third party independent entity with a goal of establishing same within 24 months from the date of this agreement.

C. Public Access

1. Footprint RealCo and the City agree to involve the community in discussions regarding land use, public access, and phasing of the remainder of the site.

2. Footprint will provide the City with clarity regarding the management of the power plant site including the landscape berm prior to commercial operation of the power plant.

3. Footprint RealCo will provide a maintenance plan for publicly accessible areas on the waterfront and the Derby Street edge prior to any development of Lot 2.

4. Footprint will contribute up to $75,000 to the City to fund a process to amend the Harbor Plan as needed to achieve these public access goals and ensure continuity and comprehensive planning along Salem's waterfront. Such payments will be made in three annual installments of $25,000 beginning on the Effective Date of this agreement and on the next two anniversaries thereof.

5. Footprint RealCo agrees to use all reasonable efforts to assure safe public use of the breakwater/jetty as a part of the next phase of development and construction.

6. Footprint RealCo will provide signage / environmental graphics to encourage public access and draw visitors from the historic portion of the harbor walk to the non-plant portion of the site. Footprint RealCo will coordinate design, placement and timing of such signage with the City's Planning Department.

D. Environmental Initiatives

1. The Energy Facility Siting Board has directed Footprint to contribute at least $300,000 to the City of Salem dedicated to the development of an off-site emission reduction program targeted to greenhouse gases and PM2.5, among other air pollutants. Footprint, with the assistance of the City, shall prepare a report detailing the activities that are to be funded by the off-site emissions

reduction program, including the costs, timeframes, and anticipated environmental benefits of the identified projects, to be submitted to the Siting Board within one year of commercial operation of the proposed facility. Such contribution will be made in three equal annual installments of $100,000 each beginning on the date of the submission of such report to the Siting Board.

2. Footprint and Footprint RealCo support Salem's efforts to engage in climate change adaptability planning and implementation. Footprint RealCo will encourage environmentally responsible development on the Lot 2.

3. Footprint will provide seed funding in the amount of $50,000 per year for 5 years for a revolving loan program for sustainable initiatives in Salem pursuant to a mechanism to be mutually agreed between Footprint and the City.

4. Footprint RealCo will support renewable energy initiatives, and will work with the City to assist with off shore wind interconnections to the National Grid switchyard on the site.

5. Footprint will continue to provide funding in the amount of $50,000 per year for 5 years that will support the city's existing environmental initiatives.

6. Footprint will define next steps and conduct any studies necessary to move forward on potential symbiotic opportunities with SESD including, but not limited to the continued exploration of the use of the SESD's greywater in the CCG Facility's cooling process.

7. Footprint RealCo will, at every reasonable opportunity, support legislation that advocates for responsible natural gas extraction.

8. Footprint RealCo will work with the City to provide the necessary infrastructure at the port to allow for a plug-in / cold ironing option for docked vessels, where feasible.

E. Employment and Inclusion

1. Footprint will provide funding needed to train public safety personnel on an ongoing basis as needed, in particular a minimum of 4, quarterly drills per year for Fire Department personnel or as agreed to with the Fire Chief; provided, that such funding shall not exceed $10,000 per year in the aggregate.

2. Footprint will adopt a "hire local" initiative whereby local workers are sought out and trained by Footprint. Footprint and the City will work together to identify appropriate goals in terms of the percentage of employees to be hired locally. The parties expressly recognize that highly specialized training is required to safely operate the CCG Facility and that nothing herein is intended to prevent Footprint from hiring employees necessary to safely and reliably operate the CCG Facility. Moreover, nothing herein is intended to interfere in any way

with any agreements that will govern the employment of individuals subject to a collective bargaining agreement.

3. The parties recognize that Footprint Power Salem Harbor Operations LLC has provided workforce retraining to individuals who were formerly employed at the existing power plant when it was permanently shut down. The parties acknowledge that in addition to providing plant employees with the necessary time to complete their training courses, Footprint Power Salem Harbor Operations LLC contributed in excess of $300,000 to fund such training which was instrumental in assisting these employees transition to new careers upon the shut down of the existing facility.

4. Footprint will establish an internship program for local youth. This program would provide, to the extent permitted by law, unpaid internships for 4 college and 2 high school interns per year to participate in 12-week internships focusing on skills and industries related to Footprint's operations (power generation, alternative energy development, etc)..

5. Footprint will translate key planning documents related to the construction of the power plant into Spanish in order to reach the widest group of stakeholders.

F. Improvements to Salem's Infrastructure

1. Footprint will contribute $75,000 per year for ten (10) consecutive years, to a fund that will be applied towards pavement management and roadway repair on and around surrounding roadways.

2. Footprint will fund and construct an improved sidewalk along Derby Street for the length of the entire Footprint site in coordination with National Grid and prior to the completion of construction of the power plant.

3. Footprint RealCo will work with the city at each stage in the development of Lot 2 to help ensure access is maintained to the public parking at the Salem Wharf on Blaney Street.

4. Footprint will provide to the City up to $67,000 per year for two (2) years during demolition and construction to assist with additional operating and maintenance costs of the Harbormaster Department associated with the power plant project.

5. Footprint will provide to the City up to $28,000 per year for two (2) years during demolition and construction to assist with communication and distribution of information related to the project through the City's Building Salem initiative.

6. Footprint will work with the City and others involved in local development to support and fund traffic calming measures including appropriate

signage, information outreach (web-based, radio and television broadcasts, letters and fliers) to inform Salem residents of possible traffic disruptions during construction of the power plant; provided, that such funding shall not exceed $10,000 per year in the aggregate.

7. Footprint will continue its support of the City's telecom/teldata/ surveillance needs by providing space on its stack for city-owned equipment, both during (to the extent feasible) and after construction, and by installing additional surveillance cameras on site in consultation with public safety personnel.

G. Other Community Investments

1. Footprint will contribute the following amounts to support Salem's educational goals: (A) $50,000 per year for 15 years to support Salem Schools' digital initiative, and (B) $25,000 per year for 15 years to support Salem Schools' athletic and enrichment programs.

2. In order to leverage State funding, Footprint will contribute a total of $75,000 per year for 10 years to the City for the Community Preservation Act ("CPA") fund in order to support workforce housing and fund the construction and maintenance of city recreational amenities. Such contribution shall be made annually beginning on January 1, 2020 and shall be reduced dollar for dollar by the amount paid by Footprint in CPA surcharge related to payments made to the City under the Tax Agreement, any successor agreement, or on an ad valorem basis should that agreement be terminated for any reason.

3. Footprint will work with the City to support and fund public art initiatives on the waterfront and the power plant site and will contribute $40,000 a year toward that effort for a period of 3 years.

III. Community Impacts

A. Noise

Footprint shall meet all noise limitations imposed with respect to the Plant under its operating permits, licenses and municipal permits under applicable municipal, state, and federal statutes and regulations. Footprint shall comply with the applicable DEP noise monitoring protocol and shall promptly forward the results of such monitoring directly to the City's designated representative.

B. Air

Footprint shall meet all air emissions requirements imposed with respect to the Plant under its operating permits and licenses and under applicable municipal, state, and federal statutes and regulations. Footprint shall comply with all applicable requirements and regulations concerning the safe transportation, handling, use, and storage of aqueous ammonia.

C. Construction and Building Permit Fee

1. Footprint and the City shall negotiate in good faith and shall attempt to agree with respect to a protocol for construction of the Plant. Such protocol may include provisions concerning the coordination of the anticipated impacts of Plant construction with those of other projects undertaken in the vicinity of the Plant, and the specification of routes for construction worker access and major plant component deliveries to the Site. A Construction Management Plan has been completed and submitted by Footprint to the City Planner in accordance with conditions outlined in the Planning Board Decision.

2. Footprint and the City agree that the total application fee for all building permits and inspections required for the construction of the Plant shall be two hundred fifty thousand dollars ($250,000.00).

D. Other Community Impacts

Commencing on June 1, 2015, and on each anniversary of such date during the term of this Agreement, Footprint shall pay to the City the amount of ten thousand dollars ($10,000), to be allocated to defraying a portion of the costs incurred by the Salem Fourth of July Celebration Committee for an annual Independence Day fireworks display, or for other recreational or related purposes.

IV. Term, Termination

A. Term.

The term of this Agreement will commence on the Effective Date and terminate on June 30, 2032; provided, that this Agreement shall automatically terminate and become null and void and of no further effect in the event the conditions precedent set forth in Section 15 of the Tax Agreement are not satisfied as set forth in the Tax Agreement.

B. Termination.

Upon the substantial and material breach of any provision of this Agreement by a party hereto, the other party may exercise any and all remedies available to it, in law, in equity, or otherwise; and further provided that the breaching party shall be entitled to cure its breach within a reasonable amount of time following its receipt of written notice from the other. Notwithstanding the foregoing, the parties acknowledge and agree that, in the event of a breach of the terms of this Agreement, the remedies available at law would be inadequate, and that the non-breaching party shall therefore be entitled to equitable relief enforcing the terms of this Agreement. This Agreement shall also terminate automatically in the event that the City terminates the Tax Agreement for any reason.

V. Force Majeure

It is distinctly understood and agreed that all parties hereto shall make a reasonable and good faith effort to perform their obligations under this Agreement. If and to the extent that either party is prevented from performing its obligations hereunder by an event of force majeure, such party shall be excused from performing hereunder and shall not be liable in damages or otherwise, and the parties instead shall negotiate in good faith with respect to appropriate modifications to the terms hereof. For purposes of this Agreement, the term force majeure shall mean any supervening cause beyond the reasonable control of the affected party, including without limitation requirement of statute or regulation; action of any court, regulatory authority, or public authority having jurisdiction; storm, flood, fire, earthquake, explosion, civil disturbance, labor dispute, or act of God or the public enemy.

VI. Miscellaneous

1. This Agreement shall be binding upon and shall inure to the benefit of the parties hereto and their respective heirs, successors, assigns, successors in interest, mortgagees, nominees, shareholders, trustees, directors, officers, agents, employees, and affiliates (collectively, "Representatives"), to the fullest extent permitted by law. The assumption of this Agreement and the obligations thereunder shall be a specific condition of any sale or transfer of the Plant or the Site or any substantial interest therein during the term of this Agreement to any party not an affiliate of Footprint. Footprint and/or Footprint RealCo may in their discretion transfer its interests, rights, and obligations hereunder to any parent or affiliate by assignment, merger, or otherwise without the prior approval of the City, and may also in its discretion collaterally assign such interests as security to the parties providing construction or long-term financing for the plant without the prior approval of the City, but written notice of such transfer shall be given. The City shall execute any and all acknowledgments and other documentation required by such financing parties in connection therewith. Any other transfer by Footprint or Footprint RealCo of their interests, rights, and obligations hereunder shall require the prior approval of the City, such approval not to be unreasonably withheld or delayed. Provided, however, that the sale of Footprint or Footprint RealCo to a third party shall not require the prior consent of the City so long as the rights and obligations hereunder are also transferred. Footprint and Footprint RealCo shall be entitled in their discretion to perform any or all of its obligations under this agreement through one or more affiliates. The liability of Footprint and Footprint RealCo or its Representatives to the City or its Representatives hereunder shall be limited solely to its or their respective interests in the Plant and the Site and Lot 2.

2. The rights and obligations of Footprint and Footprint RealCo are individual and not joint and several. Each party shall be responsible only for the payments and obligations specifically assigned to it herein and shall not in any way be responsible for payments and obligations specifically assigned to another

party. Obligations of Footprint and Footprint RealCo herein that do not specifically require funding shall be interpreted as being on a commercially reasonable basis and not to require Footprint to incur expenses, impair property rights or cede value or opportunities, except with compensation deemed sufficient by Footprint or Footprint RealCo, each in its sole discretion.

3. All notice permitted or required under the provisions of this Agreement shall be in writing, and shall be sent by registered or certified mail, postage prepaid, or shall be delivered by private express carrier, as follows or at such other address as may be specified by a party in writing and served upon the other in accordance with this section.

If to the City
Mayor
City of Salem
93 Washington Street
Salem, Massachusetts 01970

With a copy to:
City Solicitor
City of Salem
93 Washington Street
Salem, Massachusetts 01970

If to Footprint:
President
Footprint Power Salem Harbor Development LP
1140 Route 22 East, Suite 303
Bridgewater, New Jersey 08807

With a copy to:
John A. DeTore, Esq.
Rubin and Rudman LLP
50 Rowes Wharf
Boston, Massachusetts 02110

If to Footprint RealCo:
President
Footprint Power Salem Harbor Real Estate LP
1140 Route 22 East, Suite 303
Bridgewater, New Jersey 08807

With a copy to:
Joseph Correnti, Esq.
Serafini, Darling & Correnti LLP
63 Federal Street
Salem, Massachusetts 01970

4. This Agreement shall be governed by, and construed in accordance with, the laws of the Commonwealth of Massachusetts, without regard to its conflicts of law rules.

5. The Effective Date of this agreement shall be the date upon which Footprint closes on the construction financing for the CCG Facility. Footprint shall promptly notify the City of such closing.

6. All payments due by Footprint of Footprint RealCo or actions to be taken by Footprint or Footprint RealCo hereunder shall undertaken only after the CCG

Facility achieves Commercial Operation unless an earlier date is specifically provided herein.

7. The provisions of this Agreement are separate and divisible, and if any court of competent jurisdiction determines that any provision of this Agreement is void or unenforceable, the remaining provisions hereof shall remain in full force and effect.

8. This Agreement may be amended or modified only by writing executed by the parties hereto; provided, however, that if any applicable federal or state law mandates the inclusion of any term or provision into this Agreement, this section shall be understood to import such term or provision into this Agreement.

9. This Agreement has been drafted jointly by the parties hereto and accordingly shall not be construed for or against any such party solely on account of such drafting.

10. Nothing in this Agreement shall be construed as creating any rights or granting any benefits to anyone other than the City, Footprint and Footprint RealCo.

11. This Agreement may be executed simultaneously in two or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same agreement. Facsimile signatures on this Agreement shall be deemed to be original signatures.

12. Footprint and Footprint RealCo shall provide to the City other evidence of the capacity and authority of the party executing this Agreement for and on behalf of Footprint and Footprint RealCo. Footprint and Footprint RealCo shall comply with all applicable provisions of Massachusetts law relating to the appointment of a resident agent, and shall maintain on file with the Secretary of State any and all documents required by law for the conduct of business in Massachusetts.

13. Any disbursement of funds to satisfy the action items agreed upon in the CBA must be documented and made available by the City to its residents in a transparent, clear and timely way.

VII. CBA Committee

A CBA Committee shall meet quarterly to discuss the operation of the CBA and any issues thereunder. The CBA Committee shall also meet at the call of the Mayor of Salem to discuss any issues related to the operation of the CBA or any party's obligations thereunder. The CBA Committee shall be comprised of 11 members: (1) the Mayor of Salem; (2) a representative of Footprint; (3) a representative of Footprint RealCo; (4) a representative of Salem Alliance for the Environment, (5) a representative of the Historic Derby Street Neighborhood Association, (6) a representative of the Point Neighborhood Association, (7) a representative of the Salem Chamber of Commerce, (8) a representative of Salem State University, (9) a representative of Harbor Plan

Implementation Committee, (10) a representative of the Salem Partnership and (11) a member of the City Council designated by the President of the City Council. The right to membership on the CBA Committee shall belong to the represented organization and not to the individual representatives, each of whom will serve at the pleasure of their represented organization. The CBA Committee shall retain the right to seek enforcement of any applicable permit from the board, agency, or other regulatory authority with jurisdiction over the enforcement of such permit.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

In witness whereof, THE CITY OF SALEM, FOOTPRINT SALEM HARBOR DEVELOPMENT LP and FOOTPRINT SALEM HARBOR REAL ESTATE LP have caused this Agreement to be executed by their respective duly authorized officials and officers as of the date and year first above written.

Attachments: Wharfing Agreement
Tax Agreement

FOOTPRINT POWER SALEM HARBOR DEVELOPMENT LP

Scott G. Silverstein, President and COO
Footprint Power SH DevCo GP LLC,
General Partner, duly authorized

CITY OF SALEM

Kimberley L. Driscoll, Mayor
duly authorized

FOOTPRINT POWER SALEM HARBOR REAL ESTATE LP

Scott G. Silverstein, President and COO
Footprint Power SH RealCo GP LLC,
General Partner, duly authorized

APPROVED AS TO FORM:

Elizabeth Rennard, City Solicitor

In witness whereof, THE CITY OF SALEM, FOOTPRINT SALEM HARBOR DEVELOPMENT LP and FOOTPRINT SALEM HARBOR REAL ESTATE LP have caused this Agreement to be executed by their respective duly authorized officials and officers as of the date and year first above written.

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Tax Agreement

FOOTPRINT POWER SALEM HARBOR DEVELOPMENT LP

Scott G. Silverstein, President and COO
Footprint Power SH DevCo GP LLC,
General Partner, duly authorized

CITY OF SALEM

Kimberley A. Driscoll, Mayor
duly authorized

FOOTPRINT POWER SALEM HARBOR REAL ESTATE LP

Scott G. Silverstein, President and COO
Footprint Power SH RealCo GP LLC,
General Partner, duly authorized

APPROVED AS TO FORM:

Elizabeth Rennard, City Solicitor

SALEM WIND PORT

SALEM, MASSACHUSETTS

PROJECT 60681893

MAY 2022

VICINITY MAP
SCALE: 1" = 2000'

LOCATION PLAN
SCALE: 1" = 500'

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
www.aecom.com

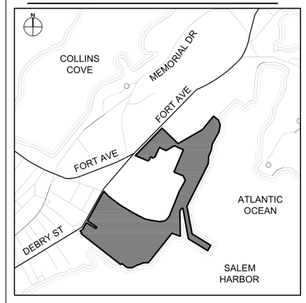
SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**A. LU**
Drawn By:	**F. LIZANO**
Checked By:	**C. TRACY**
Approved By:	**J. KLEIN**

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

COVER SHEET

SHEET NUMBER

G000

1 OF 26

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

SHEET NO.	SHEET INDEX	
	GENERAL	
G000	COVER SHEET	*
G001	SHEET INDEX	*
G002	GENERAL NOTES	
	GEOTECHNICAL	
B100	EXPLORATION LOCATION PLAN	*
B200	GEOPHYSICAL SURVEY PLAN	*
B300	FORMER POWERPLANT SITE LAYOUT	*
B401	SUBSURFACE PROFILE A-A'	*
B402	SUBSURFACE PROFILE B-B'	*
B403	SUBSURFACE PROFILE C-C'	*
B501	BORING LOGS (SHEET 1)	*
B502	BORING LOGS (SHEET 2)	*
B503	BORING LOGS (SHEET 3)	*
B504	BORING LOGS (SHEET 4)	*
B505	BORING LOGS (SHEET 5)	*
B506	BORING LOGS (SHEET 6)	*
B507	BORING LOGS (SHEET 7)	*
B508	BORING LOGS (SHEET 8)	*
B509	BORING LOGS (SHEET 9)	*
B601	GROUND IMPROVEMENT PLAN	
B701	GROUND IMPROVEMENT TYPICAL SECTIONS	
	CIVIL	
C100	SITE LAYOUT	
C200	SITE GRADING AND DRAINAGE	
C300	SITE UTILITY	
C400	SITE DETAILS	
	CIVIL - DREDGING	
D100	MARINE EXISTING CONDITIONS	*
D300	DEBRIS REMOVAL PLAN	
D301	DREDGING PLAN	
D400	DREDGING CROSS SECTIONS (A-A' & B-B')	
D401	DREDGING CROSS SECTIONS (C-C' & D-D')	
D500	DREDGING DETAILS	
D501	DREDGE MATERIAL AND TURBIDITY MANAGEMENT DETAILS	
	STRUCTURAL	
S100	GENERAL LAYOUT PLAN	*
S101	GENERAL LAYOUT PLAN - INITIAL PHASE	*
S201	DEMOLITION AREA 5	*
S202	DEMOLITION AREA 8	
S301	AREA 4 - PRE-ASSEMBLY & LOADOUT - DECK AND PILE PLANS	
S302	AREA 4 - PRE-ASSEMBLY & LOADOUT - TYPICAL SECTION	
S303	AREA 5 - WHARF AND BULKHEAD - DECK AND PILE PLANS	*
S304	AREA 5 - WHARF AND BULKHEAD - TYPICAL SECTION	*
S304.1	AREA 5 - WHARF AND BULKHEAD - ALTERNATIVE 1	
S304.2	AREA 5 - WHARF AND BULKHEAD - ALTERNATIVE 2	
S304.3	AREA 5 - WHARF AND BULKHEAD - ALTERNATIVE 3	
S305	AREA 7 - DISCHARGE CHANNEL FILL	
S306	AREA 8 - JETTY WHARF DECK PLAN	
S307	AREA 8 - JETTY WHARF PILE AND CAP PLAN	
S308	AREA 8 - JETTY WHARF TYPICAL SECTION	
S309	AREA 10 - NOTCH FILL - DECK PLAN	
S310	AREA 10 - NOTCH FILL - DECK AND PILE PLANS	
S401	AREAS 4 & 5 DECK & PILE CAP DETAILS	*
S402	BOLLARD DETAILS	*
S403	FENDER AND LIGHT POLE DETAILS	*
S404	AREA 8 DECK & PILE CAP DETAILS	
	ELECTRICAL	
E001	ABBREVIATIONS AND SYMBOLS LIST	
E100	OVERALL ELECTRICAL SITE PLAN	
E400	OVERALL ONE LINE DIAGRAM	
E500	SUBSTATION SS1 ENLARGED PLAN	
E501	SUBSTATION SS2 AND SS3 ENLARGED PLAN	
E600	SUBSTATION GATE DETAILS	
E601	GROUNDING DETAILS	

SHEET NO.	SHEET INDEX	
E602	TRANSFORMER DETAILS	
E603	HIGH MAST LIGHT POLE DETAILS	

*INCLUDED IN THIS PACKAGE

NOT FOR CONSTRUCTION

PROJECT
SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT
CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT
AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
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SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN

REVISION

R	DATE	DESCRIPTION

Designed By:	A. LU
Drawn By:	F. LIZANO
Checked By:	C. TRACY
Approved By:	J. KLEIN

PROJECT/TERM CONTRACT NUMBER
60681893

SHEET TITLE
SHEET INDEX

SHEET NUMBER
G001

2 OF 26

PRELIMINARY DESIGN

ANSI D 22" x 34"

Last saved by: LIZANOF(2022-05-13) Last Plotted: 2022-05-13
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Printed on ___% Post-Consumer Recycled Content Paper

ANSI D 22" x 34"

LEGEND

TT-101 THROUGH TT-120 TT-201 THROUGH TT-208	TEST BORINGS AND MONITORING WELLS DRILLED BY CRAWFORD DRILLING SERVICES ON BETWEEN SEPTEMBER 4 AND NOVEMBER 15, 2012. OBSERVED AND LOGGED BY TETRA TECH PERSONNEL.
B-5-1THROUGH B-5-5	TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES ON OCTOBER 23, 2012. OBSERVED AND LOGGED BY TETRA TECH PERSONNEL.
B-102 THROUGH B-126	TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES ON SEPTEMBER 10, 2012. OBSERVED AND LOGGED BY TETRA TECH PERSONNEL.
B-201 THROUGH B-216	TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES FROM NOVEMBER 14 TO 15, 2012. OBSERVED AND LOGGED BY TETRA TECH PERSONNEL.
TP-101 THROUGH TP-124 TP-201 THROUGH TP-210 TP-301 THROUGH TP-306	TEST PITS EXCAVATED BY CRAWFORD DRILLING SERVICES BETWEEN SEPTEMBER 19 AND NOVEMBER 20, 2012. OBSERVED AND LOGGED BY TETRA TECH PERSONNEL.
TP-1 THROUGH TP-6	TEST PITS EXCAVATED BY BOND BROTHERS, INC. ON AUGUST 4, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL.
	INDICATES PROPOSED TEST BORING LOCATION
	INDICATES PROPOSED TEST PIT LOCATION
A A'	SUBSURFACE PROFILE
	INDICATES PROPERTY BOUNDARY

REFERENCE:

1. BASE MAP DEVELOPED FROM AN ELECTRONIC DRAWING FILE "X-SOSWT-SRVY.DWG", PREPARED BY "MERIDIAN ASSOCIATES", NAMED "SALEM HARBOR POWER STATION", DATED AUGUST 20, 2021, ORIGINAL SCALE 1"=100', PROVIDED TO GZA ON MAY 9, 2022.

LEGEND

ATP-A	TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF LONDONDERRY, NEW HAMPSHIRE BETWEEN MARCH 26 AND 27, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL. (BORING ID ABBREVIATED FROM ATP#70-A)
BS-1	TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF LONDONDERRY, NEW HAMPSHIRE BETWEEN JANUARY 21 AND 26, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL.
B-60 (G)	TEST BORING PERFORMED BY NEW HAMPSHIRE BORING OF LONDONDERRY, NEW HAMPSHIRE BETWEEN FEBRUARY 3 AND 19, 2014. OBSERVED AND LOGGED BY GZA PERSONNEL. INDICATES SOLID PVC PIPE INSTALLED FOR GEOPHYSICAL TESTING.
PB-32 (OW)	TEST BORING PERFORMED BY CRAWFORD DRILLING SERVICES, LLC OF WESTMINSTER, MASSACHUSETTS BETWEEN MAY 6, 2013 AND JUNE 26, 2013. OBSERVED AND LOGGED BY GZA PERSONNEL. INDICATES OBSERVATION WELL INSTALLED.
P-11	TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN NOVEMBER 29, 2000 AND DECEMBER 28, 2000. OBSERVED AND LOGGED BY GZA PERSONNEL.
P-101	TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN APRIL 9 AND 21, 2003 OBSERVED AND LOGGED BY GZA PERSONNEL.
P-202	TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN DECEMBER 17, 2003 AND JANUARY 5, 2004. OBSERVED AND LOGGED BY GZA PERSONNEL.
B-1	APPROXIMATE LOCATION OF PHASE 1 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES ON MAY 27, 2014 AND OBSERVED BY GZA PERSONNEL.
B-3	APPROXIMATE LOCATION OF PHASE 2 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES FROM DECEMBER 15 TO 17, 2015 AND OBSERVED BY GZA PERSONNEL.
WB98-1	TEST BORINGS PERFORMED BY NEW HAMPSHIRE BORING INC. OF DERRY, NEW HAMPSHIRE BETWEEN JUNE 11 & 29, 1998 AND LOGGED BY NEW HAMPSHIRE BORING INC.

NOT FOR CONSTRUCTION

Last saved by: GARY.BASTIEN (2022-05-12) Last Plotted: 2022-05-12
Filename: J:\GEO\35033_JMM\FIGURES\GZA-DWGS - UPDATED\SOSWT-B100.DWG

PRELIMINARY DESIGN

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
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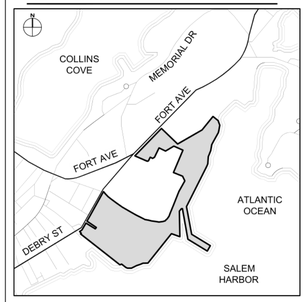
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**JJM**
Drawn By:	**GRB**
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

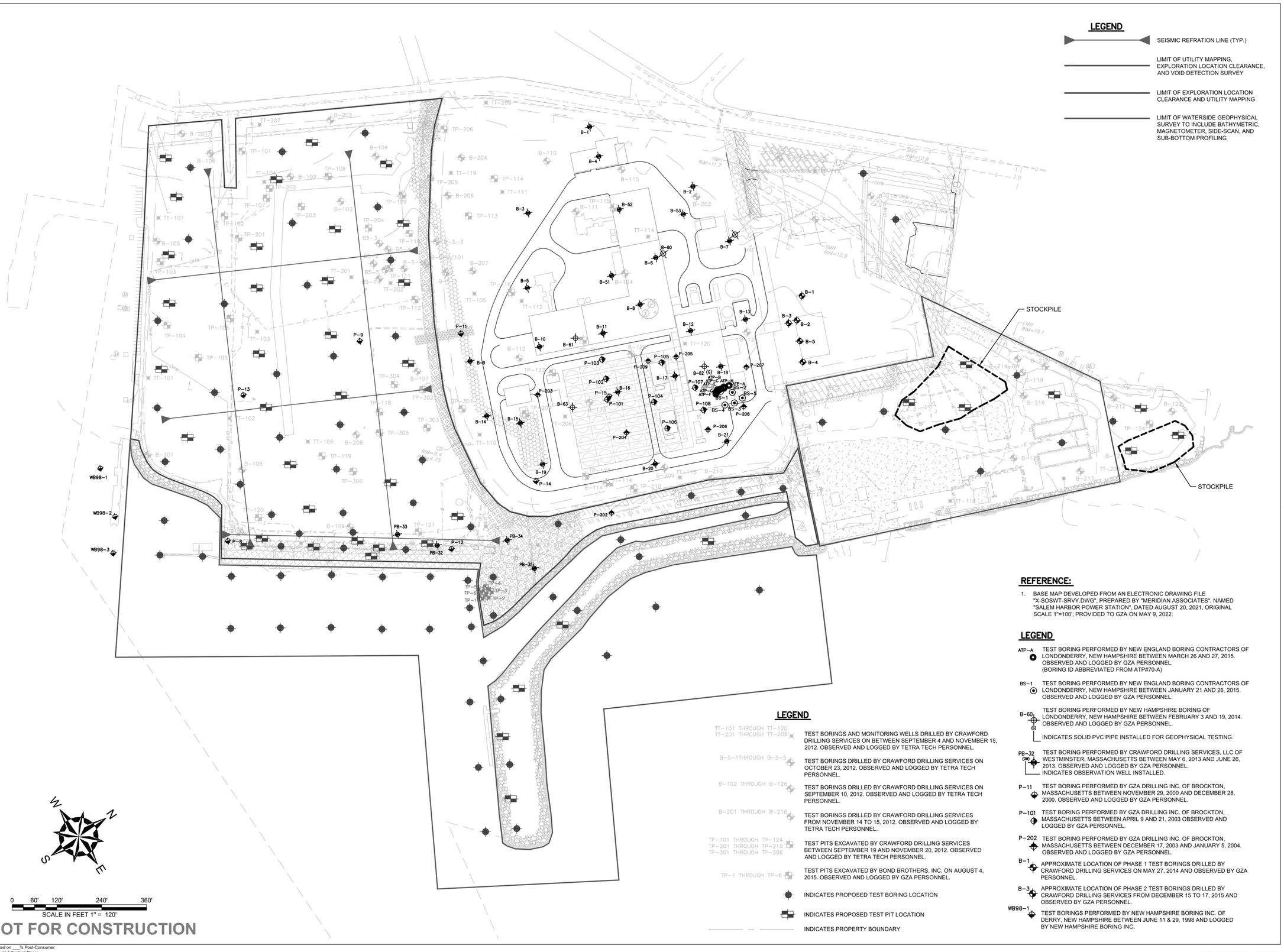
EXPLORATION LOCATION PLAN

SHEET NUMBER

B100

3 OF 26

ANSI D 22" x 34"



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INDICATES PROPOSED TEST BORING LOCATION

INDICATES PROPOSED TEST PIT LOCATION

INDICATES PROPERTY BOUNDARY

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B-1 — APPROXIMATE LOCATION OF PHASE 1 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES ON MAY 27, 2014 AND OBSERVED BY GZA PERSONNEL.

