PIER 94 / 96 CONCEPT PHASE

Final Conceptual Report

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1. Executive Summary

The offshore wind industry in the United States (U.S.) is a relatively new industry that is poised for significant growth and development. Multiple states, including California, have passed legislation creating a market for offshore wind. The federal government announced in May 2021 a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030 and 110 GW by 2050. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind in the U.S. by 2035. California Assembly Bill 525, published September 24, 2021, directs state agencies to develop a strategic plan and set state wide goals for offshore wind production by 2030 and 2045. On August 1, 2022, the California Energy Commission (CEC) established offshore wind planning goals of 2–5 GW by 2030 and 25 GW by 2045. These deployment goals will drive the development of the offshore wind industry and the need for purpose-built port infrastructure to support offshore wind projects on the US West Coast.

To date, the Bureau of Ocean Energy Management (BOEM) has identified two offshore Wind Energy Areas (WEAs) off the state of California, the Humboldt WEA and Morro Bay WEA with a combined installation capacity of approximately 4.6 GW. On December 6, 2022, BOEM held an offshore wind energy lease sale for five lease areas, two within the Humboldt WEA and three within the Morro Bay WEA. On December 7, 2022, the lease sale ended, and five provisional winners were announced – RWE Offshore Wind Holding LLC, California North Floating LLC, Equinor Wind LLC, Central California Offshore Wind LLC, and Invenergy California Offshore LLC. Refer to Table 1 for a summary of energy capacity and quantity of turbine systems. It is anticipated approximately ~1300 turbines (20 MW systems) are required to meet the CEC's target of 25 GW by 2045. Work completed to date in Federal and State OSW studies has identified a need for Bay Area ports to serve as Manufacturing (MF) sites for the offshore wind industry to help meet the CEC planning goals and to maximize the economic impact to the State of California. ***The Port of San Francisco (Port) has the potential to play a critical role in support the offshore wind industry to help meet state and federal offshore wind deployment goals.***

Therefore, the Port is evaluating the opportunity to redevelop the existing Pier 94/96 site. Pier 94/96 is an existing facility constructed in the 1960's with deep draft berths, maintenance and operational buildings, four ship-to-shore container cranes, and on-dock rail with freight rail access. The existing berth depth is maintained to 38 ft at low tide. Several potential site uses were evaluated for Pier 94/96 to support the offshore wind industry including manufacturing of floating foundations, manufacturing of offshore wind components, construction support, mooring line, anchor, and electrical cable laydown, or a home port for operations and maintenance activities for the wind energy area.

For this study, the Port has decided to develop a concept to ***use Pier 94/96 for manufacturing of floating foundations and/or wind turbine generator components***, as manufacturing facilities provide greater economic benefits and local job creation compared to other offshore wind industry site uses. The project area is comprised of approximately 95 acres of new heavy-lift wharf and uplands area at Pier 94/96. This site area is speculative and under review. The proposed site boundaries represent an area dependent on current leases and site uses. The proposed project consists of demolition of the existing wharf and cranes to facilitate the construction of a new 6,000 psf capacity heavy lift wharf. The proposed wharf is 1550 ft long by 150 ft wide with piles spaced approximately 12ft in the longitudinal direction and 14 ft in the transverse direction. The wharf will be composed of a 3 ft thick concrete deck topped with a dense graded aggregate working surface. The finish grade of the deck at the waterside edge will be +17 ft, NAVD88.

Improvements to the uplands area include deep soil mixing (DSM) ground improvements to mitigate liquefaction-induced settlement of the existing slope and to mitigate lateral spreading during the design seismic event. The uplands area will be raised and graded to accommodate the operation of heavy lift equipment and for movement of offshore wind components. In addition, existing structures will be demolished. The uplands area will be finished with a dense grade aggregate working surface and be rated for approximately 3,000 psf of load capacity.

The proposed site redevelopment at Pier 94/96 could serve both the offshore wind industry as a manufacturing site and as a FEMA emergency response site. The proposed site improvements are anticipated to cost approximately $910 million (2023 dollars, no escalation) with the site ready for tenant use in Q4 2030 if construction notice to proceed is provided early enough for the contractor to fully utilize the 2027 in-water work window.

2. Introduction

The offshore wind industry in the Pacific Outer Continental Shelf (OCS) region in the United States (U.S.) is a relatively new industry that is poised for transition towards cleaner energy. Multiple states, including California, have passed legislation creating a market for the offshore wind industry. The federal government announced in May 2021 a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030 and 110 GW by 2050. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind in the U.S. by 2035. California Assembly Bill 525, published September 24, 2021, directs state agencies to develop a strategic plan and set state wide goals for offshore wind production by 2030 and 2045. In a letter to the California Air Resources Board (CARB) dated July 22, 2022, Governor Gavin Newsom urged the California Energy Commission (CEC) to establish an offshore wind planning goal of at least 20 GW by 2045. On August 1, 2022, the CEC established a preliminary offshore wind planning goal of 2–5 GW by 2030 and 25 GW by 2045. These deployment goals will drive the development of the offshore wind industry and creates the need for purpose-built port infrastructure to support offshore wind projects in the Pacific OCS.

The Pacific OCS is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To construct floating offshore wind turbines, the components (foundations, tower section, nacelle, blades, etc.) must be manufactured. The components can then be assembled on-site or transported to a staging and integration (S&I) site where the turbine components will be assembled and transported from an onshore port to the offshore wind site.

Existing port infrastructure on the U.S. West Coast, including California, is not adequate to support the development of the offshore wind industry, and significant port investment is required to develop purpose-built offshore wind port facilities. This is because offshore wind components are large and require port facilities with adequate laydown area and infrastructure with heavy loading capacities to manufacture or assemble the turbine systems.

To address this issue, the Bureau of Ocean Energy Management (BOEM) performed a study to assess California ports and identify the quantity and size of required port facilities to meet California's offshore wind planning goals – California Floating Offshore Wind Regional Ports Assessment. The study indicated there are limited existing ports that could serve as a manufacturing/fabrication (MF) site due to the available acreage. This type of site would receive raw materials via road, rail, or waterborne transport and create larger components in the offshore wind supply chain. These large components would be exported via waterborne transport on a vessel or barge to a S&I for assembly.

The Port of San Francisco (Port) has the potential to play a critical role in support the offshore wind industry to help meet the state and federal offshore wind deployment goals. Consequently, the Port is evaluating the opportunity to develop an existing site to aid in California and West Cost energy goals. Several potential site uses were evaluated for this site – manufacturing/fabrication (foundation or components), operation and maintenance, and anchor and cable laydown. Local job creation was a critical objective for the Port when determining the project site use. For the conceptual design phase, Pier 94/96 will be designed as a MF site for foundations and/or offshore wind components. This report documents the engineering decisions completed during the conceptual phase of the project.

2.1. Site Description and Location

Pier 94/96 is an existing port facility constructed in the 1960's with deep draft berths, maintenance and operational buildings, four ship-to-shore cranes, and on-dock rail with freight rail access. The Port recently commissioned an initial study of earthquake vulnerability and found this location highly vulnerable to earthquake damage including liquefication of the uplands, slope failures of the shoreline, and damage and collapse of pile supported bulkheads and wharves (Port of San Francisco, Initial Southern Waterfront Earthquake Assessment, January 2022, Parsons/RJSD JV).

The project area selected for evaluation in this conceptual design study is comprised of approximately 95 acres of combined nearshore and wharf space at Pier 94/96, see Figure 1. This site area is speculative and under review. The proposed site boundaries represent an area dependent on current leases and site uses. The wharf at Pier 94/96 available for the project is roughly 1550 ft long. The existing as-built wharf capacity is reported to be 500 pounds per square foot (psf) for permanent loading, however a load capacity analysis was performed for higher loads for temporary use (See Attachment D). The existing berth depth is 38 ft.

Figure 1. Pier 94/96 location in the southern waterfront of the Port of San Francisco

2.2. Offshore Wind Workforce Development

The offshore wind industry is anticipating increasing domestic annual employment to meet target energy goals. Per the U.S. Offshore Wind Workforce Assessment by NREL (NREL 2022a), the greatest contributor to domestic employment from the offshore wind industry is manufacturing and supply chain if U.S.-based suppliers produce subcomponents, parts, and materials for offshore wind energy components. This is shown in grey in Figure 2. NREL also published another study, The Demand for a Domestic Offshore Wind Energy Supply Chain (NREL 2022b) that provided the number of potential jobs attributed to manufacturing specific floating offshore wind components through 2030, these results are shown in Table 1. Another study conducted by the California State Lands Commission, AB 525 Workforce Development Readiness Plan (CSLC 2023), estimates that by the early 2030s there will be a workforce demand in the Bay Area of approximately 1000 workers for the offshore wind turbine supply chain.

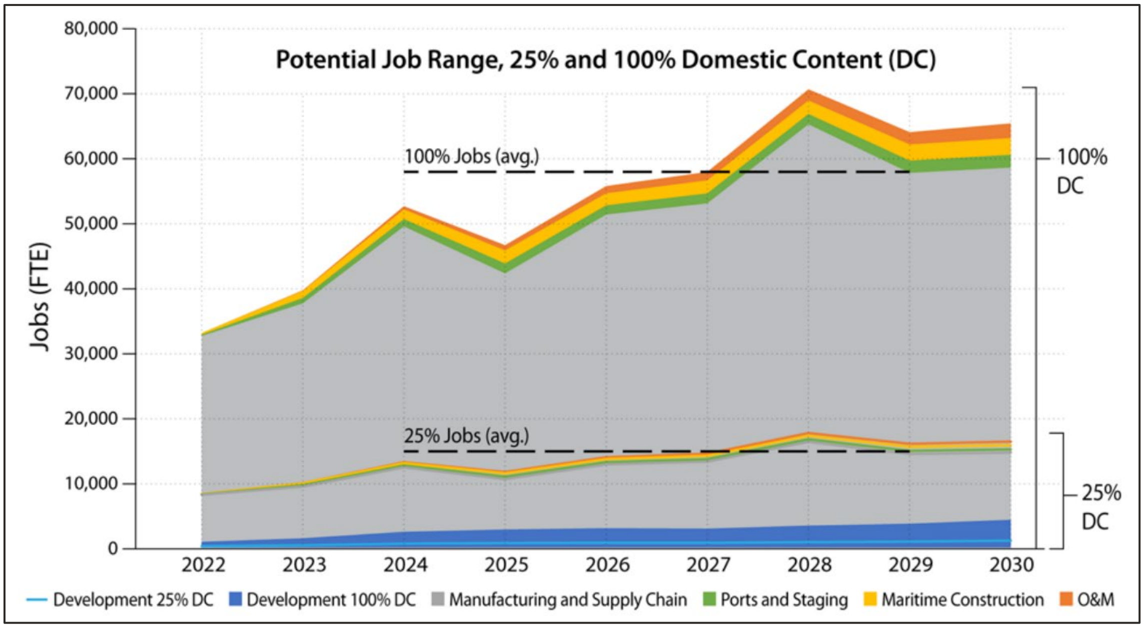

Figure 2: Potential job estimates across industry segments to support a project pipeline of 30 GW by 2030 (NREL 2022a)

Table 1: Average number of jobs for floating offshore wind components through 2030 (NREL 2022b)

Component	Average Number of Jobs Through 2030		Maximum Job Demand Through 2030	
	25% Domestic Content	100% Domestic Content	25% Domestic Content	100% Domestic Content
Nacelle	1,100	4,600	1,900	7,700
Rotor Blade	200	800	300	1,300
Towers	300	1,100	400	1,800
Floating Foundations	2,200	8,700	3,600	14,700
Substation Topside	3	15	15	60
Dynamic Array Cable	100	400	200	700
Dynamic Export Cable	200	800	300	1,400
Total	**4,103**	**16,415**	**6,715**	**17,660**

3. Site Use

3.1. Floating Offshore Wind Site Uses and Requirements

The floating offshore wind industry requires port sites to fabricate, stage, and assemble turbine components. Port sites are also required to provide ongoing operations and maintenance of the wind turbines. Based on the industry outreach completed for the BOEM study titled *California Floating Offshore Wind Regional Ports Assessment* (Moffatt & Nichol, 2023), different site types are required to support the needs of floating OSW facilities. The different site types are described below, and a rating system was developed for applicability of each site type at the Port of San Francisco:

Table 2: Offshore wind site use rating

Pier 94/96 Rating	Offshore Wind Site Use Type
Not a candidate. (Due to air draft restrictions, see Section 2.2)	**Staging and Integration (S&I) Site:** a site to receive, stage, and store offshore wind components and to assemble the floating turbine system for towing to the offshore wind area. In addition to turbine integration activities, this site use is likely to support the following services: i. **Turbine Maintenance Site:** a site to perform major maintenance on a fully assembled turbine system that cannot otherwise be performed in the offshore wind area such as replacement of a nacelle or blade. ii. **End of Life Decommissioning Site:** a site to decommission, disassemble, recycle, and dispose of turbine systems that are at end of life.
Good candidate. (Sufficient acreage, workforce availability, and berth draft)	**Manufacturing/Fabrication (MF) Site:** a port site located on a navigable waterway that receives raw materials via road, rail, or waterborne transport and creates larger components in the offshore wind supply chain. This site typically includes factory and/or warehouse buildings and space for storage of completed components. i. **Floating foundation MF** ii. **Offshore wind component MF (Tower, nacelle, blade)** iii. **Other (anchors, chains, mooring lines, electrical cables)**
Moderate candidate. (Not optimal distance from wind energy areas)	**Operation and Maintenance (O&M) Site:** a base of wind farm operations with warehouses/offices, spare part storage, and a marine facility to support vessel provisioning and refuelling/charging for the following O&M vessels during the operational period of the offshore wind farm: i. **Crew Transfer Vessel (CTV):** transfers small crews to offshore wind turbine installations for day-trip O&M visits and inspections. ii. **Service Operating Vessel (SOV):** vessels that loiter and operate as in-field accommodations for workers and platform assist for wind turbine servicing and repair work. iii. **Service Accommodation Transfer Vessel (SATV):** intermediate between SOVs and CTVs, with ability to sleep onboard for multiday trips.
Good candidate. (Sufficient berth space and depth, good workforce availability)	**Construction Support Facilities / Installation Support Site:** a base of construction operations for the fleet of construction vessels necessary for construction and commissioning of the offshore wind farm.

Good candidate. (Sufficient acreage, and berth depth)	**Mooring Line, Anchor, and Electrical Cable Laydown Site:** a site to receive and stage mooring lines, anchors, and electrical cables to support the installation of the offshore wind farm
Not a candidate. (Site is too far from wind energy areas)	**Cable Landing Site:** locations for the electrical cables to transition from the offshore (e.g., subsea cables) to a grid connection location. These sites may include electrical infrastructure onshore.

3.2. Air Draft Restrictions

Staging and integration (S&I) port sites must have no air draft restrictions, such as overhead power lines or bridges, as the fully assembled turbines may require more than 1,100 ft of vertical clearance to be towed from port to the lease areas. While there are emerging technologies for floating foundations and assemblies that have smaller air draft requirements, it is currently unknown as to if the foundation development will allow for the air draft requirements of the bridges in the San Francisco Bay. Due to the air draft restrictions of the Bay Bridge and Golden Gate Bridge, an S&I port site is not recommended for the Pier 94/96 development. Figure 3 shows a rendering of a theoretical 20 MW floating turbine system transiting near the Golden Gate Bridge to highlight that it is not feasible to safely transport under the bridge. While fully assembled turbines do not meet air draft restrictions, floating foundations and WTG components do not exceed the limitations.

Figure 3: Rendering of offshore wind turbine near Golden Gate Bridge to highlight air draft restrictions.

3.3. Floating Offshore Wind Foundation and Component Transportation

For floating foundation and component MF sites, the assembled foundation and components must be transported to an S&I for full integration of the floating offshore wind turbine. At this site, once the floating foundation is assembled in the uplands area, it is moved to the wharf to be transferred onto a semi-submersible barge, Figure 4(a). The semi-submersible barge and floating foundation are then moved to a 40 to 100-foot-deep sinking basin within the San Francisco Bay where the barge is partially submerged by taking on ballast. The foundation will then become buoyant and can be floated off the barge, Figure 4(b). The foundation is then towed to an S&I site outside of the San Francisco Bay for full assembly with the wind turbine. Based on preliminary conversations with the San Francisco Bar Pilots and the bathymetry of the bay, there are multiple sites for a sinking basin that do not require additional dredging. Therefore, transportation of the floating foundation and WTG components via vessel are feasible within the Port and the bay.

(a) (b)

Figure 4: Floating foundation operations (a) transfer of foundation onto semi-submersible, (b) semi-submersible barge sinking to float off foundation. (Source: Principle Power)

3.4. Port Wharf and Loading Requirements

Per the California State Lands Commission AB 525 Port Readiness Plan (CSLC 2023), port infrastructure requirements are site use dependent, as shown in Table 3. The required length of wharf is dependent on site use and vessel types. For example, component manufacturing facilities will serve delivery vessels and delivery barges and thus require a minimum length of 800 feet. O&M facilities will serve smaller vessels such as SOVs and CTVs and can require less wharf frontage such as 300 feet.

In general, the uplands area for foundation and component manufacturing sites shall have a capacity of 2,000 to 3,000 pounds per square foot (psf) to support storage of offshore wind turbine generator (WTG) components. Due to the significant size and weight of the WTG components, a wharf loading capacity of 6,000 psf is required for MF sites. Loading at O&M facilities is expected to range from 100 to 500 psf.

The type of site use also affects the size of the site. An O&M site shall be approximately 5 to 10 acres. For component manufacturing, a range of 30 to 100 acres is requested depending on the developer and their use.

Table 3: Approximate design criteria for port infrastructure by site use (CSLC 2023)

Design Criteria	Foundation MF	Component MF	O&M, Mooring Line & Anchor Storage, & Construction Support	Electrical Cable Laydown
Acreage, minimum	30 to 100 acres	30 to 100 acres	O&M: 5 to 10 acres Others: 10 to 30 acres	20 to 30 acres
Wharf Length	800 ft	800 ft	300 ft	500 ft
Minimum Draft at Berth	38 ft	38 ft	20 to 30 ft	30 to 35 ft
Draft at Sinking Basin*	40 to 100 ft	Not required	Not required	Not required
Wharf Loading	> 6,000 psf	> 6,000 psf	O&M: 100 to 500 psf Others: 500 psf	1,000 to 2,000 psf
Uplands / Yard Loading (for WTG components)	> 2,000 to 3,000 psf	> 2,000 to 3,000 psf	O&M: 100 to 500 psf Others: 500 psf	1,000 to 2,000 psf

*Options for transfer of floating foundation from land to water include use of semi-submersible barge and sinking basin, ramp system, or direct transfer methods (lifting portions or complete foundation units from land into water). Note that there are multiple locations of deep water within San Francisco Bay that could be adequate to serve as a sinking basin.

3.5. Wet Storage Requirements

Wet storage space is also required in addition to the upland acreage and water frontage. Port sites must have locations where floating foundations can be safely moored to mitigate the risk of weather downtime, vessel traffic, entrance channel congestion, and other transportation hazards. The size of the wet storage area is dependent on the developer's strategy, deployment schedule, downtime risk, and available port space.

3.6. Additional Port Requirements

Additional port requirements may include:

1. **Roll-on/Roll-off (RORO) Capabilities:** port sites may need RORO capability built into the wharf and yard to allow for a range of fabrication and assembly needs. Of particular importance would be to allow for inside port transfers between multiple facilities. This may require the construction of a sinking basin deeper than the proposed navigation channel depth.
2. **Green Port:** new port terminals may need infrastructure and equipment to support state and federal carbon reduction initiatives, including electrification of the terminal operations and the ability to accommodate vessel shore power. Considering greenhouse gas emission reduction initiatives and the desire to develop green ports, considerable load on the transmission grid may be needed. An assessment of power grid upgrades for the proposed development site will be needed to determine the range of power transmission upgrades needed to meet the vessel and terminal operational needs.
3. **Shoreside Vessel Services:** port sites may require all standard ship services (e.g., potable water), shore power, and security requirements.
4. **Buildings:** indoor storage/warehouses may be required for some items (e.g., floating foundation mechanical equipment, painting, welding, etc.).
5. **Environmental and Stormwater Systems:** to facilitate drainage and environmental goals, greenspace may be incorporated to the extent possible. Stormwater collection and treatment will

rely on best management practices (BMPs). Native habitat may be incorporated where appropriate.

3.7. Required Site Improvements

Based on the current site conditions at Pier 94/96, Table 4 shows the type of site improvements that would be recommended for each type of OSW site use. The requirements for each site type are further explained below.

Meeting the requirements for floating offshore wind projects are beyond the existing capabilities of ports. Upgrading existing facilities is time and capital intensive but necessary to meet energy goals. The main improvement types are as follows:

1. **New Wharf:** Demolition of the existing wharf and construction of a new wharf is required for manufacturing sites that require a heavy lift area. The weight of the offshore wind components requires a heavy lift area that far exceeds the capacity of the existing wharf.
2. **Ground Improvements:** Ground improvements such as deep soil mixing will be required to mitigate liquefaction-induced settlement and lateral spreading due to softening of young bay mud in the design seismic event.
3. **Berth Dredging:** Dredging is the removal of material at and below the mudline to deepen the water depth to accommodate the draft of the design vessels. Dredging is not anticipated for the project site for any OSW site use.
4. **Fill and Working Surface Improvements:** Surface fill is increasing the elevation or grade of the site by adding additional material to the current surface. Additional fill may be required to raise the site to finished grade to meet the project's sea level rise estimates.
5. **Civil Site Improvements:** In order to account for the new site use, stormwater, potable water, communications, sewer, parking, sidewalks, grading, landscaping, etc. will be required.
6. **New Electrical:** New and improved electrical feeds will be required to provide enough capacity for the new site demands. This is included, but not limited to, site lighting, vehicle charging, crane power, and shore power for vessels.

The Port's Pier 94/96 site is well positioned to serve as a Manufacturing / Fabrication (MF) Site or as a Mooring Line, Anchor, and Electrical Cable Laydown Site. The site may also be considered to function as an Operation and Maintenance (O&M) Site or a Construction Support Site. Depending on the selected site type, different site improvements are required. For any site use type selected, berth dredging is not anticipated. This helps reduce construction costs, environmental impacts, and construction schedule.

Table 4: Requisite Pier 94/96 site improvements by site use

Site Use	New Wharf & Ground Improvements	Berth Dredging	Fill and Working Surface Improvements	Civil Site Improvements	New Electrical
Foundation MF	X		X	X	X
Component MF*	X		X	X	X
Cable/chain/anchor laydown					X
Electrical cable laydown	X				X
SOV home port for O&M					X

* Nacelle snap site, tower manufacturing, blade manufacturing, etc.