B-3 — APPROXIMATE LOCATION OF PHASE 2 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES FROM DECEMBER 15 TO 17, 2015 AND OBSERVED BY GZA PERSONNEL.

WB98-1 — TEST BORINGS PERFORMED BY NEW HAMPSHIRE BORING INC. OF DERRY, NEW HAMPSHIRE BETWEEN JUNE 11 & 29, 1998 AND LOGGED BY NEW HAMPSHIRE BORING INC.

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

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New York, NY 10004
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SUB-CONSULTANTS

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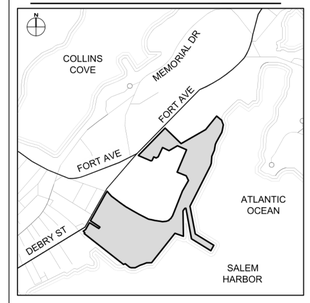
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	GRB
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

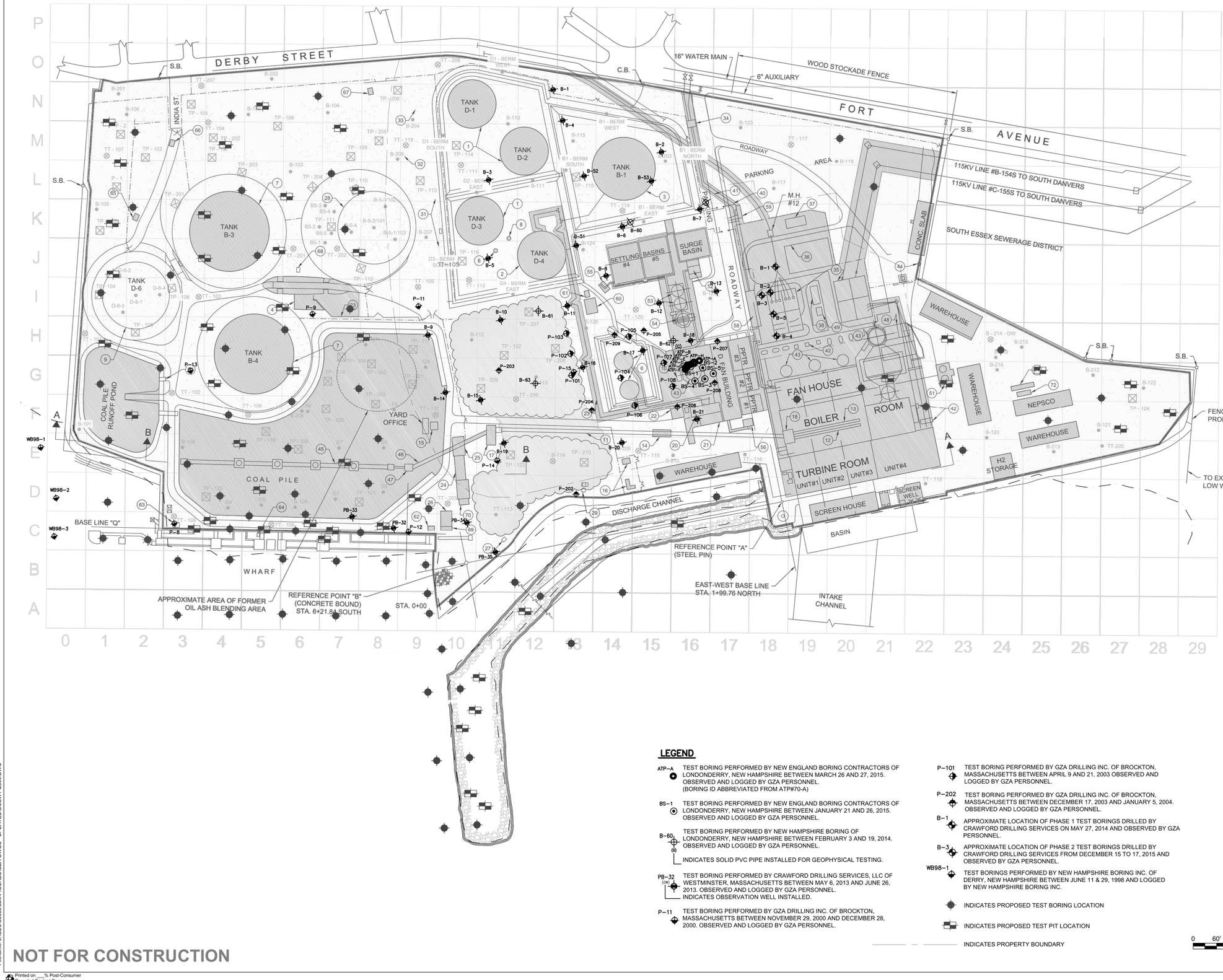
GEOPHYSICAL SURVEY PLAN

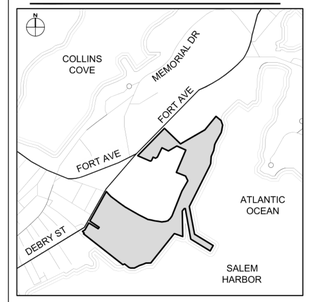
SHEET NUMBER

B200

4 OF 26

ANSI D 22" x 34"





LEGEND

- ATP-A — TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF LONDONDERRY, NEW HAMPSHIRE BETWEEN MARCH 26 AND 27, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL. (BORING ID ABBREVIATED FROM ATP#70-A)
- BS-1 — TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF LONDONDERRY, NEW HAMPSHIRE BETWEEN JANUARY 21 AND 26, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL.
- B-60 (G) — TEST BORING PERFORMED BY NEW HAMPSHIRE BORING OF LONDONDERRY, NEW HAMPSHIRE BETWEEN FEBRUARY 3 AND 19, 2014. OBSERVED AND LOGGED BY GZA PERSONNEL. INDICATES SOLID PVC PIPE INSTALLED FOR GEOPHYSICAL TESTING.
- PB-32 (OW) — TEST BORING PERFORMED BY CRAWFORD DRILLING SERVICES, LLC OF WESTMINSTER, MASSACHUSETTS BETWEEN MAY 6, 2013 AND JUNE 26, 2013. OBSERVED AND LOGGED BY GZA PERSONNEL. INDICATES OBSERVATION WELL INSTALLED.
- P-11 — TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN NOVEMBER 29, 2000 AND DECEMBER 28, 2000. OBSERVED AND LOGGED BY GZA PERSONNEL.
- P-101 — TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN APRIL 9 AND 21, 2003 OBSERVED AND LOGGED BY GZA PERSONNEL.
- P-202 — TEST BORING PERFORMED BY GZA DRILLING INC. OF BROCKTON, MASSACHUSETTS BETWEEN DECEMBER 17, 2003 AND JANUARY 5, 2004. OBSERVED AND LOGGED BY GZA PERSONNEL.
- B-1 — APPROXIMATE LOCATION OF PHASE 1 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES ON MAY 27, 2014 AND OBSERVED BY GZA PERSONNEL.
- B-3 — APPROXIMATE LOCATION OF PHASE 2 TEST BORINGS DRILLED BY CRAWFORD DRILLING SERVICES FROM DECEMBER 15 TO 17, 2015 AND OBSERVED BY GZA PERSONNEL.
- WB98-1 — TEST BORINGS PERFORMED BY NEW HAMPSHIRE BORING INC. OF DERRY, NEW HAMPSHIRE BETWEEN JUNE 11 & 29, 1998 AND LOGGED BY NEW HAMPSHIRE BORING INC.
- INDICATES PROPOSED TEST BORING LOCATION
- INDICATES PROPOSED TEST PIT LOCATION
- INDICATES PROPERTY BOUNDARY

0 60' 120' 240' 360'
SCALE IN FEET 1" = 120'

NOT FOR CONSTRUCTION

Last saved by: GARY BASTIEN(2022-05-12) Last Plotted: 2022-05-12
Filename: J:\GEO\35093.MKF\FIGURES\GZA-DWGS - UPDATED\B300WT-B300.DWG

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
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CONSULTANT

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DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN

REVISION

R	DATE	DESCRIPTION

Designed By:	**JJM**
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

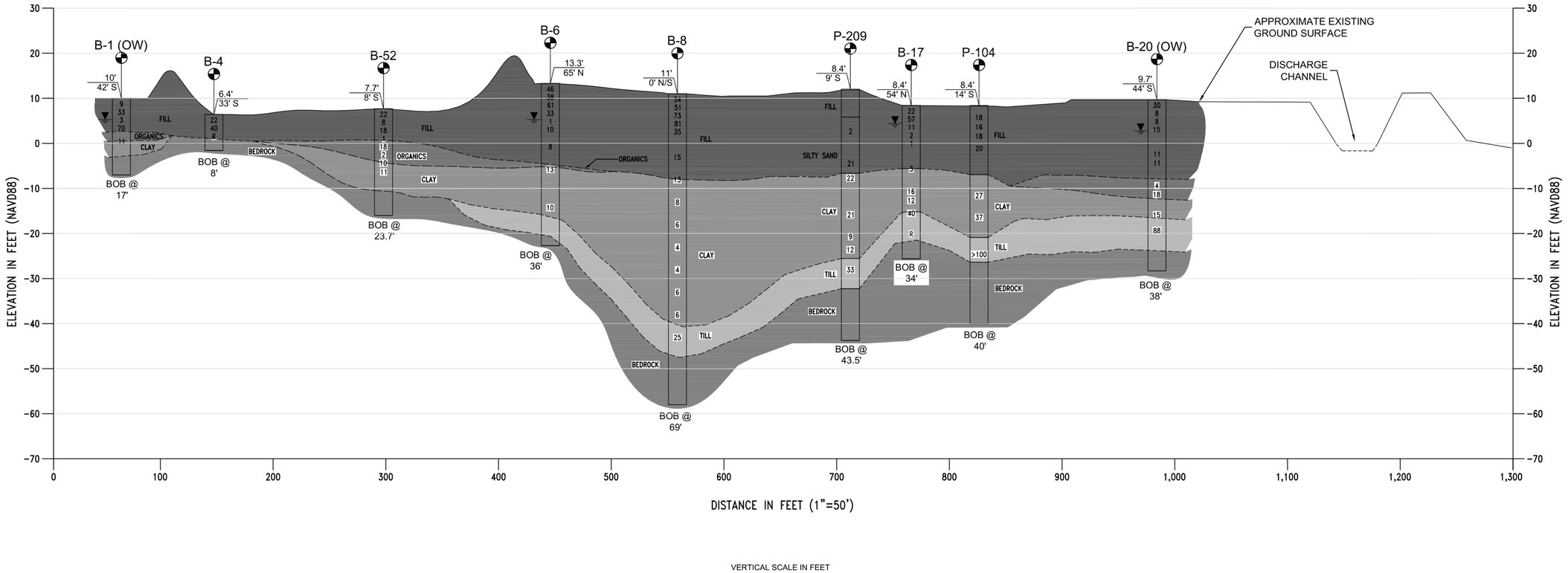
FORMER POWERPLANT SITE LAYOUT

SHEET NUMBER

B300

5 OF 26

PRELIMINARY DESIGN

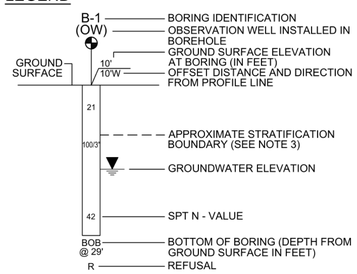


VERTICAL SCALE IN FEET
0 4' 8' 16' 24'
HORIZONTAL SCALE IN FEET
0 25' 50' 100' 150'

NOTES:

1. THE LOCATION AND ELEVATIONS OF THE BORINGS WERE APPROXIMATELY DETERMINED BY EITHER USE OF A GPS ROVER UNIT OR TAPE MEASUREMENTS FROM EXISTING TOPOGRAPHIC AND MAN-MADE FEATURES. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
2. SUBSURFACE PROFILE A - A' AT BORINGS B-20 (OW), B-17, B-8, B-6, B-52, B-4 AND B-1 (OW) WAS DEVELOPED BASED UPON BORINGS PERFORMED BY CRAWFORD DRILLING OF WESTMINSTER, MASSACHUSETTS BETWEEN MAY 6 AND 23, 2013, OBSERVED AND LOGGED BY GZA PERSONNEL.
3. THE STRATIFICATION LINES ARE APPROXIMATE, BASED UPON DATA FROM A LIMITED NUMBER OF WIDELY SPACED EXPLORATIONS AND THUS REPRESENT APPROXIMATE BOUNDARIES BETWEEN STRATUM TYPES. THE ACTUAL TRANSITIONS ARE EXPECTED TO BE MORE GRADUAL AND VARY FROM THOSE SHOWN.
4. FLUCTUATIONS IN LOCAL GROUNDWATER ELEVATIONS MAY OCCUR OVER TIME DUE TO RAINFALL, SEASONAL CHANGES IN THE RATE OF EVAPOTRANSPIRATION, TIDAL INFLUENCE, AND OTHER VARIOUS FACTORS.

LEGEND



FILL
ORGANICS
CLAY
TILL
BEDROCK

NOT FOR CONSTRUCTION

PROJECT

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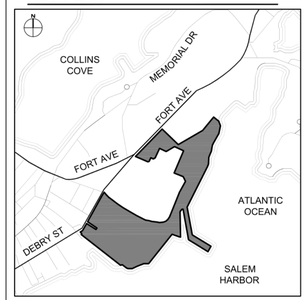
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**JJM**
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

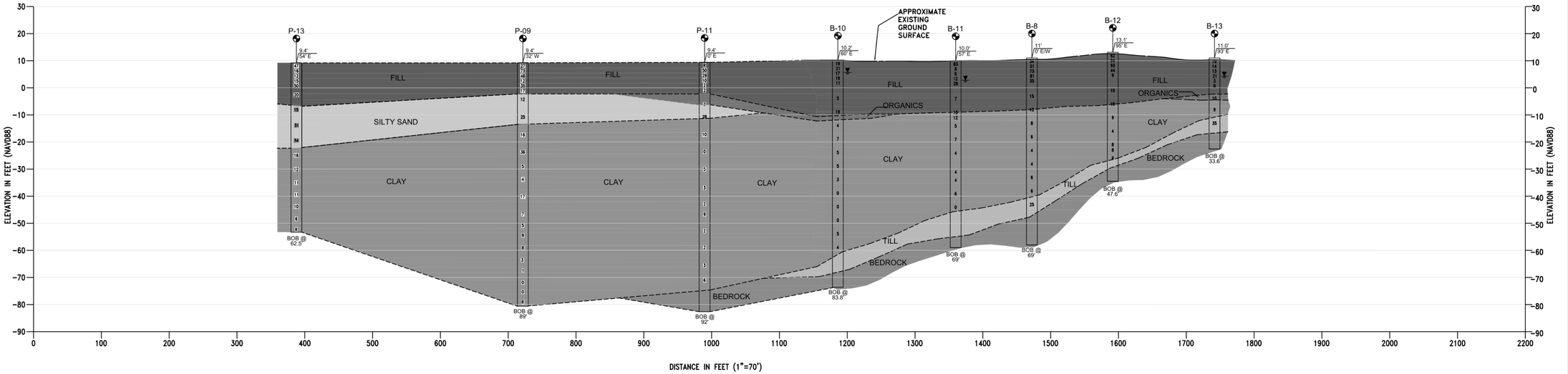
SUBSURFACE PROFILE A-A'

SHEET NUMBER

B401

6 OF 26

PRELIMINARY DESIGN



VERTICAL SCALE IN FEET
0 10' 20' 40' 60'
0 40' 80' 160' 240'
HORIZONTAL SCALE IN FEET

NOTES:

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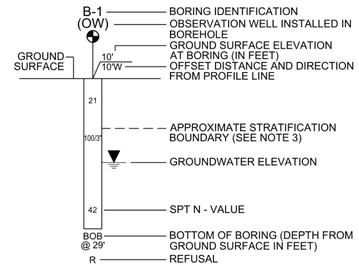

NOT FOR CONSTRUCTION

PROJECT

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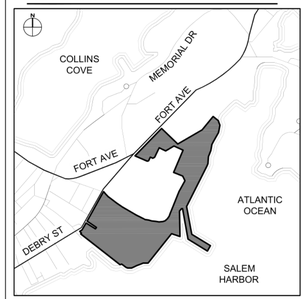
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

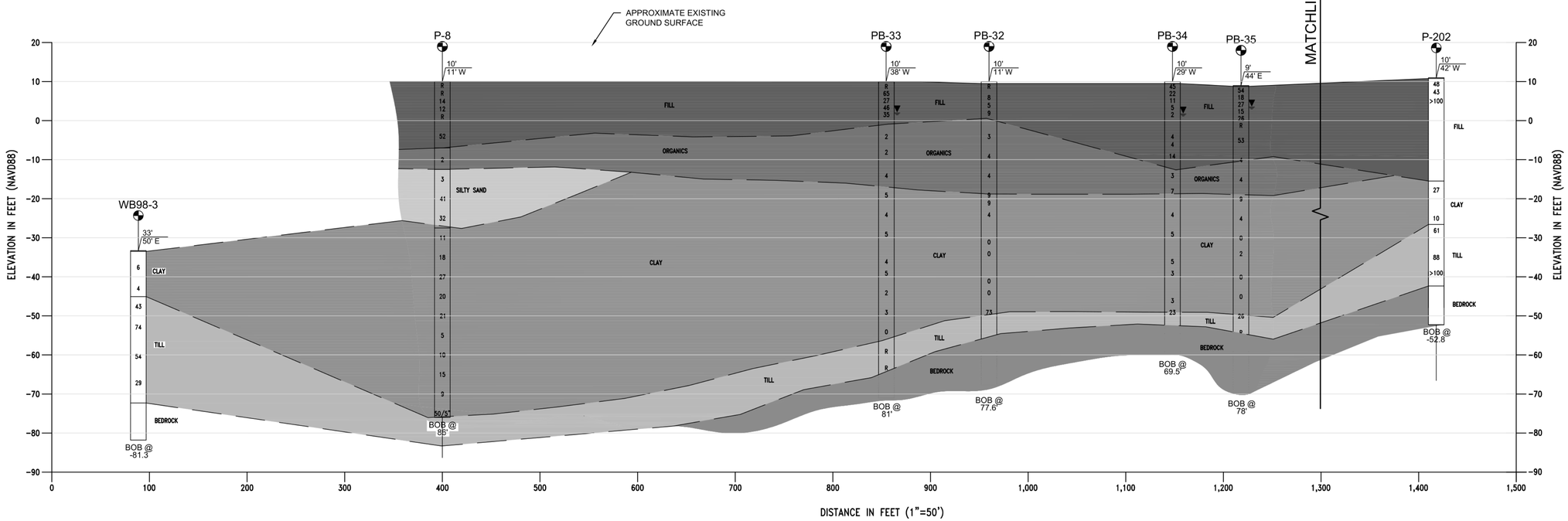
SUBSURFACE PROFILE B-B'

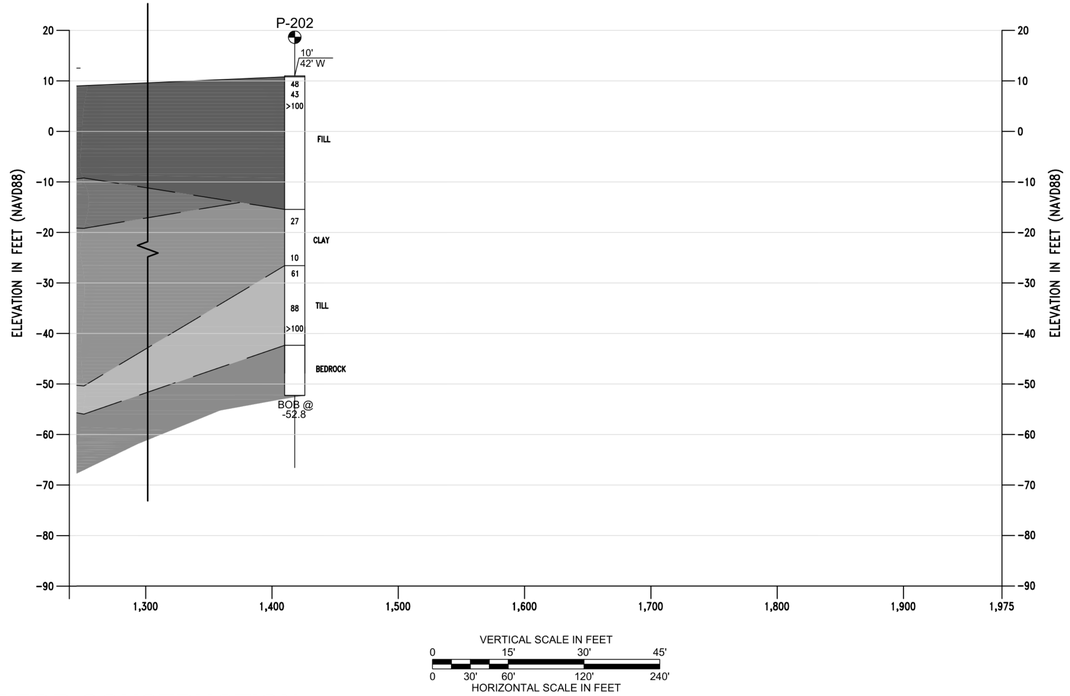
SHEET NUMBER

B402

7 OF 26

PRELIMINARY DESIGN





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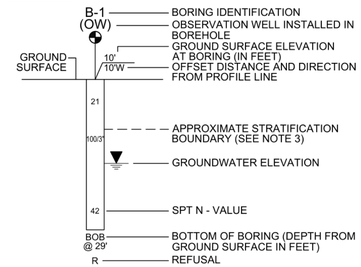
LEGEND



NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

PROJECT

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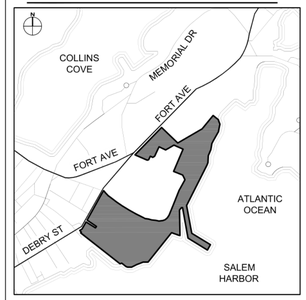

REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

SUBSURFACE PROFILE C-C'

SHEET NUMBER

B403

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-1(OW)
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.:	Crawford Drilling Services, LLC	**Type of Rig:** ATV	**Boring Location:** N3017285.781 - E823296.759
Foreman:	Darrel Green	**Rig Model:** CME 55	**Ground Surface Elev. (ft.):** 10
Logged By:	Michael Ostrowski	**Drilling Method:** Drive and Wash	**Final Boring Depth (ft.):** 17
			Date Start - Finish: 5/8/2013 - 5/9/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type:	HW	**Sampler Type:**	Split Spoon
I.D./O.D.:	4"/4.5"	**I.D./O.D. (in.):**	1-3/8"/2"
Hmr Weight (lb.):	140 lbs	**Sampler Hmr Wt (lb):**	140 lbs
Hmr Fall (in.):	30"	**Sampler Hmr Fall (in):**	30"
Other:	Auto Hammer	**Other:**	Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/16/13	1510	4.7'	well	7 days

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description Modified Burmister	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0-2	24	20	2 3 6 10	9	S-1: Top 8": Brown, dry, SILT, some fine to medium Sand, trace Roots. Bottom 12": Dark brown/black, fine to coarse SAND, some Gravel, little Silt, trace Brick.	1	0.7'	TOPSOIL 9.3'	
		S-2	2-4	24	13	6 16 17 14	33	S-2: Dense, brown, dry, fine to coarse SAND and GRAVEL, some Silt, trace Roots, trace Topsoil.	2		FILL	
5		S-3	4-6	24	5	5 2 1 1	3	S-3: Very loose, brown, fine to coarse SAND, little Silt, trace Gravel.	3	7.7'	-2.7'	
		S-4	6-8	24	13	2 8 62 53	70	S-4: Top 5": Brown, fine to coarse SAND, trace Gravel, trace (-) Silt. Bottom 8": Gray, GRAVEL and fine to coarse SAND, little Silt.	4	8.6'	BOULDER -1.9'	
		S-5	9.5-11.5	24	24	3 4 7 7	11	S-5: Top 1": Dark gray, GRAVEL, some Clay & Silt, trace fine to coarse Sand, trace wood/organic fibers, faint Hydrogen Sulfide-like odor. Bottom 23": Light brown, Silty CLAY. Pp= 3.25 tsf, Tv= 0.5 tsf	5	9.6'	ORGANICS -9.4'	
10								Additional Notes: 7. Rollerbitted from approximately 14 to 17 feet under approximately 850 psi downpressure for about 25 minutes. The drill effort appeared hard and consistent and no wash water return was observed. 8. Installed a monitoring well upon completion as shown.	6	13'	CLAY -3.0'	
											PROBABLE BEDROCK	
									7	17'	-7.0'	
15									8			
20												
25												
30								Bottom of boring at 17 feet.				

Equipment Installed: FLUSH MOUNTED ROAD BOX; Concrete; 0.8'; Bentonite Chips; 1.0'; 2" ID Solid Sch 40 PVC Well Riser; Filter Sand; 2" ID Slotted Sch 40 PVC Well Screen (0.01" Slot); -13'; Bentonite Chips; -17'

REMARKS

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4-inch ID casing to obtain samples from 4 to 7.3± feet.
3. Obtained sample at 6 feet. Driller believes the split spoon veered off of plumb during driving and did not advanced to 8 feet. Encountered casing driving refusal at approximately 7.3 feet. Rollerbitted to approximately 7.9 feet under increased drilling effort then drove the 4-inch ID casing to approximately 7.9 feet. Observed a strong petroleum-like odor from the bottom portion of sample S-4.
4. Appeared to roller bit through an apparent boulder from approximately 7.3 to 8.5± feet. Advanced the rollerbit to approximately 9.5 feet then sampled open hole.
5. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
6. Driller noted an increase in drill effort from approximately 13 to 14 feet with a small (~1" thick) drop which driller stated may have been a seam in possible bedrock. Removed the 4-inch ID casing and installed 3-inch ID casing by driving to 14 feet.

See Log Key for explanation of sample descriptions and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-1(OW)

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING WE WO BMP WO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-4
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.:	Crawford Drilling Services, LLC	**Type of Rig:** ATV	**Boring Location:** N3017260.745 - E823375.225
Foreman:	Darrel Green	**Rig Model:** CME 55	**Ground Surface Elev. (ft.):** 6.4
Logged By:	Michael Ostrowski	**Drilling Method:** Spin and Wash	**Final Boring Depth (ft.):** 8
			Date Start - Finish: 5/7/2013 - 5/7/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type:	HW	**Sampler Type:**	Split Spoon
I.D/O.D.(in):	4"/4.5"	**I.D./O.D. (in.):**	1-3/8"/2"
Hammer Weight (lb.):	N/A	**Sampler Hmr Wt (lb):**	140 lbs
Hammer Fall (in.):	N/A	**Sampler Hmr Fall (in):**	30"
Other	Spun	**Other:**	Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
No	readings	obtained		

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0.5-2.5	24	11	26 17 5 2	22	S-1: Medium dense, grayibrown, fine to coarse SAND, some Silt, little Gravel.	1	0.3'	BALLAST	6.1'
		S-2	2.5-4.5	24	10	3 3 37 20	40	S-2: Moist, gray, GRAVEL and fine to coarse SAND, little Silt.	2			
5		S-3	4.5-5.3	9	2	17 100/3"	R	S-3: Gray, GRAVEL and fine to coarse SAND, little Silt.	3		FILL	
									4	5.3'	PROBABLE BEDROCK	1.1'
								Bottom of boring at 8 feet.		8'		-1.6'
10									5			
15												
20												
25												
30												

REMARKS

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Removed ballast and top 3 inches of fill by hand to 0.5 feet before taking sample S-1.
3. Petroleum-like odor observed in samples S-1, S-2, and S-3.
4. After split spoon refusal at approximately 5.3 feet, spun 4-inch ID casing to 4.5 feet then rollerbitted from 4.5 to 8 feet under approximately 900 psi down pressure for about 20 minutes.
5. Dark gray/white rock pieces were observed in the drill cuttings from approximately 5.3 to 8 feet. Bedrock possibly encountered.
6. Borehole backfilled with drill cuttings to approximate ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-4

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-6
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.:	Crawford Drilling Services, LLC	**Type of Rig:** ATV Rig	**Boring Location:** N3017229.695 - E823685.055
Foreman:	Darrel Green	**Rig Model:** CME 55	**Ground Surface Elev. (ft.):** 13.3
Logged By:	Michael Ostrowski	**Drilling Method:** Drive and Wash	**Final Boring Depth (ft.):** 36
			Date Start - Finish: 5/13/2013 - 5/13/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type:	HW	**Sampler Type:**	Split Spoon
I.D/O.D.(in):	4"/4.5"	**I.D./O.D. (in.):**	1-3/8"/2"
Hammer Weight (lb.):	140 lbs	**Sampler Hmr Wt (lb):**	140 lbs
Hammer Fall (in.):	30"	**Sampler Hmr Fall (in):**	30"
Other:	Auto Hammer	**Other:**	Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/14/13	0730	8.0'	OUT	18 hrs

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0.5-2	18	15	14 28 18	46	S-1: Dense, brown, fine to coarse SAND, some Silt, little Gravel.	1	0.5'	ASPHALT	12.8'
		S-2	2-4	24	21	17 14 24 54	38	S-2: Dense, brown, fine to coarse SAND, some Gravel, some Silt.	2		FILL	
5		S-3	4-6	24	18	33 35 26 24	61	S-3: Very dense, brown, fine to coarse SAND and GRAVEL, little Silt.				
		S-4	6-8	24	8	17 21 12 11	33	S-4: Dense, brown, fine to coarse SAND and GRAVEL, little Silt.				
		S-5	8-10	24	1	3 1 0 4	1	S-5: Piece of gravel stuck in tip of spoon.				
10		S-6	10-12	24	7	4 5 5 5	10	S-6: Medium dense, brown, fine to coarse SAND, some Silt, some Gravel.				
15		S-7	14-16	24	4	3 5 3 3	8	S-7: Loose, brown, fine to coarse SAND and SILT, some Gravel.		18'	-4.7'	
									3	18.5'	GRAVELLY SILT -5.2'	
20		S-8	19-21	24	21	6 6 7 8	13	S-8: Stiff, brown/gray, Silty CLAY. Top 5-inches of sample had some fine gravel. Pp= 4.25 tsf, Tv= 0.825 tsf	4		CLAY	
									5	22.7'	-9.4'	
25											BOULDER	
										27'	-13.7'	
30		S-9	27.5-29.5	24	24	1 0 10 26	10	S-9: Top 13": Gray/brown, Silty CLAY, trace Gravel, trace fine to medium Sand. Bottom 11": Gray/brown, GRAVEL and fine to coarse SAND, little Silt.	6	29.5'	CLAY -16.2'	
										33.9'	TILL -20.6'	
35									7	36'	PROBABLE BEDROCK -22.7'	
40								Bottom of boring at 36 feet.	8			

REMARKS

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4-inch ID casing to obtain samples from 4 to 21 feet.
3. Observed a color change and bits of black organic silt in the wash water from approximately 18 to 18.5 feet. From approximately 18.5 to 19 feet observed the wash water change to predominantly gray Silty CLAY.
4. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
5. Rollerbitted through boulder from 22.7 to 27 feet.
6. Sampled open-hole from approximately 27.5 to 29.5. Overdrove the sample to approximately 30 feet.
7. Difficult drilling with rollerbit from about 33.9 to 36 feet. Bedrock probably encountered.
8. Borehole backfilled with drill cuttings to approximate ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-6

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-8
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.:	Crawford Drilling Services, LLC	**Type of Rig:** Truck	**Boring Location:** N3017123.79 - E823763.518
Foreman:	Darrel Green	**Rig Model:** Diedrich D-120	**Ground Surface Elev. (ft.):** 11
Logged By:	Michael Ostrowski	**Drilling Method:** Drive and Wash	**Final Boring Depth (ft.):** 89
			Date Start - Finish: 5/16/2013 - 5/17/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type:	HW	**Sampler Type:**	Split Spoon
I.D/O.D.(in):	4"/4.5"	**I.D./O.D. (in.):**	1-3/8"/2"
Hammer Weight (lb.):	140 lbs	**Sampler Hmr Wt (lb):**	140 lbs
Hammer Fall (in.):	30"	**Sampler Hmr Fall (in):**	30"
Other:	Auto Hammer	**Other:**	Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
Not	recorded			

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0.5-2	18	11	8 14 20	34	S-1: Dense, brown, fine to coarse SAND and GRAVEL, little Silt.	1	0.5'	ASPHALT	10.5'
		S-2	2-4	24	16	20 20 31 25	51	S-2: Very dense, brown, fine to coarse SAND, some Gravel, some Silt, trace Asphalt.				
5		S-3	4-6	24	17	27 32 41 45	73	S-3: Very dense, brown, fine to coarse SAND and GRAVEL, some Silt.	2			
		S-4	6-8	24	12	40 44 37 26	81	S-4: Very dense, brown/gray, GRAVEL and fine to coarse SAND, little Silt.				
		S-5	8-10	24	11	22 21 14 16	35	S-5: Dense, brown, fine to coarse SAND, some Silt, little Gravel.			FILL	
10												
15	305	S-6	14-16	24	7	8 8 7 3	15	S-6: Medium dense, brown, fine to coarse SAND and GRAVEL, little Silt.				
	↓											
	↓											
	↓									19'		-8.0'
20		S-7	19-21	24	20	10 6 7 9	13	S-7: Top 1": Brown/black, CLAY & SILT / Silty CLAY, trace organic Silt. Bottom 19": Brown/gray, Silty CLAY, trace fine to coarse Sand, one fine to coarse Sand seam (~1/8-inch thick) observed. Pp= 4.5 tsf, Tv= 0.85 tsf	3			
		S-8	24-26	24	24	3 4 4 6	8	S-8: Stiff, brown, Silty CLAY, occasional fine Sand parting (<1/16-inch thick). Pp= 2.5 tsf, Tv=0.9 tsf	4		CLAY	
25												
30		S-9	29-31	24	24	1 3		S-9: Medium stiff, gray, Silty CLAY.				

REMARKS

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4-inch ID casing to obtain samples from 4 to 21 feet.
3. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
4. Sampled open hole from 24 to 56 feet.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-8

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-8
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
						3 3	6	Pp= 1.5 tsf, Tv= 0.575 tsf				
		T-1	31-33	24	24	PUSH PUSH						
35		S-10	34-36	24	10	2 2 2 3	4	S-10: Medium stiff, gray, Silty CLAY. Pp= 1.25 tsf, Tv= 0.55 tsf				
		S-11	39-41	24	24	0 2 2 3	4	S-11: Medium stiff, gray, Silty CLAY. Pp= 1.0 tsf, Tv= 0.525 tsf			CLAY	
40												
45		S-12	44-46	24	24	2 3 3 5	6	S-12: Medium stiff, gray, Silty CLAY. Pp= 1.0 tsf, Tv= 0.55 tsf				
		T-2	46-48	24	24	PUSH PUSH						
50		S-13	49-51	24	24	3 2 4 3	6	S-13: Medium stiff, gray, CLAY and SILT, little fine to medium Sand. Pp= 1.25 tsf, Tv= 0.6 tsf				
										51.5'		-40.5'
										52.5'	BOULDER	-41.5'
55		S-14	54-56	24	10	30 15 10 12	25	S-14: Medium dense, gray, fine to coarse SAND, some Gravel, some Silt.			TILL	
60									5	58.5'		-47.5'
											BEDROCK	
65	min/ft 3 2.5	C-1	64-69	60	55			C-1: Top 28": Hard, fresh, black/white/dark gray, medium to very coarse grained Pyroxene Hornblende DIORITE with moderately close to close, moderate to subvertically dipping joints/fractures.	6			

REMARKS

5. Observed a change in drill effort at approximately 58.5 feet. Rollerbitted with a steel toothed rollerbit from approximately 58.5 to 64 feet under approximately 800 to 900 psi downpressure.
6. Installed 3-inch ID casing to 64 feet, cleaned out, then cored. Cored under approximately 300 to 350 psi downpressure.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-8

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-8
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
	3 3 3							Bottom 27": Hard, fresh, fine grained, dark gray, possible ANDESITE with close, subhorizontal to moderately dipping joints/fractures. Felsic/lite at bottom 3 inches of sample and at ~67.1 feet. RQD = 77%			BEDROCK	
								Bottom of boring at 69 feet.	7	69'		-58.0'
70												
75												
80												
85												
90												
95												
100												

REMARKS

7. Borehole backfilled with drill cuttings and cold asphalt patched after completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-8

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
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SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN

REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 1)

SHEET NUMBER

B501

9 OF 26

ANSI D 22" x 34"

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-10
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3016837.886 - E823701.15
Ground Surface Elev. (ft.): 10.2
Final Boring Depth (ft.): 83.8
Date Start - Finish: 5/29/2013 - 5/30/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs.
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/30/13	0715	4.5'	8'	~16.5 hours

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
	PUSH	S-1	0-2	24	13	6 10		S-1: Medium dense, gray-black, fine to coarse SAND and GRAVEL, some Silt,	1			
	PUSH					9 16	19	Topsoil.				
	PUSH	S-2	2-4	24	11	15 11		S-2: Medium dense, wet, brown, fine to coarse SAND, some Gravel, little Silt.				
	137					10 10	21					
5	137	S-3	4-6	24	6	7 10		S-3: Medium dense, gray-brown, fine to coarse SAND and GRAVEL, little Silt.	2			
	137					7 10	17					
	137	S-4	6-8	24	13	11 10		S-4: Medium dense, gray, GRAVEL and fine to coarse SAND, trace Silt.				
	PUSH					9 6	19					
	PUSH	S-5	8-10	24	5	12 6		S-5: Medium dense, gray, fine to coarse SAND and GRAVEL, trace Silt.				
	PUSH					5 3	11					
10	PUSH										FILL	
	PUSH											
	PUSH											
	PUSH											
	PUSH	S-6	14-16	24	2	9 2		S-6: Loose, gray, GRAVEL, some medium to coarse Sand, trace Silt.				
15	PUSH					3 1	5					
	PUSH											
	PUSH											
	PUSH											
	PUSH	S-7	19-21	24	11	13 11		S-7: Top 9": Gray, GRAVEL and fine to coarse SAND, some Clayey Silt.				
20						8 4	19	Bottom 2": Dark gray-black, Organic Clayey SILT and GRAVEL, some fine to coarse Sand, faint Hydrogen Sulfide-like odor noted.		20.5'		-10.3'
										22'	ORGANIC SILT	-11.8'
							3					
		S-8	24-26	24	24	3 2		S-8: Soft to medium staff, light gray, Silty CLAY with frequent fine Sand seams	4			
25						2 1	4	(~1/8" to 1/4" thick). Pp= 0.75 tsf, Tv= 0.4 tsf			CLAY	
		S-9	29-31	24	2	2 4		S-9: Medium stiff, light gray, Silty CLAY	5			
30												

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed casing to obtain samples from 4 to 25 feet.
3. Observed a change in wash water color and noted bits of clay-like pieces in the wash water at approximately 22 feet.
4. Tv and Pp indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf) respectively.
5. Drilled open hole to obtain samples from 29 to 71 feet.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-10

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-10
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
						3 2	7					
35		S-10	34-36	24	24	WOH 3		S-10: Medium stiff, gray, CLAY & SILT, trace fine Gravel, frequent Sand seams	6			
						2 3	5	(~1/16" to 1-1/2" thick). Pp= 0.25 tsf, Tv = 0.2 tsf				
		S-11	39-41	24	24	WOH 3		S-11: Top 8": Gray, CLAY & SILT, trace Gravel, occasional fine to coarse Sand				
40						2 3	5	seams (~1/2" thick). Bottom 16": Light gray, Silty CLAY.				
		T-1	41-43	24	24	Push Push		Pp= 0.75 tsf, Tv= 0.35 tsf				
		S-12	44-46	24	24	WOH		S-12: Soft, light gray, Silty CLAY, one ~1/2" thick, fine to coarse Sand seam				
45						WOH	3	observed at 4" from top of sample.				
						3 2		Pp= 0.75 tsf, Tv= 0.3 tsf			CLAY	
		S-13	49-51	24	24	WOH		S-13: Very soft, light gray, Silty CLAY				
50						WOH	0	Pp= 0.5 tsf, Tv= 0.275 tsf				
						WOH 3						
		S-14	54-56	24	24	WOR		S-14: Very soft, light gray, Silty CLAY.	7			
55						WOR	0	Pp= 0.25, 0.5 tsf, Tv =0.1, 0.375 tsf				
						WOH 3						
		S-15	59-61	24	24	WOR		S-15: Very soft, light gray, Silty CLAY.				
60						WOR	0	Pp= 0.25 tsf, Tv= 0.3 tsf				
						WOH 3						
									8			
65		S-16	64-66	24	24	WOH 3		S-16: Medium stiff, gray, Silty CLAY, trace Gravel, trace fine to coarse Sand on				
						2 4	5	occasion. Pp= .75 tsf, Tv= .3 tsf				

6. WOH indicates the sampler was advanced under the weight of the hammer.
7. WOR indicates the sampler was advanced under the weight of the drill rods only.
8. Noted a change in drill effort at approximately 62 feet. Water loss was noted while drilling at about 62 feet. Driller believe a sand seam may have been encountered at approximately 62 feet.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-10

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-10
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
											CLAY	
70		S-17	69-71	24	24	WOH		S-17: Soft to medium stiff, gray, CLAY & SILT.				
						WOH 4 3	4	Pp= 0.75 tsf, Tv= 0.35 tsf				
									9	71.5'		-61.3'
									10		BOULDER	
75										76'		-65.8'
											PROBABLE TILL	
										78.5'		-68.3'
									11		PROBABLE BEDROCK	
80												
									12	83.8'		-73.6'
85								Bottom of boring at 83.8 feet.				
90												
95												
100												

9. Change in drill effort noted at approximately 71.5 feet.
10. Roller bitted with a steel toothed roller bit from approximately 71.5 to 74.5 feet under approximately 1000 psi down pressure over approximately 25 minutes. Drill effort appeared somewhat consistent and water loss appeared to be significant. Borehole would not stay open so 3" ID casing was installed and advanced to about 71.8 feet. Roller bitted from 74.5 to 76 feet with increased apparently consistent effort from approximately 74.5 to 75 feet. Drill effort became less from approximately 76 to 78.5 feet and sand was observed in the wash water.
11. Roller bitted with increased apparently consistent effort from approximately 78.5 to 83.8 feet under approximately 950 psi down pressure over about 10 minutes using a carbide-tipped roller bit. Water loss was noted during roller bitting and only slight return of wash water was observed.
12. Borehole backfilled to approximately ground surface after completion.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-10

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-11
SHEET: 1 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3016997.702 - E823769.525
Ground Surface Elev. (ft.): 10.0
Final Boring Depth (ft.): 69
Date Start - Finish: 5/31/2013 - 6/5/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
6/5/13	0730	7.2'	21'	5 days

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0-2	24	8	3 19		S-1: Brown, GRAVEL and fine to coarse SAND, trace Silt, trace Glass.	1			
						64 11	83					
		S-2	2-4	24	18	7 3		S-2: Loose, dark brown, Organic SILT and fine to coarse SAND, trace Gravel.				
						5 4	8					
5	PUSH	S-3	4-6	24	1	6 4		S-3: Loose, dark brown, GRAVEL, little Organic Silt, trace fine to coarse Sand.	2			
	PUSH					2 2	6					
	PUSH	S-4	6-8	24	10	4 3		S-4: Top 6": Brown, fine to coarse SAND, some Gravel, trace Silt.				
						9 34	12	Bottom 4": Dark brown, fine to coarse SAND and GRAVEL, little Organic Silt.				
	PUSH	S-5	8-10	24	4	13 11		S-5: Medium dense, brown, fine to coarse SAND, some Gravel, little Silt, trace				
10	∂					17 10	28	Organic Silt.			FILL	
	∂											
	∂											
15		S-6	14-16	24	7	6 5		S-6: Top 4": Brown, fine to coarse SAND, some Gravel, little Silt.				
						2 1	7	Bottom 3": Brown, fine SAND, little Silt.				
										19'		-9.0'
20	PUSH	S-7	19-21	24	0	19 7		S-7: No recovery.	3			
	PUSH					6 8	13					
		S-8	21-23	24	0	8 6		S-8: No recovery.				
						6 6	12					
25		S-9	24-26	24	21	5 2		S-9: Medium stiff, gray, Silty CLAY, piece of Gravel at top of sample.	4			
						3 4	5	Pp= 1.5 tsf, Tv= 0.55 tsf			CLAY	
30		S-10	29-31	24	2	3 3		S-10: Medium stiff, gray, Silty CLAY, trace Gravel.				
						4 5	7					

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4-inch ID casing to obtain samples from 4 to 23 feet.
3. Observed clay-like material smeared on the outside of spoon for samples S-7 and S-8. No recovery possibly due to gravel in spoon tip.
4. "Tv" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
5. Drilled open hole to obtain samples from 29 to 71 feet.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-11

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-11
SHEET: 2 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
35		S-11	34-36	24	19	2 2		S-11: Medium stiff, gray, Silty CLAY, trace Gravel.				
						2 3	4	Pp= 1.0 tsf, Tv= 0.425 tsf				
		T-1	39-41	24	24	PUSH						
40						PUSH						
		S-12	41-43	24	24	1 2		S-12: Medium stiff, gray, Silty CLAY.				
						2 3	4	Pp= 0.75 tsf, Tv= 0.4 tsf				
45		S-13	44-46	24	24	2 2		S-13: Medium stiff, gray, CLAY & SILT.			CLAY	
						2 3	4	Pp= 0.75 tsf, Tv= 0.425 tsf				
50		S-14	49-51	24	24	WOH 3		S-14: Medium stiff, gray, Silty CLAY.	5			
						3 3	6	Pp= 0.75 tsf, Tv= 0.5 tsf				
55		S-15	54-56	24	21	WOR		S-15: Top 20": Gray, Silty CLAY.	6			
						WOR	0	Bottom 1": Gray, GRAVEL, some Clayey Silt, trace fine to medium Sand.		55.5'		-45.5'
						WOH 9		Pp= 0.5 to 0.75 tsf, Tv= 0.325 to 0.475 tsf			TILL with frequent Cobbles and Boulders	
60												
65										65.5'		-55.5'
									8		POSSIBLE WEATHERED ROCK	
										68'		-58.0'
70								Bottom of boring at 69 feet.	9	69'	PROBABLE BEDROCK	-59.0'

5. "WOH" indicates the sampler was advanced by the weight of the 140-pound hammer only.
6. "WOR" indicates the sampler was advanced by the weight of the drill rods only.
7. Slight difficulty from approximately 65.5 to 69 feet. The drilling from approximately 65.5 to 68 feet appeared somewhat less difficult than the drilling from 68 to 69 feet. Bedrock probably encountered.
8. Borehole backfilled with drill cuttings to approximately ground surface after completion.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-11

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-12
SHEET: 1 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3017193.463 - E823898.829
Ground Surface Elev. (ft.): 13.1
Final Boring Depth (ft.): 47.6
Date Start - Finish: 5/21/2013 - 5/21/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
Not recorded				

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0.5-2	18	10	21 24		S-1: Very dense, graybrown, fine to coarse SAND and GRAVEL, little Silt.	1	0.5'	ASPHALT	12.6'
						38	62					
		S-2	2-3.7	21	12	36 43		S-2: Very dense, graybrown, fine to coarse SAND and GRAVEL, little Silt.				
						51 50/3"	94					
5		S-3	4-6	24	14	36 48		S-3: Very dense, brown/gray, fine to coarse SAND and GRAVEL, little Silt.	2			
						45 43	93		3		FILL	
		S-4	6-8	24	9	37 24		S-4: Dense, graybrown, fine to coarse SAND and GRAVEL, little Silt.				
						20 14	44					
	PUSH	S-5	8-10	24	1	10 4		S-5: piece of Gravel in tip of spoon.	4	8'		5.1'
	189					5 5	9					
10	189											
	189											
	189											
	315	S-6	14-16	24	5	5 7		S-6: Medium dense, brown, fine to coarse SAND, some Silt, little Gravel.			POSSIBLE FILL	
15	315					3 4	10					
	315											
	315											
	315											
		S-7	19-21	24	18	28 9		S-7: Top 1": Gray, GRAVEL.	5	19.5'		-6.4'
20						10 12	19	Bottom 17": Brown/gray, Silty CLAY, top 1" contains trace organic Silt. Pp= 4.5 tsf, Tv= 1.0 tsf				
		S-8	24-26	24	17	3 4		S-8: Stiff, brown, Silty CLAY.	6			
25						5 6	9	Pp= 2.5 tsf, Tv= 0.8 tsf			CLAY	
		S-9	29-31	24	24	2 2		S-9: Medium stiff, gray, Silty CLAY.				
30												

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4-inch ID casing to obtain samples from 4 to 21 feet.
3. Observed a change in wash water color and noted bits of clay-like pieces in the wash water at approximately 18 feet. Medium-like odor.
4. Wrote rollerbitting from 8 to 14 feet, observed sand and gravel in the wash water.
5. "Tv" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
6. Drilled open hole to obtain samples from 24 to 41 feet.

REMARKS

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-12

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

PROJECT

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67 Derby Street, Salem, Massachusetts

CLIENT

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9487 Regency Square Boulevard
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CONSULTANT

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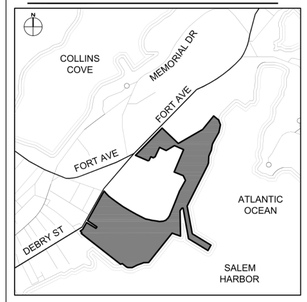
SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 2)

SHEET NUMBER

B502

10 OF 26

Last saved by: GARY.BASTIEN (2022-05-11) Last Plotted: 2022-05-12
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TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-12
SHEET: 2 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
						2 3	4	Pp= 0.5 tsf, Tv= 0.25 to 0.475 tsf				
35		S-10	34-36	24	0	3 4 4 4	8	S-10: No recovery.			CLAY	
		S-11	36-38	24	24	4 4 4 4	8	S-11: Stiff, gray, Silty CLAY. Pp= 0.5 tsf, Tv= 0.325 tsf				
		S-12	39-41	24	8	2 117 46 40	R	S-12: Top 6": Gray, CLAY & SILT, trace Gravel. Pp= 0.25 tsf, Tv= 0.2 tsf Bottom 2": Gray, GRAVEL, some Silty Clay, trace fine to coarse SAND.	7	39.5' 42'	TILL PROBABLE BEDROCK	-26.4' -28.9'
40												
45												
								Bottom of boring at 47.6 feet.		47.6'		-34.5'
50												
55												
60												
65												

REMARKS
7. Difficult drilling from about 42 to 47.6 feet. Bedrock probably encountered.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-12

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-13
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Spin and Wash

Boring Location: N3017331.277 - E823958.302
Ground Surface Elev. (ft.): 11.0
Final Boring Depth (ft.): 33.6
Date Start - Finish: 5/15/2013 - 5/16/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): N/A
Hammer Fall (in.): N/A
Other: Spun

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/16/13	0730	6.7'	19'	16.5 hrs

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0.6-2.5	23	13	17 14 5 3	19	S-1: Medium dense, brown, fine to coarse SAND and GRAVEL, little Silt.	1	0.6'	ASPHALT	10.4'
		S-2	2.5-4	18	8	4 4 10	14	S-2: Brown, GRAVEL and fine to coarse SAND, little Silt.				
5		S-3	4-6	24	4	7 10 3 2	13	S-3: Brown, fine to coarse SAND and GRAVEL, some Silt and Clay.	2		FILL	
		S-4	6-8	24	6	3 9 12 20	21	S-4: Medium dense, brown, GRAVEL and fine to coarse SAND, some Silt.				
		S-5	8-10	24	0	12 2 1 2	3	S-5: No Recovery.				
10		S-6	10-12	24	0	5 5 3 4	8	S-6:No Recovery. (2 attempts)				
										12.5'		-1.5'
										13.3'	BOULDER	-2.3'
15											ORGANICS	
		S-7	14.8-16.8	24	24	3 4 6 7	10	S-7: Top 3": Dark gray, Organic Clayey SILT, some Gravel, little fine to coarse Sand, trace Shells. Bottom 21": Light brown/gray, Silty CLAY. Pp= 3.25 tsf, Tv= 0.875 tsf.	3	15.5'		-4.5'
											CLAY	
20		S-8	19-21	24	24	3 4 5 5	9	S-8: Stiff, light brown/gray, CLAY and SILT, trace fine to coarse Sand. Pp= 2.5 tsf, Tv= 0.7	4	21.5'		-10.5'
									5			
25		S-9	24-26	24	5	19 19 16 15	35	S-9: Top 2": Gray, broken pieces of GRAVEL. Bottom 3": Brown, fine to coarse SAND, little Silt, trace fine Gravel.			TILL	
									6	27.5'		-16.5'
30											PROBABLE ROCK	
									7	33.6'		-22.6'
35								Bottom of boring at 33.6 feet.				

REMARKS
1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Advanced 4-inch ID casing to obtain samples from 4 to 16.8 feet.
3. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
4. Observed a change in drill effort at approximately 21.5 feet. Glacial till likely encountered.
5. Very difficult drilling with rollerbit from 27.5 to 33.6 feet. Bedrock likely encountered.
6. Borehole backfilled with drill cuttings and cold patched after completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-13

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-17
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: ATV
Rig Model: CME 55
Drilling Method: Drive and Wash

Boring Location: N3017090.024 - E823973.874
Ground Surface Elev. (ft.): 8.4
Final Boring Depth (ft.): 34
Date Start - Finish: 5/9/2013 - 5/9/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/10/13	0720	4.0'	out	16.5 hrs

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0-2	24	17	4 8 14 20	22	S-1: Top 6": Gray, fine to coarse SAND, little Silt, trace Gravel. Bottom 11": Brown, fine to coarse SAND and GRAVEL, little Silt.	1			
		S-2	2-4	24	21	20 32 25 17	57	S-2: Top 9": Gray/brown, fine to coarse SAND, trace Silt, trace fine Gravel. Bottom 12": Brown, fine to coarse SAND, little Gravel, little Silt.				
5	PUSH	S-3	4-6	24	0	8 7 4 2	11	S-3: No recovery.	2			
		S-4	6-8	24	5	1 1 1 0	2	S-4: Very loose, brown, fine to coarse SAND and GRAVEL, little Silt.			FILL	
		S-5	8-10	24	0	3 1 0 0	1	S-5: No Recovery.	3			
10												
										14'		-5.6'
15		S-6	14-16	24	17	2 2 1 2	3	S-6: Top 12": Gray, organic SILT, some fine to coarse Sand, trace Gravel, trace Shells. Faint Hydrogen Sulfide-like odor. Bottom 5": Light brown/gray, CLAY & SILT.		15.5'	ORGANIC SILT	-7.1'
		S-7	19-21	24	0	5 7 9 10	16	S-7: No recovery. Outside of spoon smeared with clay.			CLAY AND SILT	
20		S-8	21-23	24	24	3 5 7 7	12	S-8: Stiff, light brown/gray, Silty CLAY, trace angular Gravel, trace fine to coarse Sand. TV= 0.75 tsf, PP= 3.25 tsf.	4 5	23.5'		-15.1'
		S-9	24-25.7	24	10	26 20 20 50/2"	40	S-9: Dense, brown, fine to coarse SAND and GRAVEL, little Silt.		25.7'	TILL	-17.3'
25									6		BOULDER	
									7	28'		-19.6'
		S-10	29-29.9	11	6	17 50/5"	R	S-10: Brown, fine to coarse SAND, some Gravel, little Silt.		29.9'	TILL	-21.5'
30									8	31.5'	PROBABLE WEATHERED BEDROCK	-23.1'
											PROBABLE BEDROCK	
35								Bottom of boring at 34 feet.	9	34'		-25.6'

REMARKS
1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed casing to obtain samples from 4 to 21 feet.
3. Wash water color from approximately 8 to 14 feet appeared light brown and no color changes were observed. Able to advance the rollerbit from 8 to 14 feet without rotating the bit.
4. Observed a change in drill effort at approximately 23.5 feet.
5. "TV" and "PP" indicate pocked shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
6. Encountered split spoon refusal at approximately 25.7 feet. Small rock fragments observed in S-9 sample.
7. Drilled with rollerbit from approximately 25.7 to 28s feet for approximately 10 minutes under approximately 600 psi downpressure. Driller noted a decrease in drill effort from approximately 28 to 29 feet. Telescoped 3-inch ID casing to 29 feet, cleaned out, and took sample from 29 to 29.9 feet where split spoon refusal was encountered.
8. Rollerbitted from 29.9 to 31.5 feet with inconsistent drill effort. Observed cuttings appeared heterogeneous and mostly sand. From approximately 31.5 to 34 feet, the drill effort appeared more consistent and the drill cuttings appeared to consist mostly of gray/white possible rock pieces. Advancement from 31.5 to 34 feet took approximately 20 minutes at approximately 500 to 700 psi down pressure. Lost drilling water from 31.5 to 34 feet. Based on cuttings and observed drilling effort, weathered and/or fractured bedrock possibly encountered.
9. Borehole backfilled with drill cuttings to approximately ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-17

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-20(OW)
SHEET: 1 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Spin and Wash

Boring Location: N3016910.829 - E824135.971
Ground Surface Elev. (ft.): 9.7
Final Boring Depth (ft.): 38
Date Start - Finish: 5/23/2013 - 5/23/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D./O.D. (in.): 4"/4.5"
Hammer Wt: N/A
Hammer Fall: N/A
Other: Spun

Sampler Type: Split Spoon
I.D./O.D (in.): 1-3/8"/2"
Sampler Hmr Wt: 140 lbs
Sampler Hmr Fall: 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/31/13	1255	6.9'	well	2 days

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description Modified Burmister	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)	Equipment Installed
		S-1	0.6-2	17	7	18 19 11	30	S-1: Dense, brown, GRAVEL and fine to coarse SAND, some Silt.	1	0.6'	ASPHALT	9.7'	FLUSH MOUNTED ROAD BOX
		S-2	2-4	24	3	9 6 2 24	8	S-2: Loose, brown, fine to coarse SAND, some Silt, little Gravel.					Concrete 0.8' Bentonite Chips 2.5' 2" ID Solid Sch 40 PVC Well Riser
5		S-3	4.3-6.3	24	7	1 2 6 10	8	S-3: Medium stiff, brown, Clayey SILT and fine to coarse SAND, some Gravel.	2 3		FILL		
		S-4	6.3-8.0	21	10	2 7 8 50/3"	15	S-4: Medium dense, dark brown, GRAVEL, some fine to coarse Sand, some Silt.	4	8'		1.7'	Filter Sand
10											BOULDERS		2" ID Slotted Sch 40 PVC Well Screen (0.01" Slot)
										12'		-3.3'	
		S-5	12-14	24	6	6 6 5 4	11	S-5: Medium dense, brown, GRAVEL and fine to coarse SAND, little Silt.					13.3'
15		S-6	14-16	24	5	7 6 5 6	11	S-6: Medium dense, brown, GRAVEL and fine to coarse SAND, little Silt.	5 6		SAND/GRAVEL or POSSIBLE FILL		
										17.8'		-7.8'	
		S-7	19-21	24	1	3 3 1 2	4	S-7: Soft, gray, organic Clayey SILT, little Gravel, little fine to coarse Sand, strong Hydrogen Sulfide-like odor.			ORGANIC SILT		
20		S-8	21-23	24	24	7 8 10 10	18	S-8: Top 10": Gray, organic SILT & CLAY, little fine to coarse Sand, trace Shells, strong Hydrogen Sulfide-like odor. Bottom 14": Brown, CLAY & SILT, trace Gravel. Pp= 3.0-4.5 tsf, Tv= 0.775 tsf	7	22'		-12.3'	
									8		CLAY AND SILT		
25		S-9	24-29	24	24	5 6 9 8	15	S-9: Very brown, CLAY and SILT, trace fine to coarse Sand seam (~1/8" thick). Pp= 4.25 tsf, Tv= 0.8 tsf	9	26.2'		-16.9'	
											TILL		
30		S-10	29-31	24	5	37 53		S-10: Very dense, brown, GRAVEL and fine					

REMARKS
1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Spun and washed casing to sample depths to obtain samples from 4 to 8 feet.
3. Rollerbitted through cobble from 4 to 4.3 feet.
4. Rollerbitted from 8 to 9 feet then spun 4-inch ID casing to 9 feet. Rollerbitted to 12 feet then sampled open hole.
5. Telescoped 3-inch ID casing and spun the casing to 14 feet. Washed out to 14 feet then sampled.
6. Spun and washed out 3-inch ID casing to obtain samples from 14 to 23 feet.
7. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
8. Sampled open hole from 24 to 31 feet.
9. Observed a change in drill effort at approximately 26.2 feet and the drill cuttings from approximately 26. 2 to 29 feet appeared to consist mostly of Sand/Gravel bits.