Note that Table 4 assumes no new wharf or ground improvements are required for certain site uses. However, it is possible that the permitting / regulatory approval process for this new use may require improvements to mitigate seismic risk that are not captured in Table 4.

3.8. Selected Site Use for Concept Study

For the concept study, based on industry outreach and Moffatt and Nichol's evaluation, the Port has decided to proceed with utilizing Pier 94/96 for **manufacturing of floating foundations and/or WTG components**, as manufacturing facilities provide greater economic benefits compared to other site uses. Figure 5 illustrates the loading criteria for this site type and Figure 6 shows a rendering for this potential site development.

Figure 5. Pier 94/96 location in the southern waterfront of the Port of San Francisco

Figure 6: Site rendering of potential site development for use as a MF site

4. Summary of Conceptual Engineering

The following attachments summarize the work completed to date and provide additional background and information regarding the conceptual engineering design. Note that these attachments were developed as supporting documents for the Conceptual Report. Some information may have been superseded or updated by the Conceptual Report.

- Attachment A: Basis of Design Memorandum
- Attachment B: Data Gap Memorandum
- Attachment C: Outreach Memorandum
- Attachment D: CADEMO Project Preliminary Assessment
- Attachment E: Wharf and Uplands Assessment Memorandum
- Attachment F: Geotechnical Engineering Memorandum
- Attachment G: Preliminary Permitting and Regulatory Approval Evaluation
- Attachment H: Conceptual Engineering Drawings
- Attachment I: Project Schedule Memorandum
- Attachment J: Cost Estimate Memorandum

Attachment A: Basis of Design Memorandum

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BASIS OF DESIGN MEMORANDUM

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Azadeh Bozorgzadeh & Carolyn Donohoe (Moffatt & Nichol)
Cc:	Matt Trowbridge & Jennifer Lim (Moffatt & Nichol)
Date:	September 15, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study** **Basis of Design (BOD) Memorandum**
M&N Job No.:	220388-01

This Basis of Design (BOD) memorandum establishes the design criteria for the project. The BOD is a living document that will evolve as the project progresses. This memorandum is organized as follows:

1. Project Introduction
2. Site Conditions
3. Offshore Wind Port Requirements
4. Permitting
5. Ground Improvements
6. Structural Design Criteria
7. Civil Design Criteria
8. Electrical Design Criteria

1. Project Introduction

1.1. Project Background

The offshore wind industry in the Pacific Outer Continental Shelf (OCS) region in the United States (U.S.) is a relatively new industry that is poised for significant growth and development. Multiple states, including California, have passed legislation creating a market for the offshore wind industry. In May 2021, the federal government announced a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030 and 110 GW by 2050. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind in the U.S. by 2035.

California Assembly Bill 525, published September 24, 2021, directs state agencies to develop a strategic plan and set statewide goals for offshore wind production by 2030 and 2045. In a letter to the California Air Resources Board (CARB) dated July 22, 2022, Governor Gavin Newsom urged the California Energy Commission (CEC) to establish an offshore wind planning goal of at least 20 GW by 2045.

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The Pacific OCS is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To construct floating offshore wind turbines, the components (foundations, tower section, nacelle, blades, etc.) must be manufactured. The components can then be assembled on-site or transported to a staging and integration (S&I) site where the turbine components will be assembled and transported from an onshore port to the offshore wind site.

Existing port infrastructure on the U.S. West Coast, including the California coast, is not adequate to support the development of the offshore wind industry, and significant port investment is required to develop purpose-built offshore wind port facilities. This is because offshore wind components are large and require port facilities with adequate laydown area and infrastructure with heavy loading capacities to manufacture or assemble the components.

To address this issue, the Bureau of Ocean Energy Management (BOEM) performed a study to assess California ports and identify the quantity and size of required port facilities to meet California's offshore wind planning goals – California Floating Offshore Wind Regional Ports Assessment (BOEM 2023). The study indicated there are limited existing ports that could serve as a manufacturing facility (MF) site due to the available acreage. This type of facility would receive raw materials via road, rail, or waterborne transport and create larger components in the offshore wind supply chain. These large components would be exported via waterborne transport on a vessel or barge to a S&I for assembly.

The Port of San Francisco (Port) has the potential to play a critical role in supporting the offshore wind industry to help meet the state and federal offshore wind deployment goals. Consequently, the Port is evaluating the opportunity to develop an existing facility to aid in California and West Coast OSW energy goals. Several potential site uses were evaluated for this site – manufacturing (foundation or components), operation and maintenance, and anchor and cable laydown. Local job creation was a critical objective for the Port when determining the project site use. For the conceptual design phase, the project site will be designed for development as a manufacturing facility for either OSW components or foundations.

To help meet the 2045 deployment targets, the schedule of the project is critical and must be delivered on an aggressive timeline to be ready for the offshore wind industry. The design criteria, means and methods, and phasing of the project will continue to be evaluated throughout the design process to accelerate delivery to the maximum extent possible.

1.2. Site Description and Location

Pier 94/96 is an existing port facility constructed in the 1960's with deep draft berths, maintenance and operational buildings, four ship-to-shore cranes, and on-dock rail with freight rail access, see Figure 1. The Port recently commissioned an initial study of earthquake vulnerability and found this facility highly vulnerable to earthquake damage including liquefaction of the uplands, slope failures of the shoreline, and damage and collapse of pile supported bulkheads and wharves (Port of San Francisco, Initial Southern Waterfront Earthquake Assessment, January 2022, Parsons/RJSD JV).

The project area is comprised of approximately 95 acres of combined nearshore and wharf space at Pier 94/96. The wharf at Pier 94/96 available for the project is roughly 1550 ft long. The existing berth depth is 38 ft.

Figure 1: Project Location Map

1.3. Datum and Units

The horizontal datum shall be the North American Datum of 1983, 2007 realization (NAD83 2007), State Plane Coordinate System (SPCS), California Zone 3.

The vertical datum shall be the North American Vertical Datum of 1988 (NAVD88).

United States Customary System (USCS - feet, inches, pounds, etc.) units shall be used.

1.4. Governing Codes, Standards, and References

The following codes, standards, and references shall govern the design of the facility:

American Concrete Institute (ACI):

- ACI 224R-01, Control of Cracking in Concrete Structures
- ACI 318-19, Building Code Requirements for Structural Concrete

American Institute for Steel Construction (AISC):

- AISC 303-16, Code of Standard Practice for Steel Buildings and Bridges
- AISC 341-16, Seismic Provisions for Structural Steel Buildings
- AISC 360-16, Specification for Structural Steel Buildings

American Society of Civil Engineers (ASCE):

- ASCE 7-16, Minimum Design Loads for Buildings and Other Structures
- ASCE 41-17, Seismic Evaluation and Retrofit of Existing Building
- ASCE 61-14, Seismic Design of Piers and Wharves

American Welding Society (AWS):

- AWS D1.1, Structural Welding Code, 2020

California Code of Regulations:

- 2022 California Building Code (CBC)
- 2022 California Electrical Code (CEC)
- 2022 California Mechanical Code (CMC)

Hydrology Manual:

- 2016 San Francisco Stormwater Management Requirements and Design Guidelines

Illumination Engineering Society (IES)

- The Lighting Handbook, 10^{th} edition

National Fire Protection Association

- NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

Oil Companies International Marine Forum (OCIMF):

- Mooring Equipment Guidelines (MEG4), 4th Edition, 2018

Permanent International Association of Navigation Congresses (PIANC):

- PIANC MarCom WG 145, Berthing Velocity Analysis of Seagoing Vessels over 30,000 dwt, 2022
- PIANC WG 33, Guidelines for the Design of Fenders Systems, 2002
- PIANC WG 34, Seismic Design Guidelines for Port Structures, 2001

Port of Long Beach (POLB):

- Wharf Design Criteria, POLB WDC Version 5.0, October 22, 2021

Port of San Francisco:

- Guidance for Incorporating Sea Level Rise into Capital Planning, 2020
- Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco Sea Level Rise Checklist, Version 3.0, 2023
- Port Building Code Amendments – Draft Rev. 1, 2022
- Port Existing Building Code Amendments – Draft Rev. 1, 2022
- Port Green Building Code Amendments – Draft, 2022
- Port Mechanical Code Amendments – Draft, 2022
- Port Electrical Code Amendments – Draft, 2022
- Port Plumbing Code Amendments – Draft, 2022
- WRP Seismic Criteria and Performance Requirements – Draft 2, 2023

United States Army Corps of Engineers (USACE)

- USACE EM 1110-2-1100, Coastal Engineering Manual, 2002
- USACE EM 1110-2-2502, Retaining and Flood Walls, 1989
- USACE ER 1110-2-1806 Earthquake and Design and Evaluation for Civil Works Projects, 2016

Unified Facilities Criteria (UFC)

- UFC 4-152-01 Design: Piers and Wharves, 2017
- UFC 4-159-03 Design: Moorings, 2020

Occupational Safety and Health Administration (OSHA)

- Occupational Safety and Health Standards for Shipyard Employment 1915.82

1.5. Existing Surveys

Below are the surveys that have been provided for reference:

- Pier 94/96 Post-Dredge Survey – June 2015
- Port of San Francisco Pier 80, 94, and 96 Conditional Multibeam Survey – November 2019
- NOAA Survey Pier 94-96 Channel – October 2019
- Pier 96 Topographic Survey – April 2021

1.6. Ongoing Projects

Below are the ongoing projects within the project site limits:

- Pier 96 Gatehouse Demolition

1.7. Functional Requirements

The site will incorporate functional requirements to support the OSW industry as well as Federal Emergency Management Agency (FEMA) requirements. FEMA has designated the site to operate as an emergency response staging area. The following requirements represent the functional aspects that shall be incorporated into the project:

<u>Offshore Wind Functional Requirements</u>

1. The minimum water depth at the berth shall be -38.4 NAVD88 (-38 ft mean lower low water (MLLW)) in the berth pocket.

2. To provide for transfer of floating foundations from land to water, use of water space with minimum dimensions of 1,000 ft by 600 ft and maintained to a minimum depth of -100 ft MLLW is ideal. It is anticipated that portions within the San Francisco Bay can be used for this activity.

3. The berth shall accommodate roll-on / roll-off (RORO) vessels with a maximum elevation of +18 ft MLLW for offloading components directly from a delivery vessel. The berth shall have adequate fendering and mooring points to accommodate this operation.
4. The wharf must be designed for heavy lift crane operation (crawler and/or ring crane).
5. The wharf and uplands shall be designed to accommodate the design vessels and the heavy lifting, transport, and storage loading associated with both wind turbine generator (WTG) components and floating foundations [i.e., cranes and self-propelled modular transporters (SPMTs)]. Based on the anticipated site use, the design uniform live loading criteria shall be 3,000 psf for the uplands and 6,000 psf on the wharf.
6. All areas accessible for crawler cranes and transporting WTG components and floating foundations shall be designed with a flexible pavement of well-graded, dense grade aggregate of a minimum thickness of 3 ft on the uplands and 3 ft on the wharf.
7. The marine structures are not designed for vessel or barge impact, vehicular impact, blast loading, or other impact loads.
8. For delivery vessels, fenders shall be generally spaced at 50 ft, maximum, and bollards shall be generally spaced at 75 ft, maximum. This spacing requirement shall be used as guidance when laying out the fenders and bollards. However, it is recognized that in some instances the spacing will be exceeded, as needed, or require a different fender system to match structural or operational requirements (i.e., RORO vessels).
9. The site will be designed to prevent local settlement that would inhibit self-propelled modular transporter (SPMT) movement.
10. To mitigate long-term consolidation settlement during construction and operation, areas receiving fill or permanent/long-term loads will be improved using wick drains, soil improvement (stone columns or DSM), and surcharge placement.
11. The terminal will be designed to minimize emissions by using electrified equipment, alternative fuels, and ship-to-shore power (cold ironing).
12. The terminal shall be designed to limit direct stormwater discharge to the bay through permeable pavement, bioswales, retention structures, or other applicable methods/technologies.
13. The terminal will minimize its visual impact to the surrounding community through use of vegetated screening, fences, and setback of equipment/buildings as appropriate.
14. The site layout shall provide vehicular access to select adjacent tenants (Recology and MARAD).

FEMA Requirements

1. The site shall have the capabilities to serve as a debarkation site for marine cargo (containers) and vehicles as a federal staging area (FSA). This includes accommodating up to one Mobile Communications Operations Vehicle (MCOV). The site must also be able to route wheeled vehicles, fuel tankers, and high-priority equipment via MARAD roll-on/roll-ships.
2. The wharf shall be able to berth one tactical auxiliary crane ship (T-ACS) vessel for debarkation purposes.
3. The site shall have locations for temporary federal bulk fuel and distribution operations when required by FEMA.
4. Depending on selected FEMA health and medical response/surge, the site may need to accommodate deployment and arrival of teams via roll-on/roll-off logistics operations.
5. The site shall accommodate the potential usage for rotary-wing patient evacuations. This includes supporting a helicopter landing zone.

1.8. Basis of Operations

The terminal will be developed to serve as a component manufacturing, foundation manufacturing, laydown, or operations and maintenance facility. The site will also serve as a FEMA federal staging area to support the area, when called upon. The high-level concept of operations for the site is as follows.

For component manufacturing sites, the terminal will provide acreage to accommodate manufacturing factories, any storage/ assembly racks, and SPMT transport of components. Materials used in the manufacturing of components may be received via vessel, truck, or rail. The components, such as blades, nacelles, and/or tower sections, are produced on-site within the manufacturing facility then loaded onto vessels and barges for transport to other port locations for staging and integration.

For foundation manufacturing sites, the terminal will provide acreage to accommodate manufacturing facilities, any storage/ assembly racks, and SPMT transport of components. Materials used in the manufacturing of foundations may be received via vessel, truck, or rail. The foundation sections produced on-site can take advantage of the adjacent concrete batch plant and/or other material production facilities within the Port of San Francisco's Maritime Eco-Industrial Center. The foundation sections may be assembled on site or transported to a separate site for assembly, staging, and integration.

If the foundation is fabricated at this facility, once the foundation unit is complete it is stationed next to the wharf for roll-out onto a semi-submersible barge. The semi-submersible barge will be moored at the berth and the completed foundation unit is moved onto the semi-submersible barge via SPMTs. An example of this procedure is shown in Figure 2. The semi-submersible barge then transports the foundation to a predetermined deep-water area or sinking basin and performs a "float-off" operation in which the semi-submersible barge ballasts down until the foundation becomes buoyant. The foundation is then towed to a different site facility to be outfitted with the WTG components and eventually towed out to the wind farm installation site.

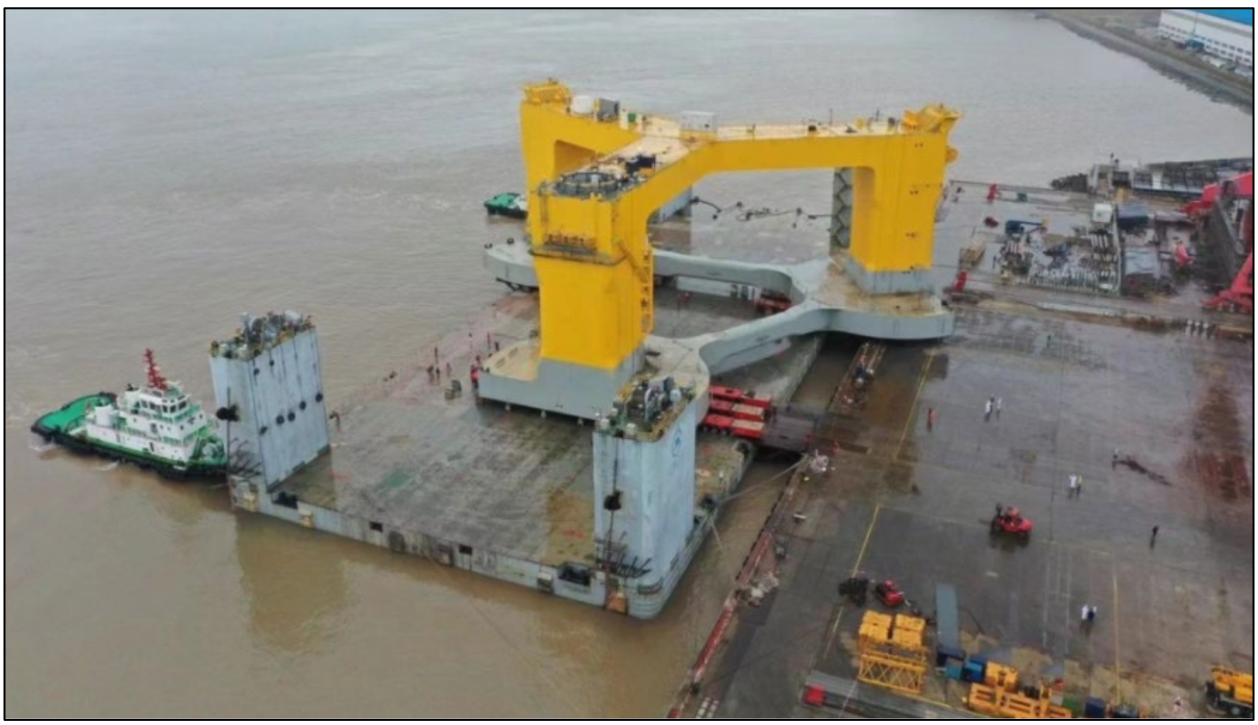


Figure 2: Semi-submersible foundation being loaded onto a Semi-submersible barge using SPMTs. (Source: Wison Offshore & Marine)

For FEMA use, the site will be used as a federal staging area to San Francisco County and the neighboring vicinity. The site will serve as a multiuse location to help with the emergency effort. The site is expected to be able to receive containers from the Port of Stockton as well as vehicles from the Port of Benicia for use and distribution during the response effort. A T-ACS will be established at the site. The site will also be used as a potential rotary-wing patient evacuation point and as a distribution location for vehicles and bulk fuel.

1.9. Site Phasing Requirements

The project site is expected to be utilized by CADEMO in the near future with minimal site improvements or developments required. Following this period of use, the site shall be developed to cater to the selected site use for the OSW industry.

2. Site Conditions

2.1. Metocean Conditions

2.1.1. Tides

Tidal elevations for Pier 94/96 are shown in Table 1. Tidal datum elevations in the project vicinity were obtained from the San Francisco Public Utilities Commission (SFPUC), 2014.

Table 1: Tidal Elevations in the Project Vicinity

Description	Datum	Water Level (ft, NAVD88)	Water Level (ft, MLLW)
Highest Observed Water Level*	-	+9.4	+9.8
Mean Higher High Water	MHHW	+6.5	+6.8
Mean High Water	MHW	+5.9	+6.2
Mean Sea Level	MSL	+3.3	+3.6
Mean Low Water	MLW	+0.8	+1.1
North American Vertical Datum of 1988	NAVD88	0.0	+0.4
Mean Lower Low Water	MLLW	-0.4	0.0
Lowest Observed Water Level*	-	-2.8	-2.4

*Note: *The highest and lowest observed water levels are based on the water level data at NOAA station 9414750, Alameda, CA, which is approximately 4.2 miles northeast of the project site.*

2.1.2. Sea Level Rise

Current guidance for California recommends evaluation of sea-level rise (SLR) impacts using a scenario-based analysis. The best available science and most recent guidance is summarized in *the State of California Sea-Level Rise Guidance* (OPC, 2018) and *Guidance for Incorporating Sea Level Rise into Capital Planning* (City and County of San Francisco, 2020) has been adopted herein.

Table *2* summarizes the SLR projections from OPC (2018) for low, medium-high, and extreme risk aversion scenarios for San Francisco. The predicted SLR in 2100 (end of structure lifespan) is between 2.4 ft to 3.4 ft for the low risk aversion, and between 5.7 ft and 6.9 ft for the medium to high risk aversion.

Table 2: Projected SLR (in ft) for San Francisco, Relative to Year 2000 (OPC, 2018, City and Country of San Francisco, 2020)

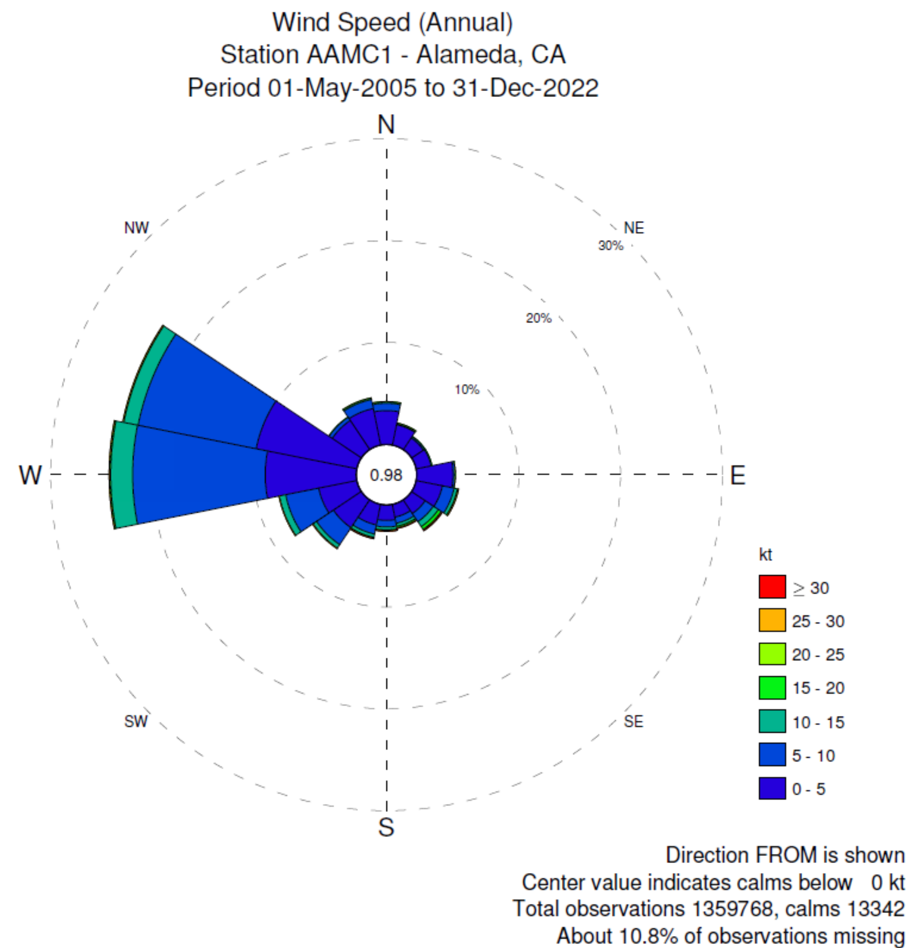
Year	Emission Scenarios*	Low Risk Aversion, Likely (17% Probability)	Medium – High Risk Aversion (0.5% Probability)	Extreme Risk Aversion
2030	Medium	0.5	0.8	1.0
	High	0.5	0.8	
2040	Medium	0.8	1.3	1.8
	High	0.8	1.3	
2050	Medium	1.1	1.9	2.7
	High	1.1	1.9	
2060	Low	1.3	2.4	3.9
	Medium	1.3	2.4	
	High	1.5	2.6	
2070	Low	1.5	3.1	5.2
	Medium	1.7	3.3	
	High	1.9	3.5	
2080	Low	1.8	3.9	6.6
	Medium	2.0	4.1	
	High	2.4	4.5	
2090	Low	2.1	4.7	8.3
	Medium	2.4	5.0	
	High	2.9	5.6	
2100	Low	2.4	5.7	10.2
	Medium	2.8	5.9	
	High	3.4	6.9	

**High emissions represent RCP 8.5, medium emissions represent RCP 4.5, low emissions represent RCP 2.6.*

2.1.3. Wind

Wind data representative of the South-Central Bay was collected from Alameda, NOAA Station 9414750, located approximately 4.2 miles northeast of the project site. The annual wind rose (illustrated in Figure *3*) shows that winds are predominately from the west and west-northwest directions. Wind speeds (2-minute duration) are generally less than 30 knots at the site, with 0.3% of time exceeding 20 knots.