See log key for explanation of sample descriptions and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-20(OW)

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING WIE W/O BMP W/O FIELD TEST WINIE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-20(OW)
SHEET: 2 of 2
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description Modified Burmister	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)	Equipment Installed
						35 34	88	to coarse SAND, some Silt.					
35													
											TILL		
										33.8'		-23.8'	
40									10		PROBABLE BEDROCK		
										38'		-28.3'	
45													
								Bottom of boring at 38 feet.					
50													
55													
60													
65													

REMARKS
10. Difficult drilling from about 33.5 to 38 feet. Bedrock probably encountered.

See log key for explanation of sample descriptions and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-20(OW)

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING WIE W/O BMP W/O FIELD TEST WINIE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: B-52
SHEET: 1 of 1
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3017223.797 - E823522.763
Ground Surface Elev. (ft.): 7.7
Final Boring Depth (ft.): 23.7
Date Start - Finish: 5/6/2013 - 5/6/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
5/6/13	1255	2.7'	14'	5 mins

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Depth (ft.)	Pen. (in)	Rec. (in)	Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Depth (ft.)	Stratum Description	Elev. (ft.)
		S-1	0-2	24	13	5 7 15 21	22	S-1: Top 6": Dark brown, fine to coarse SAND, some Gravel, some Silt, trace Roots. Bottom 7": Brown/gray, fine to coarse SAND, some Gravel, little Silt.	1	0.5'	TOPSOIL	7.2'
		S-2	2-4	24	7	16 4 4 5	8	S-2: Loose, gray/brown, fine to coarse SAND, some Gravel, little Silt.			FILL	
5	PUSH	S-3	4-6	24	3	12 11 7 2	18	S-3: Medium dense, gray, fine to coarse SAND, some Gravel, little Silt.	2			
		S-4	6-8	24	14	3 1 0 1	1	S-4: Top 9": Gray, fine to coarse SAND, some Silt, little Gravel. Bottom 5": Gray/brown, fine to coarse SAND, some Gravel, some Fibrous Peat, little Silt.		7'		0.7'
		S-5	8-10	24	0	12 10 8 5	18	S-5: No Recovery.			FILL WITH ORGANICS	
10		S-6	10-12	24	10	2 1 1 1	2	S-6: Very loose, gray/brown, fine to coarse SAND, some Silt, little Gravel, trace fine-grained Peat.				
		S-7	12-14	24	24	4 5 5 6	10	S-7: Stiff, light brown/gray, Silty CLAY. TV= 0.725 tsf, PP= 3.25 tsf.	3	12'		-4.3'
		S-8	14-16	24	24	4 5 6 8	11	S-8: Stiff, light brown/gray, Silty CLAY, trace Sand. TV= 0.775 tsf, PP= 2.75 tsf.			SILTY CLAY	
15												
									4	18.3'		-10.6'
20											POSSIBLE BEDROCK	
									5	23.7'		-16.0'
25								Bottom of boring at 23.7 feet.				
30												

REMARKS
1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed casing to obtain samples from 4 to 18 feet.
3. "TV" and "PP" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
4. Encountered increased drilling resistance while rollerbitting from approximately 18.3 to 23.7 feet under approximately 750 psi down pressure for approximately 2 hours. Drill cuttings consisted of dark gray/white pieces.
5. Borehole backfilled with drill cuttings to approximate ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: B-52

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINIE; 8/14/2013

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

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9487 Regency Square Boulevard
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CONSULTANT

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SUB-CONSULTANTS

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GeoDesign
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SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
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DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN

REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 3)

SHEET NUMBER

B503

11 OF 26

Last saved by: GARY.BASTIEN (2022-05-11) Last Plotted: 2022-05-12
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PRELIMINARY DESIGN

GZA GeoEnvironmental, Inc.
Engineers/Scientists
One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-8
Page No. 1 of 3
File No. 16534.00
Checked By: JWK

Drilling Co.	GZA Drilling, Inc.		Casing	Sampler	Groundwater Readings			
Foreman	John Boyde	Type	HW	Split Spoon	Date	Time	Depth	Stab. Time
GZA Rep.	Marcie Stewart	I.D./O.D.	4"/4-1/2"	1-3/8"/2"	12/21/00	1521	At ground surface	During drilling
Date Start	12/21/00 End 12/28/00	Hammer Wt.	300#	140#	12/28/00	0957	11.37'	Before grout
Location	See Exploration Location Plan	Hammer Fall	30"	30"				
GS. Elev.	15.12' Datum MLW	Other						

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6" /RQD%	Penetration (min/ft)	Sample Description & Classification	Stratum Description	NOTES
			S-1	5/4	0-2	50/5"		Very dense, black, fine SAND, some Silt, trace wood, trace Coal, trace Cinders.	1" ASPHALT	1
			S-2	5/2	2-4	50/5"		Very dense, black, fine SAND, trace Silt, trace GRAVEL, trace Coal, trace Cinders.		
5			S-3	24/7	4-6	4-4		Medium dense, brown, fine to coarse SAND and GRAVEL, little Silt, trace Brick, trace Shells.		
						10-6				
			S-4	24/6	6-8	12-7		Medium dense, tan, fine SAND, little Silt, little Gravel.		
						5-5				
			S-5	10/0	8-10	12-100/4"		No recovery.	FINE TO COARSE SAND (FILL)	
10										
			C-1	12/11	10-12	100%	4 min.	Boulder.		2
							5 min.			
			S-6	24/10	13-15	12-24		Very dense, gray, fine to medium SAND, trace Silt, some wood.		
15						28-38				
									17½	
									CLAYEY SILT	
20			S-7	24/12	19-21	2-1		Very loose, gray, Clayey SILT, little fine Sand, trace Gravel, trace Shells.		
						1-1				
									22.5%	
25			S-8	24/19	24-26	2-2		Very loose, brown, fine SAND, little Silt, trace Gravel.	FINE SAND	
						1-2				
			S-9	24/22	29-31	19-17		Dense, tan, fine SAND and SILT, trace		

NO EQUIPMENT INSTALLED

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Possible boulder. Changed to core barrel, cored approximately 1 foot to clear obstruction.
3. Bottom of boring at approximately 86 feet.
4. Boring location: S 13+44.11 E 2+56.90.

GZA GeoEnvironmental, Inc. G:\16534.29\16534-00.JWK\REPORTS\BORING LOGS\29IPWP1.xls P-8

GZA GeoEnvironmental, Inc.
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Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-8
Page No. 2 of 3
File No. 16534.00
Checked By: JWK

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
						24-36		Clay, trace Gravel.		
									FINE SAND	
35			S-10	24/24	34-36	4-14		Dense, tan, fine SAND, little Silt, trace Gravel.		
						18-36				
									37.5%	
40			S-11	24/24	39-41	3-4		Medium dense, gray, Clayey SILT, little fine Sand, trace Gravel.		
						7-10				
									CLAY AND SILT	
45			S-12	24/22	44-46	4-7		Very stiff, gray, CLAY and SILT.		
						11-21				
									47.5%	
50			S-13	24/24	49-51	7-12		Very stiff, gray, Silty CLAY.		
						15-15				
									SILTY CLAY	
55			S-14	24/24	54-56	5-8		Very stiff, gray, Silty CLAY, trace fine Sand.		
						12-11				
60			S-15	24/24	59-61	6-9		Very stiff, gray, Silty CLAY, trace fine Sand.		
						13-15				
			S-16	24/24	64-66	4-3		Medium, gray, Silty CLAY, trace fine Sand.		

NO EQUIPMENT INSTALLED

Notes:

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One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-8
Page No. 3 of 3
File No. 16534.00
Checked By: JWK

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
						2-6				
70			S-17	24/24	69-71	4-3	Pp=0.41 tsf	Stiff, gray, Silty CLAY, trace fine Sand.		
						7-7				
									SILTY CLAY	
75			S-18	24/24	74-76	5-8		Stiff, gray, Silty CLAY, trace fine Sand.		
						7-6				
80			S-19	24/24	79-81	5-5	Pp=0.27 tsf	Stiff, gray, Silty CLAY, trace fine Sand.		
						4-8				
85			S-20	23/23	84-86	WOR-WOR	Pp=0.16 tsf	Stiff, gray, Silty CLAY, trace fine Sand.		
						8-50/5"				
								Bottom of Boring at 86'.		3
90										
95										

NO EQUIPMENT INSTALLED

Notes:

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One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-9
Page No. 1 of 3
File No. 16534.00
Checked By: JWK

Drilling Co.	GZA Drilling, Inc.		Casing	Sampler	Groundwater Readings			
Foreman	John Boyde	Type	HW	Split Spoon	Date	Time	Depth	Stab. Time
GZA Rep.	Marcie Stewart	I.D./O.D.	4"/4-1/2"	1-3/8"/2"	12/08/00	0823	At ground surface	During drilling
Date Start	12/08/00 End 12/11/00	Hammer Wt.	140#	140#	12/11/00	1206	2.70'	Before grout
Location	See Exploration Location Plan	Hammer Fall	30"	30"				
GS. Elev.	14.69' Datum MLW	Other						

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
									2" ASPHALT	
			S-1	24/10	0-2	56-19		Medium dense, black, fine to coarse SAND, some Silt, little Gravel, little Cinders.		
						9-42				
			S-2	24/22	2-4	36-30		Very dense, black, fine to coarse SAND, little Silt, (Cinders).		
						43-47				
5			S-3	24/9	4-6	38-28		Dense, black, fine to coarse SAND, little Silt (Cinders).	FINE TO COARSE SAND (FILL)	
						20-12				
			S-4	24/5	6-8	15-8		Medium dense, black, fine to coarse SAND, some Gravel, little Silt, trace Cinders.		
						4-5				
			S-5	24/7	8-10	39-25		Dense, black, fine to coarse SAND and GRAVEL, little Silt, little Cinders, trace Brick.		
10						10-9				
			S-6	24/12	10-12	7-8		Medium dense, black, fine to coarse SAND, some Gravel, little Silt, trace Cinders, trace Brick.		
			S-6A	/6		9-7		Medium dense, gray SILT, trace fine Sand.	11.5%	
			S-7	24/0	13-15	6-6		No recovery.		
15						6-9				
									SILT	
20			S-8	24/6	19-21	7-9		Medium dense, dark gray SILT, trace fine Sand.		
						16-30				
									22.5%	
25			S-9	24/8	24-26	5-6		Very stiff, blue-gray, Silty CLAY, trace fine Sand.	SILTY CLAY	
						10-10				
			S-10	24/5	29-31	11-17		Hard, blue-gray, Silty CLAY, trace fine Sand.	29.5% FINE SAND	

NO EQUIPMENT INSTALLED

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Bottom of boring at approximately 89 feet.
3. Boring location: S 8+76.27 E 6+57.33.

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GZA GeoEnvironmental, Inc.
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Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-9
Page No. 2 of 3
File No. 16534.00
Checked By: JWK

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
			S-10A	/17		19-22		Dense, brown, fine SAND, little Silt, trace Gravel.		
									FINE SAND	
									32.5%	
35			S-11	24/24	34-36	1-2	Pp=0.21 tsf	Medium, gray, Silty CLAY, trace fine Sand.		
						3-4				
									SILTY CLAY	
40			T-1		39-41	PUSH		Shelby Tube Sample.		
									41½	
			S-12	24/22	41-43	5-2		Loose, dark gray to tan, fine SAND, some Silt, trace Clay, trace Gravel.		
						2-11			FINE SAND	
									43.5%	
45			S-13	24/24	44-46	3-12	Pp=0.10 tsf	Very stiff, gray, Silty CLAY, trace fine Sand.		
						5-8				
									SILTY CLAY	
									47.5%	
50			S-14	24/24	49-51	WOR-4		Medium, gray, CLAY.		
						3-5				
55									CLAY	
			S-15	24/24	56-58	WOR-3	Pp=0.10 tsf	Medium, gray, CLAY.		
						2-3				
60			S-16	24/24	59-61	4-4	Pp=0.12 tsf	Stiff, gray, CLAY.		
						5-6				
			S-17	24/24	64-66	2-4	Pp=0.11 tsf	Medium, gray, CLAY.		

NO EQUIPMENT INSTALLED

Notes:

GZA GeoEnvironmental, Inc. G:\16534.29\16534-00.JWK\REPORTS\BORING LOGS\29IPWP2.xls P-9

GZA GeoEnvironmental, Inc.
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Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-9
Page No. 3 of 3
File No. 16534.00
Checked By: JWK

DEPTH	CASING	BLOWS	Sample Information: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
						4-10				
70			S-18	24/24	69-71	WOR-WOR	Pp=0.08 tsf	Soft, gray, CLAY.		
						3-2				
									CLAY	
75			S-19	24/24	74-76	WOR-WOR	Pp=0.16 tsf	Very soft, gray, CLAY.		
						1-5				
80			T-2		79-81	PUSH		Shelby Tube Sample.		
			S-20	24/24	81-83	WOR-WOR	Pp=0.18 tsf	Very soft, gray, CLAY.		
						WOR-3				
									83.5%	
85			S-21	24/24	84-86	WOR-WOR	Pp=0.22 tsf	Very soft, gray, Silty CLAY, trace fine to Sand.		
						WOR-7			SILTY CLAY	
			S-22	0/0	89-91	50/0"		No recovery.		
90								Bottom of Boring at 89'.		2
95										

NO EQUIPMENT INSTALLED

Notes:

GZA GeoEnvironmental, Inc. G:\16534.29\16534-00.JWK\REPORTS\BORING LOGS\29IPWP3P2.xls P-9

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
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Jacksonville, FL 32225

CONSULTANT

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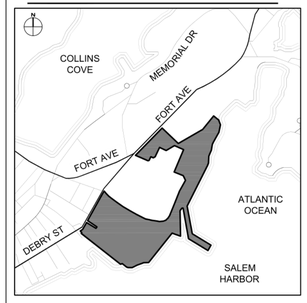
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 4)

SHEET NUMBER

B504

12 OF 26

GZA GeoEnvironmental, Inc.
Engineers/Scientists
One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-11
Page No. 1 of 3
File No. 16534.00
Checked By: JWK

Drilling Co.	GZA Drilling, Inc.			Casing	Sampler	Groundwater Readings			
Foreman	John Boyd		Type	HW	Split Spoon	Date	Time	Depth	Stab. Time
GZA Rep.	Marcie Stewart		I.D./O.D.	4"/4-1/2"	1-3/8"/2"	12/21/00	0826	At ground surface	During drilling
Date Start	12/13/00	End 12/13/00	Hammer Wt.	300#	140#				
Location	See Exploration Location Plan		Hammer Fall	30"	30"				
GS. Elev.	14.85'	Datum MLW	Other						

DEPTH	CASING BLOWS	Sample Info: No.	Pen./ Rec.	Depth (Ft.)	Blows/6" /RQD%	Field Test Data /Penetration (min/ft)	Sample Description & Classification	Stratum Description	NOTES
								3" ASPHALT	
		S-1	10/6	0-2	63-62/4"		Very dense, brown, fine to coarse SAND, little Silt, trace Glass, trace Gravel.		
		S-2	24/10	2-4	31-26		Very dense, red-brown, fine to medium SAND, some Gravel, little Silt.	FINE TO COARSE SAND (FILL)	
					24-23				
5		S-3	24/10	4-6	14-22		Medium dense, brown, fine to coarse GRAVEL, some fine to coarse Sand, little Silt.	5.5'±	
					7-3		Medium dense, gray, SILT, trace fine Sand.		
		S-4	24/0	6-8	2-5		No recovery.	SILT	
					5-4				
		S-5	24/14	8-10	2-1		Very loose, gray, SILT, little Gravel,Little fine to coarse Sand.	9.5'±	NO EQUIPMENT INSTALLED
10					1-2				
		S-6	24/9	10-12	1-1		Soft, gray, CLAY, trace fine to coarse Sand, trace Gravel.	CLAY	
					1-1				
								13.5'±	
15		S-7	24/18	14-16	1-4		Medium, gray, Silty CLAY, little Gravel, trace fine to coarse Sand, trace Shells.	SILTY CLAY	
					3-3				
								17.5'±	
								SILT	
20		S-8	24/12	19-21	5-7		Medium dense, tan SILT, trace Clay, trace fine Sand.	20.5'±	
		S-8A	/7		21-16		Medium dense, tan, fine to medium SAND, little Silt, trace Gravel.	FINE TO MEDIUM SAND	
								22.5'±	
25		S-9	24/21	24-26	2-1		Medium, gray, Silty CLAY, trace fine Sand.		
					3-2			SILTY CLAY	
		S-10	24/24	29-31	2-2		Medium gray, Silty CLAY, trace fine Sand.		

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Bottom of boring at approximately 92 feet.
3. Boring location: S 6+96.63 E 5+96.65.

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GZA GeoEnvironmental, Inc.
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One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

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DEPTH	CASING BLOWS	Sample Info: No.	Pen./ Rec.	Depth (Ft.)	Blows/6" /RQD%	Field Test Data /Penetration (min/ft)	Sample Description & Classification	Stratum Description	NOTES
					3-4			SILTY CLAY	
35		T-1		34-36	PUSH		Shelby Tube Sample.		
								36'±	
		S-11	24/14	36-38	WOR-9		Loose, tan, fine SAND, little Silt, trace Gravel.		
					1-2				
40		S-12	24/24	39-41	WOR-WOR		Very loose, gray, fine SAND, some Clayey SILT, trace Gravel.	FINE SAND	NO EQUIPMENT INSTALLED
					WOR-WOR				
								42.5'±	
45		S-13	24/18	44-46	WOR-2	Pp=0.14 tsf	Medium, gray, CLAY.		
					3-3				
50		S-14	24/20	49-51	1-1	Pp=0.10 tsf	Soft, gray, CLAY.		
					2-1			CLAY	
55		T-2		54-58	PUSH		Shelby Tube Sample.		
		S-15	24/16	56-58	WOR-1		Very soft, gray, CLAY.		
					1-4				
60		S-16	24/21	59-61	5-4	Pp=0.03 tsf	Stiff, gray, CLAY.		
					5-8				
		S-17	24/24	64-66	WOR-WOR	Pp=0.11 tsf	Soft, gray, CLAY.		

Notes:

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Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-11
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DEPTH	CASING BLOWS	Sample Info: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data /Penetration (min/ft)	Sample Description & Classification	Stratum Description	NOTES
					2-3			CLAY	
70		S-18	24/24	69-71	WOR-WOR	Pp=0.17 tsf	Soft, gray, CLAY.		
					2-4				
								72.5'±	
75		S-19	24/24	74-76	WOR-WOR	Pp=0.16 tsf	Soft, gray, Silty CLAY, trace fine Sand.		NO EQUIPMENT INSTALLED
					3-4				
								SILTY CLAY	
80		S-20	24/21	79-81	WOR-WOR		Medium dense, gray, Silty CLAY, trace fine Sand.		
					6-6				
								84'	
85		C-1	60/55	84-89	0%	4 min.	Gravel, possible cobbles and boulders.		
						2.5 min.			
						3.5 min.		ROCK	
						3 min.			
						8 min.			
90		C-2	36/33	89-92		9 min.	Hard, slightly to moderately weathered, slightly to moderately fractured, fine to coarse grained Volcanic TUFF joints fractures: very close to close, horizontal.		
						12.5 min.			
						14 min.			
							Bottom of Boring at 92'.		2
95									

Notes:

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Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-13
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File No. 16534.00
Checked By: JWK

Drilling Co.	GZA Drilling, Inc.			Casing	Sampler	Groundwater Readings			
Foreman	Judson Zachar/Marcie Stewart		Type	NW	Split Spoon	Date	Time	Depth	Stab. Time
GZA Rep.			I.D./O.D.	3"/3-1/2"	1-3/8"/2"	12/06/00	1335	At ground surface	During drilling
Date Start	12/06/00	End 12/07/00	Hammer Wt.	300#	140#	12/07/00	1224	14.27'	After drilling
Location	See Exploration Location Plan		Hammer Fall	30"	30"	12/07/00	1235	17.89'	Before grout
GS. Elev.	14.66'	Datum MLW	Other						

DEPTH	CASING BLOWS	Sample Info: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
		S-1	24/13	0-2	11-37		Dense, black, fine to medium SAND, some Gravel (Cinders).		
					10-12				
		S-2	24/11	2-4	8-10		Medium dense, black, fine to medium SAND, some Gravel (Cinders).		
					6-6				
5		S-3	24/0	4-6	8-6		No recovery.		
					6-5				
		S-4	24/4	6-8	10-8		Medium dense, brown, fine to medium SAND, little Silt, trace Gravel, trace brick.	FINE TO MEDIUM SAND (FILL)	
					7-4				
		S-5	24/	8-10	14-50				
10									
		S-6	24/8	12-14	4-8		Medium dense, gray, fine to medium SAND, some Silt, little Gravel, trace Shells, trace Wood.		
					12-15				
15								16'±	NO EQUIPMENT INSTALLED
		S-7	24/22	18-20	5-7		Medium dense, gray SILT, some fine Sand, trace Gravel.		
					8-9				
20								FINE SAND AND SILT	
		S-8	24/20	23-25	8-16		Dense, gray, fine SAND and Clayey SILT.		
					15-17				
25									
		S-9	24/21	28-30	9-13		Dense, gray, Clayey SILT and fine SAND.		
					21-16				

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Bottom of boring at approximately 62.5 feet.
3. Boring location: S 12+28.76 E 6+31.42.

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Norwood, Massachusetts 02062

Salem Harbor Boiler Replacement Project
Salem, Massachusetts

Boring No. P-13
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Checked By: JWK

DEPTH	CASING BLOWS	Sample Info: No.	Pen./ Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description & Classification	Stratum Description	NOTES
								FINE SAND	
								31.5'±	
		S-10	24/22	33-35	5-7	Pp=0.83 tsf	Very stiff, gray, Silty CLAY, trace fine Sand.		
35					9-9				
		S-11	24/24	38-40	4-5	Pp=0.58 tsf	Stiff, gray, Silty CLAY, trace fine Sand.	SILTY CLAY	
					7-7				
40									NO EQUIPMENT INSTALLED
		S-12	24/24	43-45	4-5	Pp=0.33 tsf	Stiff, gray, Silty CLAY, trace fine Sand.		
					6-6				
45								46.5'±	
		S-13	24/24	48-50	3-5	Pp=0.25 tsf	Stiff, gray, CLAY.		
					6-7				
50								CLAY	
		S-14	24/24	53-55	4-5	Pp=0.25 tsf	Stiff, gray, CLAY.		
					5-8				
55								56.5'±	
		S-15	24/24	58-60	2-2	Pp=0.20 tsf	Medium, gray, Silty CLAY, trace fine Sand.		
					4-7			SILTY CLAY	
60									
		S-16	4/4	62-64	50/4"		Very dense, gray, coarse GRAVEL and Silty CLAY, some fine to medium Sand.		2
							Bottom of Boring at 62.5'.		

Notes:

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Norwood, Massachusetts 02062

Salem Harbor Emission Control Project
Salem, Massachusetts

Boring No. P-104
Page: 1 of 2
File No. 17716.00
Checked By: JER

Drilling Co.	GZA Drilling, Inc.			Casing	Sampler	Groundwater Readings			
Foreman	F. Gardella		Type	HW	Split Spoon	Date	Time	Depth	Casing	Stab.
GZA Rep.	J. Zachar		I.D./O.D.	4"/4-1/2"	1-3/8"/2"					
Date Start	04/21/03	End 04/21/03	Hammer Wt	Spin	140#					
Location	See Exploration Location Plan		Hammer Fall	-	30"					
GS. Elev.	Datum		Other	NVII Core Barrel						

Depth	CASING BLOWS	Sample Info: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
		S-1	20/4	0.3-2	17/8"-12	-	ASPHALT 0.3. Dense, dark brown SAND and GRAVEL, trace Silt.		
					19				
		S-2	24/5	2-4	7-10	-	Medium dense, dark brown SAND and GRAVEL, trace Silt.		
					8-5				
5		S-3	24/4	4-6	12-10	-	Medium dense, brown, coarse SAND and GRAVEL, trace Silt.		
					6-4				
		S-4	24/6	6-8	3-8	-	Medium dense, brown SAND and GRAVEL, some Cobbles, trace Silt.		
					10-11				
10		S-5	24/3	8-10	18-11	-	Medium dense, brown GRAVEL and SAND, some Cobbles, trace Silt.	FILL	
					9-13				
		S-6	24/3	13-15	12-8	-	Medium dense, coarse GRAVEL, trace Sand and Silt.		
15					5-7				NO EQUIPMENT INSTALLED
								17±	2
		S-7	24/18	20-22	8-13	Pp=3.85 tsf	Very stiff, olive SILT and CLAY.		
20					14-15				
		T-1	24/17	23-25	Push	-	Shelby tube #1-104.	SILTY CLAY	
25									
		S-8	24/19	26-28	8-6	Pp=1.80 tsf	Very stiff, olive, Silty CLAY, little Sand.		
					31-41				
								30±	

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Spun HW casing from ground surface to 19', approximately 2' into the silty clay strata.
3. Borehole was tremie grouted upon completion of sampling.
4. Pocket penetrometer data reported under "Field Test Data" column.

GZA GeoEnvironmental, Inc. P-104

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

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SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
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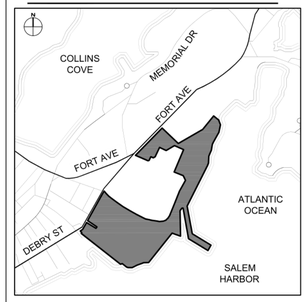
SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 5)

SHEET NUMBER

B505

13 OF 26

GZA GeoEnvironmental, Inc.
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One Edgewater Drive
Norwood, Massachusetts 02062

Salem Harbor Emission Control Project
Salem, Massachusetts

Boring No. P-104
Page: 2 of 2
File No. 17716.00
Checked By: JER

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
								TILL	
		S-9	3/2	33-33.3	50\3"	-	Very dense, dark gray, fine SAND and SILT, some coarse Chips of Bedrock.		
35								35'±	
		C-1	60/60	35-40	3 Min.	RQD=79%	BEDROCK.		
					3 Min.		Hard, slightly weathered, moderately fractured to sound medium grained, gray DIORITE, close to moderately close, shallow to steep joints.	BEDROCK	
					3 Min.				
					3 Min.				
40					3 Min.				
							Bottom of Boring at 40 Feet		
45									
50									
55									
60									

Notes:

GZA GeoEnvironmental, Inc. P-104

GZA GeoEnvironmental, Inc.
Engineers/Scientists

One Edgewater Drive
Norwood, Massachusetts 02062

SALEM HARBOR STATION
SALEM, MASSACHUSETTS

Boring No. P-202
Page: 1 of 3
File No. 17941
Checked By: DM/DJS

Drilling Co.	GZA Drilling, Inc.	Casing	Sampler	Groundwater Readings	
Foreman	John Boyd, Frank Gardella	Type	PW, HW,NW	Split Spoon	Date / Time / Depth / Casing / Stab.
GZA Rep.	Derek Simpson, Sean Kearney	I.D./O.D.	5", 4", 3"	1-3/8"/2"	12/19/03 / 7:00 / 6' / 14' / 17.5 Hours
Date Start	12/17/03 End 12/23/03	Hammer Wt.		140#	
Location	See Exploration Location Plan	Hammer Fall		30"	
GS. Elev.	16 ft. ± Datum Mean Low Water	Other			

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
		S-1	24\10.5	0-2	16-26	ND	Very dense brown-gray, fine to coarse SAND, trace Cinders, trace Silt. SW.	2"± Asphalt	1
					22-26				
		S-2	21/4	2-3.8	13-20	0.1	Dense, brown-gray GRAVEL, little fine to coarse Sand, trace Silt, trace Cinders. GW.		2
					23-52\3"				
5		C-1	12/12	3.8-4.8	NR		Very dense, brown-gray GRAVEL, some fine to medium Sand, trace Silt, trace Brick, trace Cinders. GW.		
		S-3	16/4	4.8-6.1	15-35	ND			3
					100/4"		C-2: BOULDER.		
		C-2	12/9	6.5-7.5	NR	N/A			
							C-3: BOULDER.		
10		C-3	6/4	9.0-9.5	NR	N/A	(Note: 5-inch Casing spun 0 to 23 feet).		
15		C-4	36/18	14-17	5 min.		C-4: BOULDER.	BOULDERY FILL	
					6 min.				
					NR				
20		C-5	24/22	20-22	NR		C-5: Hard, gray, DIORITE Boulder.		
					NR				
							(Note: Roller bit broke off down the hole @ 23').		
		C-6	36/15	23-26	6 min.		C-6: Hard, gray DIORITE Boulder.		
25					6 min.				