Extreme value analysis (EVA) was performed based on the wind observation data at Alameda (NOAA station 9414750) and the resulted extreme wind speeds are listed in Table 3.



Percentage of Occurrence

Wind Speed, kt	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	4.19	2.18	1.55	1.55	3.75	4.22	3.61	2.38	2.56	3.40	5.72	7.76	24.24	23.41	3.81	4.70	99.02
≥ 30																	
25 - 30							0.03										0.05
20 - 25						0.02	0.11	0.05	0.02	0.02			0.01				0.24
15 - 20	0.02					0.09	0.32	0.16	0.11	0.10	0.04	0.02	0.13	0.09		0.02	1.10
10 - 15	0.14	0.03	0.02			0.34	0.59	0.29	0.28	0.33	0.41	0.64	2.16	1.43		0.15	6.84
5 - 10	0.72	0.13	0.16	0.07	0.21	1.17	0.97	0.62	0.64	0.92	2.00	3.31	13.02	11.83	0.38	0.90	37.05
0 - 5	3.31	2.01	1.36	1.47	3.54	2.60	1.58	1.25	1.50	2.03	3.27	3.79	8.91	10.06	3.42	3.63	53.73

Figure 3: Annual Wind Rose at Alameda, CA (2-minute Duration Wind Speeds)

Table 3: Extreme Wind Speeds

Return Period (years)	2-minute Wind Speed at 10 m Elevation (knots)
1	28.2
5	33.0
10	35.0
25	37.8
50	39.8
100	41.9

2.1.4. Wave

The Port Building Code (2022) specifies design wave condition at each pier within the Port. Table 4 shows the 100-year significant wave heights and the associated peak wave periods for each portion of the project site.

Table 4: 100 Year Wave Conditions

Location	100yr Significant Wave Height (ft)	100yr Peak Wave Period (sec)
Pier 94	5.4	5.0
Pier 94 South End	5.3	5.0
Pier 96	5.2	5.0

2.1.5. Current

The Port Building Code (2022) provides site specific current conditions within the Port. Table 5 lists the estimated surface current velocity during spring tides at each portion of the project site.

Table 5: Peak Current Speeds

Location	Peak Flood Current Speed (ft/sec)	Peak Ebb Current Speed (ft/sec)	Current Direction
Pier 94	4.7	1.7	Parallel to Berth
Pier 94 South End	4.5	1.8	
Pier 96	4.5	1.6	

2.1.6. Tsunami

Per ASCE Tsunami Design Geodatabase Version 2022-1.0, the expected tsunami inundation elevation at Pier 96 is approximately 16.5 ft above NAVD88. Note the ASCE tsunami has a mean recurrence interval of 2475 years and is required to be evaluated for Risk Category III and IV structures.

Design tsunami runup, currents, and corresponding loads on structures shall be evaluated at the detailed design phase.

2.1.7. Extreme Water Levels and Design Elevation

The extreme high and low water levels estimated at the project site are summarized in Table 6 for different return periods. The extreme high water levels are based on the site specific values from SFPUC (2014), while the extreme low water levels are based on the observation data at the nearest tide gauge at Alameda (NOAA Station 9414750). For comparison, the extreme high water levels at Alameda are also listed in Table 6.

Table 6: Extreme Water Levels, Epoch: 1983-2001

Return Period (year)	Site-specific Extreme High Water Level (SFPUC, 2014) (ft, NAVD88)	Extreme High Water Level at Alameda (ft, NAVD88)	Extreme Low Water Level at Alameda (ft, NAVD88)
1	-	7.4	-1.5
2	8.0	8.0	-2.1
10	8.7	8.6	-2.5
100	9.9	9.2	-2.8

The Base Flood Elevation (BFE) at the project site is 12.0 ft above NAVD88, per FEMA Flood Insurance Rate Map (FIRM), effective as of March 2021 – map 0602980251A.

The minimum site elevation requirement will vary, depending on the selected emission level and risk aversion for SLR. The elevations listed in were calculated using 1-yr still water level (7.4 ft NAVD 88), SLR in 2100 (varies) and 100-yr wave crest (approximately 5.0 ft), based on the assumption that a 100-yr storm event occurs with a 1-yr tidal level. A probability approach is recommended to evaluate the design elevation in the detailed design phase.

Due to the operating limit by RORO vessels, the deck elevation is preliminarily set at +17.0 ft NAVD88. Final elevation will be determined based on a detailed RORO and sea level rise assessment. The deck height shall be reevaluated in 2070 and adaptation plans shall be implemented if needed to account for updated SLR projections.

Table 7 were calculated using 1-yr still water level (7.4 ft NAVD 88), SLR in 2100 (varies) and 100-yr wave crest (approximately 5.0 ft), based on the assumption that a 100-yr storm event occurs with a 1-yr tidal level. A probability approach is recommended to evaluate the design elevation in the detailed design phase.

Due to the operating limit by RORO vessels, the deck elevation is preliminarily set at +17.0 ft NAVD88. Final elevation will be determined based on a detailed RORO and sea level rise assessment. The deck height shall be reevaluated in 2070 and adaptation plans shall be implemented if needed to account for updated SLR projections.

Table 7: Estimated Minimum Site Elevation (ft, NAVD88)

Year	Emission Scenarios*	Low Risk Aversion (17% Probability)	Medium – High Risk Aversion (0.5% Probability)
2070	Low	13.9	15.5
	Medium	14.1	15.7
	High	14.3	**15.9**
2100	Low	14.8	18.1
	Medium	15.2	18.3
	High	**15.8**	19.3

**High emissions represent RCP 8.5, medium emissions represent RCP 4.5, low emissions represent RCP 2.6.*

2.2. Geotechnical Conditions

Based on the review of available geotechnical reports, limited subsurface information is available at the proposed Pier Wind fill site. Review of these reports and other reports in the vicinity of the proposed site indicates that the subsurface conditions generally consist of about 40 ft deep sandy and debris fills down to approximately -30 ft MLLW, underlain by Young Bay Mud (YBM) down to approximately -100 ft MLLW.

Below the YBM, a layer of about 20 ft thick bay sand deposits was encountered, which was underlain by the Old Bay Mud down to approximately -200 ft MLLW where the bedrock was encountered.

All of the existing piles supporting the wharves appear to be terminating within the sand dike that extends down to approximately -110 ft MLLW.

Existing fills, YBM, and the proposed fill potentially consisting of fine-grained materials that will be placed within the Pier 94/96 landmass are expected to experience significant short-term and long-term consolidation settlements. Ground improvement measures consisting of wick drains and surcharge are typically used to accelerate the settlement process to reduce the long-term settlements to within the acceptable limits.

Ground improvement behind the sand/rock dike (on the landside) and in front of the dike (on the waterside) will be needed to improve the stability of the dike during seismic events.

Piles that will support the proposed wharf will be driven deep to extend into the bedrock to achieve the required axial capacity.

2.3. Other Site Constraints

In addition to serving as a facility for the OSW industry, the site shall also function as a FEMA emergency response staging area. The site is adjacent to existing, non-project related Port lease areas as well as a local rail line (SF Bay Rail, LLC).

3. Offshore Wind Port Requirements

3.1. Offshore Wind Turbine System Dimensions and Weights

Currently, 12 megawatt (MW) offshore wind turbine systems are commercially available. However, the anticipated size of turbine systems to be installed on the US West Coast will be on the order of 15 MW or larger. Table 8 summarizes the anticipated dimensions for a floating turbine system with capacity of up to 20 – 25 MW (BOEM 2023). Turbine device dimensions provided are relative to the future industry needs for 15 to 25 MW size devices. Smaller size devices (beam, draft) are currently in development but are at reduced turbine capacity. The values outlined in the table are those recommended for planning a major port terminal on a 50-year time horizon to meet the anticipated needs of the continuously developing offshore wind industry. In addition, Figure 4 shows a depiction of the turbine dimensions (BOEM 2023).

Table 8: Floating offshore wind turbine dimensions (BOEM 2023)

Floating Offshore Wind Turbine	Approximate Dimension (ft)	Approximate Dimension (m)
Foundation Beam / Width	Up to 425 ft x 425 ft	Up to 130 m x 130 m
Draft (Before Integration)	15 – 25 ft	4.5 – 7.5 m
Draft (After Integration)	20 – 50 ft	6 – 15 m
Hub/Nacelle Height (from Water Level)	Up to 600 ft	Up to 183 m
Tip Height (from Water Level)	Up to 1,100 ft	Up to 335 m
Rotor Diameter	Up to 1,000 ft	Up to 305 m

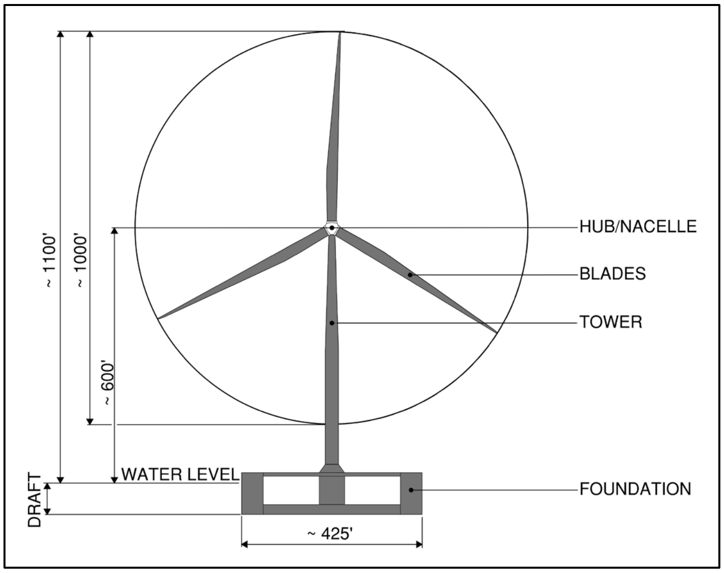


Figure 4: Floating offshore wind turbine dimensions (BOEM 2023)

3.2. Design Vessels

The vessels expected to call on the proposed port facility will consist of wind delivery vessels, semi-submersible barges, and FEMA operation vessels such as auxiliary crane ships (ACS) and roll-on/roll-off (RORO) vessels. Wind delivery vessels will consist of cargo carriers, ROROs, and barges bringing both the foundation raw materials and WTG components to the site. The semi-submersible barges are assumed to be purpose built smart ballasting barges.

3.2.1. FEMA ACS Vessel

Characteristics of the ACS for FEMA operation are listed in Table *9*.

Table 9: FEMA Auxiliary Crane Ships

Vessel Characteristic	T-ACS
Length Overall	668.3
Beam	76.1
Depth	-
Summer Draft	33.0 ft
Deadweight Tonnage	17,781 MT
Displacement	32,006 MT

3.2.2. Wind Delivery Vessel

Characteristics of the current industry wind delivery vessel, the S2L-Type heavy cargo vessel, are shown in Table 10.

Table 10: Wind Delivery Design Vessel

Vessel Characteristic	S2L-Type
Length Overall	608.3 ft
Beam	83.0 ft
Depth	52.2 ft

Summer Draft	34.8 ft
Deadweight	23,660 MT
Displacement	43,500 MT[1]

[1] Displacement is assumed based on a block coefficient of 0.85

3.2.3. Semi-Submersible Barge

The characteristics for the semi-submersible barge that will be used to transfer the floating foundations from the wharf into the water are shown in Table 11.

Table 11: Purpose-Built Semi-Submersible Vessel

Vessel Characteristic	Purpose Built Semi-Sub
Length Overall	500.0 ft
Summer Draft	20.0 ft
Beam	500.0 ft

3.2.4. RORO Vessels

The current industry RORO vessel is the ST-Class RORO vessel and current design delivery barge is the 455 Series Barge with the characteristics shown in Table 12. A future RORO vessel for wind operation is also listed to ensure the project can accommodate future vessels. The dimensions for the Future RORO were determined by increasing the ST-Class RORO dimensions by 33%.

The stern ramp for RORO vessels is restricted to +18 ft MLLW (+17.6 ft NAVD88). The minimum deck elevation at current water levels and estimated future water levels shall accommodate RORO vessel restrictions.

Table 12: RORO Design Vessels

Vessel Characteristic	ST-Class RORO (Wind & FEMA)	455 Series Barge (Wind)	Future RORO (Wind)
Length Overall	496.9 ft	400.0 ft	660.5 ft
Beam	83.3 ft	105.0 ft	110.8 ft
Depth	19.4 ft	25.0 ft	25.8 ft
Summer Draft	18.6 ft	19.0 ft	24.7 ft
Deadweight	9,000 MT	17,442 MT	17,000 MT[2]
Displacement	17,455 MT[1]	20,947 MT	41,000 MT[1]

[1] Displacement is assumed based on a block coefficient of 0.78
[2] Deadweight tonnage is estimated based on industry RORO vessel DWT trend.

3.2.5. Operations and Maintenance (O&M) Vessels

Depending on the operations and maintenance plans, crew transfer vessels (CTVs), service accommodation transfer vessels (SATVs), and service operating vessels (SOVs) can be utilized. These vessels can be used for day trip visits and inspections (CTVs) up to multiday or multiweek trips (SATVs, SOVs). The characteristics of these vessels are shown in Table 13.

Table 13: O&M Vessels

Vessel Characteristic	Crew Transfer Vessel (CTV)	Service Accommodation Transfer Vessel (SATV)	Service Operating Vessel (SOV)
Length Overall	65 – 90 ft	100 – 130 ft	200 – 400 ft
Beam	22 – 30 ft	30 – 50 ft	50 – 80 ft
Draft	5 – 10 ft	10 – 16 ft	16 – 25 ft

3.2.6. Offshore Wind Turbine Device – Foundation Only

The offshore wind turbine foundation is expected to be a semi-submersible floating structure made of steel, concrete, or a hybrid of steel and concrete. The site shall be able to accommodate the manufacturing of foundation subcomponents with the potential for assembly of the foundation system. The floating foundation system would then be transported to a staging and integration site for final turbine assembly.

3.3. Air Draft and Bridge Clearance Requirements

The air gap restrictions are approximately 204 ft for the D-E span of the Bay Bridge, and 225 ft for the Golden Gate Bridge. The specific air gap varies based on the water level. Real tide data for the Bay Bridge can be found on the NOAA website. All site use activity shall conform to the air draft restriction for movement out of the bay.

3.4. Sinking Basin Requirements

If the site is to be used for the manufacturing and partial assembly of the floating foundations, to provide for transfer of assembled floating foundations from land to water, where “float-off” operations will be performed by semi-submersible barges, a sinking basin within San Francisco Bay shall be provided. The length of the sinking basin shall accommodate both the semi-submersible barge in Table 11. A sinking basin area with the approximate dimensions of 600 feet by 1,000 feet at the base is required. Per discussion with the San Francisco Bar Pilots on 06/12/2023, general anchorage 9 or temporary anchorage 7 may be used for float-off operations.

4. Permitting

Based on our understanding, the Project will be required to comply with the National Environmental Policy Act (NEPA) on the federal side and with the California Environmental Quality Act (CEQA) on the state side. It is recommended that a joint NEPA/CEQA process be pursued if it is determined that the Project requires an Environmental Impact Statement/Environmental Impact Report (EIS/EIR). A number of additional analyses and technical studies may be needed to inform the CEQA/NEPA process. An amendment to the existing Port Waterfront Plan may be required to authorize the final Project.

The environmental regulatory framework applicable to this project is summarized in Table 14**.** This summary is focused on the overarching regulations that apply to the proposed in-water construction and drive BMPs, and potentially impact design considerations, means and methods, schedule, and/or cost.

Table 14: Applicable Environmental Regulations

Agency	Law, Regulation or Guidance	Project Applicability and Considerations
	Federal	
United States Army Corps of Engineers (USACE) (NEPA Lead Agency to be confirmed)	National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321 et seq. and Code of Federal Regulations (CFR) 1500 et seq. Council on Environmental Quality Regulations for Implementing NEPA	NEPA environmental document – anticipated to be an Environmental Assessment (EA) or an Environmental Impact Statement (EIS)
USACE	Rivers and Harbors Act of 1899, Section 10	Requires a permit for work and placement of structures in navigable waters of the U.S.
USACE	Rivers and Harbors Act of 1899, Section 14 as codified in 33 USC 408	Requires a Section 408 permit to modify any USACE structure or navigable waterway
United States Environmental Protection Agency (USEPA)	Clean Air Act Amendments of 1990	Air Quality Conformity Permits during construction associated with construction equipment
National Oceanic and Atmospheric Administration (NOAA)/ National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS)	Federal Endangered Species Act (ESA) of 1973	ESA species may be present in the Project area. Consultation is required as part of the NEPA review. ESA-listed marine mammals are the species with the most potential to impact the Project in-water activities with respect to noise and turbidity monitoring, resulting in work stoppages during pile installation. Impacts could result in a "Take" that triggers mitigation.
NOAA / NMFS	Marine Mammal Protection Act	Non-ESA listed marine mammals may be present in the Project area. Consultation is required as part of the NEPA review. Marine mammals are the species with the most potential to impact the Project in-water activities with respect to noise from pile driving, resulting in work stoppages during pile installation. Impacts could result in a "harassment" that triggers mitigation.
NOAA/NMFS, USFWS	Magnuson-Stevens Fishery Conservation and Management Act of 1976	Essential fish habitat designation may require consultation; may trigger Best Management Practices (BMPs) and/or mitigation.
NOAA/NMFS	National Invasive Species Act of 1996	If presence of invasive species is detected could trigger BMPs for construction vessels and equipment.
NOAA/NMFS	Noise Control Act of 1972	Incorporate reasonable and feasible noise abatement measures to reduce or eliminate noise impact.

State		
San Francisco Bay Regional Water Quality Control Board (SFBRWQCB)	Clean Water Act (CWA) Section 401 and Water Quality Certification of 1972, Porter Cologne Act of 1969	Water Quality Certification required for discharge into navigable waters. This determines water quality considerations including potential groundwater contamination, best management practices (BMPs), and turbidity monitoring.
State Lands Commission (SLC)	Public Trust Doctrine	Confirmation that Project is authorized under existing lease agreement or amendment to the current lease required.
California Department of Fish and Wildlife (CDFW)	California Endangered Species Act	2081 Incidental Take Permit.
CalEPA / CARB	Clean Air Act of 1988	Compliance with CARB regulatory program for emission reduction from stationery and mobile sources.
Bay Area Air Quality Management District (BAAQMD)	State Implementation Plan (SIP)	The BAAQMD is responsible for issuing air quality permits for stationary equipment in the Bay Area and management of the resulting emissions.
BCDC **San Francisco Bay Conservation and Development Commission**	McAteer-Petris Act Suisan Marsh Preservation Act	Issues five types of permits: Major, Administrative / Minor, Regionwide, Abbreviated Regionwide, or Amendments to existing permits.
Local		
Port of San Francisco may be lead agency for CEQA	California Environmental Quality Act (CEQA) 1970	CEQA Environmental Document – lead agency may determine appropriate level of review is a Negative Declaration (ND), Mitigated Negative Declaration (MND) or an Environmental Impact Report (EIR). Port anticipated to conduct engineering and structural review of Project plans.
City of San Francisco	City Municipal Code	Demolition, Grading, Building, Fire, Electrical, Plumbing, Water and Sanitation approvals may be required.

5. Ground Improvements

The existing fill placed underwater is expected to be liquefiable. To minimize liquefaction-induced hazards (seismic settlement, lateral spreading, loss of soil bearing/lateral capacity), ground improvement is anticipated. Ground improvement may also be used to mitigate short- and long-term consolidation settlement of the backland fills and the YBM. Among the available ground improvement methods, deep soil mixing (DSM), the vibro-replacement technique (stone columns), and wick drains (with or without surcharge) are expected to be appropriate. Ground improvement behind the sand/rock dike (on the landside) is anticipated and in front of the dike (on the waterside) is also possible. Final recommendations will be based on cost and schedule considerations. Ground improvement scheme will be developed to meet the following goals:

- Mitigate liquefaction potential.
- Reinforce fill and fine-grained soil layers to minimize static and earthquake-induced settlements, improve structural performance, and reduce seismically induced lateral earth pressures on the piles and rock dike.
- Mitigate lateral spreading of the existing sand/rock dike.
- Support heavy loads or foundations.

6. Structural Design Criteria

6.1. Seismic Design Criteria and Performance Requirements

The seismic design and performance criteria shall follow California Building Code 2022, Port Building Code Amendments – Draft Rev. 1, 2022, ASCE 61-14, and WRP Seismic Criteria and Performance Requirements – Draft 2, 2023. The following seismic criteria are chosen for the project (Ref. WRP Seismic Criteria and Performance Requirements – Draft 2, 2023, Table B. Earthquake Performance Objective Summary) after meeting with the Port and reviewing the above documents on 05/17/2023:

Table 15: Earthquake Levels and Performance Criteria

Hazard Level	Earthquake	Performance Requirements
Level 1	Frequent Earthquake (100-yr Return Period)	No Damage
Level 2	Rare (DE = 2/3 MCER)	Full function resumes immediately/Some cosmetic repairs may be performed later
Level 3	Extreme (MCER)	Life safety

6.2. Settlement Criteria

The seismic settlement shall be less than 12 in. for Frequent Earthquake (Level 1) and less than 24 in. for Rare (DE) and Extreme (MCER).

6.3. Design Loads

Dead Load

Dead load shall include the self-weight of the structure including any permanent attachments.

- Steel: 490 pcf
- Concrete: 150 pcf
- Dense Graded Aggregate: 145 pcf

Buoyancy Load (B)

Buoyancy load shall be considered using a seawater unit weight of 64.1 pcf.

Live Load (L)

The following live loads shall be considered:

- Uplands Storage and Staging Area: 3,000 psf
- Marine Structure (Heavy Lift Wharf): 6,000 psf

Wind Load (W)

Wind loads, on structural components when berth is vacant, shall comply with ASCE 7-16 requirements. Design wind speed shall be 103 mph (3 second gust at 33 feet above ground), risk category IV.

Current Load (C)

Current forces on structural pipe members shall be determined in accordance with API RP 2A. Lift, drag and mass coefficients shall be determined for each member taking into account its cross-section and inclination and marine growth. Current forces on vessels shall be determined in accordance with the OCIMF Mooring Equipment Guidelines (MEG4) for static mooring analyses. Design current speed and direction to be confirmed.

Berthing Load (Be)

PIANC Guidelines for the Design of Fenders Systems (2002) shall be used to determine the required berthing energy for the design vessels, size of the fender system, and the berthing load. The structure shall be designed for the maximum fender load, including a +/- 10% tolerance in fender performance. The fender panel shall include ultra-high molecular weight (UHMW) facing to provide a maximum coefficient of friction of 0.2. Horizontal and vertical forces on fender system shall be considered based on friction between the vessel and fender panel.

Mooring Load (M)

The vessel with the strongest mooring line minimum breaking load (MBL) should be used to determine the bollard capacity safe working load (SWL). The mooring load shall be applied 180 degrees horizontally and at an angle of +25, 0, and -25 degrees to the horizontal plane. The bollards shall be designed for one mooring line per bollard. Structures shall be designed to accommodate 100% SWL on a single bollard and 60% SWL on an adjacent bollard(s), simultaneously. Application of the 60% SWL on adjacent bollards shall be based on designer judgement with consideration of mooring line arrangements. In addition, actual mooring forces from the mooring analysis shall be checked.

Earthquake Load (E)

As the site is required to serve as a FEMA federal staging area, the site will be designed as an essential facility, site-specific response spectra shall be developed, with use of the next generation (NGA) relationships. The seismic performance of the wharf elements shall follow the performance-based approach outlined in WRP Seismic Criteria and Performance Requirements (Draft 2, 05/12/2023). The design of the concrete deck structure and piles will be based on performance objectives for all three levels of ground shaking, for the design of essential facilities (EPO-A), Table 15.

All structures shall be designed using load combinations per UFC 4-152-01. Wind and Current loads shall be operating loads when combined with operating loads (Live, Mooring and/or Berthing). Wind and Current loads shall be extreme loads during vacant / non-operating conditions (no Mooring and/or Berthing). Seismic loads shall coincide only with operating environmental conditions. Table 16 and Table 17 shows the Load and Resistance Factor Design (LRFD) and Allowable Service Design (ASD) load combinations that shall be used.

Table 16: Load Combinations – Load and Resistance Factor Design (LRFD)

Load Case	U0	U1	U2	U3	U4	U5	U6	U7	U8	U9
D[a]	1.4	1.2	1.2	1.2	1.2	1.2	1.0+k	1.0-k	1.2	1.2
L	-	1.6[b]	-	1.6[b]	-	1.6[b]	0.1	-	1.6[b]	1.0
B	1.4	1.2	1.2	1.2	1.2	1.2	1.2	0.9	1.2	1.2
Be	-	-	1.6[c]	-	-	-	-	-	-	-
C	-	-	1.2	1.2	1.2	1.2	-	-	-	1.2
H[d]	-	1.6	1.6	1.6	1.6	1.6	1.0	1.0	1.6	1.6
Eq	-	-	-	-	-	-	1.0	1.0	-	-
W	-	-	-	-	1.0	-	-	-	-	1.0
M	-	-	-	-	-	1.6[e]	-	-	-	-
R+S+T	-	-	-	1.2	-	-	-	-	-	-
Ice	-	-	-	0.5	-	-	-	-	1.0	1.0

Table 17: Load Combinations – Allowable Stress Design (ASD)

Load Case	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
D[a]	1.0	1.0	1.0	1.0	1.0	1.0	1.0+k	1.0-k	1.0	1.0
L	-	1.0	-	1.0	-	1.0	0.1	-	1.0	0.75
B	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0	1.0
Be	-	-	1.0	-	-	-	-	-	-	-
C	-	-	1.0	1.0	1.0	1.0	-	-	1.0	1.0
H[d]	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Eq	-	-	-	-	-	-	0.7	0.7	-	-
W	-	-	-	-	0.6	-	-	-	-	0.6
M	-	-	-	-	-	1.0	-	-	-	-
R+S+T	-	-	-	1.0	-	-	-	-	-	-
Ice	-	-	-	0.2	-	-	-	-	0.7	0.7

Notes:

a) 0.9 (0.6 ASD) for checking members for minimum axial load and maximum moment.

b) 1.3 for the maximum outrigger float load from a truck crane.

c) Accidental Berthing: 1.2 support structure, 1.0 fender system components.

d) Where the effect of H resists the primary variable effect, a load factor of 0.9 (0.6 ASD) shall be included with H where H is permanent and H shall be set to zero for all other conditions.

e) 1.6 for the mooring loads from the mooring analysis and 1.0 for the SWL of bollards.

f) k = 0.5 (PGA)

6.4. Material Properties

All materials shall comply with latest applicable ASTM specifications.

Concrete shall be normal-weight concrete with a minimum 28-day compressive strength of 5,000 psi, maximum water-to-cementitious ratio of 0.4 and a minimum clear cover to the reinforcing steel of 3-inches.

6.5. Design Life

The design life of the wharf structure shall be 75 years. Consumable components such as fenders and cathodic protection anodes shall be replaced per the manufacturer's recommendations. Design life represents the physical condition of the marine facility and its ability to perform its function as originally designed assuming regular inspection and maintenance activities are carried out.

7. Civil Design Criteria

7.1. Stormwater Design

Stormwater system shall be designed per the San Francisco Stormwater Management Requirements and Design Guidelines with the Rational Method.

7.1.1. Stormwater Compliance

The project site lies within the Port of San Francisco's jurisdiction, within the City of San Francisco and County of San Francisco. The San Francisco Bay Regional Water Control Board has jurisdiction within the project limits. NPDES Construction General Permit (Order No. 2022-0057-DWQ, General Permit No. CAS000002) applies to this project.

In addition, the POSF has adopted the San Francisco Stormwater Management Requirements and Design Guidelines (May 2016) that applies to all new and redevelopment projects that create and/or replace 5000sf of impervious surface.

Those activities that are considered industrial and have a Standard industrial Classification (SIC) code will be required to obtain coverage under the Statewide General Permit for Stormwater Discharges Associated with Industrial Activities, Order 2014-0057-DWQ (Industrial General Permit) implements the federally required stormwater regulations in California for stormwater associated with industrial activities discharging to waters of the United States.

7.2. Parking

Project will provide on-site parking and electrical vehicle charging stations for all employees, contractors, visitors, etc. No off-site parking will be allowed.

7.3. Site Grading Design

Development of the site will require consideration for future SLR and flood protection. SLR criteria is outlined in Section 2.1.2. Site Conditions that will be the basis for minimum finished elevations on the marine terminal site are:

- The minimum elevation within the yard will be +17.9 ft NAVD88, and the minimum finish floor elevations (FFE) for the buildings will be +18.9 ft NAVD88. The minimum elevations for storm drain inverts and the bottom of bioretention basins (bottom of gravel layer) will be +13.4 ft NAVD88.
- The minimum slope for the finish grade surface will be between 0.5-1%. Due to the large scale of the site, a flatter grade will help to minimize the amount of fill needed to construct the site, but drainage of the site needs to be considered.
- All paved driving surfaces shall have a 0.5% minimum cross slope.

The uplands will graded to meet the slope requirements for SPMT transportation (maximum slope of 3%, with preferred slope of 1%).

7.4. Design of Erosion, Sedimentation and Pollution Control

The Contractor shall develop a Stormwater Pollution Prevention Plan (SWPPP) to satisfy the Construction General Permit (CGP).

The project shall develop a post-construction stormwater plan to satisfy the local Low Impact Development (LID) standards and/or Industrial General Permit (IGP).

Also, refer to Section 7.1.

7.5. Fire Protection Water

Fire water will be needed to provide fire suppression for the various buildings to be constructed on the site. Fire water will also need to serve all fire hydrants throughout the site. Firewater service will be provided by a new line from Jennings St. The existing system pressure/capacity will be assessed to determine if it is adequate for new hydrants/buildings or if the project will need to include booster or upsize of upstream source pipes.

7.6. Potable Water

Potable water will be needed for the various buildings and berths to be constructed on the site. Potable water will be needed for general office use (restrooms, kitchens, etc.) and to serve the vessels moored at the berths. Depending on the activities within each building, there may be additional potable water demands. Potable water will be provided by a new X” line from XXX.

7.7. Sanitary Sewer

Sanitary sewer service will be needed for the various buildings to be constructed on the site. Sanitary sewer service will be limited to demands from general office use (restrooms, kitchens, etc.). If there are industrial processes on the site that generate wastewater, they will need to be evaluated individually to determine if the wastewater generated by these processes can be sent directly to the sanitary sewer system, or if on-site pre-treatment is needed. Onsite treatment and disposal of domestic wastewater is not expected for this site. Depending on the downstream invert connection, lift stations may be required.

7.8. Finished Surface Materials

The terminal surfacing material will be dense grade aggregate with a total thickness of approximately 3 ft. Due to concerns with the potential for mobilizing fines in stormwater runoff, a two-layer, 3 ft finished surface will likely be required. The upper finished surface should be a cleaner crushed aggregate product that has been screened to minimize the amount of fines. Pavements are not planned nor desired for the finished surface of the terminal. The heavy loads anticipated on the site make paving the entire site impracticable. Additionally, the crushed aggregate surface allows ease of maintenance for re-grading the finished surface when settlement from the heavy loads occurs. If localized areas of pavement are needed to meet industrial area runoff collection and treatment, that area should be minimized, and additional subsurface soil improvements will likely be needed in order to provide adequate support for pavements.

Pavement will be applied on the transportation corridor for vehicular lanes and parking lots.

7.9. Landscaping

Landscaping is not part of the project design. However, it may be required in the LID water quality treatment devices or requested by Port of San Francisco community stakeholders. Roadway median, shoulders and project perimeter will be evaluated for biofiltration treatment with landscaping, and vegetative screening may be considered.

7.10. Signage

The project shall be designed to meet the Federal Highway Administration Manual on Uniform Transportation Control Device standards. Entrance signage and/or informational signage may be required at the request of the Port or community stakeholders.

8. Electrical Design Criteria

The site will be utilized to support the offshore wind industry while also maintaining a secondary use as a FEMA emergency response staging facility. Operations at the site will be continuous and varied for all phases of the build-out and requiring significant power. It is assumed that the facility will function as an all-electric facility. Therefore, reliable power will be essential to the success of the terminal. Conceptualized as an all-electric facility (without diesel/gas engine driven equipment), reliable power will be essential to the success of the terminal. The expected operations and equipment requiring power include:

- Manufacturing/assembly buildings
- Warehouse and administrative/office building(s)
- On-site material heavy transport
- On-site light material transport
- Manufacturing/construction equipment and tools
- Cranes
- Site lighting
- Vessel shore power
- Miscellaneous electrical loads.

Power will be distributed to the site at medium voltage (e.g., 12,470 volts) and transformed down to utilization voltages (e.g., 480V, 208V and 120V) all at 60 Hz.

8.1. Shore Power

The electrical design will accommodate vessels at berth which may be required to plug into shore power. Shore Power will be provided for different applications such as 6.6 kV for vessels and 480 for hoteling applications. Accommodation will be provided for future applications such as 11kV substation and transformer for Ro-Ro's, which are all custom made and may require long lead times.

8.2. Large Transport Equipment and Vehicle Charging

Yard transport equipment, including self-propelled modular transports (SPMTs), are assumed to be utilized at the facility, the electrical design shall accommodate SPMT charging stations. Electrified vehicles (e.g. maintenance fleet) will require charging stations.

8.3. Site Lighting

Lighting for the facility will be achieved with a combination of high mast light towers (100-150 ft, height to be determined) using LED light fixtures near the wharf and low mast / roadway light poles around the manufacturing facility. The number and location of the light poles will be determined during the design phase to ensure a minimum level of 1 footcandle along the pierhead, average of 5 footcandles with the minimum of 1 footcandle on the wharf, and maximum of 10 footcandles with the lighting uniformity ratio of 10:1 maintained. A lighting control system will be provided to allow for dawn dusk control with dimming to security lighting levels if there are no night-time operations taking place. Dark-Sky Complaint lighting will be used as appropriate. The total load for each light tower is estimated at 10 KW (kilowatts).

8.4. Building Power

The electrical design will accommodate the various buildings such as warehousing, manufacturing buildings, and offices. The building design shall meet Title 24 requirements. Manufacturing/assembly buildings may have significant power needs (e.g. greater than 5 MW).

8.5. Equipment and Tools

It is expected that a variety of power tools, including arc-welding equipment will be used at the terminal, and outlets for the equipment will be required. These outlets will be located at HMLs and other strategic locations around the terminal.

8.6. Cranes

The wharf crane will have multiple motors for its operational movements, with the hoist motor being the largest. Depending on the type of crane, multiple motors may be used during lifts. Crawler cranes as well will require power.

8.7. Equipment Staging Area Loads

Equipment staging is a key component of the offshore wind terminal. Wind turbine equipment including nacelles and tower sections require power while staged for components such as heaters (to prevent condensation and moisture buildup) and electronics. This equipment accounts for a considerable terminal load.

8.8. Site Electrical Infrastructure Considerations

It is expected the Pier 94/96 sites overall will see a significant increase in power needs. The design team will work with the utility, PG&E, to ascertain the available capacity of the existing utility feeds and determine the necessary upgrades to the line. Distribution will be routed around the site as much as possible around the perimeter to feed loads discussed in sections above. The design may consider portable backup power connection and transfer mechanism to ensure continuity of power flow in the event of outages.

Electrical requirements (if any) associated with the secondary use of a FEMA emergency response staging area must be further developed/understood.

Attachment B: Data Gap Memorandum

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DATA GAP MEMORANDUM

To: Rod Iwashita & Simon Betsalel (Port of San Francisco)

From: Adrian N. Pearson & Nolan Gross (M&N)

Cc: Azadeh Bozorgzadeh, Matthew Trowbridge, Jennifer Lim, Carolyn Donohoe (Moffatt & Nichol)

Date: June 19, 2023

Contract: FSP Contract ID: 1000027731
Contract Service Order #: MN-01

Subject: **Pier 94/96 Offshore Wind Study**
Data Gap Memorandum

M&N Job No.: 220388-01

This memorandum summarizes Moffatt & Nichol's (M&N) data review task and identifies gaps in project data. M&N requested data from the Port of San Francisco (Port) via email on March 9, 2023. The Port provided data on March 7, 10, 13, 23, and 29 and again on April 11 and 20. M&N's subconsultant, Earth Mechanics, Inc. (EMI) furnished additional project data to M&N on March 16 with the Port's approval.

Below is a checklist of the requested data with empty boxes signifying data gaps, accompanied by comments on the gaps' significance. Refer to Attachment 1 for the complete list of data received.

- ☑ As-built/record drawings of the Pier 94/96 facility
- ☑ Pier 96 wharf load capacity chart
- ☑ Existing crane removal cost estimate (if available)
- ☑ Requirements for the site to be used by FEMA as an emergency response site
- ☑ Requirements provided by CADEMO to date for their proposed use (or we could obtain this through interface with CADEMO team)
- ☐ Recent bathymetric survey(s) at the terminal and in the navigation channel from the Golden Gate to the terminal berth pocket
    - M&N received bathymetric surveys dated October and November of 2019. These suffice for this phase of design, but more recent surveys will be required for the next phase.
- ☑ Recent topographic survey(s) of the site
- ☐ Plot maps of available site(s) and location of easements required for other tenants
    - M&N has sketches of the approximate boundaries of the site but no survey plat showing parcel or lease boundaries for the project site nor neighboring tenant facilities. This is not

required for this phase of design but will be required in the next phase.

☑ Previous geotechnical data and recommendation reports (studies, investigations, testing, analysis, evaluation, design, etc.)

☑ As-built/record drawings and/or utility maps of all existing subsurface pipelines and utilities in the vicinity of the project

☐ Port to advise if any known FAA limitations for crane operation at site
- FAA limitations are important to identify at this phase of design in case they present any fatal flaws to the project (e.g., restriction on crane heights which may impact construction activities).

☑ Previous environmental documents for projects at or near the site that may impact the development of the site

☑ Previous inspection reports of the existing wharf

☑ Results of the Port project planning and engineering to date including the Port's Master Plan

☑ Recent studies or evaluations completed at the site including the Port of San Francisco Southern Waterfront Initial Seismic Study, January 2022, Parsons/RJSD JV

☐ Drone photos/videos provided by the Port would be ideal to support proposed visualization and rendering work (if available)
- Photos and videos would be helpful but are not required at this phase of design.

Attachment 1 – List of Data Received

Project: Pier 94/96 Offshore Wind Study				
Client: Port of San Francisco				
Date: June 19, 2023				
Subject: Data Gap Memorandum - Attachment 1: List of Data Received				
M&N Project Number: 220388-01				
File Name	**Date**	**Owner**	**File Type**	**Received From**
As-Builts				
Pier 96 LASH Terminal Site Preperation & Substructure	11/7/1969	POSF	.pdf	POSF
L.A.S.H. Terminal Transit Shed	11/3/1960	POSF	.pdf	POSF
Gabion Wall Completion	7/1/1988	POSF	.pdf	POSF
LASH Substructure	11/7/1969	POSF	.pdf	POSF
LASH Terminal Buildings and Sitework	7/29/1971	POSF	.pdf	POSF
LASH Terminal Site Elevation	10/30/1970	POSF	.pdf	POSF
Pier 96 LASH Terminal	5/14/1971	POSF	.pdf	POSF
Pier 96 Breakwater	7/8/1974	POSF	.pdf	POSF
Pier 96 1980 Repaving	7/1/1980	POSF	.pdf	POSF
San Francisco Container Terminal - South - Gate Modification	9/12/1986	POSF	.pdf	POSF
InterModal Container Transfer Facility Phase 1	3/17/1986	POSF	.pdf	POSF
Pier 96 Wetlands Enhancement Projects	6/4/2004	POSF	.pdf	POSF
Pier 96 Maintenance Dredging Fiscal Year 2003-2005	11/21/2003	POSF	.pdf	POSF
Pier 96 Maintenance Dredging Fiscal Year 2006-2010	10/17/2005	POSF	.pdf	POSF
Pier 96 Pavement Reconstruction and Resurfacing	9/10/1990	POSF	.pdf	POSF
San Francisco Container Terminal -South	7/5/1989	POSF	.pdf	POSF
Pier 96 Miscellaneous Drawings	Various	POSF	.pdf	POSF
San Francisco Container Terminal - North Terminal- Container Wharf and Backlands Improvements	4/15/1987	POSF	.pdf	POSF
Pier 27 Berth Improvements for the New Cruise Terminal	7/5/2013	POSF	.pdf	POSF
Pier 92 Apron Repairs	7/14/2016	POSF	.pdf	POSF
Pier 92 Fender Replacement Project	10/4/2018	POSF	.pdf	POSF
Pier 94 Binder	3/19/1973	POSF	.pdf	POSF
Pier 94 Backlands Improvement Plans 2018	3/16/2018	POSF	.pdf	POSF
Pier 94 Fence Detail Plans	2/21/2017	POSF	.pdf	POSF
Pier 94 Admin Building Fence Project	2/21/2017	POSF	.pdf	POSF
Pier 94 Site preparation and Substructure	4/11/1973	POSF	.pdf	POSF
Pier 94 Electric Container Cranes	8/8/1973	POSF	.pdf	POSF
Pier 94 East Crane Power Supply	7/24/1974	POSF	.pdf	POSF
Pier 94 East Administration Building	4/10/1974	POSF	.pdf	POSF
Pier 94 East Grading	3/12/1975	POSF	.pdf	POSF
Pier 94 East Container Terminal	6/11/1975	POSF	.pdf	POSF
Pier 94 North Grading	1/21/1976	POSF	.pdf	POSF
Bathymetric and Topographic Surveys				
Pier 94/96 Post-Dredge Survey	6/2/2015	POSF	.pdf	POSF
Port Of San Fransisco Pier 80, 94, and 96 Conditional Multibeam Survey	11/1/2019	POSF	.pdf	POSF
Piers 80, Islais Creek, Islais Creek Approach, and Piers 90-96 Dredge Areas	No Date	POSF	.pdf	POSF
NOAA Survey Pier 94-96 Channel	10/1/2019	POSF	.pdf	POSF
POSF_191101_Peir80_94_96_3X3	No Date	POSF	.pdf	POSF
16674 - Pier 96 Topo	4/23/2021	POSF	.DWG/.PDF	POSF
Pier 96 Site conditions	2/18/2022	POSF	.DWG/.PDF	POSF
Pier94_19Oct30	2/23/2018	POSF	.DWG	POSF
Geotechnical Information				
Appendix E Proposed LASH Terminal Sea Wall Lot 352	11/14/1969	POSF	.pdf	EMI
Preliminary Report Stability During Eathquake LASH Terminal Pier 96	12/12/1969	POSF	.pdf	EMI
Soil Engineering Services Proposed LASH Terminal Seawall Lot 352 India Basin	10/16/1969	POSF	.pdf	EMI
Soil Engineering Services Proposed LASH Terminal Seawall Lot 352 India Basin	11/5/1969	POSF	.pdf	EMI
Preliminary Report Stability During Earthquake LASH Terminal	12/12/1969	POSF	.pdf	EMI
Seismic Stability Studies Proposed For Sand Dike for LASH Terminal Facility	7/30/1970	POSF	.pdf	EMI
Seismic Stability Studies Proposed for LASH Terminal Facility	7/31/1970	POSF	.pdf	EMI
Seismic Stability Studies Proposed For Sand Dike for LASH Terminal Facility	11/5/1970	POSF	.pdf	EMI
Soil Engineering Services Proposed for LASH Terminal Seawall Lot 352 between India Basin	11/5/1970	POSF	.pdf	EMI
Geotechnical Consultation Pavement Design and Estimate Container Yard LASH Term	5/9/1978	POSF	.pdf	EMI
Site Investigation and Feasibility Study of Hunters Point Reclmation District	10/13/1958	POSF	.pdf	EMI
Progress Report Proposed Circulating Water System Hunters Point Power Plant	4/26/1972	POSF	.pdf	EMI
India Basin Development	11/14/1973	POSF	.pdf	EMI
Site Invetigation Proposed Pier 98	7/3/1974	POSF	.pdf	EMI
Preliminary Soil and Geological Investigation for 25+ Acre Landfill Project Hunters Point	12/1/1975	POSF	.pdf	EMI
Initial Southern Waterfront Earthquake Assessment	1/19/2022	POSF	.pdf	POSF
Geotechnical Engineering Memorandum Feasibility Study	11/25/2014	POSF	.pdf	POSF
Geotechnical Evaluation Indicator Pile Driving	8/20/2013	POSF	.pdf	POSF
Pier 80 Subsidence Investigation - Geotechnical Data Report	4/14/2023	Lotus Water	.pdf	POSF
Site Investigation Report - Pier 94 Backlands Improvement and Amador Street Sanitary Pump Station	6/15/2012	POSF	.pdf	POSF
Geotechnical Investigation - Pier 94 Backlands Improvements	7/5/2012	POSF	.pdf	POSF