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Field testing results represent total organic vapor levels, referenced to a benzene standard, measured in the headspace of sealed soil sample jars using an organic vapor meter equipped with a photoionization detector (PID) and 10.6 eV lamp. Results are in parts per million by volume (ppmv). ND indicates nothing detected (<0.1 ppmv).
3. "C" in Sample No. Column indicates core sample taken. Numbers in Blows/6" Column indicates coring rate in min/foot (NR = not recorded) (RQD = Rock Quality Designation).

GZA GeoEnvironmental, Inc. P-202

GZA GeoEnvironmental, Inc.
Engineers/Scientists

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Norwood, Massachusetts 02062

SALEM HARBOR STATION
SALEM, MASSACHUSETTS

Boring No. P-202
Page: 2 of 3
File No. 17941
Checked By: DM/DJS

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
					7 min.		(Note: 4-inch Casing spun 0 to 31 feet).		
								27'±	
		S-4	24/14	28-30	16-18	ND	Very stiff gray, Silty CLAY, trace (-) Gravel. CH.		
30					9-9				
							(Note: 3-inch Casing spun 0 to 52.5 feet).	SILTY CLAY	
		ST-1	24/22	33-35	PUSH		Collected Shelby Tube P202-#ST-1.		
35									
		S-5	24/14	35-37	3-5	ND	Stiff, gray, Silty CLAY, trace (+) fine Sand. CH.		
					5-8				
								38'±	
		S-6	24/9	38-40	10-27	ND	Very dense, gray, Silty CLAY, little fine to medium Sand, trace (+) Gravel. CL. (Bottom 1": fine to medium Sand, some Gravel, little Silt).		NO EQUIPMENT INSTALLED
40					34-29				
		C-7	18/8	41.5-43	NR		C-1: Hard, dark gray, DIORITE Boulder.		
45									
		S-7	21/7	45-47	32-40	ND	Very dense, gray, fine to coarse SAND, some Gravel, little Silt. SW-SM.	GLACIAL TILL	
					48-100\3"				
50									

Notes:

GZA GeoEnvironmental, Inc. P-202

GZA GeoEnvironmental, Inc.
Engineers/Scientists

One Edgewater Drive
Norwood, Massachusetts 02062

SALEM HARBOR STATION
SALEM, MASSACHUSETTS

Boring No. P-202
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File No. 17941
Checked By: DM/DJS

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
		S-8	5/1	50-50.4	100\5"	ND	Very dense, dark gray, GRAVEL. GW.		
								52.5'±	
		C-8	60/54	53.5-58.5	5 min.	RQD=90%	Hard, very slightly weathered, slightly fractured, greenish gray GABBRO, fine to medium grained, moderate to steep dipping, close to moderate seared fractures, Pyrite coatings in top foot, Quartz filled fractures in bottom 5 feet. FELSIC DIKE from 57-58'.		4
55					8 min.				
					5 min.				
					9 min.				
					8 min.				
		C-9	60/57	58.5-63.5	6 min.	RQD=95%	C-9 (Top 10"): Hard, black, fresh, slightly fractured BASALT, fine grained, FELSIC DIKE in bottom 4".	BEDROCK	
60					7 min.				
					7 min.		C-9 (Bottom 50"): Hard, gray, fresh, DIORITE, medium grained, Quartz filled fractures.		
					6 min.				
					6 min.				
65							Bottom of Boring at 63.5 Feet		
70									
75									

Notes:
4. Core barrel jammed @ 53.5 ft.

GZA GeoEnvironmental, Inc. P-202

GZA GeoEnvironmental, Inc.
Engineers/Scientists

One Edgewater Drive
Norwood, Massachusetts 02062

Boring No. P-209
Page: 1 of 2
File No. 17941.00
Checked By: DM

Drilling Co.	GZA Drilling, Inc.	Casing	Sampler	Groundwater Readings	
Foreman	Frank Gardella	Type	HW	Split Spoon	Date / Time / Depth / Casing / Stab.
GZA Rep.	Sean Kearney	I.D./O.D.	4"	1-3/8"/2"	12/31/03 / 0700 / 4.1' / 39' / 17 Hours
Date Start	12/30/03 End 12/31/03	Hammer Wt.		140#	
Location	See Exploration Location Plan	Hammer Fall		30"	
GS. Elev.	17 ft. ± Datum Mean Low Water	Other			

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
								6" ASPHALT	
		S-1	N\A	2-3	N\A	0.7	Black, fine to coarse SAND, little Gravel, trace (+) Cinders, trace (+) shells, (air hammer spoils). SW	FILL	
5		S-2	N\A	5-6	N\A	0.3	Dark Brown, fine to medium SAND, some Gravel, trace (+) Silt, trace (-) Brick, trace (-) Cinders, (air hammer spoils). SW	6'±	3
		S-3	24/3	9-11	2-1	1.2	Very loose, brown, fine to medium SAND, some Silt, little Gravel, wet. SM		4
10					1-2				NO EQUIPMENT INSTALLED
								SILTY SAND	
							(Note: Drilled through boulder 14 to 16 ft.)		5
15									
		S-4	24/3	16-18	10-13	3.0	Medium dense, dark brown, fine to medium SAND, some Silt, trace (-) roots (organic odor observed). SM		
					8-7			18'±	
		S-5	24/21	18-20	5-9	ND	Very stiff, tan /grey, Silty CLAY, trace (+) fine Sand, lenses of gray Silty Clay, wet. CH		
20					13-11				
								SILTY CLAY	
									6
25									

Notes:
1. Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
2. Field testing results represent total organic vapor levels, referenced to a benzene standard, measured in the headspace of sealed soil sample jars using an organic vapor meter equipped with a photoionization detector (PID) and 10.6 eV lamp. Results are in parts per million by volume (ppmv). ND indicates nothing detected (<0.1 ppmv).
3. Used 4-inch air hammer 0 to 9 ft.

GZA GeoEnvironmental, Inc. P-209

GZA GeoEnvironmental, Inc.
Engineers/Scientists

One Edgewater Drive
Norwood, Massachusetts 02062

Boring No. P-209
Page: 2 of 2
File No. 17941.00
Checked By: DM

Depth	CASING BLOWS	Sample Information: No.	Pen/Rec.	Depth (Ft.)	Blows/6"	Field Test Data	Sample Description and Classification	Stratum Description	NOTES
		ST-1	24/14	25-27	PUSH		Shelby Tube Sample P209-#ST #1		
		S-6	24/23	27-29	5-8	ND	Very Stiff tan, Silty CLAY, trace (+) fine Sand, wet. CH	SILTY CLAY	
					13-12				
30		ST-2	24/21	29-31	PUSH		Shelby Tube Sample P209#ST-2		
		S-7	24/23	31-33	3-4	ND			
					5-6		Stiff, gray, Silty CLAY, trace (-) fine Sand. CH		
		ST-3	24/24	33-35	PUSH		Shelby Tube Sample P202#ST-3		
35									
		S-8	24/23	35-37	4-6	ND	Very stiff, gray, Silty CLAY, trace (-) fine Sand. CH		
					6-7				
								38'±	
		S-9A	24/16	39-41	14-14	ND	(Top 11") Hard, olive tan, SILT and CLAY, little fine to medium Sand (1/8" fine Sand lenses), trace (+) Gravel. ML-CL		
40		S-9B			19-37	ND		GLACIAL TILL	
							(Bottom 5") Dense, Brown, fine to medium SAND, trace (+) Gravel, trace (-) Silt, high Biotite Mica content, (possible pulverized boulder). SW		
							Bottom of Boring at 43.5 Feet		
45									
50									

Notes:

GZA GeoEnvironmental, Inc. P-209

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

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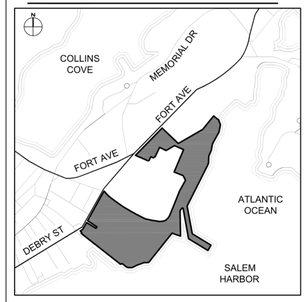
GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 6)

SHEET NUMBER

B506

14 OF 26

ANSI D 22" x 34"

Last saved by: GARY.BASTIEN (2022-05-11) Last Plotted: 2022-05-12
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PRELIMINARY DESIGN

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-32
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Spin/Drive and Wash

Boring Location: N3016307.733 - E823893.794
Ground Surface Elev. (ft.): 10
Final Boring Depth (ft.): 77.6
Date Start - Finish: 6/20/2013 - 6/21/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: PW/HW
I.D/O.D.(in): 5"/5-1/2"/ 4"/4-1/2"
Hammer Weight (lb.): Spun/140 lbs.
Hammer Fall (in.): Spun/30"
Other: Spun/Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
No	Readings	Obtained		

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0.5-1.6	13	11	10 85 100/1"	R	S-1: Black, fine to coarse SAND, some Gravel, some Silt/possible Ash.	1	0.5'	ASPHALT	9.5'
5		S-2	4-6	24	11	7 4 4 4	8	S-2: Loose, black, fine to coarse SAND, some Gravel, some Silt, trace Ash.	2		FILL	
		S-3	6-8	24	16	4 3 2 2	5	S-3: Loose, black, fine to coarse SAND and GRAVEL, little Silt, trace Ash.	3			
		S-4	8-10	24	3	7 7 2 2	9	S-4: Top 1": Gray/green, GRAVEL and Organic SILT. Bottom 2": Green/gray, Organic CLAY and SILT, strong Hydrogen Sulfide-like odor.		9'		1.0'
10												
15		S-5	14-16	24	18	4 1 2 3	3	S-5: Soft, green/gray, Organic SILT and CLAY, trace Shells, strong Hydrogen Sulfide-like odor. Bottom 2 inches of sample appeared black.				
		T-1	16-18	24	21	PUSH PUSH			4			
20		S-6	19-21	24	3	2 2 2 5	4	S-6: Medium stiff, dark gray, Organic SILT and CLAY, little fine to coarse Sand, trace Shells, Hydrogen Sulfide-like odor noted.			ORGANICS	
25		S-7	24-26	24	17	3 1 3 3	4	S-7: Medium stiff, dark gray, Organic CLAY and SILT, trace fine to coarse Sand, trace Gravel, trace Fibers, trace Shells, strong Hydrogen Sulfide-like odor noted.				
										29'		-19.0'
30		S-8	29-31	24	1	4 4		S-8: Piece of Gravel with Clay/Silt smeared on it in tip of spoon.			CLAY	

REMARKS
1. Unable to spin 5" ID casing past through 3' obstruction. Driller stated he believed the obstruction may have contained metal. Offset from original location approximately 1.5 feet east.
2. Spun and washed 5" ID casing to obtain sample from 4 to 6 feet.
3. Drove and washed 4" ID casing to obtain samples from 8 to 31 feet.
4. Gravel and organics observed in the wash water from 16 to 29 feet.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-32

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-32
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
						5 5	9					
		S-9	31-33	24	17	4 5 4 4	9	S-9: Stiff, light brown, Silty CLAY, one fine to medium Sand seam observed (~1/8-inch thick). Pp= 2.25, 1.5, 1.5, 2.75 tsf, Tv= 0.5, 0.45, 0.375 tsf.	5			
35		S-10	34-36	24	24	WOH 2 2 2	4	S-10: Medium stiff, gray, Silty CLAY, trace Sand. Pp= 0.5, 0.75, 0.75 tsf, Tv= 0.075, 0.2, 0.25, 0.4 tsf.	6 7			
		T-2	39-41	24	21	WOR PUSH			8			
40		S-11	41-43	24	24	WOH WOR WOR 2	0	S-11:Very soft, gray, Silty CLAY. Pp= <0.25 tsf, Tv= 0.025, <0.025 tsf.	9			
45		S-12	44-46	24	24	WOR WOR WOR WOH	0	S-12: Very soft, gray, Silty CLAY. Pp= 0.25, <0.25 tsf, Tv= 0.05, 0.025, 0.05 tsf.			CLAY	
50		T-3	49-51	24	24	WOR PUSH						
		S-13	51-53	24	24	WOR WOR WOR 2	0	S-13: Very soft, gray, Silty CLAY. Pp= 0.25 tsf, Tv= 0.025, 0.1, 0.025, 0.05 tsf.				
55		S-14	54-56	24	24	WOR WOR WOR WOH	0	S-14: Very soft, gray, Silty CLAY. Pp= 0.25 tsf, Tv= 0.05, 0.075, 0.05, 0.025 tsf.				
60		S-15	59-61	24	9	22 19 54 32	73	S-15: Top 3": Gray, Silty CLAY, trace Angular Gravel, trace fine to coarse Sand. Bottom 6": Dark gray, GRAVEL, some fine to coarse Sand, some Silt.		59.3'		-49.3'
											TILL	
65									10	63.5'		-53.5'
										65'	POSSIBLE BOULDER	-55.0'
									11		PROBABLE FRACTURED BEDROCK	
										66.5'		-56.5'

REMARKS
5. Drilled and sampled open-hole from approximately 31 to 61 feet.
6. "Pp" and "Tv" indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf), respectively.
7. "WOH" indicates the sampler was advanced by the weight of the 140 lb hammer only.
8. WOR indicates the sampler was advanced by the weight of the rods on top of the sampler only.
9. Sample from 41 to 43 may have been disturbed during opening of sampler.
10. Driller noted changes at approximately 63.5 feet and 65 feet, driller stated there may have been a boulder from 63 to 65.5 feet.
11. Drill effort from approximately 65 to 66.5 feet appeared somewhat consistent (possible fractured bedrock) and the roller/drilling from approximately 66.5 to 67.8 appeared hard and consistent (probable bedrock).

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-32

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-32
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
	min/ft								12			
70	3 2 2 2 2.5	C-1	67.8-72.8	60	55			C-1: (~ 67.8 to 69.2') Hard, fresh, dark gray/black, with occasional white speckles, fine to coarse-grained BASALT (~ 1/4 of cross sectional area of core) appears to be DIABASE, with moderately close to close, moderately dipping joints/fractures. (~ 69.2 to 72.2') Hard, fresh to slightly weathered, dark gray/black with white speckles, mostly coarse-grained, DIABASE, (~ 1/3 to 1/2 of cross sectional area of core) appears to be BASALT), with very close to moderately close with subhorizontal to vertically dipping, fine to coarse Sand coated joints/fractures. (~72.2 to 72.4') Hard to very hard, very slightly weathered, white/gray with black speckles, very coarse to coarse-grained, DIORITE with subhorizontal sand coated fractures (1-4 to 1-inch thick DIORITE intrusions noted at approx. 70.1 and 72.2 feet). C-2: (~ 72.6 to 76.3') Hard, fresh, fine-grained, dark gray, BASALT with close, subhorizontal to subvertically dipping joints/fractures. DIORITE intrusions noted at approx. 73.9 to 74 feet, 74.2 to 74.3 feet, 74.3 to 74.9 feet and to 75.3 to 75.5 feet. (~ 76.3 to 77.6') Hard, fresh coarse-grained, dark gray/black/white GABBRO with close to very close subhorizontal to vertically dipping joints/fractures. Bottom of boring at 77.6 feet.			BEDROCK	
75	2.5 3 2.5 2.5 2.5 2/10"	C-2	72.8-77.6	58	60				13 14	77.6'		-67.6'
80												
85												
90												
95												
100												

REMARKS
12. Installed and spun 3" ID casing to approximately 67.8, then cleaned out and cored.
13. Data in column named "Casing Blows/Core Rate" column represents core barrel penetration rate in minutes per foot. RQD = "Rock Quality Designation".
14. Borehole backfilled and asphalt cold patched to approximate ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-32

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-33
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3016237.735 - E823893.985
Ground Surface Elev. (ft.): 10
Final Boring Depth (ft.): 81
Date Start - Finish: 6/11/2013 - 6/12/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
6/12/13	0720	9'		~18 hours

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
		S-1	0-2	24	15	11 33 112 73	R	S-1: Top 5": Black COAL. Bottom 10": Brown-orange, fine to coarse SAND and GRAVEL, some Silt.	1			
5		S-2	2-4	24	13	40 37 28 17	65	S-2: Top 10": Brown, fine to coarse SAND and GRAVEL, some Silt. Bottom 3": Black COAL.				
		S-3	4-6	24	13	10 11 16 12	27	S-3: Medium dense, black COAL.	2			
		S-4	6-8	24	15	11 23 23 28	46	S-4: Top 6": Black, fine to coarse SAND, some Gravel, little Silt, little Coal. Bottom 9": Brown, GRAVEL and fine to coarse SAND, little Silt.			FILL	
10		S-5	8-10	24	9	18 20 15 11	35	S-5: Dense, brown, fine to coarse SAND and GRAVEL, little Silt.				
										11'		-1.0'
15		S-6	14-16	24	15	2 1 1 2	2	S-6: Soft, dark brown-gray, Organic SILT & CLAY, strong Hydrogen Sulfide-like odor noted.	3			
		T-1	16-18	24	24	Push Push			4			
20		S-7	18-20	24	24	1 1 1 2	2	S-7: Very soft, dark gray-brown, Organic SILT & CLAY, occasional fine Sand seams (~1/16" to 1/4" thick), Hydrogen Sulfide-like odor noted.			ORGANICS	
25		S-8	24-26	24	13	2 2 2 3	4	S-8: Medium stiff, dark gray-brown, Organic Clayey SILT, some fine Sand, trace Shells, Hydrogen Sulfide-like odor noted.				
									5	27'		-17.0'
30		S-9	29-31	24	24	2 2		S-9: Medium stiff, gray, Silty CLAY, occasional fine to medium Sand seam (~1/16"	6		CLAY	

REMARKS
1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drove and washed 4" ID casing to obtain samples from 4 to 15 feet.
3. Observed change in drill casing and bits of gravel, Silt in the wash water at approximately 11 feet.
4. Drilled and sampled open hole from 31 to 61 feet.
5. Driller noted change in wash water color at approximately 27 feet.
6. Tv and Pp indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf) respectively.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-33

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-33
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
						3 3	5	thick). Pp= 1.0, 1.75 tsf, Tv= 0.8 tsf				
35		S-10	34-36	24	6	3 2 2 4	4	S-10: Medium soft, gray, CLAY & SILT.				
		S-11	39-41	24	16	2 2 3 3	5	S-11: Medium stiff, gray, Silty CLAY. Pp= 0.25 to 0.5 tsf, Tv = 0.3 to 0.35 tsf				
40		T-2	44-46	24	24	Push Push						
45		S-12	46-48	24	24	WOH 1 3 3	4	S-12: Medium stiff, gray, Silty CLAY. Pp= 0.5 to 0.75 tsf, Tv = 0.4 to 0.45 tsf	7		CLAY	
50		S-13	49-51	24	24	WOH 2 3 3	5	S-13: Medium stiff, gray, Silty CLAY. Pp= 0.5 to 0.75 tsf, Tv= 0.4 to 0.45 tsf				
55		S-14	54-56	24	24	WOH WOH 2 3	2	S-14: Soft, gray, Silty CLAY. Pp= 0.5 to 0.75 tsf, Tv= 0.375 to 0.45 tsf				
60		S-15	59-61	24	24	WOH WOH 3 4	3	S-15: Soft, gray, Silty CLAY. Pp= 0.5 tsf, Tv= 0.4 to 0.45 tsf				
65		S-16	64-66	24	24	WOR WOR WOH 14	0	S-16: Very soft, gray, Silty CLAY, frequent fine Sand seams (1/16" thick), bottom 2" of sample contained fine Gravel. Pp= 0.25 to 0.5 tsf, Tv= 0.3 to 0.325tsf for bottom 6", 0.4 tsf for top 6".	8	66'	TILL	-56.0'

REMARKS
7. WOH indicates the sampler was advanced by the weight of the 140 lb. hammer only.
8. WOR indicates the sampler was advanced by the weight of the rods on top of the sampler only.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-33

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-33
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
70		S-17	69-71	24	10	17 51 51 40	R	S-17: Very dense, gray, GRAVEL and fine to coarse SAND, little Silt.	9		TILL	
75	min/ft 2 1.5 1.5 2.5 0.5/4	S-18	74-74.5	6	6	120/6"	R	S-18: Very dense, gray-brown, GRAVEL and fine to coarse SAND, little Silt (possible completely weathered rock).		74.5'	POSSIBLE WEATHERED ROCK	-64.5'
		C-1	76-79.7	16				C-1: Top 24": Moderately hard, very slightly to slightly weathered, light pink/white/black, amorphous to very coarse grained, DIORITE with very close to close, moderately to subvertically dipping joints/fractures. Bottom 18": Hard, fresh to very slightly weathered, dark gray/black/white, coarse to very coarse grained, GABBRO with close to very close, moderately dipping joints/fractures.	10	76'	BEDROCK	-66.0'
80		C-2	79.7-81	16				C-2: Top 24": Moderately hard, very slightly to slightly weathered, light pink/white/black, amorphous to very coarse grained, possible RHYOLITE with very close to close, moderately to subvertically dipping joints/fractures. Bottom 18": Hard, fresh to very slightly weathered, dark gray/black/white, coarse to very coarse grained, homeblende DIORITE with close to very close, subvertically dipping joints/fractures.		81'		-71.0'
85	2							Bottom of boring at 81 feet.	11			
90												
95												
100												

REMARKS
9. Borehole would not stay open at approximately 69 feet so 3" ID casing was telescoped by spinning to 69 feet. The casing was washed out to 69 feet before sampling. Spun and washed 3" ID casing to obtain sample S-18.
10. Spun and washed 3" ID casing to 76 feet then cored.
11. Borehole backfilled to approximately ground surface upon completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-33

171634.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

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AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
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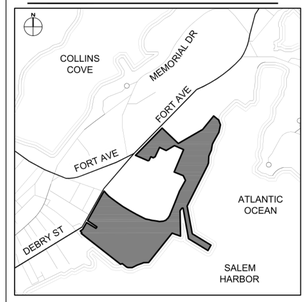
SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 7)

SHEET NUMBER

B507

15 OF 26

ANSI D 22" x 34"

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-34
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Drive and Wash

Boring Location: N3016488.965 - E824075.587
Ground Surface Elev. (ft.): 10
Final Boring Depth (ft.): 69.5
Date Start - Finish: 6/13/2013 - 6/17/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: HW
I.D/O.D.(in): 4"/4.5"
Hammer Weight (lb.): 140 lbs
Hammer Fall (in.): 30"
Other: Auto Hammer

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
6/17/13	0800	8.3'		~3 days

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
0		S-1	0.5-2	18	10	18 24 21	45	S-1: Dense, brown, GRAVEL, some fine to coarse Sand, some Silt.	1	0.5'	ASPHALT	9.5'
		S-2	2-4	24	13	13 11 11 8	22	S-2: Medium dense, brown-orange-black, fine to coarse SAND and GRAVEL, some Silt, trace Wood.				
5		S-3	4-6	24	9	9 6 5 3	11	S-3: Medium dense, brown, fine to coarse SAND, some Gravel, some Silt, trace Ash.	2			
		S-4	6-8	24	9	4 2 3 4	5	S-4: Loose, brown, fine to coarse SAND and GRAVEL, little Silt, trace Wood.				
		S-5	8-10	24	7	2 1 1 1	2	S-5: Loose, brown-gray, GRAVEL, little fine to coarse Sand, little Clayey Silt, petroleum-like odor noted, slight sheen noted.				
10											FILL	
15		S-6	14-16	24	1	2 1 3 5	4	S-6: Loose, brown, fine to coarse SAND and GRAVEL, some Silt.				
		S-7	16-18	24	1	2 1 3 5	4	S-7: Loose, brown, fine to coarse SAND and GRAVEL, some Silt.				
20		S-8	19-21	24	10	10 7 7 7	14	S-8: Medium dense, brown, fine to coarse SAND and GRAVEL, some Clayey Silt.		23'		-13.0'
									3			
25		S-9	24-26	24	23	3 1 2 3	3	S-9: Soft, green-gray, Organic SILT & CLAY and fine to medium SAND, trace Shells, strong Hydrogen Sulfide-like odor.			ORGANICS	
		T-1	26-28	24	24	Push Push			4			
									5	28'		-18.0'
		S-10	28-30	24	24	3 3 4 6	7	S-10: Medium stiff, light brown CLAY & SILT. Pp= 2 to 2.5 tsf, Tv= 0.75 tsf	6		CLAY	
30												

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. Drive and washed 4" ID casing to obtain samples from 4 to 28 feet.
3. Observed a change in wash water color and bits of Organic Silt in the wash water at approximately 23 feet.
4. Drilled and sampled open hole from 28 to 61 feet.
5. Observed grey-blue Clay at the bottom of the test pit.
6. Tv and Pp indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf) respectively.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-34

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-34
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
35		S-11	34-36	24	18	WOH 2 2 3	4	S-11: Medium stiff, gray, Silty CLAY. Pp= 0.75 to 1.0 tsf, Tv= 0.375, 0.42, 0.55 tsf				
40		S-12	39-41	24	24	WOH 2 3 3	5	S-12: Medium stiff, gray, Silty CLAY. Pp= 0.5 to 0.75 tsf, Tv = 0.315, 0.425, 0.55 tsf				
45		T-2	44-46	24	24	Push Push					CLAY	
		S-13	46-48	24	24	WOH 2 3 3	5	S-13: Medium stiff, gray, Silty CLAY, trace Sand. Pp= 0.5 to 0.75 tsf, Tv= 0.5, 0.3, 0.55 tsf				
50		S-14	49-51	24	24	WOR WOH 3 4	3	S-14: Medium stiff, gray, Silty CLAY. Pp= 0.5 tsf, Tv= 0.175 to 0.2 tsf				
55		T-3	54-56	24	23	Push Push						
		S-15	56-58	24	24	WOR WOH 3 4	3	S-15: Medium stiff, gray, Silty CLAY. Pp= 0.5, 0.75, 0.75, 1.25 tsf, Tv = 0.2, 0.3, 0.4 tsf				
60		S-16	59-61	24	5	21 10 13 13	23	S-16: Medium dense, gray, GRAVEL, some Silty Clay, little fine to coarse Sand.		59'		-49.0'
											TILL	
									7	62'		-52.0'
65			66-								BEDROCK	

7. Spun 3" ID casing to about 63 feet where the spin shoe appeared to break. Cored from 66 to 67.5 feet before the core barrel jammed and the borehole would not stay open to continue coring. Replaced the 3" ID casing spin shoe, spun casing to approximately 66 feet then roller bitted to 67.5 feet before continuing coring at 67.5 feet.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-34

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-34
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
70		C-1	67.5	18	14			C-1: Hard, fresh to very slightly weathered, dark gray with occasional white speckles, fine to medium grained BASALT with close to very close, moderately to subvertically dipping, joints/fractures. Rock type from 66.4 to 66.7 feet appears to be white Diorite. RQD = 22%.			BEDROCK	
		C-2	67.5-69.2	20	16			C-2: Hard, fresh, dark gray, fine grained BASALT with close to very close, subhorizontal to subvertically dipping joints/fractures. Felsic dikes at approximately 67.7 and 68.1 to 68.3 feet. RQD = 20%				
		C-3	69.2-69.5	4	6			C-3: Hard, fresh to slightly weathered, dark gray, fine grained BASALT with close to very close, moderately to vertically dipping joints/fractures. RQD = 0%		69.5'		-59.5'
75								Bottom of boring at 69.5 feet.				
80												
85												
90												
95												
100												

8. Core barrel jammed at 69.2 feet and appeared to jam at about 69.5 feet. Upon removal of the core barrel after advancement to 69.5 feet it was observed that the core bit had melted and additional damage to the barrel had occurred. This appeared to be due to the fractured nature of the bedrock. Water loss was noted while coring from 69.2 to 69.5 feet.
9. Borehole backfilled to approximately ground surface with drill cuttings and then asphalt cold patch after completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-34

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-35
SHEET: 1 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Drilling Co.: Crawford Drilling Services, LLC
Foreman: Darrel Green
Logged By: Michael Ostrowski

Type of Rig: Truck
Rig Model: Diedrich D-120
Drilling Method: Spin and Wash

Boring Location: N3016485.112 - E824178.711
Ground Surface Elev. (ft.): 9
Final Boring Depth (ft.): 78
Date Start - Finish: 6/12/2013 - 6/19/2013

H. Datum: NAD 83
V. Datum: NAVD 88

Auger/Casing Type: PW/HW
I.D/O.D.(in): 5"/5.5"/4"/4.5"
Hammer Weight (lb.): 140 lbs.
Hammer Fall (in.): 30"
Other: Spun

Sampler Type: Split Spoon
I.D./O.D. (in.): 1-3/8"/2"
Sampler Hmr Wt (lb): 140 lbs
Sampler Hmr Fall (in): 30"
Other: Auto Hammer

Groundwater Depth (ft.)