Project: Pier 94/96 Offshore Wind Study				
Client: Port of San Francisco				
Date: June 19, 2023				
Subject: Data Gap Memorandum - Attachment 1: List of Data Received				
M&N Project Number: 220388-01				
File Name	**Date**	**Owner**	**File Type**	**Received From**
Utilities				
Pier 96 LASH Terminal - Telephone and Fire Alarm Duct Plan	2/24/1971	POSF	.pdf	POSF
Pier 94-96 Storm Drain and Outfall Repairs	4/26/2017	POSF	.pdf	POSF
Map of the Utilities	7/12/2012	POSF	.pdf	POSF
2021 Google Mpas P96 Light Mast and Power Poles	7/13/1905	POSF	.pdf	POSF
Section 16530 Pier 94 High Mast Lighting	8/15/2015	POSF	.pdf	POSF
Pier 96 LASH Terminal Building and Site Work - Electrical Details	12/1/1970	POSF	.pdf	POSF
PG&E Requirements for Customer-Owned Poles	8/15/2017	POSF	.pdf	POSF
Port High Mast Lighting Pier 94/96 Light Pole Locations	8/28/2014	POSF	.pdf	POSF
Storm Drain and Outfall Repairs	4/26/2017	POSF	.pdf	POSF
Pier 94 Backlands Improvement Project Specification Section 33 40 00 Storm Drainage	3/16/2018	POSF	.pdf	POSF
Storm Drain and Outfall Repairs - As Builts	4/9/2018	POSF	.pdf	POSF
Enviromental Studies				
File Number 27549S Serial Number 03-047 SAP Approval Piers 94 & 96	8/21/2003	POSF	.pdf	POSF
File Number 27549S Serial Number 04-014 Episode 2 Pier 94/96 Suitability Determination	4/22/2004	POSF	.pdf	POSF
File Number 2013-00333S: Port of San Francisco berth 94/96 Maintenance Dredging	5/22/2015	POSF	.pdf	POSF
Islais Creek Channel & Approach, Piers 92,94, and 96 Sediment Characterization Report	6/13/2014	POSF	.pdf	POSF
Naturally-Occurring Asbestos Characterization Report - Backlands Improvement Project	3/7/2018	POSF	.pdf	POSF
Site Mitigation Plan - SFDPH's Article 22A Compliance - Pier 94/Seawall Lot Backlands Improvement	3/9/2018	POSF	.pdf	POSF
Asbestos Dust Mitigation Plan - Pier 94/Seawall Lot 3440 Backlands Improvements	7/16/2018	POSF	.pdf	POSF
Report on Landfill Cap Installation Completion	3/15/2019	POSF	.pdf	POSF
Port Specification 31 23 10 Landfill Cap	No Date	POSF	.pdf	POSF
Inspection and Assessment Reports				
Inspection of Waterside Facilities at Hunters Point Nevel Shipyard	3/1/1994	POSF	.pdf	POSF
Piers 94-96 Wharf Substructure -- Rapid Structura Assessment	12/22/2003	POSF	.pdf	POSF
Pier 96 Feasibility Assessment	1/25/2022	POSF	.pdf	POSF
POSF Pier 96 Review of Prairie's January 2022 Feasibility Assessment	4/5/2022	POSF	.pdf	POSF
Assessment of the Seawall Sotrm Water Collection System and Sinkholes Pier 96	3/14/2011	POSF	.pdf	POSF
Miscellaneous Studies				
Parsons Pier 96 Sheet Pile Wall Design Study Proposal	8/25/2017	POSF	.pdf	POSF
Revised Mooring Analysis for Fender Design Pier 27 Cruise Terminal	3/7/2013	POSF	.pdf	POSF
Section 2310 Pile Installation	1/26/2010	POSF	.pdf	POSF
Port of San Francisco Pier 92 Fender System Supporting Calculations	10/17/2018	POSF	.pdf	POSF
Pier 94 Backland Improvements Specifications	2/29/2016	POSF	.pdf	POSF
Eletrical Infrastructure GIS Aerial View Pier 94	9/9/2021	POSF	.pdf	POSF
San Francisco Water Power Sewer Application for Electrical Service	6/6/2016	POSF	.pdf	POSF
Pier 80-96 Eco-Industrial Strategic Plan	March-16	POSF	.pdf	POSF
Pier 96 Crane Demo Hazmat Specs-Estimates	No Date	POSF	.pdf	POSF
Miscellaneous Studies				
Parsons Pier 96 Sheet Pile Wall Design Study Proposal	8/25/2017	POSF	.pdf	POSF
Revised Mooring Analysis for Fender Design Pier 27 Cruise Terminal	3/7/2013	POSF	.pdf	POSF
Section 2310 Pile Installation	1/26/2010	POSF	.pdf	POSF
Port of San Francisco Pier 92 Fender System Supporting Calculations	10/17/2018	POSF	.pdf	POSF

Attachment C: Outreach Memorandum

moffatt & nichol

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OUTREACH SUMMARY MEMORANDUM

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Jennifer Lim & Carolyn Donohoe (Moffatt & Nichol)
Cc:	Matt Trowbridge & Azadeh Bozorgzadeh (Moffatt & Nichol)
Date:	August 14, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study Outreach Summary Memorandum**
M&N Job No.:	220388-01

The Port of San Francisco (Port) and Moffatt & Nichol (M&N) conducted offshore wind (OSW) industry outreach to determine the Port's potential site development opportunities, inform the Basis of Design, and identify the site use types that best align with the Port's long-term goals. This memorandum documents the meetings held.

Any meeting held on or before May 12, 2023 was based on a superseded site layout. Upon Port consideration and feedback from initial outreach meetings the site layout was increased to the 95-acre layout shown in Figure 1.

Figure 1. 95-acre Site Layout

Outreach included the following stakeholders:

1. Applicable federal and state agencies
2. OSW developers who won leases in the BOEM Pacific Wind Lease Sale 1
3. Manufacturers of floating foundations for wind turbines
4. Terminal operators and marine transportation companies
5. Other California port authorities involved in the OSW industry

Table 1 summarizes the status of outreach to date. Meeting minutes for each meeting are attached as an appendix.

Table 1: OSW Stakeholder Meetings

OSW Stakeholder	Meeting Time
Federal & State Agencies	
Bureau of Ocean Energy Management (BOEM)	Held on March 31
California State Lands Commission (SLC)	Held on April 5
California Energy Commission (CEC)	Held on April 17
National Renewable Energy Laboratory (NREL)	Held on April 19
Developers	
Cierco (CADEMO State Project)	Held on March 20
Copenhagen Infrastructure Partners (CIP)	Held on April 24
Ocean Winds	Held on April 27
RWE	Held on May 16
Equinor US Wind	Held on June 1
Invenergy	Held on May 15
Foundation System Manufacturers	
Aikido Technologies	Held on April 7
Glosten Pelastar	Held on April 12
Hexicon & COWI	Held on April 18
SBM Offshore	Held on May 12
Principle Power	Held on May 23
Terminal Operators and Marine Transportation	
Foss Offshore Wind	Held on April 4
Crowley	Held on April 27
Port Authorities	
Port of Humboldt	Held on April 5
Port of Long Beach	Held on April 5
NW Seaport Alliance (Ports of Seattle & Tacoma)	Held on May 11
Other	
Brian Sabina	Held on April 19

PORT OF SAN FRANCISCO

APPENDIX: OUTREACH MEETING MINUTES

Federal and State Agencies

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Bureau of Ocean Energy Management (BOEM)
10:30 AM – 11:00 AM PDT, 3/31/23
Attendees:

Name	**Affiliation**	**Email**
Guiltinan, Sara V	BOEM	Sara.Guiltinan@boem.gov
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Delepine, Boris	POSF	boris.delepine@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Moreno, Dominic	POSF	dominic.moreno@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com
Iwashita, Rod	POSF	rod.iwashita@sfport.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Project overview and description of Pier 94/96 site was presented.

Open Discussion

- Permitting
    - Where does OSW lease area permitting stop and where does Port permitting begin?
- Need for additional port funding opportunities
    - MARAD PIDP grants are not enough to support the port development needs.
- OSW leasing areas
    - State to finish AB525 and sea space identification before they move forward with the next lease area.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with California State Lands Commission
11:30 AM PDT, 4/5/23
Attendees:

Name	Affiliation	Email
Delepine, Boris	POSF	boris.delepine@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com
Koller, Matthew	CSLC	Matthew.Koller@slc.ca.gov
Boggiano, Reid	CSLC	Reid.Boggiano@slc.ca.gov
Mattox, Jennifer	CSLC	Jennifer.Mattox@slc.ca.gov
Pearson, Adrian	M&N	apearson@moffattnichol.com
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Port's goals for joining the OSW industry
- Overview of the current project scope of work and site.

Open Discussion

- Discussed environmental documentation needs
- Port intends to engage the local community first
- AB525 shows opportunities for different CA ports and then ports initiate projects.
- CSLC is not dictating what each port must do but providing information to facilitate projects and collaboration.
- The team discussed not "getting ahead of the funding" which was an issue on East Coast projects.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with CEC (California, Energy Commission)
10:00 AM PDT, 4/17/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Charles Labitan	POSF	charles.labitan@sfport.com
Michael Martin	POSF	michael.martin@sfport.com
Boris Delepine	POSF	boris.delepine@sfport.com
David Beaupre	POSF	david.beaupre@sfport.com
Deaver, Paul	CEC	Paul.Deaver@energy.ca.gov
Jennifer Lim	M&N	jlim@moffattnichol.com
Trowbridge, Matt	M&N	MTrowbridge@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Discussed site vicinity, adjacent underserved communities, and underutilized shipyards.

Further Discussion

- Timing for completion of the Pier 94/96 improvement project
- Job impact in the area
- AB 525 report
    - Working on O&M strategic plan, assessment of economic benefits of offshore wind, workforce development and training for offshore wind industry.
- Economic development to the north and south of Pier 94/96
- Pier 94/96 identified as site that needs improvement to mitigate risks as part of seismic vulnerability study project.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with NREL (National Renewable Energy Laboratory)
12:00 PM PDT, 4/19/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Delepine, Boris	POSF	boris.delepine@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Shields, Matt	NREL	matt.shields@nrel.gov
Pearson, Adrian	M&N	apearson@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Trowbridge, Matt	M&N	MTrowbridge@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Site vicinity, adjacent underserved communities, and underutilized shipyards.
- Need for CA port collaboration.

Open Discussion

- NREL study covers CA, OR, and WA and assigns potential site uses to each port based on port characteristics. The study includes varying levels of OSW deployment and regional assessments for 10 scenarios with a time horizon of 2045.
    - Tentative publication date is July.
- Overall supply chain, logistics, and port costs.
- Pier 94/96 is a strong candidate a manufacturing site.
- Takeaways
    - CA needs many MF facilities (>12)
    - Domestic supply chain can be competitive with or cheaper than international. Transportation is a big factor.
    - Steel quantity is a challenge. If imported, projects lose local benefits and IRS deductions.
    - Dept. of Energy FLOE prizes for both steel and concrete foundation systems.
    - Positive impact for jobs in underserved communities. Community engagement is key.
- How to collaborate with other ports?
- Transportation costs are much less than procurement and installation costs.
- POSF has the opportunity for competitive advantage by being the first mover, providing certainty to developers.

Developers

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Cierco
09:00 AM PDT, 3/20/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalol, Simon	POSF	simon.betsalel@sfport.com
Collier, Robert	Cierco	robert.collier@ciercoenergy.com
Cook-Clarke, Will	Cierco	-
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Pearson, Adrian	M&N	apearson@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the project was provided.

Open Discussion

- CADEMO needs the site by late 2026 / early 2027
- Wharf occupancy for construction and assembly for 12-18 months, excluding set-up and demobilization.
- Wet storage area needed in bay prior to towing?
- Final turbine integration in POLA (Q1/Q2 2028) and final installation (Q2/Q3 2028)
- Could do different options (25 acres or 50 acres)
- CADEMO's presentation
    - Proposed site use and required acreage
    - Metrics for foundation system, equipment, vessels, and wharf

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with CIP
01:00 PM PDT, 4/24/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Alrayes, Ali	CIP	AAlrayes@vineyardoffshore.com
Lim, Jennifer	M&N	jlim@moffattnichol.com

Team Introductions

- CIP is a Humboldt leaseholder
- Attendees introduced themselves.

Project Background

- Site introduction

Open Discussion

- Provisionally won lease in December
- Multiple bottle necks
  - Interconnection with transmission - 10 year process
  - Don't think operational before 2033 or 2035
  - Floating offshore wind requires custom port design
  - Permitting and procurement
- Current activities
  - Setting up a team on the ground and familiarizing themselves with CA
  - Leveraging global portfolio to see where this technology will go to
  - 1st wave of projects
    - Primary fabrication will happen in Asia and come to the US for some form of assembly.
  - Tubular sections for manufacturing that would provide tubes to get assembled in Humboldt or POLB
  - New Jersey Wind Port
    - Set up port facility to accept future sublease applications for manufacturing facilities
    - Bring in pre-assembled components
- Steel makes more sense than concrete
  - Steel makes more sense outside of America than in the US
  - CIP Estimates 4.5 - 5.5 metric tonnes per floater foundation

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Ocean Winds

9:00 AM PDT, 4/27/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Courchene, Brent	Ocean Winds	brent.courchene@oceanwinds.com
Martinez, Santiago Rodrigez	Ocean Winds	Santiago.Rodriguez@oceanwinds.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	Abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Site introduction
  - Location in the bay, project size, etc. (50 acres site)
  - Eco-industrial area: short rail line, concrete batch plant, Pier 70 shipyard in the past.
  - Lots of potential resources.
  - Focus on clean energy and job creation.
- Bridge clearance – around 200', berth depth at wharf is 38'
- Connect with industry to determine best use site (most useful and cost effective).

Open Discussion

- Channel priority in the port during specific times for floating foundations.
- For towing, weather windows are important to get as well as wave generated from large vessels moving though the bay
- Timeline for OW: 3-4 years to start construction, waiting for supply chain development
- Options to evaluate Pier 70 and Pier 80.
- Site requirements:
  - O&M sites
    - Base building
  - Storage of components – 50 acres (marshalling and turbine integration)
    - If restricted do assembly and installation while getting new components
  - Distance to the bridge – about 8 miles (7 nautical miles)
- For use of CTV, POSF is not a great option due to distance to Morro Bay
- Berth length is concerning, vessels needed to berth are quite large
- Wharf loading – quayside access is very important.
- Pinch point is difficult for site usage.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with RWE
09:00 AM PDT, 5/16/23
Attendees:

Name	Affiliation	Email
Betsalol, Simon	POSF	simon.betsalel@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Marshall, Sarah	RWE	Sarah.marshall@rwe.com
Nuttall, Jonathan	RWE	jon.nuttall@rwe.com
Rainey, Patrick	RWE	patrick.rainey@rwe.com
Thedinga, Jan	RWE	Jan.Thedinga@rwe.com
Ehrhorn, Malin	RWE	Malin.ehrhorn@rwe.com
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com

<u>Team Introductions</u>

- Attendees introduced themselves.

<u>Project Background</u>

- Overview of the Pier 94/96 site and surrounding area
- Good transport for MF facility

<u>Open Discussion</u>

- Long wharf won't restrict vessels.
- Adjacent concrete batch plant is good.
- Volume of traffic in the bay
- Existing bearing is quite low
- The planned loading is sufficient
- Wharf/Quay is 150' but recognizes that ring crane foundation is larger.
- Relationship with other shipyards in the area?
- What is the current RWE plan?
    - Technology, working with a few select in more detail.
    - Building plans for feasibility and economic feasibility. Looking at both concrete and steel substructures
    - Still to stage components - will be coming by vessel, even if not being integrating.
- O&M:
    - Hydrogen powered or electric vessels?
- Noise restrictions

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Equinor

11:30 AM to 12:00 PM PDT, 06/01/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Overend, Michael Margi	Equinor	MMAGR@equinor.com
Saluja, Varun	Equinor	VARS@equinor.com
Sorheim, Paul James	Equinor	pajs@equinor.com
Trowbridge, Matt	M&N	mtrowbridge@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	Abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Discussed the site vicinity, adjacent underserved communities, and underutilized shipyards.
- Positive feedback and support from the port commission for redeveloping pier 94/96 for OSW industry.
- Discussion on the site limit, line of fence, wetlands.

Open Discussion

- POSF is a good candidate as a supply chain support terminal.
- Pier 94/96 is a great site for manufacturing and storage as well.
- Discussed when Pier 94/96 would be ready for developers

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Invenergy
011:30 AM PDT, 5/15/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Birmingham, David	Invenergy	dbirmingham@invenergy.com
Lee, June	Invenergy	JLee@invenergy.com
Crowe, Brendan	Invenergy	BCrowe@invenergy.com
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Discussed the project limits and surrounding site
- Updated site limits – 90 acres upland (3000psf)
    - Wharf – 1550ft length (6000psf)

Open discussion

- What is the timeline for the project/site?
    - ROM cost and timeline – will be submitted in June
    - Port still evaluating site usage
    - Expecting late 2020
- Seems like other manufacturers (vestas, GE, etc.) are holding off to see where things are headed
- New site layout is promising in terms of development and interest.
- Site cannot be S&I with current known technology due to air gap restrictions (220 ft)
- No channel width restrictions or main channel depth restrictions
- Invenergy
    - In phase on mapping landscape for the Morro Bay lease
    - Waiting on the results of the strategic plan (AB 525)
    - Manufacturers are also waiting to see how the process plays out on the East Coast for OSW, which helps explain the hesitation on the West Coast

Foundation System Manufacturers

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Aikido Technologies
01:00 PM PDT, 4/7/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Sam Kanner	Aikido	sam.kanner@aikidotechnologies.com
Bingbin Yu	Aikido	bingbin.yu@aikidotechnologies.com
Kristin Brief	Breakthrough Energy	kristin.brief@befellows.org
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Port of SF overview and description of Pier 94/96 site
- Timeline for completion - Late 2020s and early 2030s is the target

Open Discussion

- Main innovation is the loads up for integration and assembly
- Use MF sites for towers, same material and shapes
- 1 platform per month for principle power
- Use more existing infrastructure
- Can also use semi-sub barges
- Existing nacelle technology cannot be used to be assembled in this manner
  - Perform the platform and tower first, nacelle on later
- Non-upending, operational in Europe
- Non-operational, upending in California / US
- Three legged with a central column
- Width folded up
  - 2 tower diameters
  - Tower is 10-12m for 15 MW

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Glosten Pelastar
10:00 AM PDT, 4/12/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Volpenhein, Kris	Glosten	kevolpenhein@glosten.com
Beattie, Kyle	Glosten	kcbeattie@glosten.com
Trowbridge, Matt	M&N	MTrowbridge@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Site vicinity, adjacent underserved communities, and underutilized shipyards.

Open Discussion

- Presented on TLP concepts, advantages of using TLP foundation, and deployment approaches.
- Modular assembly and transportation approach to speed up production.
- Subsea robotic (quieter construction) construction approach.
- Anchoring the tension legs to seabed was discussed.
- Micropiles have been considered as an option. Rocky seabed can be challenging.
- 1-2 years before developers will know what type of technology they want on-site.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Hexicon Group
11:00 AM PDT, 4/18/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Theodore Paradise	Hexicon	theodore.paradise@hexicongroup.com
Adrienne Downey	Hexicon	adrienne.downey@hexicongroup.com
Marc Percher	COWI	MCPR@COWI.COM
Ted Trenkwalder	COWI	twt@cowi.com
Jim Kearney	COWI	jwk@cowi.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Pearson, Adrian	M&N	apearson@moffattnichol.com
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Lim, Jennifer	M&N	jlim@moffattnichol.com

Team Introductions

- Hexicon is involved in fabrication of floating foundation system components and the integration of components.
- Attendees introduced themselves.

Project Background

- Discussed the site vicinity, adjacent underserved communities, and underutilized shipyards.
- Scope of the study which is limited to Pier 94/96.

Open Discussion

- Pinch-point between the two parcels of backland property may be an issue for moving components.
- Presented their proposed plans for the site.
- Discussed a sloped launch (i.e., ship launch) versus a new wharf
    - New wharf is easier and faster to permit.
- Dimensions / numbers for foundation system and site were discussed

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with SBM
11:00 AM PDT, 5/12/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
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De Prins, Alexandre	SBM	Alexandre.DePrins@sbmoffshore.com
Tropeano, Enrico	SBM	Enrico.tropeano@sbmoffshore.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Trowbridge, Matt	M&N	mtrowbridge@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	abozorgzadeh@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Introduction to the site and project area revision.
- Discussed the site vicinity, adjacent underserved communities, Pier 92, and underutilized shipyards.
- Due to air draft restriction, the goal is to have foundation or other OSW components to be assembled in SF and the final integration to happen in Humboldt.

Open Discussion

- Site is suitable for assembly of component but not integration of turbine.
- Presented the floater foundations that they are currently building in Marseille, France (8.4 MW Turbine.
- Presented their foundation design for a 20 MW turbine for California.
- Pier 94/94 can be FSS assembly hub, which needs Load-in area, Storage area, Assembly area, FSS final area, Launching area, and Quay Storage area.
- The anchoring Logistic Hub requires less square footage and bearing load capacity. It includes Storage, Load-in area, and Load-out area.
- SBM has many years of experience with manufacturing and installation of tensioned leg floaters for oil and gas industry (Brazil, Gulf of Mexico).
- Timeline and when the OSW project would start - estimated to be close to 2030.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Principle Power

8:00 AM PDT, 5/23/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Kruger, Thalia	Principle Power	tkruger@principlepowerinc.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	Abozorgzadeh@moffattnichol.com
Trowbridge, Matt	M&N	mtrowbridge@moffattnichol.com

<u>Team Introductions</u>

- Attendees introduced themselves.

<u>Project Background</u>

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Discussed the site's vicinity, adjacent underserved communities, and underutilized shipyards.
- Future upgrade on facilities and timeline associated with that.

<u>Open Discussion</u>

- Principle Power has installed FOW (Floating Offshore Wind Turbines) in Portugal (3 x 8.33MW) operating since 2020 and in Scotland (5x9.5MW) operating since 2021, with a secured 5GW pipeline of global projects.
- Proven patented floating technology with TRL 9 ready to large-scale mass manufacturing based on a 15-year track record. Manufacturing one floating foundation per week is the goal.
- Working currently on industrialization program aimed to reduce cost, improve schedule, and maximize flexibility in final assembly.
- Principle Power has experience in all operational port and logistics aspects for all the project phases: assembly, load-our and transportation, WTG integration, offshore Installation, inspections & maintenance, and large correctives.

Terminal Operators and Marine Transportation

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Foss Offshore Wind
09:00 AM PDT, 4/4/23
Attendees:

Name	Affiliation	Email
Sloane Perras	Foss Offshore Wind	sperras@fossoffshorewind.com
Pearson, Adrian	M&N	apearson@moffattnichol.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Trowbridge, Matthew	M&N	MTrowbridge@moffattnichol.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Discussed background of the site and study.

Open Discussion

- Potential OSW Site Uses
    - Foundation and component manufacturing
- Access corridor between the two ~25 acre parcels at Pier 94/96 is narrow.
- Overhead restrictions: Bay Bridge and Golden Gate Bridge.
- MARSEC restrictions and operational flexibility around the site.
- Shipyard is underutilized and could be used to support OSW operations.
- Cable/chain/anchor laydown – tie to manufacturing to maximize benefits & $$$ for Port.
- Electrical cable laydown site – tie to manufacturing to maximize benefits & $$$ for Port.
- Community engagement and Port's goal to partner with tenant's and neighbors.
- Ship husbandry would engage local merchants to service vessels (e.g., provisions)
- Developers like stability and schedule, willing to come a bit further from the OSW area because of this for SOV home port.
- SOVs are approximately 300' LOA on the east coast, would need to be larger on west coast.
- Crew Transfer Vessels (CTVs) are 100' LOA minimum.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Crowley

11:00 AM PDT, 4/27/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Coleman, Andre	POSF	andre.coleman@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com
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Matthews, Evan	Crowley	Evan.Matthews@crowley.com
Andreini, Jeff	Crowley	Jeffrey.Andreini@crowley.com
Goedhard, Bart	Crowley	Bart.Goedhard@crowley.com
Lim, Jennifer	M&N	jlim@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	Abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Site vicinity, adjacent underserved communities, and underutilized shipyards.
- Need for CA port collaboration.

Open Discussion

- POSF is a good candidate as a supply chain support terminal.
- Discussed when Pier 94/96 would be ready to developers
- Possible partnership with the Port
- Potential site use includes manufacturing, warehouses, distribution center (supply chain), and floater integration.
- More waterfront area is more desirable.

Port Authorities

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Port of Humboldt
09:00 AM PDT, 4/5/23
Attendees:

Name	Affiliation	Email
Delepine, Boris	POSF	boris.delepine@sfport.com
Iwashita, Rod	POSF	rod.iwashita@sfport.com
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Beaupre, David	POSF	david.beaupre@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Holmlund, Rob	POH	rholmlund@humboldtbay.org
Pearson, Adrian	M&N	apearson@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Discussed the project and surrounding areas of Pier 94/96

Open Discussion

- Seeking collaborative and complimentary approach with other Ports
- POSF key for manufacturing, not S&I
- Supply chain, workforce, and advocacy are key factors.
- Lots of acreage and wet storage space at Humboldt
- Wharf and floating components must maintain a 450 ft clearance to the federal navigation channel.
- Public opposition is rooted in confusion about the OSW industry as a whole. Part of educating the public is breaking it down into three components: offshore wind farms, port facilities, and transmission line upgrades.
- Coos Bay and Columbia River terminals are under consideration.
- Wetland mitigation is required at Humboldt. Stormwater drainage is a challenge given the large acreage of site.
- What does testing and commissioning of fully integrated turbines look like at the ports and offshore wind farms?
- 3,000 miles of mooring lines are needed for OSW in CA – need industry support.
- PDIP grant is not enough.
- Federal funds are needed for port collaboration.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Port of Long Beach
04:00 PM PDT, 4/5/23
Attendees:

Name	Affiliation	Email
Delepine, Boris	POSF	boris.delepine@sfport.com
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
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Killeen, Eamonn	POLB	eamonn.killeen@polb.com
Herrera, Clint	POLB	clint.herrera@polb.com
Donohoe, Carolyn	M&N	cdonohoe@moffattnichol.com
Pearson, Adrian	M&N	apearson@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Overview of the Pier 94/96 site and backlands which may be dedicated to OSW fabrication activities.
- Discussed the site vicinity, adjacent underserved communities, underutilized shipyards.

Open Discussion

- POLB is behind Port of Humboldt in project development but are engaged in the BOEM AB-525 study.
- POLB is wrapping up concept study
- Pier Wind project involves reclaimed land and needs a streamlined permitting process.
- Community engagement approach is similar to POSF, but has not happened yet.
- MARAD Port Infrastructure Development Program (PIDP) grants will not be sufficient
- California Association of Port Authorities (CAPA) funding stream - applications due in September.
- Short timeline of grant funding needs and the need to keep California ahead in the floating OSW industry.
- Inflation Reduction Act of 2022 (IRA) which could be used for manufacturing renewable energy technology.
- Context and scale of the overall OSW industry on the west coast versus port development costs.
- Application for funding by California ports vs. individual ports.
- Nacelle fabrication / assembly makes sense for POSF as it is close to Silicon Valley.

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with NW Seaport Alliance

1:00 PM PDT, 5/11/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Ryter, Stan	Port Of Tacoma	sryter@portoftacoma.com
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Howard, Thais	Port of Tacoma	thoward@portoftacoma.com
Jordan, Jason	NW Seaport Alliance	jjordan@nwseaportalliance.com
Fletcher, Gloria	Port of Tacoma	gfletcher@portoftacoma.com
Maietta, Jennifer	NW Seaport Alliance	jmaietta@nwseaportalliance.com
Trowbridge, Matt	M&N	MTrowbridge@moffattnichol.com
Bozorgzadeh, Azadeh	M&N	Abozorgzadeh@moffattnichol.com

Team Introductions

- Attendees introduced themselves.

Project Background

- Site introduction.
    - Location in the bay, project size, etc. (50 acres site), FEMA use, allowable existing live loads.
- Eco-industrial area: Lots of potential resources, close to Bayview and Hunter's point (historically disadvantaged community), which has a focus on clean energy and job creation.
- The project is at an early stage and no developer is selected.

Open Discussion

- Next phase is to look for funding, partnering with developers & operators.
- Considering cargo related type of activities for OSW.
    - Less likely for manufacturing and assembling.
    - The biggest concern is retrofitting/strengthening the terminals and no vacant Terminals.
- They have deep water and no air draft restriction.
- NW ports are identified as key ports for OSW.
- Community outreach and environmental permitting will start in the future
- Networking of ports and working together are essential.

Other

Port of San Francisco Pier 94/96 OSW Study
Outreach Meeting with Brian Sabina
03:00 PM PDT, 4/19/23
Attendees:

Name	Affiliation	Email
Iwashita, Rod	POSF	rod.iwashita@sfport.com
Betsalel, Simon	POSF	simon.betsalel@sfport.com
Beaupre, David	POSF	david.beaupre@sfport.com
Delepine, Boris	POSF	boris.delepine@sfport.com
Labitan, Charles	POSF	charles.labitan@sfport.com
Sabina, Brian	Sabina Strategies	brian@sabinastrategies.com
Trowbridge, Matt	M&N	mtrowbridge@moffattnichol.com
Pearson, Adrian	M&N	apearson@moffattnichol.com
Lim, Jennifer	M&N	jlim@moffattnichol.com

Team Introductions

- Brian Sabina
  - Negotiate state strategy
  - Economic developer for New Jersey Wind Port
- Additional attendees introduced themselves.

Project Background

- Project overview and description of Pier 94/96 site was presented

Open Discussion

- Discussed lessons learned at the NJ wind port

Attachment D: CADEMO Project Preliminary Assessment

moffatt & nichol

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CADEMO PROJECT PRELIMINARY ASSESSMENT

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Khoa Pham (Moffatt & Nichol)
Cc:	Azadeh Bozorgzadeh, Jennifer Lim, & Matt Trowbridge (Moffatt & Nichol)
Date:	September 8, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study CADEMO Project Preliminary Assessment**
M&N Job No.:	220388-01

This memorandum summarizes the preliminary assessment performed for the known existing conditions of Pier 94/96 to determine the capabilities for use in the CADEMO Project. This assessment provides an evaluation of the existing wharf for allowable temporary uniform loads, seismic loading is not considered.

Pier 94/96 was constructed in the early 1970’s. The existing wharf is 78 feet wide and is supported by 18-inch octagonal precast, prestressed concrete piles, as shown in Figure 1. The pile spacing, transverse to the wharf, is 10 feet, on center, with 12 feet typical bent spacing, longitudinal to the wharf. The bent spacing is reduced to 6 feet at the crane girders. The tributary area for the typical pile is 12 feet by 10 feet is 120 square feet.

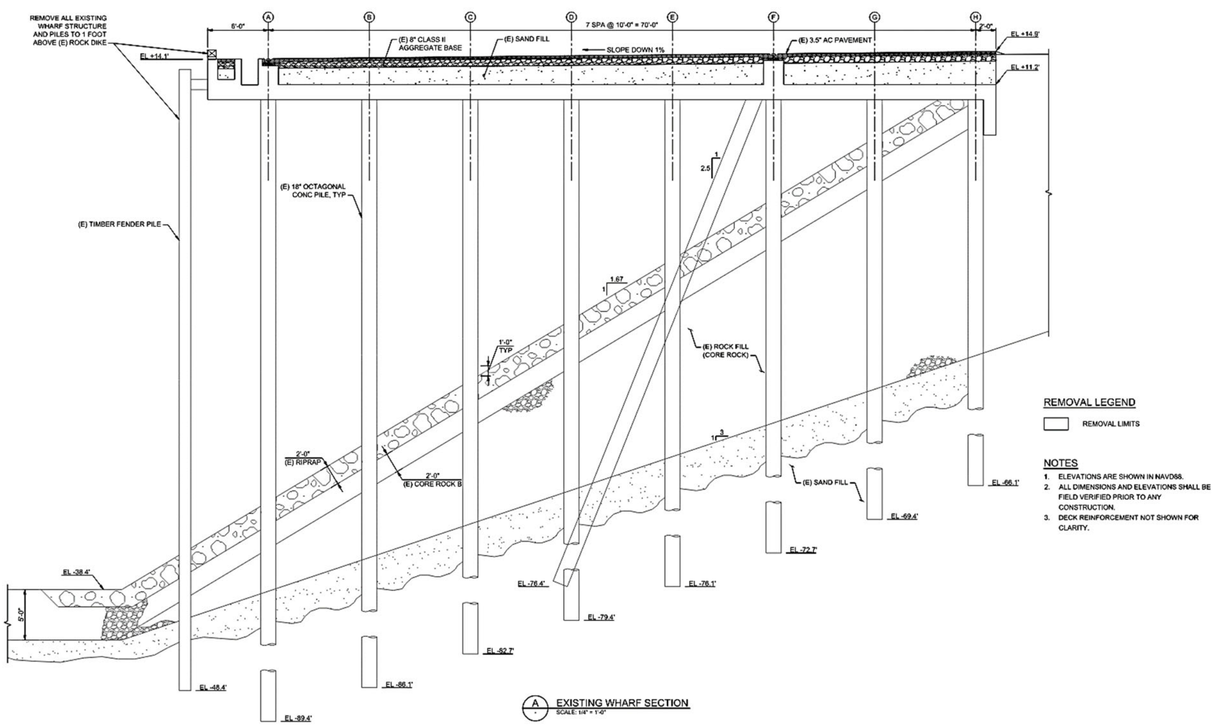

Figure 1. Existing wharf plan

The concrete deck has a thickness of 18 inches; with an assumed specified concrete compressive strength of 4000 psi. A layer of aggregate and sand fill, varying in thickness, is on top of the concrete deck. The wharf surface is finished with a 3.5-inch asphalt concrete (AC) pavement. The deck is sloped at a rate of 0.5% towards the landside while the AC pavement is sloped at a rate of 1% towards waterside.

The combined thickness of the fill and AC pavement is approximately 4 ft. A density of 120 pounds per cubic feet (pcf) is assumed for the fill and a density of 150 pcf is used for the concrete. The uniform deadload from the deck and fill is 700 pounds per square feet (psf).

Although the wharf as-built drawings report the wharf capacity to be 500 psf, a load capacity analysis was performed for temporary loads related to the CADEMO project. The estimated pile service load capacity varies between 300 and 350 kips. The corresponding total allowable uniform loads are 2500 psf and 2900 psf, respectively. Consequently, the allowable uniform live loads are 1800 psf and 2200 psf. **Therefore, the CADEMO 2000 psf loading appears feasible for the existing wharf for temporary use.** However, CADEMO will need to submit a detailed work plan and loading plan to demonstrate the allowable loads for temporary use are not exceeded.

The deck strength is marginal for the required 2000 psf uniform live load. Punching shear between the deck and pile is the limiting strength. A safety factor less than 1.6 may be considered due to higher certainty of the live loads. Additionally, the expected deck concrete strength may be higher than the specified value, which could lead to a better factor of safety.

The evaluated existing wharf strength was based on the as-built documents. Over the lifespan of a structure, elements are subject to wear and damage. Marine structures such wharf structures are particularly vulnerable to damage due to chemical, tidal and wave actions.

The degree and rate of damage are dependent on the material and construction quality. Review of inspection and testing reports can reveal the current conditions of the structures, extent of damages and if the structure strength is jeopardized. Additional inspection of the structure and material sample testing of structural components will provide a better understanding of the current condition and capacity of the structure.

Attachment E: Wharf and Uplands Assessment Memorandum

moffatt & nichol

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(510) 645-1238
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WHARF AND UPLANDS ASSESSMENT MEMORANDUM

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Khoa Pham (Moffatt & Nichol)
Cc:	Azadeh Bozorgzadeh, Jennifer Lim, & Matt Trowbridge (Moffatt & Nichol)
Date:	August 2, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study** **Wharf and Uplands Assessment Memorandum**
M&N Job No.:	220388-01

This memorandum summarizes the design of the wharf for the concept phase of the Pier 94/96 Offshore Wind Study.

Existing Pier 94/96 Wharf and Uplands

The Pier 96 wharf was built in 1970 and three years later in 1970, Pier 94 was built. The deck elevation of the wharves are +14.1 ft and +14.9 ft at the waterside and landside respectively (NAVD88). Both locations feature a paved area over fill with a 78-ft wharf on the eastern edge. The wharf is constructed on a dike with an 18-inch concrete slab supported by 18-inch octagonal prestressed concrete piles, as shown in Figure 1. Pile spacing is 10 feet (transverse to the wharf) and typical bent spacing is 12 feet (longitudinal to the wharf). Bent spacing at the crane girders is 6 feet. All the piles are terminated in the dike. Three feet of sand fill and asphalt paving is placed on top of the wharf deck. There are two crane girders 50 feet apart with the waterside one 6 feet from the edge of the wharf. Battered piles at each bent (12 feet spacing) are installed along the landside crane girder.

The existing concrete deck will be demolished and existing piles will be cut approximately 1 foot above the mudline (not extracted).

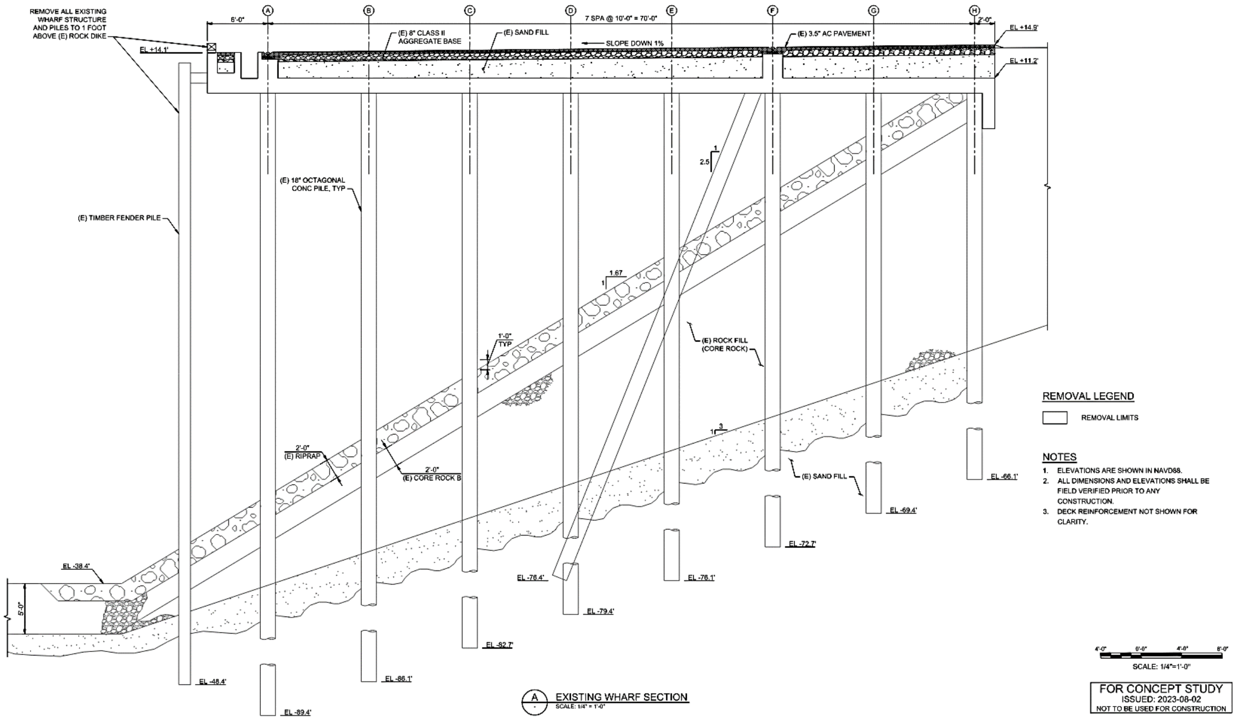


Figure 1. Existing wharf section

Wharf Elevation and Geometry

The new wharf deck elevation is set to **+17.0 ft NAVD88**, to accommodate for a maximum elevation for vessel roll-on / roll-off (RORO) operational requirements of +18 ft. Sea level rise values are based on *State of California Sea-Level Rise Guidance (2018).* For the San Francisco Bay area, a SLR of 2.8 feet by 2100 feet is recommended for this design.

Based on discussion with the Port, the length of the wharf is **1,550 feet long**, which covers the full length of Pier 94 and a portion of Pier 96, and the **width is 150 feet** to provide adequate space for offshore wind (OSW) operations, as shown in Figure 2. The wharf deck may also support ring crane operations. Depending on the configuration, the wharf may be wider at certain locations to accommodate the ring crane footprint. Additional details of the ring crane foundation will be determined in the next phase.

Wharf Deck and Uplands

The proposed new wharf is 150 ft wide compared to the existing 78-ft width. The existing upland needs excavation to create a 4-ft clearance between the bottom of the new wharf deck and the finished grade to allow room for inspections.

The new deck system is a flat deck with uniform thickness between piles, simplifying any necessary work in case of misaligned or out of tolerance piles after installation. A cut-off wall will be required on the landside edge of the existing wharf. Additionally, a drop-down beam section may also be needed on the waterside edge of the wharf deck to facilitate the connection of the fender system and the bollards.

The next phase of the project should evaluate whether a continuous or discrete fender system is required to ensure adequate fendering for the planned floating foundations, barges, and vessels at the site. Furthermore, the next phase should verify the specific geometrical requirements for accommodating a RORO vessel, including aspects such as fendering, bollard spacing and other relevant considerations.

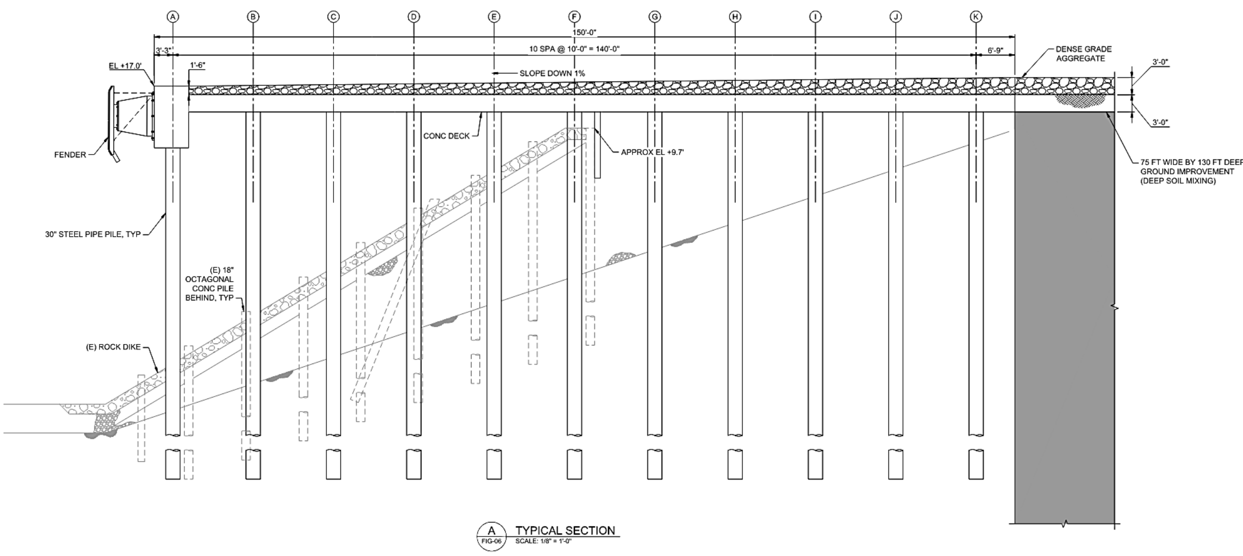


Figure 2. Proposed wharf cross section

Wharf Demand

Based on similar projects and offshore wind port requirements from the Bureau of Ocean Energy Management (BOEM) California Floating Offshore Wind Regional Ports Assessment, the distributed live load on the wharf is estimated to be 6,000 psf. This live load is not reducible. In addition, a 3 feet thick layer of dense grade aggregate (DGA) will be placed on top of the wharf deck to distribute the load from crawler cranes and other equipment.