Date	Time	Water Depth	Casing	Stab. Time
6/18/13	0725	5.5'		~17 hours

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
0		S-1	0-2	24	10	3 15 39 8	54	S-1: Top 2": Dark brown, GRAVEL, some Topsoil, some fine to coarse Sand. Bottom 8": Brown, fine to coarse SAND, some Silt, some Gravel.	1	0.2'	TOPSOIL/GRAVEL	8.8'
		S-2	2-4	24	13	10 9 9 7	18	S-2: Medium dense, brown, fine to coarse SAND, little Gravel, little Silt.				
5		S-3	4-6	24	6	12 13 14 4	27	S-3: Medium dense, brown, fine to coarse SAND and GRAVEL, some Silt.				
		S-4	6-8	24	3	8 7 8 9	15	S-4: Medium dense, brown, GRAVEL, some fine to coarse Sand, little Silt.			FILL	
		S-5	8-10	24	0	15 8 18 21	26	S-5: No Recovery. Piece of Gravel in tip of spoon.	2			
10		S-6	10-11	12	6	8 100/6"	R	S-6: Top 5": Brown, GRAVEL and fine to coarse SAND, some Silt Bottom 1": Gray, possible Organic SILT & CLAY, some Gravel, some fine to coarse Sand	3	11'		-2.0'
											BOULDERS	
15		S-7	14-16	24	3	15 21 32 21	53	S-7: Dense, brown, GRAVEL and fine to coarse SAND, little Silt, trace Wood	4	14'		-5.0'
											FILL	
20		S-8	19-21	24	13	10 3 1 1	4	S-8: Medium stiff, dark green-gray, Organic SILT & CLAY, trace Shells, strong Hydrogen Sulfide-like odor	5	19'		-10.0'
		T-1	21-23	24	22	Push Push						
25		S-9	24-26	24	24	2 2 2 2	4	S-9: Medium stiff, dark green, Organic Silty CLAY, trace fine to medium Sand, trace Shells, occasional fine to coarse Sand seam (~1/2" thick), strong Hydrogen Sulfide-like odor			ORGANICS	
										28'		-19.0'
		S-10	29-31	24	24	3 4 5 6	9	S-10: Stiff, light brown, Silty CLAY, trace Sand. Pp= 2.25 to 3.0 tsf, Tv = 0.6 tsf	6 7		CLAY	
30												
35		S-11	34-36	24	24	2 1 3 2	4	S-11: Medium stiff, gray, Silty CLAY, trace Sand. Pp= 0.5 to 0.75 tsf, Tv = 0.3 tsf				

1. Ground surface elevation obtained by GZA utilizing a Leica Viva GNSS GPS rover unit and should only be considered accurate to the degree implied by the method used.
2. 4" ID casing deflected from plumb at approximately 8 feet due to a possible boulder or cobble and was removed and replaced with 4" ID casing with a spin shoe.
3. Spun and washed 4" ID casing to obtain samples from 8 to 11 feet.
4. Drilled and sampled as it was being spun to 14 feet. Removed the casing and stopped drilling. Continued drilling on 6/18/03 by installing and spinning 5" ID casing to 14 feet then washed out and sampled.
5. Spun and washed out 4" ID casing to obtain samples from 19 to 23 feet.
6. Change in drill effort and wash water color observed at approximately 28 feet.
7. Tv and Pp indicate pocket shear vane and pocket penetrometer test results in tons per square foot (tsf) respectively.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-35

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-35
SHEET: 2 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
40		S-12	39-41	24	24	WOH WOH WOH 3 Push Push	0	S-12: Very soft, gray, Silty CLAY, trace Sand. Pp= 0.25 to 0.5 tsf, Tv= 0.25 to 0.5 tsf	8			
		T-2	41-43	24	24						CLAY	
45		S-13	43-45	24	24	WOH WOH 2 3	2	S-13: Soft, gray, Silty CLAY, trace Sand. Pp= 0.125 to 0.25 tsf, Tv= 0.25 tsf				
50		S-14	49-51	24	24	WOR WOR WOH 3	0	S-14: Soft, gray, Silty CLAY. Pp= 0.25 to <0.25 tsf, Tv= 0.025 to <0.025 tsf	9			
55		S-15	54-56	24	24	WOR WOR WOH 3	0	S-15: Very soft, gray, Silty CLAY. Pp= 0.25 tsf, Tv = 0.025 to <0.025 tsf				
60		S-16	59-61	24	11	14 11 15 16	26	S-16: Medium dense, gray, fine to coarse SAND and GRAVEL, little Silt.	10	58.5'		-49.5'
											TILL	
65		S-17	64-64.4	5	1	25/5" 25/0"	R	S-17: Gray, fine to coarse SAND and GRAVEL, trace Silt.	11	64.4'		-55.4'
									12			
70	min/ft 4 3 3 3.5 3.5 3 3 2.5 2 2.5	C-1	68-73	60	60			C-1: (68-70.4'): Hard to very hard, fresh, medium to coarse grained, dark gray/black/white GABBRO (DIABASE), with moderately close, moderately dipping joints/fractures. White Rhyolite/Clorite intrusion observed from approximately 68.6 to 68.7 feet. (70.4-71.1'): Very hard, fresh, very coarse to medium grained, white/light pink DIORITE with very close to close, moderately to subvertically dipping joints/fractures. (71.1-72'): Very hard, fresh, fine to medium grained, gray/white/black, possible ANDESITE, with close, subhorizontally dipping joints/fractures. (72-73'): Very hard, fresh, very coarse to medium grained, gray/white with occasional black DIABASE with moderately close to close, moderately dipping joints/fractures. RQD = 82%	13		BEDROCK	
75		C-2 C-3	73-73.5 73.5-78	6 54	6 54				14			
80								C-2: Very hard, fresh, very coarse to medium grained, gray/white with occasional black DIORITE with moderately close to close, moderately dipping, closely spaced joints/fractures. RQD = 0% C-3: (73.5-73.9'): Very hard, fresh, very coarse to medium grained, gray/white with occasional black DIORITE with moderately close to close, moderately dipping	15	78'		-69.0'

8. WOH indicates the sampler was advanced by the weight of the hammer only.
9. WOR indicates the sampler was advanced by the weight of the drill rods only.
10. Driller noted a change in color approximately 58.5 feet.
11. Borehole would not stay open to 64 feet so 3" ID casing was spun and washed to obtain sample S-17.
12. Drill effort from approximately 64.4 to 68 appeared to indicate the rock was fairly fractured. Water loss was noted during drilling from 64.4 to 68 feet.
13. Roller bitted to 68 feet
14. Water loss was noted while coring.
15. Borehole backfilled to approximately ground surface after completion.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-35

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

TEST BORING LOG

GZA GeoEnvironmental, Inc. *Engineers and Scientists*

Footprint Power Salem Harbor Development
Salem, Massachusetts

BORING NO.: PB-35
SHEET: 3 of 3
PROJECT NO: 171634.00
REVIEWED BY: DJS

Depth (ft)	Casing Blows/ Core Rate	Sample No.	Sample Depth (ft.)	Sample Pen. (in)	Sample Rec. (in)	Sample Blows (per 6 in.)	SPT Value	Sample Description and Identification (Modified Burmister Procedure)	Remark	Stratum Depth (ft.)	Stratum Description	Stratum Elev. (ft.)
85								joints. (73.9-75.4'): Hard, fresh, fine grained, dark gray/black BASALT, with close to very close, subvertically dipping joints/fractures. (75.4-75.8'): Very hard, fresh, very coarse to medium grained, white/gray with occasional black, DIORITE, with very close, moderately to subvertically dipping joints/fractures. (75.8-78'): Very hard to hard, fresh, medium to coarse grained, dark gray/black, with occasional white GABBRO, with moderately close, moderately dipping joints/fractures.				
90												
95												
100												
105												
110												
115												
120												
125												
130								Bottom of boring at 78 feet.				

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

Boring No.: PB-35

17163A.00 FOOTPRINT POWER_SALEM_MA.GPJ; BORING STRATUM ONLY NO FIELD TEST WINE; 8/14/2013

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY

CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
www.aecom.com

SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN

REVISION

R	DATE	DESCRIPTION

Designed By:	JJM
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 8)

SHEET NUMBER

B508

16 OF 26

Last saved by: GARY.BASTIEN (2022-05-11) Last Plotted: 2022-05-12
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PRELIMINARY DESIGN

NEW HAMPSHIRE BORING INC.
P.O. BOX 165
DERRY NH 03038
TEL:-603-437-1610

Boring #:WB983 Project:SALEM PORT DEVELOPMENT Project # :
Project Address: City:SALEM State:MA Zip:
Date Start:06/12/98 Date End:06/15/98 Location:See Plan

Casing	Sampler	Casing	Sampler
TYPE :H-S-A	S/S	SIZE:4 1/4 in. I.D.	1 3/8 in. I.D.
HAMMER:	140 lbs.	FALL:	30 in.

GROUNDWATER OBSERVATION

DATE	DEPTH	CASING	STABILIZATION PER.
06/12/98		OUT	Upon Completion

DP.	S./#	DEPTH	PEN	REC	BLOWS/6"	ST/CH	SAMPLE DESCRIPTION
							~~LOW TIDE -30' TO MUD LINE~~ SURFACE EL -28.0
5'	S-1	5'-7'	24"	18"	2-2-4-6		Soft, gray clay with some fine sand and silt.
10'	S-2	10'-12'	24"	18"	1-1 3-3		Soft gray clay.
15'	S-3	15'-17'	24"	18"	1-5 38-27	16'	Dense fine to coarse sand and gravel.
20'	S-4	20'-24'	24"	4"	32-52 22-15		NOTE: Casing sunk past 25' to 27' while washing.
25'	S-5	27'-29'	24"	8"	100-40 14-19		Very dense medium to coarse gravel and fine to medium sand.
30'							

DRILLER: G.Twombly HELPER:S.Mathers INSPECTOR: D.Smith

REMARKS: Page 1 of 2.

S/#: SAMPLE # PEN: PENETRATION REC: RECOVERY ST/CH: STRATA CHANGE

NEW HAMPSHIRE BORING INC.
P.O. BOX 165
DERRY NH 03038
TEL:-603-437-1610

Boring #:WB983 Project:SALEM PORT DEVELOPMENT Project # :
Project Address: City:SALEM State:MA Zip:
Date Start:06/12/98 Date End:06/15/98 Location:See Plan

Casing	Sampler	Casing	Sampler
TYPE :H-S-A	S/S	SIZE:4 1/4 in. I.D.	1 3/8 in. I.D.
HAMMER:	140 lbs.	FALL:	30 in.

GROUNDWATER OBSERVATION

DATE	DEPTH	CASING	STABILIZATION PER.
06/12/98		OUT	Upon Completion

DP.	S./#	DEPTH	PEN	REC	BLOWS/6"	ST/CH	SAMPLE DESCRIPTION
	S-6	34'-36'	24"	10"	18-18 11-12		
35'							
	S-7	39'	2"	2"	120-2"	39'	Bedrock
40'	C-1	40'-45'	60"	56"	9 min/ft 8 min/ft 8 min/ft 7 min/ft 8 min/ft		Rolled to 40' to set casing
45'	C-2	45'-48'	36"	32"	9 min/ft 10min/ft 9 min/ft		Terminated boring at 48'
50'							
55'							
60'							

DRILLER: G.Twombly HELPER:S.Mathers INSPECTOR: D.Smith

REMARKS: Page 2 of 2.

S/#: SAMPLE # PEN: PENETRATION REC: RECOVERY ST/CH: STRATA CHANGE

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
www.aecom.com

SUB-CONSULTANTS

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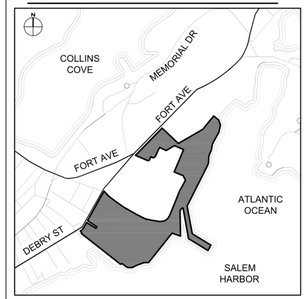
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**JJM**
Drawn By:	
Checked By:	
Approved By:	

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

BORING LOGS (SHEET 9)

SHEET NUMBER

B509

17 OF 26

ANSI D 22" x 34"

Last saved by: GARY.BASTIEN(2022-05-11) Last Plotted: 2022-05-12
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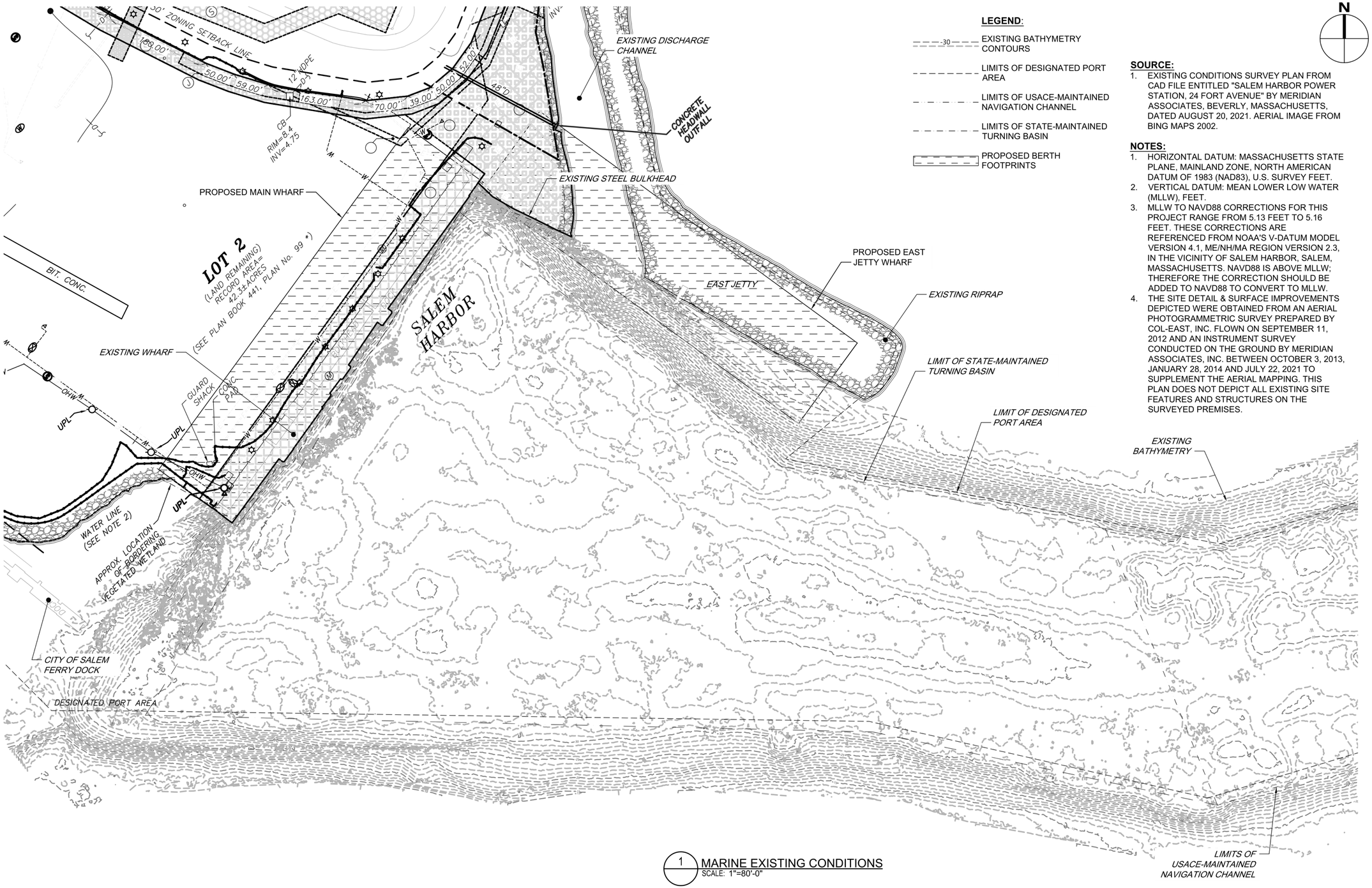
PRELIMINARY DESIGN

ANSI D 22" x 34"



LEGEND:

- EXISTING BATHYMETRY CONTOURS
- LIMITS OF DESIGNATED PORT AREA
- LIMITS OF USACE-MAINTAINED NAVIGATION CHANNEL
- LIMITS OF STATE-MAINTAINED TURNING BASIN
- PROPOSED BERTH FOOTPRINTS

SOURCE:

1. EXISTING CONDITIONS SURVEY PLAN FROM CAD FILE ENTITLED "SALEM HARBOR POWER STATION, 24 FORT AVENUE" BY MERIDIAN ASSOCIATES, BEVERLY, MASSACHUSETTS, DATED AUGUST 20, 2021. AERIAL IMAGE FROM BING MAPS 2002.

NOTES:

1. HORIZONTAL DATUM: MASSACHUSETTS STATE PLANE, MAINLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83), U.S. SURVEY FEET.
2. VERTICAL DATUM: MEAN LOWER LOW WATER (MLLW), FEET.
3. MLLW TO NAVD88 CORRECTIONS FOR THIS PROJECT RANGE FROM 5.13 FEET TO 5.16 FEET. THESE CORRECTIONS ARE REFERENCED FROM NOAA'S V-DATUM MODEL VERSION 4.1, ME/NH/MA REGION VERSION 2.3, IN THE VICINITY OF SALEM HARBOR, SALEM, MASSACHUSETTS. NAVD88 IS ABOVE MLLW; THEREFORE THE CORRECTION SHOULD BE ADDED TO NAVD88 TO CONVERT TO MLLW.
4. THE SITE DETAIL & SURFACE IMPROVEMENTS DEPICTED WERE OBTAINED FROM AN AERIAL PHOTOGRAMMETRIC SURVEY PREPARED BY COL-EAST, INC. FLOWN ON SEPTEMBER 11, 2012 AND AN INSTRUMENT SURVEY CONDUCTED ON THE GROUND BY MERIDIAN ASSOCIATES, INC. BETWEEN OCTOBER 3, 2013, JANUARY 28, 2014 AND JULY 22, 2021 TO SUPPLEMENT THE AERIAL MAPPING. THIS PLAN DOES NOT DEPICT ALL EXISTING SITE FEATURES AND STRUCTURES ON THE SURVEYED PREMISES.

1 MARINE EXISTING CONDITIONS
SCALE: 1"=80'-0"

GRAPHIC SCALE: 1" = 80'-0"
80' 0 80' 240'

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PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
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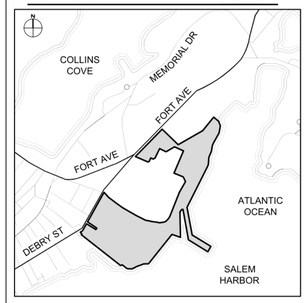
SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**D_BINKNEY**
Drawn By:	**P_SCIABA**
Checked By:	**M_MAHONEY**
Approved By:	**--**

PROJECT/TERM CONTRACT NUMBER

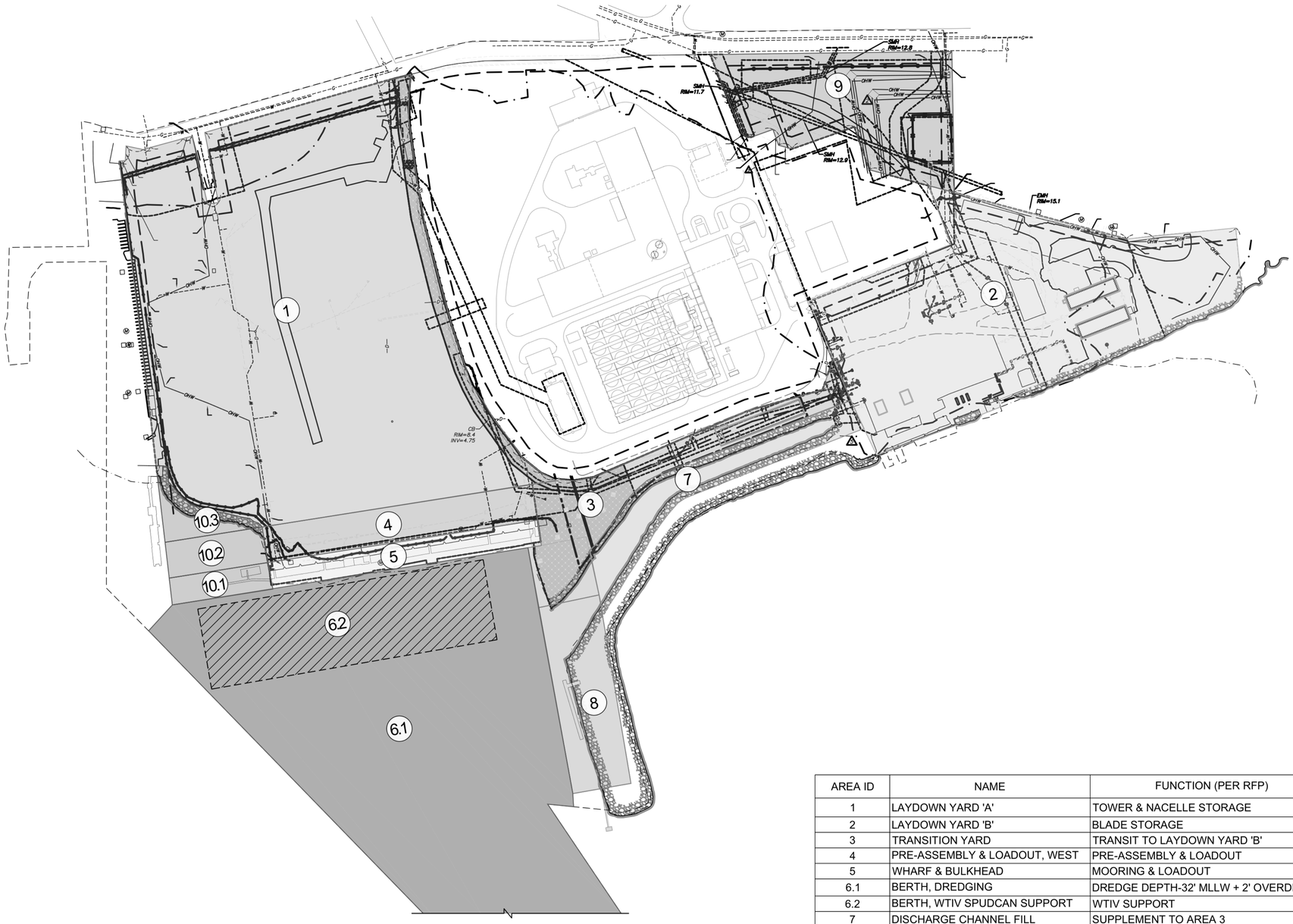
60681893

SHEET TITLE

MARINE
EXISTING CONDTIONS

SHEET NUMBER

D100



1 GENERAL LAYOUT PLAN
SCALE: 1" = 150'-0"

AREA ID	NAME	FUNCTION (PER RFP)	LIVE LOAD CAPACITY
1	LAYDOWN YARD 'A'	TOWER & NACELLE STORAGE	4,000 PSF
2	LAYDOWN YARD 'B'	BLADE STORAGE	4,000 PSF
3	TRANSITION YARD	TRANSIT TO LAYDOWN YARD 'B'	60 TON AXLE SPMT
4	PRE-ASSEMBLY & LOADOUT, WEST	PRE-ASSEMBLY & LOADOUT	6,000 PSF
5	WHARF & BULKHEAD	MOORING & LOADOUT	6,000 PSF
6.1	BERTH, DREDGING	DREDGE DEPTH-32' MLLW + 2' OVERDREDGE	N/A
6.2	BERTH, WTIV SPUDCAN SUPPORT	WTIV SUPPORT	WTIV SUPPORT
7	DISCHARGE CHANNEL FILL	SUPPLEMENT TO AREA 3	60 TON AXLE SPMT
8	JETTY WHARF	INBOUND COMPONENT DELIVERY	4,000 PSF
9	PARKING	PARKING	AASHTO HL-93
10.1	ALCOVE FILL, WHARF	SOUTH EXTENSION OF AREA 5	SAME AS AREA 5
10.2	ALCOVE FILL, PRE-ASSEMBLY	SOUTH EXTENSION OF AREA 4	SAME AS AREA 4
10.3	ALCOVE FILL, LAYDOWN	SOUTH EXTENSION OF AREA 1	SAME AS AREA 1

GRAPHIC SCALE: 1" = 150'-0"
150' 75' 0 75' 150' 300' 450'

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

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Jacksonville, FL 32225

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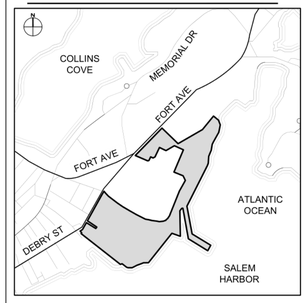
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DEJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

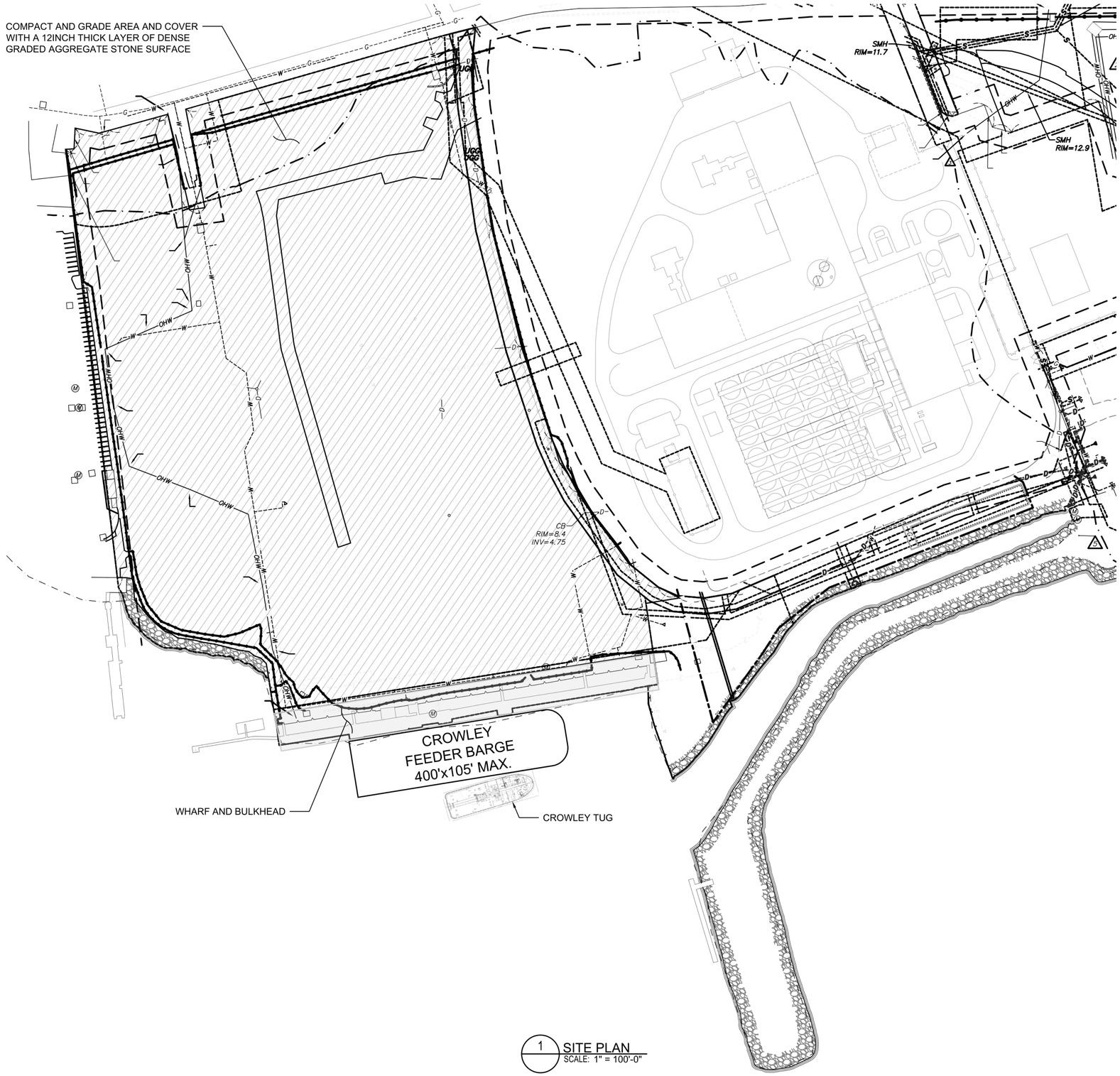
GENERAL LAYOUT PLAN

SHEET NUMBER

S100

19 OF 26

ANSI D 22" x 34"



1 SITE PLAN
SCALE: 1" = 100'-0"

GRAPHIC SCALE: 1" = 150'-0"
150' 75' 0 75' 150' 300' 450'

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

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Filename: C:\USERS\FERRERA\ACCDOCS\AECOM\CI\AMER (USA) 60681893-SALEM OSW TERMINAL\900 DESIGN COLLABORATION\02_SHEETS\07_STRUCTURAL\SOSWT-S101.DWG

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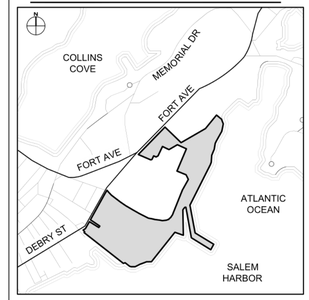
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

60681893

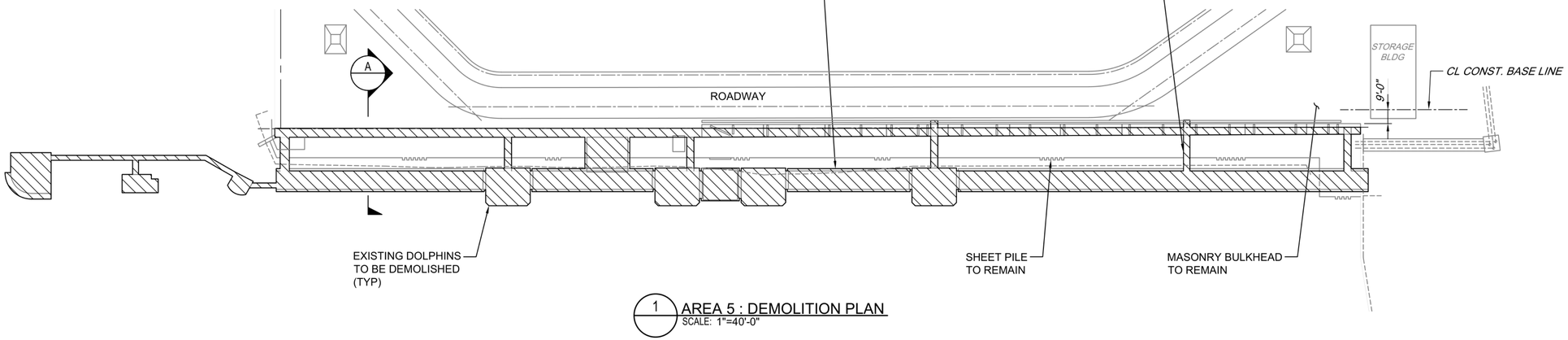
SHEET TITLE

GENERA LAYOUT PLAN
INITIAL PHASE

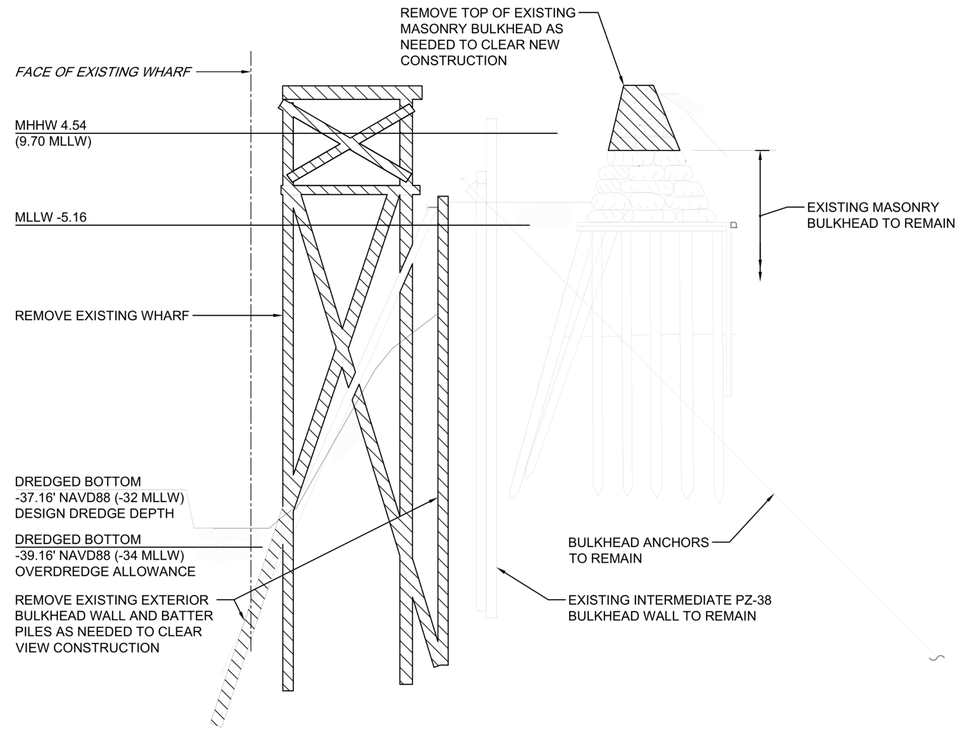
SHEET NUMBER

S101

20 OF 26



1 AREA 5 : DEMOLITION PLAN
SCALE: 1"=40'-0"



A AREA 5 : DEMOLITION SECTION
SCALE: 1/8" = 1'-0"