Wharf Loading:

- Live Load = 6,000 psf (Non reducible)
- Dense grade aggregate working surface / pavement = 3 feet thick
- Wharf deck thickness = 3 feet
- Total Combined Unfactored Load = 6,890 psf

Wharf Pile Types and Pile Selection

Due to the deep layer of Bay Mud at the site, it is necessary to extend the piles to the bedrock to achieve sufficient axial capacity. A pile grid of 12 feet (longitudinally) by 14 feet (transverse) is used for supporting the wharf deck. This spacing enables the installation of new piles between the existing ones after they have been cut off. The piles used in the conceptual study are 30-inch diameter x 1.0-inch wall thickness steel pipe piles.

The next phase of the project should evaluate the following considerations to confirm pile size selection:

- Complete geotechnical investigation at the site
- Perform drivability analysis
- Perform wharf seismic analyses
- Evaluate pile to deck seismic capacity and details
- Evaluate options and cost for protection of steel piles (anodes, sleeves/jackets, etc.)
- Evaluate pile sourcing options including transportation options to site
- Complete a test pile program

Attachment F: Geotechnical Engineering Memorandum

Earth Mechanics, Inc.

Geotechnical & Earthquake Engineering

DATE: June 16, 2023 **EMI PROJECT NO:** 23-112-1

TO: Matthew Trowbridge, S.E. / Moffatt & Nichol (M&N)
Azadeh Bozorgzadeh, Ph.D., P.E. / M&N
Jennifer Lim, P.E. / M&N

FROM: Amin Rahmani, Ph.D., G.E. / Earth Mechanics, Inc. (EMI)
Amir Zand, Ph.D., G.E. / EMI
Arul K. Arulmoli, Ph.D., G.E. / EMI

SUBJECT: ***Preliminary Geotechnical Memorandum***
Pier 94/96 Offshore Wind Study,
Port of San Francisco, California

INTRODUCTION

This memorandum summarizes the preliminary geotechnical evaluations completed by Earth Mechanics, Inc. (EMI) for the Port of San Francisco (POSF) Piers 94 and 96 Offshore Wind Study project. The POSF is evaluating the opportunity to develop the existing facility to aid in California and West Coast Offshore Wind (OSW) energy goals. This offshore wind terminal will be developed to serve as a manufacturing and launch facility for different types of components of the OSW structures.

The preliminary geotechnical evaluations include; (i) review and synthesis of the data available for Piers 94 and 96, (ii) site and subsurface conditions review, (iii) preliminary geotechnical recommendations for foundations (e.g. pile foundations, bearing capacity, and settlement), and (iv) preliminary seismic hazard evaluations including liquefaction, slope stability, and lateral spreading hazards.

It should be noted that this memorandum is based on limited existing available geotechnical information dating back as far as 1960s; therefore, the findings presented herein should be considered preliminary and are subject to change when additional geotechnical data of the existing waterfront conditions become available.

EMI performed this work as a subconsultant to Moffatt & Nichol (M&N).

PROJECT DESCRIPTION

The POSF intends to develop existing Piers 94 and 96 to an OSW Terminal for manufacturing and launch of OSW component to the Pacific Outer Continental Shelf (OCS) region. The existing port infrastructure on the U.S. West Coast, including the California coast, is not adequate to support the offshore wind industry, and significant port investment is required to develop purpose-built offshore wind port facilities. This is because offshore wind components are large and require port facilities with adequate laydown area and infrastructure with heavy loading capacities to manufacture or assemble the components. The proposed improvements will include a new larger wharf with increased load capacity, manufacturing facilities on the land side, and seismic improvements to mitigate liquefaction and lateral spreading at the site. This memorandum provides preliminary geotechnical recommendations for these improvements. In order to meet the California Energy Commission (CEC) 2030 and 2045 deployment targets, an aggressive timeline for design and construction of the OSW Terminal is required. The POSF is also considering leasing the existing Piers 94/96 site, with minor improvements, to CADEMO pilot OSW project. CADEMO will use the facilities for construction and launch of floating platforms. If approved, the anticipated date of this occupancy is late 2026/early 2027. This memorandum provides preliminary geotechnical evaluation of the existing facilities for this purpose.

A site location map is provided in Figure 1.

AVAILABLE DATA REVIEW

Available geotechnical and subsurface data for Piers 94/96 were reviewed and used in preparation of this memorandum. Table 1 shows a summary of available geotechnical borings for Piers 94/96.

Boring locations performed by Harding Miller Lawson & Associates in 1968 (HMLA, 1969) are shown in Figure 2.

The existing Franciscan bedrock surface elevations were obtained from the USGS Maps dated 1954 and 1968.

TABLE 1. SUMMARY OF AVAILABLE SOIL BORING INFORMATION

Agency/ Contractor	No of Borings	Approx. Ground Surface El. (ft)	Depth Range of Borings (ft)	Boring Type	Drilled Year
AGS, Inc.	12	0 to +17	9 to 63.5	RW, B	1989
Harding Associates	8	-27 to -12	57 to 138	B	1961
Harding Associates	2	+10.9 to +11.8	48.0 to 56.5	B	1964
Harding Associates	4	+10.9 to +11.2	50 to 60	B	1964
Harding Associates	11	+10.3 to +12	17 to 88	B	1966/ 67
Harding Associates	4	+2.7 to +3.3	69.5 to 150	RW	1982
Woodward-Clyde Consultants	6	NS	20 to 22	HSA	1982
AGS, Inc.	14	NS	19 to 81.5	RW, CT	1989
Harding Associates	11	-0.8 to +5.9	5 to 126	RW, HSA	1967
Harding Associates	15	-50 to +16	7 to 182	RW, HSA	1971/ 73
Harding Associates	39	-25 to +16.8	54 to 180	RW, B	1968/69
Dames and Moore	14	+8.1 to +31.2	42 to 120	RW	1971
Harding Associates	11	-12 to +25	78 to 180	RW, HSA	1973/74
Harding Associates	4	+2.7 to +3.3	69 to 150	RW	1982
GTC	10	+0.5 to +3.5	132.5 to 172.5	RW	1983
VBI	10	NS	107.3 to 141.1	CP	2000
Geomatrix Consultants	14	+11.0 to +19.5	31.0 to 131.5	RW	2000
Harding Associates	12	NS	6.5 to 10	NM	1982
Dames and Moore	8	-45.5 to +13.0	38.7 to 196.3	RW	NM

Notes:RW = Rotary Wash; HSA = Hollow-Stem Auger; CP = Cone Penetrometer, B= Bucket; CT= Cable Tool; NS=not shown.

ACCELERATION RESPONSE SPECTRUM

The seismic design follows the performance-based approach outlined in WRP Seismic Criteria and Performance Requirements (Draft 2, 05/12/2023). The design approach will be based on three seismic hazard levels and associated performance levels:

- Level 1: Ground motion with probability of exceedance of 40% in 50 years or 100-year return period (no damage)

- Level 2: The Design Earthquake per ASCE 7-16* (ASCE, 2016), defined as 2/3 of the MCE_R (minor damage)
- Level 3: The risk-targeted maximum considered earthquake (MCE_R) per ASCE 7-16 (ASCE, 2016) (life safety protection)

For geotechnical evaluations, in accordance with ASCE 7-16, the geometric mean maximum considered earthquake (MCE_G) was considered for Level 3, and 2/3 of MCE_G was used in the geotechnical evaluations for Level 2.

Preliminary acceleration response spectrum (ARS) for the three earthquake levels were evaluated using probabilistic seismic hazard analysis (PSHA) results from the 2018 USGS National Seismic Hazard Maps (NSHM 2018). ARS was evaluated for V_{s30} of 260 m/s (Site Class D) and 150 m/s (Site Class E), and envelope of the two ARS was used for preliminary evaluations.

Peak ground accelerations for use in geotechnical evaluations are approximately 0.268g, 0.550g, and 0.825g for Level 1, Level 2, and Level 3 earthquakes, respectively.

SUBSURFACE CONDITIONS

The available site investigations include 60 to 160 ft deep landside and waterside borings performed by Harding Miller Lawson & Associates in 1968 (HMLA, 1969). The boring location map is shown in Figure 2. Three geotechnical cross-sections representing the site conditions along the south end (cross-section A) and east end (cross-section B and C) of Pier 94/96 are presented in Figures 3 to 5. A sand dike is present to prevent a local failure of the existing structures. At the southern edge (Figure 3), the sand dike is retained by a sheet pile wall that is terminated within the sand dike. At the eastern edge (Figures 4 and 5), all piles supporting the existing wharf are terminated within the sand dike. Per the available record drawings (HLMA, 1969), the bottom of the sand dike is at approximate elevation of -55 ft MLLW at south end where the land is retained by an anchored sheet pile. The sand dike extends to much deeper depths at approximate El. of -140 ft MLLW at cross-section B and El. -110 ft MLLW at cross-section C.

The subsurface conditions at Piers 94/96 generally consists of about 35 to 45 ft deep sandy fills down to approximate El. -32 ft MLLW, underlain by Young Bay Mud (YBM) down to El. -100 to -130 ft MLLW. Bay sand deposit was encountered within the elevation range of -100 to -130 ft MLLW. Below these layers, Old Bay Clay (OBC) was encountered at El. range of -130 to -200 ft MLLW. The Franciscan bedrock is expected to be at El. -200 ft MLLW (landside) to -250 ft MLLW (waterside) per the USGS bedrock map.

GEOTECHNICAL SEISMIC HAZARDS

According to the National Research Council (NRC, 1994) and Reyna (1991), liquefaction potential of the existing sand dike and sandy fills at Piers 94/96 site is expected to be low during earthquakes with PGA of up to 0.20g (e.g., the 1989 Loma Prieta earthquake). Partial liquefaction of the sandy fill at the backland is expected under the OLE earthquake. Liquefaction of the backland and the sand dike is expected under the CLE and DE earthquakes. Liquefaction is anticipated to be more extensive in the backland and sand dike under the MCE_G earthquake. Preliminary estimates of the seismically-induced settlement are on the order of about 8” to 12” under Level 1, about 18” to 24” under Level 2 earthquake, and more than 2 ft under the Level 3 earthquake. To evaluate the lateral ground movements during the three earthquake levels, pseudo-static slope stability analyses were performed using the computer program SLIDE2 v9.027 (Rocscience, 2023). The evaluations were based upon limiting equilibrium of circular failure modes and sliding block failure modes using the Spencer’s method (Spencer, 1967) which was recommended by SCEC (2002). The seismically induced lateral slope displacements were determined using the Newmark sliding block procedure using the yield acceleration estimated from the pseudo-static analyses. Newmark sliding block displacements under the three earthquake events were estimated using empirical equations recommended in the NCHRP Report 611 (Transportation Research Board, 2008) for the Western United States (WUS) sites. The estimated displacements are intended to be used as a screening tool at this preliminary stage of the project. More rigorous approaches such as the latest semi-empirical procedures (e.g., Bray and Macedo, 2019) and/or more sophisticated analyses such as finite element or finite difference modeling may be used in later phases of the project to predict ground movements more adequately.

The SLIDE2 program analysis outputs are presented in Appendix A. The general failure mechanism appears to be the sand dike moving outward (toward the water) while the pile supported superstructure moves out as a block. Lateral displacements for existing condition (no new piles) are expected to be large and for higher earthquake levels present a flow slide condition. With consideration of pile pinning effects of the new 30”x1” steel pipe piles, preliminary estimates of lateral displacement of the sand dike are on the order of 6 inches under Level 1, about 4.5 ft Level 2, and about 10 ft under Level 3. In addition to the lateral displacements, vertical settlements of the sand dike and the wharf are also expected due to seismically induced settlements, as explained earlier.

As noted earlier, all of the above screening analyses and estimates are preliminary and subject to change as they are based on decades old site-specific data. Additional field explorations and laboratory testing programs are needed to confirm or update these results. It should be also noted that the analyses used in this study were simplified approaches that may be appropriate for screening purposes. Complexities associated with seismic soil-wharf structure interaction may need to be included in future final evaluations using more sophisticated analyses such as finite element or finite difference modeling.

GROUND MOVEMENT MITIGATION APPROACHES

Based on preliminary data provided by the M&N structural engineering team, the proposed OSW Terminal new wharf will be supported on 30-inch diameter, open-ended, driven steel pipe piles.

The piles will be driven between the existing piles, and will extend into the bedrock. The pinning force from these piles will provide additional lateral resistance and reduce the lateral movement of the new wharf.

Various land-based ground improvement techniques are available for mitigation of ground movements and slope stabilization. A suitable ground improvement method should be selected based on subsurface material type, accessibility, presence of existing utilities and structures, cost, amount of spoils created by the proposed method, and various other factors.

Vibratory methods such as vibro-compaction or vibro-replacement may not be appropriate for the site since they are not expected to improve the YBM and the vibration could densify the sand below the pile tip and may cause the wharf to settle and rotate. Ground improvement by deep soil mixing (DSM) is expected to be a viable ground improvement technique for this site. The DSM method is an in-situ soil mixing technology that mixes existing soils with cementitious materials using mixing shafts consisting of auger cutting heads, discontinuous anger flights and mixing paddles. The DSM method is also desirable since it does not generate much vibration during construction. Based on the results from our limited preliminary analyses, installing a block of improved ground behind the sand dike on the landside is expected to stabilize the slope and reduce the lateral movements.

Preliminary pseudo-static slope stability analyses were performed for the improved ground conditions using the computer program SLIDE2 v9.027 (Rocscience, 2023). A surcharge load of 250 psf was assumed in the analyses. The slope stability analysis outputs are presented in Appendix A. Based on the preliminary analyses, by creating a 75-foot wide block of DSM (DSM buttress) on the land side, in combination with new pile pinning force will reduce lateral movement under Level 1 to negligible level (less than 1.0 inch). The displacements under Level 2 and 3 earthquakes are estimated to be approximately 1.5 ft and 4.5 ft, respectively. These displacements are estimated based on the assumption that surface loads on landside are no more than 250 psf. The displacements are expected to increase if the surface loads exceed 250 psf.

The preliminary extents of the ground improvement zone required to reduce the slope displacements are shown in Appendix A.

PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

Existing Conditions (for CADEMO Project)

We understand that the CADEMO project involves a 12 to 18 month occupancy of the wharf for construction and dispatching of four concrete barge or steel Tension-Leg Platform (TLP) floating platforms. The platforms will be constructed on site and launched from Pier 94/96 wharf.

It should be noted that EMI has not evaluated CADEMO project for seismic conditions.

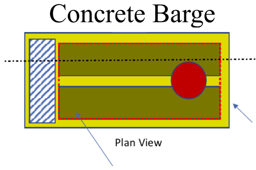
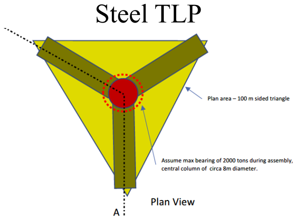
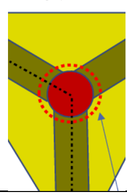
Based on information provided by structural engineers, the project requires bearing capacities in range of 2,000 to 5,000 psf within large areas, as shown in Table 1 below.

TABLE 2. CADEMO PROJECT REQUIREMENTS

Area	Activity	Requirements	
Storage / Assembly Area (Area is flat, drained and clear of obstructions)	▪ Component storage area ▪ Floater assembly ▪ Contractor's office, parking, etc.	Area: Bearing capacity: Crane:	13 Acres [300mx175m (min)] 2000 psf, $10t/m^2$ [Approx. $100kN/m^2$] Local ad hoc areas of higher capacity ($25t/m^2$) Mobile / Capacity 250t Mobile / Capacity 1600t -increased local bearing Hook Height: 250 ft [75m] Reach : 100 ft [30m]
Wharf Apron	▪ Offloading components ▪ Launch of floaters ▪ Semi-sub barge loading	Length: Bearing capacity: Crane: (ideally, but could be done via vessel crane or SPMT's) Bollards:	650 ft [200m (min), 400m (preferred) General 2000 psf, $10t/m^2$ [Approx. $100kN/m^2$] Local for crane and load out 5000 psf or $25t/m^2$[Approx. $250kN/m^2$] SPMTs capacity TBC Capacity: 1600t, Reach: 475ft [145m] Hook height: 250ft [75m] 100t capacity (TBC)

Settlement: Using available limited consolidation test data, settlement for the proposed loads were evaluated. Majority of the long-term settlement is due to consolidation of the YBM layer. The results are shown in Table 2.

TABLE 3. PRELIMINARY ESTIMATES OF LONG-TERM SETTLEMENT

Load Case	**Demand**	**Estimated Total Settlement Under the Actual Demand**		**Estimated Total Settlement Under 2,000 psf Bearing Pressure**	
		6 months	**12 months**	**6 months**	**12 months**
Concrete Barge 	17,000 tons over area of 80x50m (Actual Demand: 850 psf)	~2.5 inches	~4.0 inches	~5.5 inches	~8.0 inches
Steel TLP 	4,500 tons over area of 100x100x100m (Actual Demand: ~250 psf)	< 1 inch	~1.0 inch	~5.5 inches	~8.0 inches
Steel TLP Central Column 	2,000 tons over central column with Dia. 8.0 m (Actual Demand: ~8,000 psf **)	~3.0 inches	~4.0 inches	N/A	N/A

** The long-term settlements presented in this table are preliminary.*
*** Only long-term settlement is evaluated, geotechnical bearing capacity should be checked separately.*

Long-term settlements can be mitigated by excavating the existing fill layer (unit weight of 120 pcf) and replacing it with lightweight cellular concrete (LCC, avg. unit weight of about 40 pcf). A 10-foot deep over-excavation can eliminate settlement from a uniform load of 800 psf. It should be noted that, due to the low density, the LCC should not be placed below water table.

For loads exceeding 2,000 psf bearing capacity of the soil should be evaluated on a case-by-case basis. Local soil improvements such as DSM columns or deep foundations may be necessary to support these loads.

<u>Axial Pile Capacity:</u> The existing wharf is supported on 95 ton (design load) precast concrete piles, tipped in the sand dike. According to Parsons-Brinkerhoff (1983), pile driving records indicate that majority of the piles, with exception of the north end of Pier 94 (Pile rows 194 to 206) achieved the required blowcounts corresponding to their design capacity. Subsequent load tests on the "low blowcount" piles indicated that even these low blowcount piles have exceeded the design capacity due to pile setup. This implies that other piles outside of this "low blowcount zone" currently have axial capacities that well exceed their design capacity. Therefore, for the intended temporary use

of the wharf, a preliminary design capacity of 150 to 175 tons (300 to 350 kips) can be assumed for the piles outside of the “low blowcount zone”. This value should be confirmed by performing pile load tests.

Future OSW Terminal Pile Design

Based on the information from structural engineers, open-ended Steel 30”x1.0” pipe piles in a 14 ft x12 ft grid were assumed to support the future wharf for the OSW Terminal. The design load for these piles under service load combination is 1,150 kips.

The piles should be driven to bedrock to eliminate long-term settlement of the pile. Based on bedrock elevations, the recommended preliminary pile tip elevation for cost estimation purposes is -200 to -250 ft (average El. -220 ft).

Closed-ended piles are not recommended due to anticipated difficulty in driving them through the OBC layer. Due to the excessive length of the proposed piles, splicing in the field is anticipated.

Future OSW Terminal Bearing Capacity and Settlement

The future OSW Terminal will include 3 ft of dense graded aggregate (DGA) fill in the upland area to raise the elevation from +13.5 to +16.5 (all elevations approximate). This fill will result in long-term consolidation settlement of the soft bay mud layer.

Long-term settlements from the DGA fill can be mitigated by excavating the existing fill layer (unit weight of 120 pcf) and replacing it with lightweight cellular concrete (LCC, avg. unit weight of about 40 pcf). A 5-foot deep over-excavation can eliminate settlement from a uniform load of 400 psf. It should be noted that, due to the low density, the LCC should not be placed below water table. Alternatively, settlement can be accelerated by installation of wick drains and surcharging the site.

According to Basis of Design memorandum (M&N, 2023), live load of 3,000 psf from cranes and self-propelled modular transporters (SPMTs) is anticipated in the uplands. The site soils provide adequate bearing capacity to support these transient loads with limited footprint. For larger load areas exceeding 2,000 psf (for example storage areas), bearing capacity of the soil should be evaluated on a case-by-case basis. Local soil improvements such as DSM columns may be necessary to support these loads.

Sustained loads such as storage areas will also cause long-term settlement due to consolidation of the soft bay mud layer. Depending on load magnitude, settlement can be mitigated using overexcavation and LCC backfill, surcharging and wick drains, or ground improvement with DSM columns.

CONCLUSIONS

This preliminary geotechnical memorandum documents a geotechnical evaluation of the seismic hazards, vulnerability, and preliminary foundation recommendations at Piers 94/96 in the Southern Waterfront of the POSF. This memorandum includes review and synthesis of the available geotechnical data available at the project site, characterization of subsurface conditions, preliminary geotechnical and foundation recommendations, and anticipated seismic hazards including liquefaction and lateral spreading on the existing infrastructures and possible mitigation measures.

Based on the results of the preliminary analyses discussed in this memorandum, geotechnical seismic hazards for the existing Piers 94/96 appear to be marginal during the Level 1 event having a 100-year return period (from a geotechnical stand point). The hazards become more extensive and severe under Level 2 and Level 3 earthquakes. Ground improvement techniques such as DSM on the landside, in combination with a new steel pile-supported wharf structure, may be a viable option for the retrofit of the project site for the intended OSW Terminal use.

The OSW Terminal will include DGA fill placement and large sustained loads, which could result in consolidation settlement. Long-term settlement can be mitigated using overexcavation and LCC backfill, surcharging and wick drains, or ground improvement with DSM columns.