GRAPHIC SCALE: 1/8" = 1'-0"
5' 0' 5' 10' 15' 20' 25'

GRAPHIC SCALE: 1" = 40'-0"
40' 20' 0 20' 40' 80' 120'

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PROJECT

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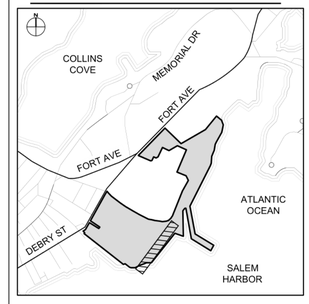


REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

DEMOLITION AREA 5

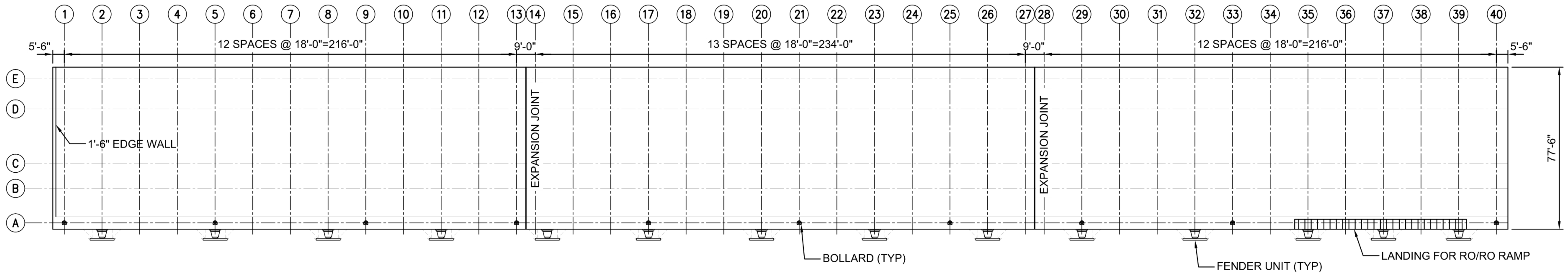
SHEET NUMBER

S201

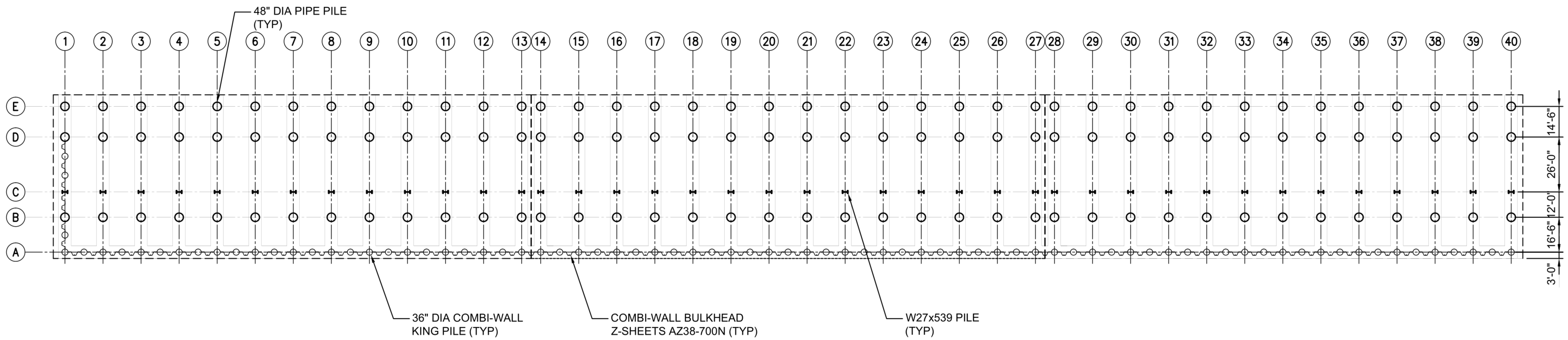
21 OF 26

PRELIMINARY DESIGN

ANSI D 22" x 34"



1 AREA 5 DECK PLAN
SCALE: 1" = 30'-0"



2 AREA 5 PILE AND PILE CAP PLAN
SCALE: 1" = 30'-0"

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GRAPHIC SCALE: 1" = 30'-0"
30' 15' 0 15' 30' 60' 90'

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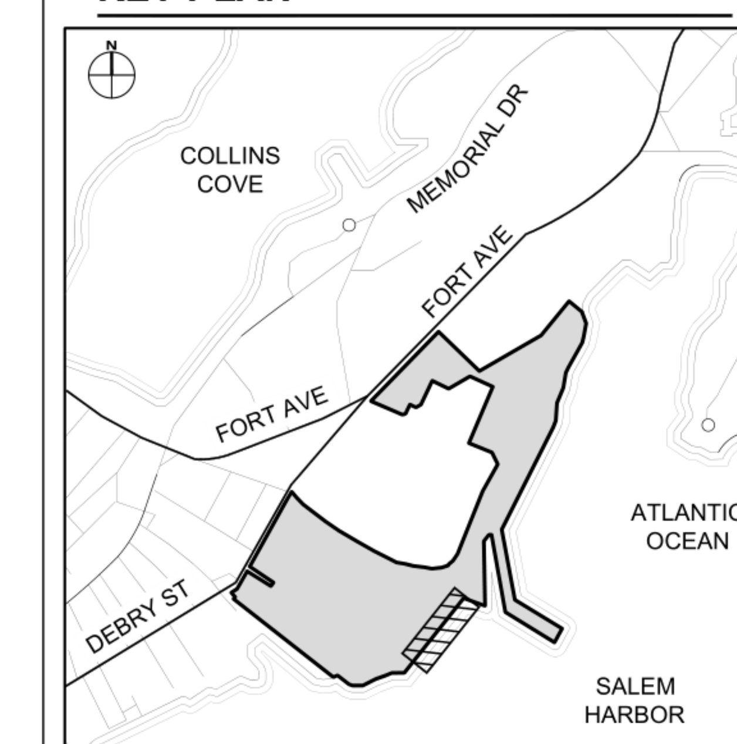
KEY PLAN



REVISION

R	DATE	DESCRIPTION

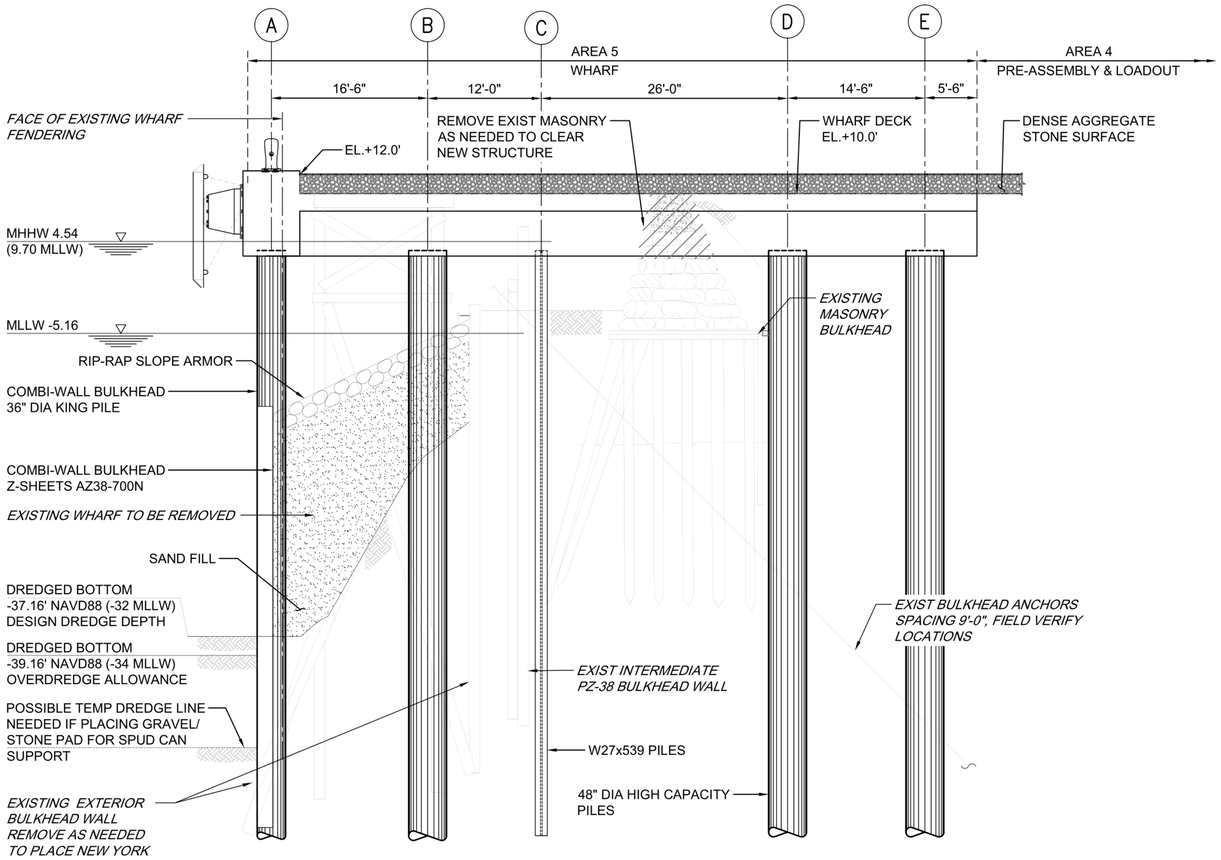
Designed By:	J. KLEIN
Drawn By:	F. LIZANO
Checked By:	P. DELJOUI
Approved By:	P. DELJOUI

PROJECT/TERM CONTRACT NUMBER
60681893

SHEET TITLE
AREA 5
WHARF AND BULKHEAD -
DECK AND PILE PLANS

SHEET NUMBER
S303

PRELIMINARY DESIGN



A / S303 AREA 5 : TYPICAL WHARF SECTION
SCALE: 1/8" = 1'-0"

GRAPHIC SCALE: 1/8" = 1'-0"
5' 0' 5' 10' 15' 20' 25'

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PRELIMINARY DESIGN

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ANSI D 22" x 34"

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

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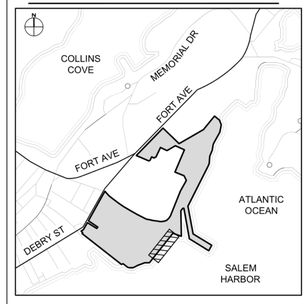
DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

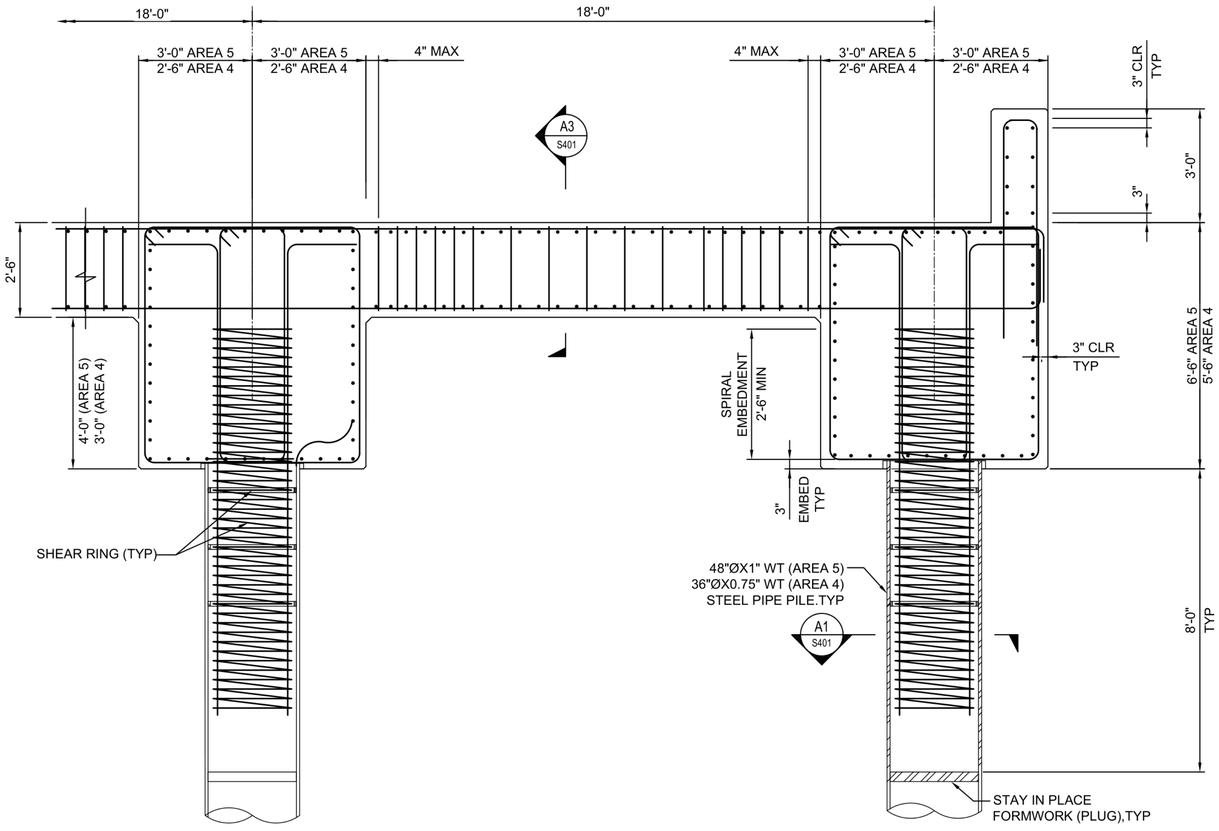
AREA 5 : WHARF AND BULKHEAD - TYPICAL SECTION

SHEET NUMBER

S304

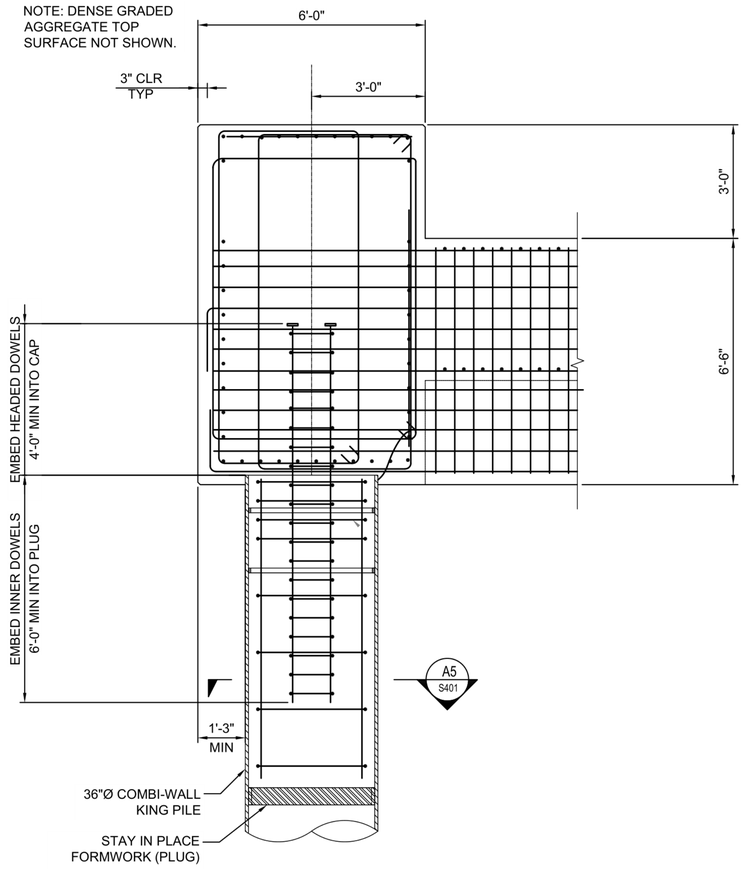
23 OF 26

NOTE: DENSE GRADED AGGREGATE TOP SURFACE NOT SHOWN.

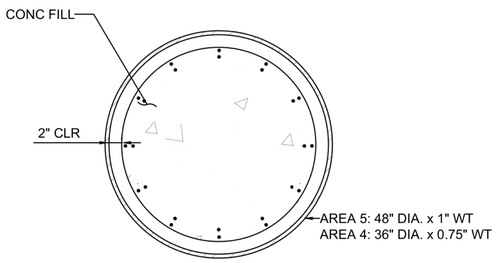


C1 - AREA 5 TYPICAL DECK AND PILE CAP SECTION (SHOWN)
AREA 4 TYPICAL DECK AND PILE CAP SECTION (AS NOTED)
SCALE: 1/2" = 1'-0"

NOTE: DENSE GRADED AGGREGATE TOP SURFACE NOT SHOWN.

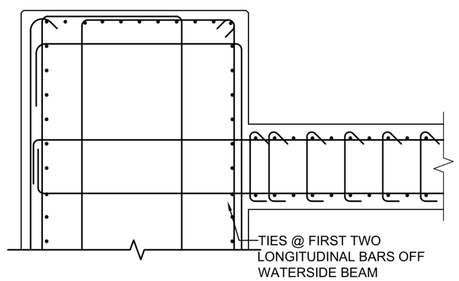


C4 - AREA 5 FASCIA BEAM
SCALE: 1/2" = 1'-0"

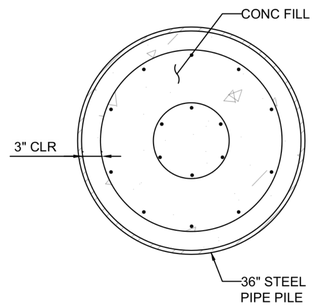


A1 - S401 STEEL PIPE PILE PLUG
SCALE: 1" = 1'-0"

NOTE: DENSE GRADED AGGREGATE TOP SURFACE NOT SHOWN.



A3 - S401 AREA 5 TYPICAL DECK SECTION
SCALE: 1" = 1'-0"



A5 - S401 KING PILE PLUG
SCALE: 1" = 1'-0"

NOTES
1. ALL PILE CAP, WALL CAP, AND SLAB LONGITUDINAL REINFORCING SHALL TERMINATE IN STANDARD 90° HOOKS, UON.
2. #4/0 BARE COPPER GROUND EXOTHERMICALLY WELDED TO STEEL PILE AND REINFORCEMENT IN PILE CAP WHERE REQUIRED

GRAPHIC SCALE: 1" = 1'-0"
1' 6" 0' 1' 2' 3'

GRAPHIC SCALE: 1 1/2" = 1'-0"
0 6" 1' 2'

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

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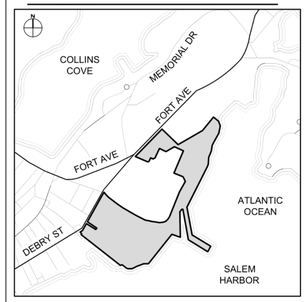
KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

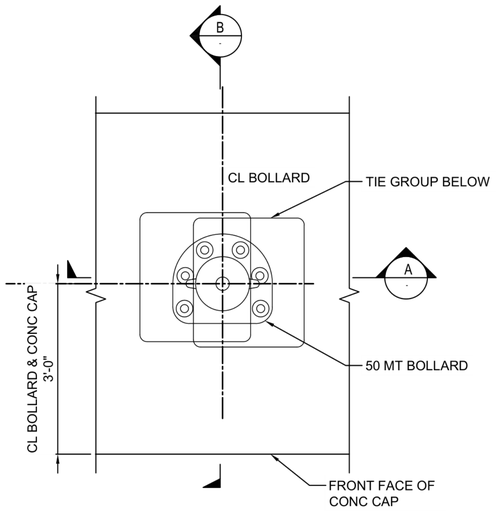
60681893

SHEET TITLE

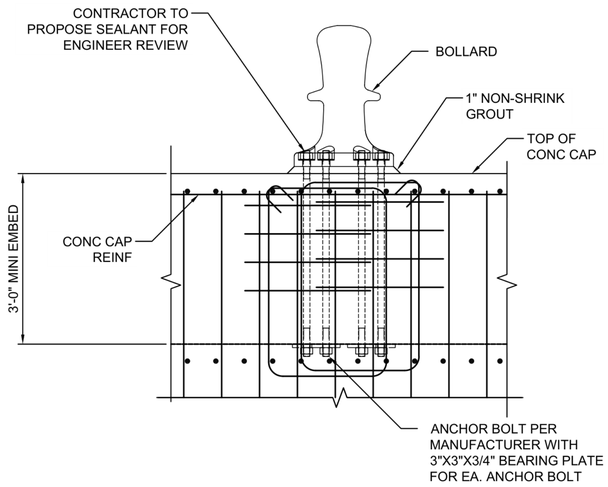
AREA 4 & 5 DECK & PILE CAP DETAILS

SHEET NUMBER

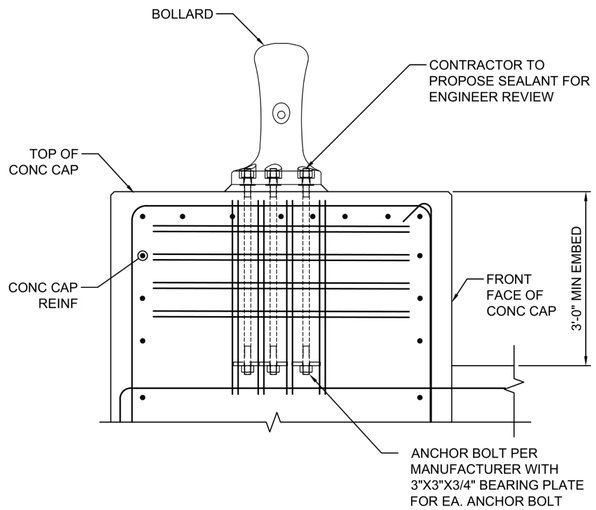
S401



1 50 MT BOLLARD PLAN
SCALE: 3/4"=1'-0"

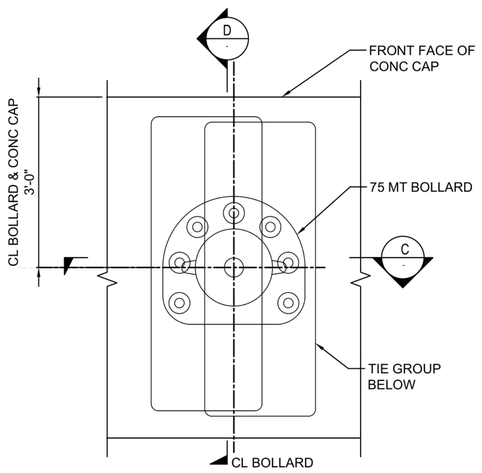


A 50 MT SECTION
SCALE: 3/4"=1'-0"

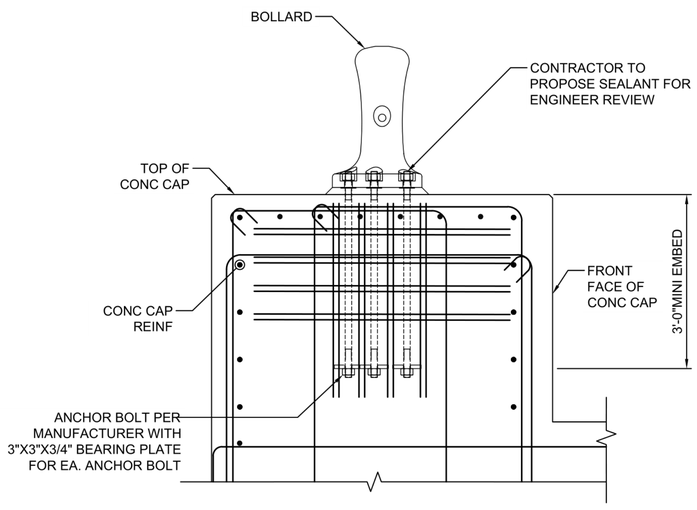


NOTE:
BOLLARD CONNECTION DETAILS ARE THE RESPONSIBILITY OF CONTRACTOR. CONTRACTOR TO VERIFY THAT ANCHORAGE SIZE AND EMBEDMENT IS ADEQUATE. NOTE THAT SUPPLEMENTARY STEEL REINFORCEMENT MAY BE REQUIRED TO ADEQUATELY ANCHOR BOLLARD TO CONCRETE. CONTRACTOR TO SUBMIT SIGNED/SEALED CALCULATIONS AND SHOP DRAWINGS BY A MASSACHUSETTS REGISTERED PROFESSIONAL ENGINEER.

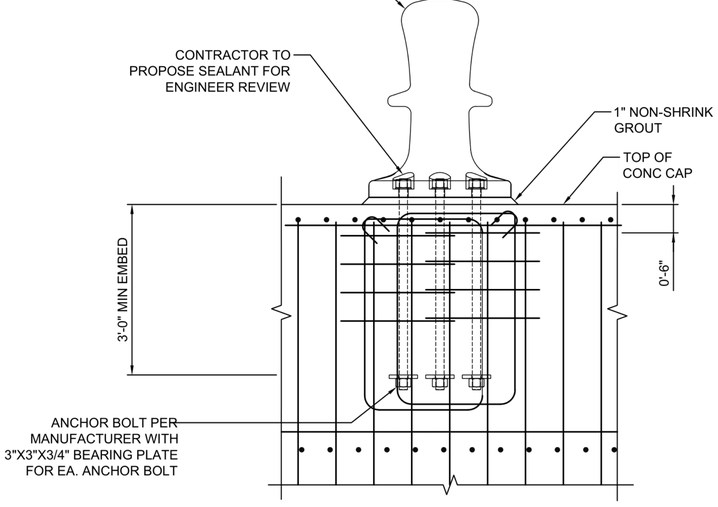
B 50 MT SECTION
SCALE: 3/4"=1'-0"



2 75 MT BOLLARD PLAN
SCALE: 3/4"=1'-0"



C 75 MT SECTION
SCALE: 3/4"=1'-0"



D 75 MT SECTION
SCALE: 3/4"=1'-0"

GRAPHIC SCALE: 3/4" = 1'-0"
1' 6" 0' 1' 2' 3' 4'

NOT FOR CONSTRUCTION

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
AECOM TECHNICAL SERVICES, INC.
605 3rd Ave, 2nd Floor
New York, NY 10004
212.377.8400 tel 212.377.8410 fax
www.aecom.com

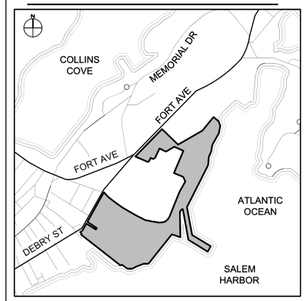
SUB-CONSULTANTS

GEOTECHNICAL ENGINEERING
GeoDesign
984 Southford Road, Middlebury, CT 06762

SITE INVESTIGATION & ENVIRONMENTAL LOADS
GZA
188 Valley Street, Suite 300, Providence, RI 02909

DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

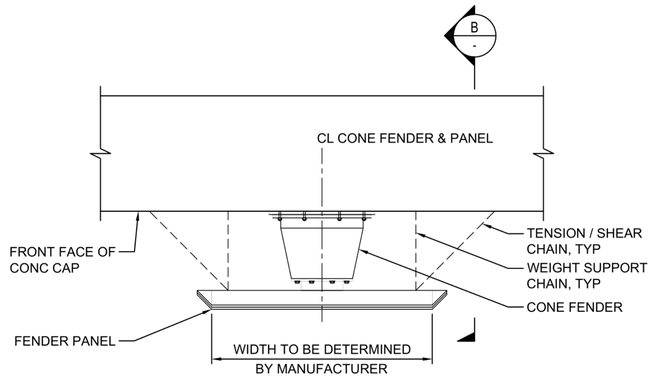
60681893

SHEET TITLE

BOLLARD DETAILS

SHEET NUMBER

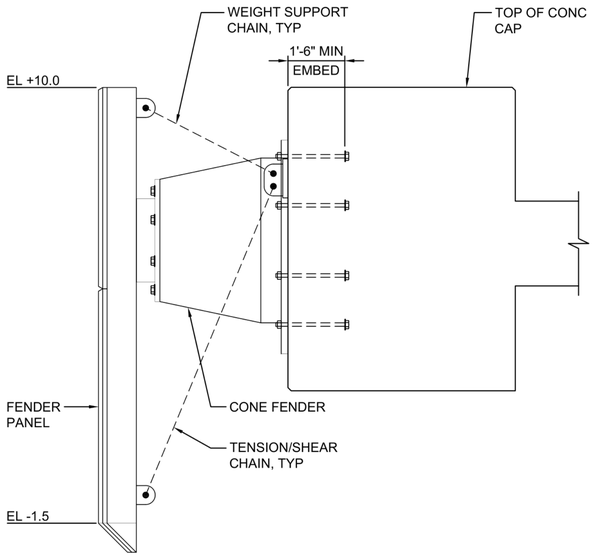
S402



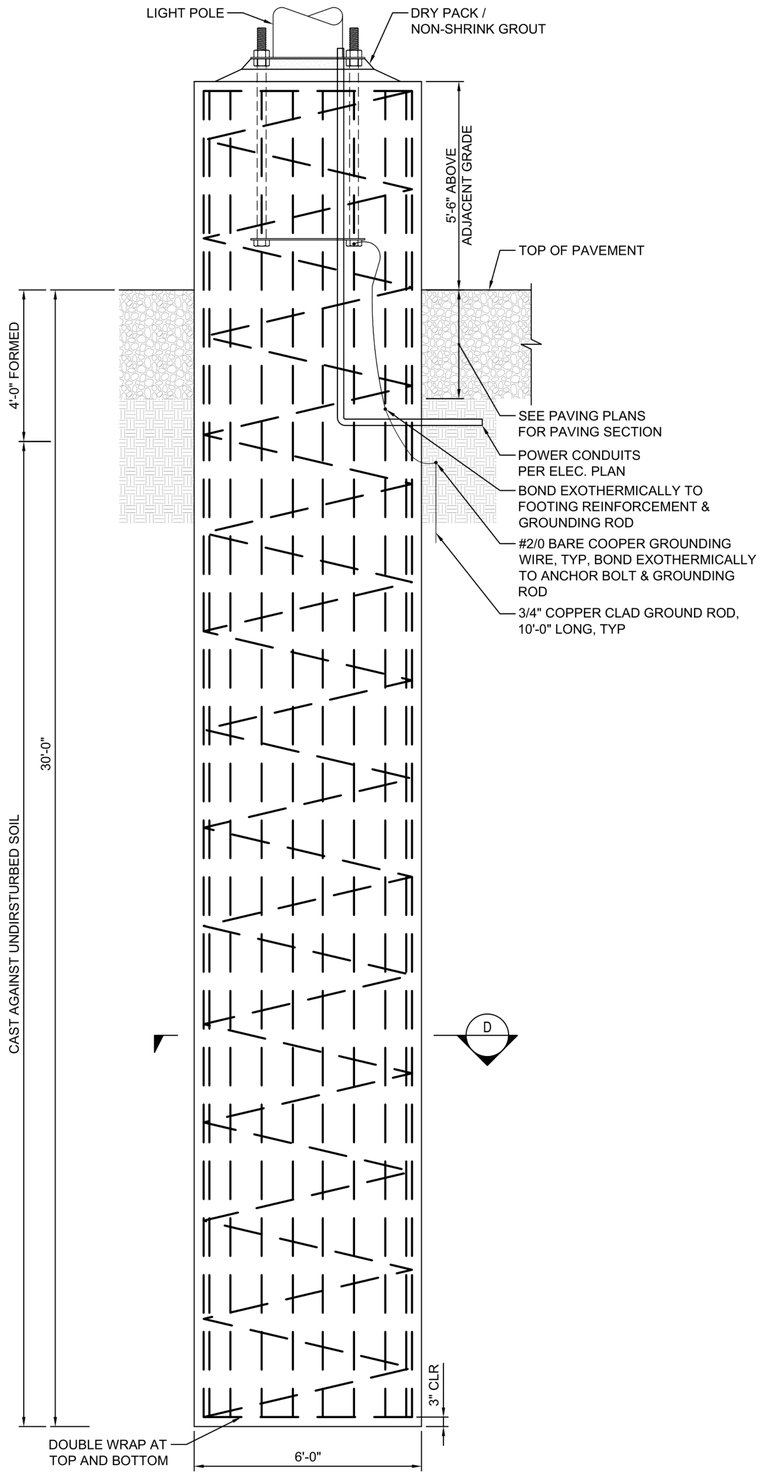
FENDER NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR FENDER SYSTEM DESIGN BASED ON THE PERFORMANCE REQUIREMENTS IN THE CONTRACT DOCUMENTS. SEE THE SPECIFICATIONS FOR ADDITIONAL FENDER SYSTEM REQUIREMENTS. CONTRACTOR TO SUBMIT STAMPED AND SEALED SHOP DRAWINGS AND CALCULATIONS BY A MASSACHUSETTS REGISTERED PROFESSIONAL ENGINEER FOR THE DESIGN OF THE FENDER SYSTEM.

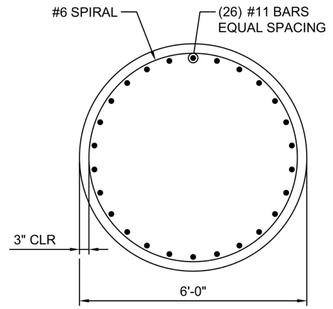
A FENDER PLAN
SCALE: 1/4"=1'-0"



B SECTION
SCALE: 1/2"=1'-0"



C 150' LIGHT POLE FOUNDATION DETAIL
SCALE: 1/2"=1'-0"



D LIGHT POLE FOUNDATION SECTION
SCALE: 1/2"=1'-0"

NOTES:

1. fc = 5000 PSI
2. LIGHT POLE, ANCHOR BOLT AND BASE PLATE WILL BE DESIGNED BY POLE MANUFACTURER. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING A CITY PERMIT FOR THESE ITEMS. ANCHOR BOLTS SHALL HAVE A MINIMUM EMBEDMENT OF 4FT INTO DRILLED SHAFT.
3. IF GROUNDWATER ENCOUNTERED, PLACE CONCRETE IN WATER VIA TREMIE METHOD.
4. CONTRACTOR SHALL PROVIDE ENGINEER WITH CALCULATIONS FOR TOP OF DRILLED SHAFT FORCES AND ANCHORAGE FOR REVIEW PRIOR TOP CONSTRUCTION.

GRAPHIC SCALE: 1/4" = 1'-0"
5' 4' 3' 2' 1' 0 5'

GRAPHIC SCALE: 1/2" = 1'-0"
1' 6" 0 1' 2' 3' 4' 5' 6'

PROJECT

SALEM WIND PORT
67 Derby Street, Salem, Massachusetts

CLIENT

CROWLEY
CROWLEY WIND SERVICES, Inc.
9487 Regency Square Boulevard
Jacksonville, FL 32225

CONSULTANT

AECOM
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212.377.8400 tel 212.377.8410 fax
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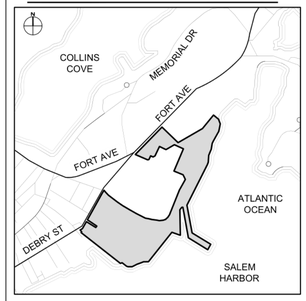
DREDGE & DREDGE MATERIAL MANAGEMENT
Anchor Qea OCS JV
9 Water St., Amersbury, MA 01913

KEY PLAN



REVISION

R	DATE	DESCRIPTION

Designed By:	**J. KLEIN**
Drawn By:	**F. LIZANO**
Checked By:	**P. DELJOUI**
Approved By:	**P. DELJOUI**

PROJECT/TERM CONTRACT NUMBER

60681893

SHEET TITLE

FENDER AND LIGHT POLE DETAILS

SHEET NUMBER

S403

26 OF 26

NOT FOR CONSTRUCTION

PRELIMINARY DESIGN

Major Cost Category	2022	2023	2024	Total
Engineering/Design	$815,427	$800,901		$1,616,328
Construction Management / Administration		$1,318,971	$1,758,629	$3,077,600
NEPA and Permitting	$194,636	$219,512		$414,148
Construction				$0
Environmental Controls Allowance		$28,371	$85,112	$113,483
Civil Demolition		$860,512		$860,512
Laydown Area Improvements			$4,023,553	$4,023,553
Site Improvements			$1,745,680	$1,745,680
Water System Allowance			$113,483	$113,483
PAZ Combi-Wall Steel Bulkhead		$5,030,280	$6,148,119	$11,178,399
Foundation Piles - Heavy Lift Platform		$4,718,728	$11,010,366	$15,729,094
Concrete Bulkhead Cap			$4,748,962	$4,748,962
Concrete Heavy Lift Platform			$15,110,007	$15,110,007
Electrical Infrastructure Allowance			$212,780	$212,780
Total				$58,944,029

Project Salem Wind Port
Title Phase 1 Estimate
For Crowley Wind Services LLC

SALEM OSW TERMINAL
SALEM, MA
CROWLEY WIND SERVICES, INC
10% ESTIMATE FOR INTITIAL GRANT APPLICATION

BidItem	Bid Description	Bid Quantity	Units	Labor and Burden	Permanent Material	Construction Material	Total Equipment	Subcontractor	TOTAL DIRECT COST
500000	***AREA 5 - WHARF & BULKHEAD (LOADOUT)***	***1***	***LS***	***$ 5,508,273***	***$ 16,138,481***	***$ 585,459***	***$ 3,025,297***	***$ 5,335,069***	***$ 30,592,580***
502000	**ENVIRONMENTAL CONTROLS ALLOWANCE**	**1**	**LS**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 69,696**	**$ 69,696**
502100	ENVIRONMENTAL CONTROLS BUDGET	1	AC	$ -	$ -	$ -	$ -	$ 69,696	$ 69,696
503000	**CIVIL DEMOLITION**	**1**	**LS**	**$ 144,954**	**$ -**	**$ -**	**$ 156,834**	**$ 226,700**	**$ 528,489**
503100	DEMO EXIST SEAWALL WHERE REQ'D	2,239	CY	$ 144,954	$ -	$ -	$ 156,834	$ 226,700	$ 528,489
506000	**SITE IMPROVEMENTS**	**1**	**LS**	**$ 185,256**	**$ 770,147**	**$ -**	**$ 116,717**	**$ -**	**$ 1,072,120**
506210	FURNISH & PLACE 12-IN DGA 700FT WHARF GRANT	1,815	CY	$ 26,996	$ 81,312	$ -	$ 14,416	$ -	$ 122,724
506220	FURNISH & PLACE SAND BF 700FT WHARF GRANT	9,810	CY	$ 54,200	$ 515,025	$ -	$ 30,216	$ -	$ 599,441
506230	FURNISH & PLACE RIPRAP 700FT WHARF GRANT	1,528	CY	$ 104,060	$ 173,810	$ -	$ 72,085	$ -	$ 349,955
513000	**WATER SYSTEM ALLOWANCE**	**1**	**LS**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 69,696**	**$ 69,696**
513100	DOMESTIC WATER BUDGET	1	AC	$ -	$ -	$ -	$ -	$ 69,696	$ 69,696
521000	**PAZ COMBI-WALL STEEL BULKHEAD**	**1**	**LS**	**$ 920,983**	**$ 4,586,917**	**$ 289,000**	**$ 1,068,380**	**$ -**	**$ 6,865,280**
521100	PAZ36/AZ28-700N COMBI-WALL BH - 700-FT WHARF	860	LF	$ 920,983	$ 4,586,917	$ 289,000	$ 1,068,380	$ -	$ 6,865,280
531000	**FOUNDATION PILES - HVY LIFT PLATFORM**	**1**	**LS**	**$ 770,583**	**$ 8,131,158**	**$ -**	**$ 758,374**	**$ -**	**$ 9,660,116**
531030	INTERMEDIATE W27 X 539 PILES - 700FT WHARF GRANT	2,540	LF	$ 184,949	$ 2,419,170	$ -	$ 227,994	$ -	$ 2,832,113
531040	48-IN PIPE PILES - 700FT WHARF GRANT	8,190	LF	$ 585,634	$ 5,711,989	$ -	$ 530,380	$ -	$ 6,828,003
541000	**CONCRETE BULKHEAD CAP**	**1**	**LS**	**$ 1,082,860**	**$ 532,750**	**$ 216,507**	**$ 465,653**	**$ 618,833**	**$ 2,916,603**
541100	CONCRETE BULKHEAD CAP - 700FT WHARF GRANT	1,905	CY	$ 1,082,860	$ 532,750	$ 216,507	$ 465,653	$ 618,833	$ 2,916,603
551000	**CONCRETE HVY LIFT PLATFORM**	**1**	**LS**	**$ 2,403,637**	**$ 2,117,509**	**$ 79,952**	**$ 459,338**	**$ 4,219,465**	**$ 9,279,900**
551020	HEAVY LIFT PAD - 700FT WHARF GRANT	8,963	CY	$ 2,403,637	$ 2,117,509	$ 79,952	$ 459,338	$ 4,219,465	$ 9,279,900
561000	**ELECTRICAL INFRASTUCTURE ALLOWANCE**	**1**	**LS**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 130,680**	**$ 130,680**
561100	SITE ELECTRICAL BUDGET	1	AC	$ -	$ -	$ -	$ -	$ 130,680	$ 130,680
	TOTAL DIRECT COST			**$ 5,508,273**	**$ 16,138,481**	**$ 585,459**	**$ 3,025,297**	**$ 5,335,069**	**$ 30,592,580**
	INDIRECT ALLOWANCE	15.00%		$ 826,241	$ 2,420,772	$ 87,819	$ 453,795	$ 800,260	$ 4,588,887
	SUBTOTAL			**$ 6,334,514**	**$ 18,559,254**	**$ 673,278**	**$ 3,479,092**	**$ 6,135,330**	**$ 35,181,467**
	OH&P ON SELF-PERFORM	10.00%		$ 633,451	$ 1,855,925	$ 67,328	$ 347,909	$ 80,026	$ 2,984,640
	GC FEE ON SUBS	5.00%						$ 266,753	$ 266,753
	SUBTOTAL								**$ 38,432,861**
	CONTINGENCY	20.00%							$ 7,686,572
	SUBTOTAL								**$ 46,119,433**
	ESCALATION (4.5% PER ANNUM TO MID-PT APPROX FEB 2024)	8.01%							$ 3,692,967
	TOTAL SUGGESTED ROM BUDGET								***$ 49,812,400***

NOTES:

1. **THIS ESTIMATE FOR EARLY GRANT APPLICATION INCLUDES 700 LF WHARF FRONTAGE (AREA 5)**
2. **THIS ESTIMATE FOR GRANT APPLICATION; NO WORK FOR AREAS 1 OR 4 IS INCLUDED**
3. **ASSUMED THIS WORK WOULD BE LET AS A STANDALONE CONTRACT.**
4. **THIS ESTIMATE IS ONLY FOR THE WORK SHOWN - NOT COMPLETE BUILDOUT OF AREA 5**
5. **NO STRUCTURAL DEMOLITION INCLUDED**
6. **NO MARINE HDWR INCLUDED (FENDERS, BOLLARDS, LADDERS, ETC...)**
7. **THIS ESTIMATE ASSUMES A MINIMUM OF FIVE (5) BIDS WILL BE RECEIVED**

Congress of the United States
Washington, DC 20515

May 9, 2022

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Buttigieg:

We write to you regarding funding for the Salem Offshore Wind Terminal project through the FY2022 Port Infrastructure Development grant program.

The City of Salem is seeking to redevelop the historic port of Salem, Massachusetts, into a new, world class heavy-lift deployment facility for offshore wind marshalling operations. The proposed facility will be constructed on 42 acres of remediated waterfront property with a deep-water dock and more than 2,300 linear feet of frontage on Salem Harbor.

With sufficient upland area and a deep-water federally maintained navigation channel with no height or width limitations, Salem is uniquely positioned to support the needs of the Commonwealth for offshore wind deployment. The site is among a very short list of ports in the country with the physical characteristics necessary for marshalling of fixed bottom and future floating offshore wind turbines. With this project, the Commonwealth has an opportunity to increase its collective port capacity and retain its position as the first mover and leader in U.S. offshore wind development.

This project represents a significant step in supporting the Commonwealth in reaching its renewable energy goals while providing social, environmental, business, and economic benefits to Salem and surrounding communities. Through this partnership, the Port of Salem will be developed into a marshalling hub for the deployment of over two gigawatts of already approved offshore wind capacity in the initial five-year port utilization period alone. Finally, this project will leverage private investment as part of the overall project funding.

We request your full and fair consideration of this critical project. Thank you for your prompt attention to this request.

Sincerely,

Edward J. Markey
United States Senator

Elizabeth Warren
United States Senator

Seth Moulton
Member of Congress

COMMONWEALTH OF MASSACHUSETTS
THE GENERAL COURT
STATE HOUSE, BOSTON 02133-1053

May 12th, 2022

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Buttigieg:

We write to urge you to support the funding of the Salem Offshore Wind Terminal project through an award of an FY2022 Port Infrastructure Development grant. As members of the Northshore Delegation, we represent various cities and towns in Massachusetts from the southern points in Lynn to the northern coast in Gloucester and are in support of this grant proposal.

The city of Salem, Massachusetts is seeking to redevelop its historic port to become a critical infrastructure component of the offshore wind industry in the United States. Overall, the Salem port has a long history in New England. In the eighteenth and nineteenth centuries, it was the nation's leading port for trade with Asia. Most recently, it served as a coal-fired power plant. In conjunction with the Commonwealth of Massachusetts, the city of Salem intends to develop the port into a world-class heavy-lift deployment facility for offshore wind marshaling operations. The facility will be constructed on 42 acres of land in the same location as the former coal-powered plant. This site will be beneficial for the Salem Offshore Wind Terminal, as it contains a deep-water dock and nearly ½ mile of frontage on the Salem Harbor.

In combination with sufficient upland in the area and a deep-water federally maintained navigation channel with no height or width limitations, Salem is uniquely positioned to support the United States' needs for offshore wind deployment. The site has the necessary characteristics for marshaling fixed bottom and future floating offshore wind turbines. With this project, the Commonwealth has an opportunity to increase its collective port capacity and contribute much to the development of the U.S. offshore wind industry.

This project represents a significant step in helping both the U.S. and the Commonwealth reach their renewable energy goals while providing social, environmental, business, and economic benefits to Massachusetts. It is important to note that this project includes leveraging significant private investment as part of the overall project funding. Through this partnership, the port of Salem will be developed into a marshaling hub for the deployment of over two gigawatts of already approved offshore wind capacity in the initial five-year port utilization period alone with many gigawatts to follow.

On behalf of the Commonwealth of Massachusetts, we thank you for your consideration in supporting this important project. The positive economic and environmental impacts will provide the Commonwealth and the entire country with a return on investment that is far greater than the grant award.

Sincerely,

Jerry Parisella
State Representative
Sixth Essex- Beverly

Paul F. Tucker
State Representative
Seventh Essex- Salem

Joan B. Lovely
State Senator
Second Essex

Senator Brendan P. Crighton
State Senator
Third Essex

Senator Bruce E. Tarr
State Senator
First Essex & Middlesex

Daniel Cahill
State Representative
Tenth Essex – Lynn

Sally P. Kerans
State Representative
Thirteenth Essex- Danvers, Peabody & Middleton

Peter Capano
State Representative
Eleventh Essex- Lynn & Nahant

Thomas P. Walsh
State Representative
Twelfth Essex- Peabody

Ann-Margaret Ferrante
State Representative
Fifth Essex- Gloucester & Rockport

Jamie Zahlaway Belsito
State Representative
Fourth Essex- Hamilton, Ipswich, Manchester-by-the-Sea, Rowley, Topsfield & Wenham

The Commonwealth's Leadership University™

April 29, 2022

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Buttigieg:

Thank you for your considering a Port Infrastructure Development Grant to ensure the development of the new Offshore Wind Terminal in Salem Massachusetts.

The City of Salem seeks to redevelop the historic port of Salem Massachusetts into a new world class offshore wind equipment marshalling and terminal operation. The proposed facility will be constructed on 42 acres of remediated waterfront property that was formally a coal fired power plant. It will include a deep-water dock and more than 2,300 lineal feet of frontage on Salem Harbor.

This project represents a significant step in helping the Commonwealth reach its renewable energy goals while providing social, environmental, business, and economic benefits to Salem and the entire Commonwealth. The project will also position the Commonwealth as a leader in the offshore wind industry.

Located nearby, Massachusetts Maritime Academy (MMA) is uniquely positioned to educate and train the young men and women to enter the offshore wind workforce in deck officer, engineering, and logistics roles that will be in high demand. MMA is already preparing for future graduate demands by partnering with Crowley Maritime, the new OSW terminal operator, to create the first-of-its-kind training and workforce development program dedicated to the New England offshore wind energy industry.

I would like to thank you again for your consideration in supporting this important project. The positive economic and environmental impacts will provide the Commonwealth clean energy, great jobs and an exciting new field for our graduates.

Respectfully,

Thank you for your consideration.

Very respectfully,

Francis X. McDonald, LPD
Rear Admiral, U.S. Maritime Administration
President, Massachusetts Maritime Academy
Office: 508-830-5001
fmcdonald@maritime.edu

International Longshoremen's Association AFL-CIO

Bernard J. O'Donnell
International Vice President

George McEvoy III
Atlantic Coast District Vice President

Boston Fish Pier, West Building • Suire 304A • Boston, MA 02210

May 5, 2022

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Dear Secretary Buttigieg:

Thank you for your consideration of a Port Infrastructure Development Grant to ensure the development of the new Offshore Wind Terminal in Salem Massachusetts.

The City of Salem seeks to redevelop the historic port of Salem Massachusetts into a new world class offshore wind equipment marshalling and terminal operation. The proposed facility will be constructed on 42 acres of remediated waterfront property that was formally the site of a coal fired power plant. It will include a deep-water dock and more than 2,300 lineal feet of frontage on Salem Harbor. The new terminal will be a marshalling hub for the deployment of over two gigawatts of already-approved offshore wind capacity in the initial five-year port utilization period alone.

This project represents a significant step in helping the Commonwealth reach its renewable energy goals while providing social, environmental, business, and economic benefits to Salem and the entire Commonwealth.

In addition to the renewable energy benefits of the project, it will also create nearly 400 good-paying, family sustaining jobs that will benefit the men and women of the International Longshoremen's Association as well as other unions. An additional 400 jobs will be created in the first five years including port operations, wind turbine marshalling, and offshore construction. The project is slated to provide up to $850 million in direct investment in the region during the development and construction phases.

Over the initial 20 years of operation, the terminal is projected to provide up to $2 billion in total economic activity.

It is important to note that this project includes leveraging state and private party investment as part of the overall project funding.

I would like to thank you again for your consideration in supporting this important project. The positive economic and environmental impacts will provide the Commonwealth a return on investment that is far greater than the grant award. The new OSW terminal impacts will provide the Commonwealth with clean energy, great jobs and economic and environmental sustainability.

Respectfully,

Bernard O'Donnell
Vice President, ILA

George McEvoy
Vice President, ACD

CC: Harold Daggett, President, ILA
Dennis Daggett, Executive Vice President, ILA
Stephen Knott, Secretary-Treasurer, ILA
John D. Baker, General Organizer, ILA
James H. Paylor, Assistant General Organizer, ILA
Alan A. Robb, Assistant General Organizer, ILA
Benny Holland, Jr., Executive Vice President Emeritus, ILA
Peter Clark, Vice President, ILA
Mazzola Mardon, P.C.

ATTACHMENTS FORM

Instructions: On this form, you will attach the various files that make up your grant application. Please consult with the appropriate Agency Guidelines for more information about each needed file. Please remember that any files you attach must be in the document format and named as specified in the Guidelines.

Important: Please attach your files in the proper sequence. See the appropriate Agency Guidelines for details.

1) Please attach Attachment 1	1234-01_Project Narrative_051	Add Attachment	Delete Attachment	View Attachment
2) Please attach Attachment 2	1235-02_Attachments Form_Risk	Add Attachment	Delete Attachment	View Attachment
3) Please attach Attachment 3	1236-03_BCA Narrative_051622	Add Attachment	Delete Attachment	View Attachment
4) Please attach Attachment 4	1237-04_BCA Spreadsheet-unloc	Add Attachment	Delete Attachment	View Attachment
5) Please attach Attachment 5	1238-05_Project Schedule_0512	Add Attachment	Delete Attachment	View Attachment
6) Please attach Attachment 6	1239-06_Funding Commitment Le	Add Attachment	Delete Attachment	View Attachment
7) Please attach Attachment 7	1240-07_Community Benefits Ag	Add Attachment	Delete Attachment	View Attachment
8) Please attach Attachment 8	1241-08_Project Engineering D	Add Attachment	Delete Attachment	View Attachment
9) Please attach Attachment 9	1242-09_Budget Information fo	Add Attachment	Delete Attachment	View Attachment
10) Please attach Attachment 10	1243-10_Project Cost Estimate	Add Attachment	Delete Attachment	View Attachment
11) Please attach Attachment 11	1244-11_Letters of Support_05	Add Attachment	Delete Attachment	View Attachment
12) Please attach Attachment 12		Add Attachment	Delete Attachment	View Attachment
13) Please attach Attachment 13		Add Attachment	Delete Attachment	View Attachment
14) Please attach Attachment 14		Add Attachment	Delete Attachment	View Attachment
15) Please attach Attachment 15		Add Attachment	Delete Attachment	View Attachment

OMB Number: 4040-0004
Expiration Date: 12/31/2022

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 05/16/2022

4. Applicant Identifier:

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: City of Salem

* b. Employer/Taxpayer Identification Number (EIN/TIN): (b)(4)

* c. UEI: (b)(4)

d. Address:

* Street1: 98 Washington Street

Street2:

* City: Salem

County/Parish:

* State: MA: Massachusetts

Province:

* Country: USA: UNITED STATES

* Zip / Postal Code: 01970-3506

e. Organizational Unit:

Department Name: Salem Harbor Port Authority

Division Name:

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:

* First Name: Seth

Middle Name:

* Last Name: Lattrell

Suffix:

Title: Port Authority Deputy

Organizational Affiliation: City of Salem

* Telephone Number: 9786195685

Fax Number:

* Email: slattrell@salem.com

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

C: City or Township Government

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Maritime Administration

11. Catalog of Federal Domestic Assistance Number:

20.823

CFDA Title:

Port Infrastructure Development Program

*** 12. Funding Opportunity Number:**

MA-PID-22-001

* Title:

2022 Port Infrastructure Development Program Grants

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Development of an empty property into a large Offshore Wind marshaling port that enables numerous offshore wind turbine installations.

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: MA-006 * b. Program/Project: MA-006

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 10/01/2022 * b. End Date: 01/01/2025

18. Estimated Funding ($):

* a. Federal	33,835,953.00
* b. Applicant	25,108,076.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	58,944,029.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name: Seth

Middle Name:

* Last Name: Lattrell

Suffix:

* Title: Port Authority Deputy

* Telephone Number: 9784202584 Fax Number:

* Email: slattrell@salem.com

* Signature of Authorized Representative: Seth R Lattrell * Date Signed: 05/16/2022

OMB Number: 4040-0008
Expiration Date: 02/28/2025

BUDGET INFORMATION - Construction Programs

NOTE: Certain Federal assistance programs require additional computations to arrive at the Federal share of project costs eligible for participation. If such is the case, you will be notified.

COST CLASSIFICATION	a. Total Cost	b. Costs Not Allowable for Participation	c. Total Allowable Costs (Columns a-b)
1. Administrative and legal expenses	$	$	$
2. Land, structures, rights-of-way, appraisals, etc.	$	$	$
3. Relocation expenses and payments	$	$	$
4. Architectural and engineering fees	$ 1,616,328.00	$	$ 1,616,328.00
5. Other architectural and engineering fees	$ 3,491,748.00	$	$ 3,491,748.00
6. Project inspection fees	$	$	$
7. Site work	$	$	$
8. Demolition and removal	$	$	$
9. Construction	$ 53,835,953.00	$	$ 53,835,953.00
10. Equipment	$	$	$
11. Miscellaneous	$	$	$
12. SUBTOTAL *(sum of lines 1-11)*	$ 58,944,029.00	$	$ 58,944,029.00
13. Contingencies	$	$	$
14. SUBTOTAL	$ 58,944,029.00	$	$ 58,944,029.00
15. Project (program) income	$	$	$
16. TOTAL PROJECT COSTS *(subtract #15 from #14)*	$ 58,944,029.00	$	$ 58,944,029.00

FEDERAL FUNDING

17. Federal assistance requested, calculate as follows: (Consult Federal agency for Federal percentage share.) Enter the resulting Federal share.	Enter eligible costs from line 16c Multiply X ____ %	$ 0.00

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C.1352

OMB Number: 4040-0013
Expiration Date: 02/28/2025

1. * Type of Federal Action:
- [ ] a. contract
- [x] b. grant
- [ ] c. cooperative agreement
- [ ] d. loan
- [ ] e. loan guarantee
- [ ] f. loan insurance

2. * Status of Federal Action:
- [ ] a. bid/offer/application
- [x] b. initial award
- [ ] c. post-award

3. * Report Type:
- [x] a. initial filing
- [ ] b. material change

4. Name and Address of Reporting Entity:

[x] Prime [ ] SubAwardee

** Name:* NA

** Street 1:* NA *Street 2:*

** City:* NA *State:* *Zip:*

Congressional District, if known:

5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:

6. * Federal Department/Agency:

NA

7. * Federal Program Name/Description:

Port Infrastructure Development Program

CFDA Number, *if applicable:* 20.823

8. Federal Action Number, *if known:*

9. Award Amount, *if known:*

$

10. a. Name and Address of Lobbying Registrant:

Prefix: ** First Name:* NA *Middle Name:*

** Last Name:* NA *Suffix:*

** Street 1:* NA *Street 2:*

** City:* NA *State:* *Zip:*

b. Individual Performing Services (including address if different from No. 10a)

Prefix: ** First Name:* NA *Middle Name:*

** Last Name:* NA *Suffix:*

** Street 1:* NA *Street 2:*

** City:* NA *State:* *Zip:*

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

*** Signature:** Seth R Lattrell

***Name:** *Prefix:* ** First Name:* NA *Middle Name:*

** Last Name:* NA *Suffix:*

Title: **Telephone No.:** **Date:** 05/16/2022

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