Additional geotechnical investigation is needed before more advanced analyses can be performed to understand the seismic behavior of the site and develop appropriate mitigation measures.

The site was also evaluated for existing conditions and potential CADEMO project use, and preliminary geotechnical recommendations are provided for this occupancy scenario.

All of the analyses and predictions presented in this memorandum are preliminary and subject to change as they are based on limited site-specific data and developed using simplified analyses. This memorandum will be updated when sufficient site-specific geotechnical information becomes available.

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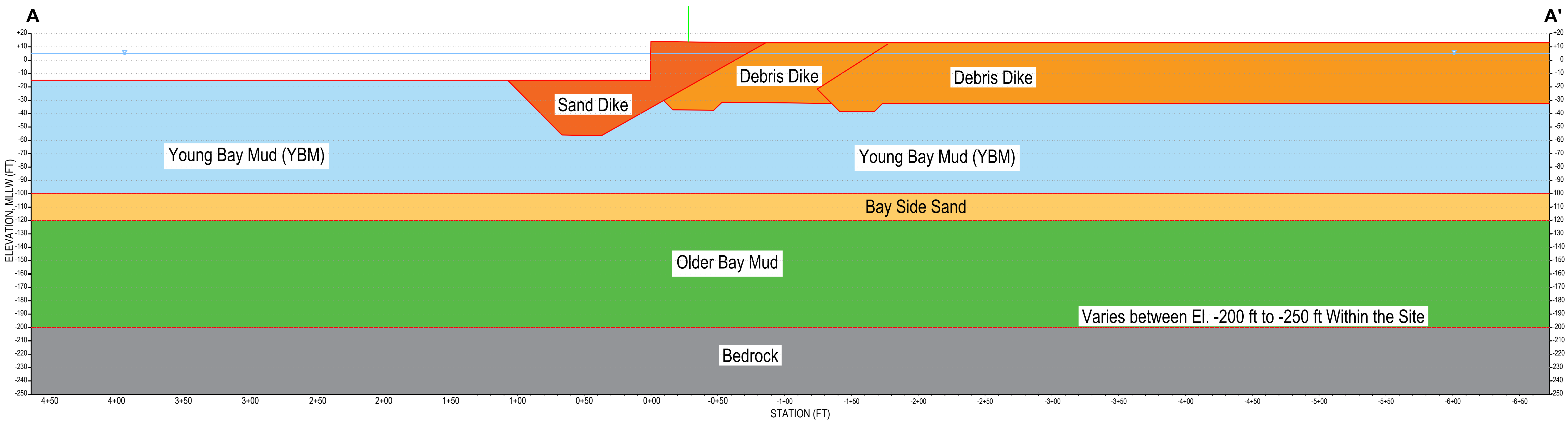
APPENDICES

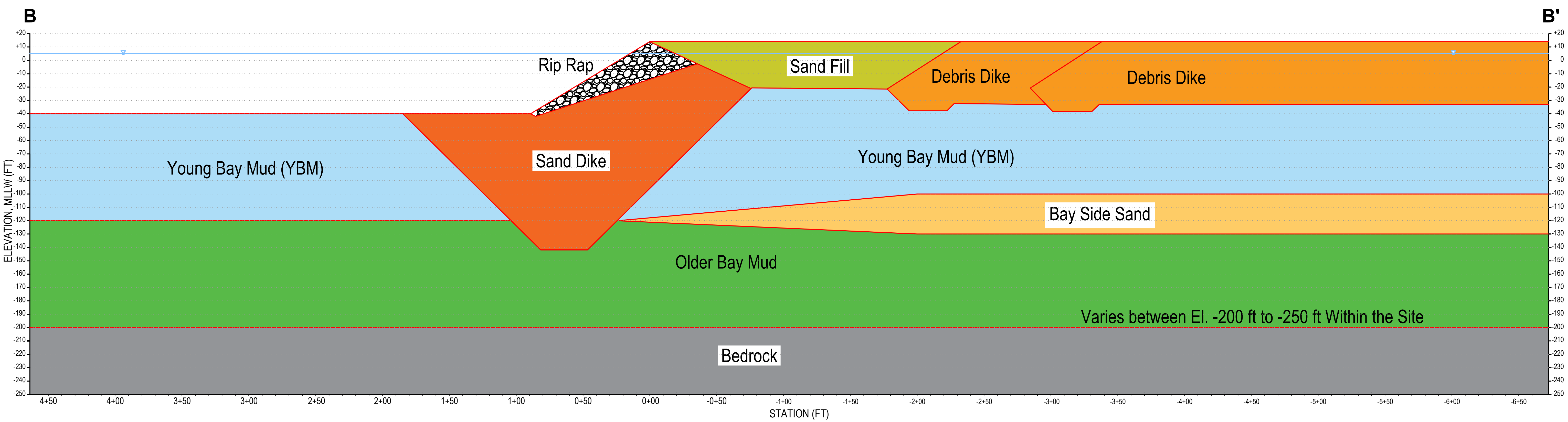
APPENDIX A Preliminary Geotechnical Analyses

FIGURE 1. PROJECT LOCATION MAP

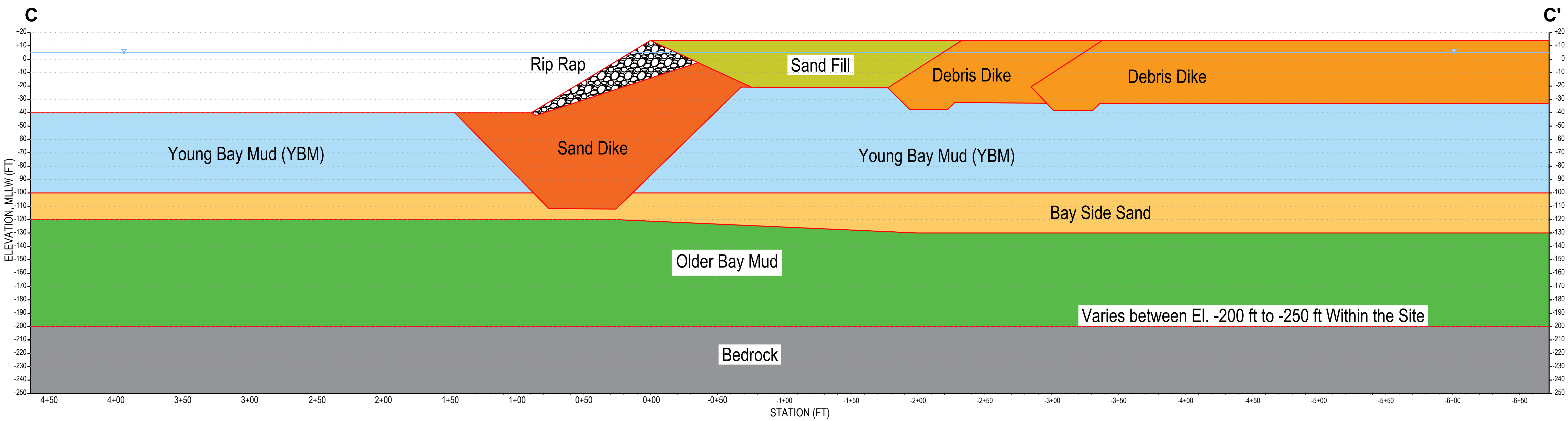
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	POSF Pier 94/96 Offshore Wind Study, San Francisco, CA		Location of Borings by Harding Miller Lawson & Associates (1968)
	EMI Project No. 23-112-1	Date:06-15-2023	Figure 2



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	POSF Pier 94/96 Offshore Wind Study, San Francisco, CA		Geotechnical Cross-Section A-A'
	EMI Project No. 23-112-1	Date:06-15-2023	Figure 3



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	POSF Pier 94/96 Offshore Wind Study, San Francisco, CA	Geotechnical Cross-Section B-B'
	EMI Project No. 23-112-1 / Date:06-15-2023	Figure 4

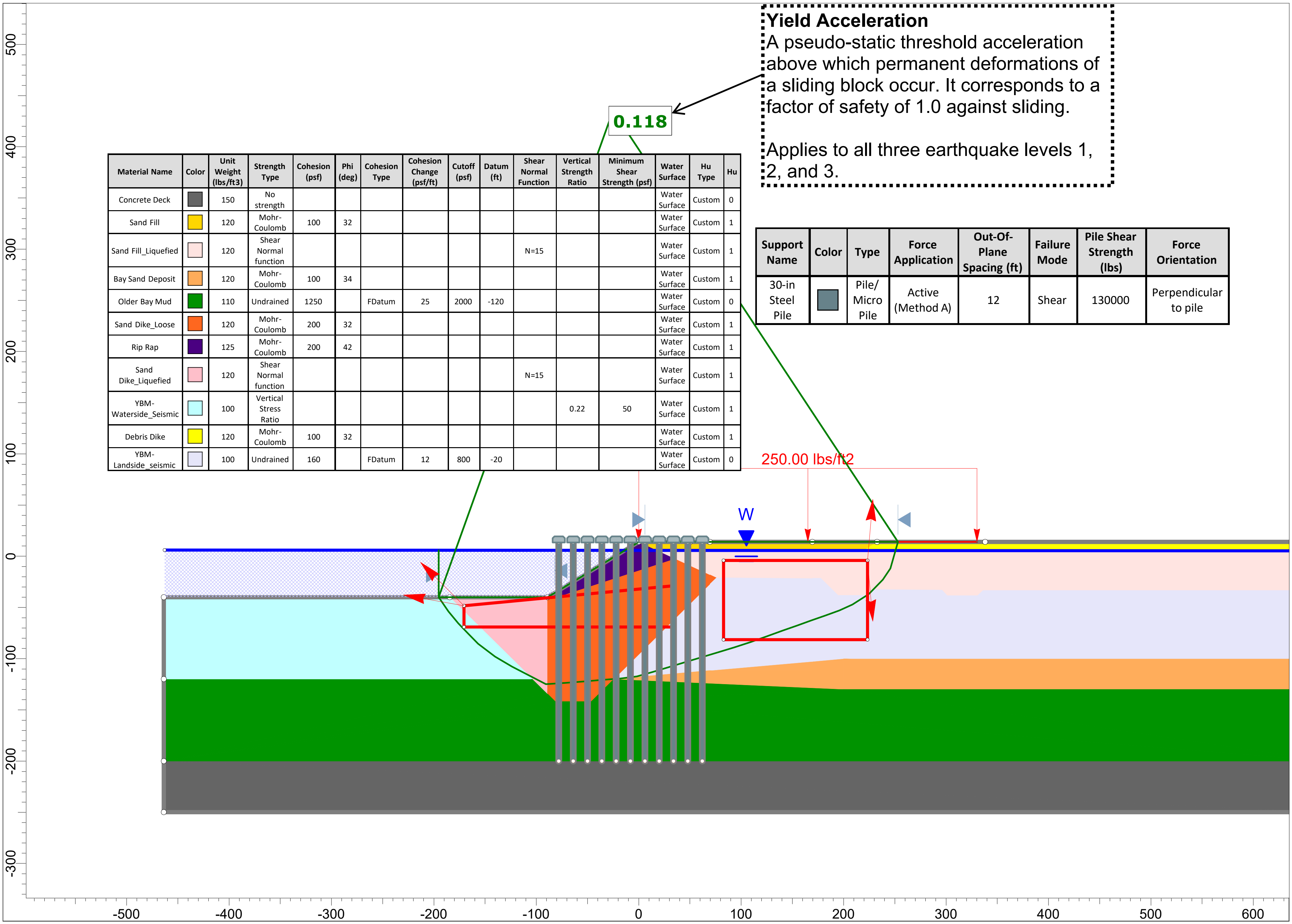


Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

POSF Pier 94/96 Offshore Wind Study, San Francisco, CA		Geotechnical Cross-Section C-C'
EMI Project No. 23-112-1	Date:06-15-2023	Figure 5

APPENDIX A

PRELIMINARY GEOTECHNICAL ANALYSES



Yield Acceleration
A pseudo-static threshold acceleration above which permanent deformations of a sliding block occur. It corresponds to a factor of safety of 1.0 against sliding.

Applies to all three earthquake levels 1, 2, and 3.

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)	Datum (ft)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface	Hu Type	Hu
Concrete Deck		150	No strength										Water Surface	Custom	0
Sand Fill		120	Mohr-Coulomb	100	32								Water Surface	Custom	1
Sand Fill_Liquefied		120	Shear Normal function							N=15			Water Surface	Custom	1
Bay Sand Deposit		120	Mohr-Coulomb	100	34								Water Surface	Custom	1
Older Bay Mud		110	Undrained	1250		FDatum	25	2000	-120				Water Surface	Custom	0
Sand Dike_Loose		120	Mohr-Coulomb	200	32								Water Surface	Custom	1
Rip Rap		125	Mohr-Coulomb	200	42								Water Surface	Custom	1
Sand Dike_Liquefied		120	Shear Normal function							N=15			Water Surface	Custom	1
YBM-Waterside_Seismic		100	Vertical Stress Ratio								0.22	50	Water Surface	Custom	1
Debris Dike		120	Mohr-Coulomb	100	32								Water Surface	Custom	1
YBM-Landside_seismic		100	Undrained	160		FDatum	12	800	-20				Water Surface	Custom	0

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
30-in Steel Pile		Pile/ Micro Pile	Active (Method A)	12	Shear	130000	Perpendicular to pile

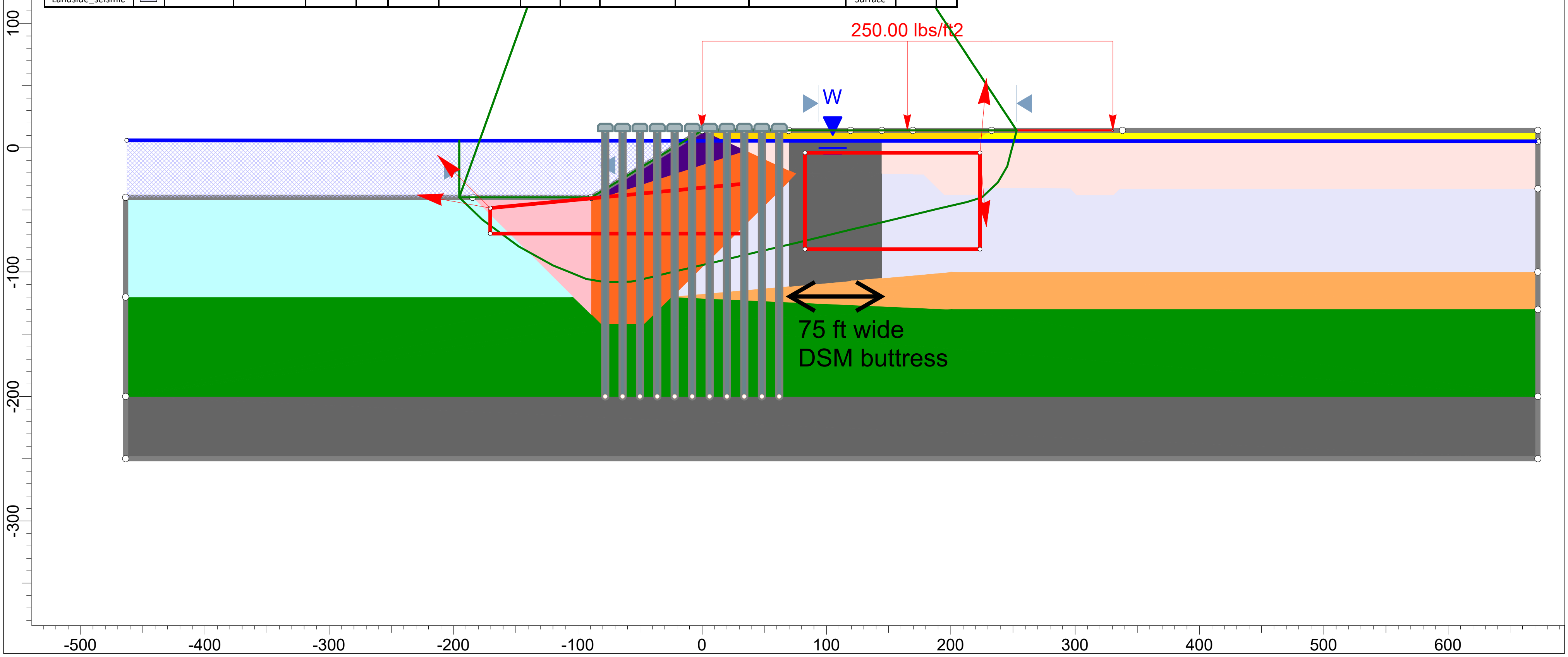
Yield Acceleration
A pseudo-static threshold acceleration above which permanent deformations of a sliding block occur. It corresponds to a factor of safety of 1.0 against sliding.

Applies to all three earthquake levels 1, 2, and 3.

0.227

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)	Datum (ft)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface	Hu Type	Hu
Concrete Deck		150	No strength										Water Surface	Custom	0
Sand Fill		120	Mohr-Coulomb	100	32								Water Surface	Custom	1
Sand Fill_Liquefied		120	Shear Normal function							N=15			Water Surface	Custom	1
Bay Sand Deposit		120	Mohr-Coulomb	100	34								Water Surface	Custom	1
Older Bay Mud		110	Undrained	1250		FDatum	25	2000	-120				Water Surface	Custom	0
Sand Dike_Loose		120	Mohr-Coulomb	200	32								Water Surface	Custom	1
Rip Rap		125	Mohr-Coulomb	200	42								Water Surface	Custom	1
Sand Dike_Liquefied		120	Shear Normal function							N=15			Water Surface	Custom	1
YBM-Waterside_Seismic		100	Vertical Stress Ratio								0.22	50	Water Surface	Custom	1
DSM Buttress		115	Mohr-Coulomb	4320	1								Water Surface	Custom	1
Debris Dike		120	Mohr-Coulomb	100	32								Water Surface	Custom	1
YBM-Landside_seismic		100	Undrained	160		FDatum	12	800	-20				Water Surface	Custom	0

Support Name	Color	Type	Force Application	Out-Of-Plane Spacing (ft)	Failure Mode	Pile Shear Strength (lbs)	Force Orientation
30-in Steel Pile		Pile/ Micro Pile	Active (Method A)	12	Shear	130000	Perpendicular to pile



Estimated Newmark's Sliding Block per NCHRP 6-11 (No Ground Improvement)

Earthquake Level	PGA (g)	k_{max} (g)	k_y (g)	PGV (in/sec)	Newmark Displacement (in)
Level 1	0.268	0.268	0.12	27.01	5
Level 2	0.550	0.550	0.12	63.43	53
Level 3	0.825	0.825	0.12	95.15	127

* PGV=55*S_{1M} per NCHRP Eq 5-11

Estimated Newmark's Sliding Block per NCHRP 6-11 (With 75 ft wide DSM buttress)

Earthquake Level	PGA (g)	k_{max} (g)	k_y (g)	PGV (in/sec)	Newmark Displacement (in)
Level 1	0.268	0.268	0.22	27.01	1
Level 2	0.550	0.550	0.22	63.43	15
Level 3	0.825	0.825	0.22	95.15	50

* PGV=55*S_{1M} per NCHRP Eq 5-11

Attachment G: Preliminary Permitting and Regulatory Approval Evaluation

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Preliminary Permitting & Regulatory Approval Evaluation

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From:	Tonia McMahon & Emily Beck (Moffatt & Nichol)
Cc:	Azadeh Bozorgzadeh, Matt Trowbridge, Jennifer Lim (Moffatt & Nichol)
Date:	September 1, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study** **Preliminary Permitting & Regulatory Approval Evaluation Memorandum**
M&N Job No.:	220388-01

This memorandum documents Moffatt & Nichol's (M&N) preliminary evaluation of environmental and permitting considerations and regulatory approval processes that may impact the development options, cost, and schedule for the Port of San Francisco (Port) Pier 94/96 site to support the offshore wind (OSW) industry.

This memorandum is organized as follows:

1. Executive Summary
2. Introduction
3. Project Background and Introduction
4. Overview of Regulatory Framework
5. Regulatory Approvals Timeline
6. Timeline Assumptions
7. Regulatory Approvals ROM Cost
8. Challenges to the Timeline
9. Recommendations for Timeline Acceleration

1. Executive Summary

In support of the federal government's May 2021 goal to deploy 30 gigawatts (GW) of offshore wind in the U.S by 2030 and 110 GW by 2050, the California Energy Commission (CEC) established a preliminary offshore wind planning goal of 2-5 GW by 2030 and 25 GW by 2045. An estimated 1300 turbines of 20 MW average capacity would be required to meet this target goal.

The Port of San Francisco (Port) is uniquely positioned to serve the offshore wind industry (OSW) and has identified the Pier 94/96 maritime wharfs and terminal areas as a strong candidate for the development of five different OSW site uses including:

1. Manufacturing / Fabrication Site for offshore wind components including nacelles, towers, blades, etc. (MF OSW Components)
2. Manufacturing / Fabrication Site for floating foundations (MF Foundations)
3. Mooring Line, Anchor, and/or Electrical Cable Manufacturing and Laydown Site
4. Construction Support Facility
5. Operation and Maintenance Site (O&M)

The Pier 94/96 Offshore Wind Study project area selected for evaluation in this conceptual design and planning study is comprised of approximately 95 acres of Port owned land including the Pier 94/96 maritime wharfs, nearshore terminal areas, and adjacent backland areas. Piers 94 and 96, constructed in the mid 1960's and 1970's respectively, include deep draft berths (38 feet), available wharf deck area roughly 1,550 ft long, on-dock rail with freight rail access, four ship-to-shore gantry cranes (abandoned/to be removed), and maintenance and operational buildings. The Port's 2022 Study of Earthquake Vulnerability found the Pier 94/96 facilities highly vulnerable to earthquake damage. The adjacent backland areas included in the OSW Study project area current uses include construction material storage and staging, sand and rock material handling and truck transfer, and rail.

Federal, state, and local statutes provide a regulatory framework for in-water, shoreline, and upland activities associated with the Port's completion of infrastructure improvements at Pier 94/96 to support the floating offshore wind industry, including operations for any of the above OSW site uses, and emergency response staging by the Federal Emergency Management Agency (FEMA) ("Project"). The applicable regulations and agencies with discretionary permitting are listed below with notes on Project relevance. The Project will be required to comply with the National Environmental Policy Act (NEPA) on the federal side and with the California Environmental Quality Act (CEQA) on the state side. It is recommended that a joint NEPA/CEQA process be pursued if it is determined that the Project requires an Environmental Impact Statement/Environmental Impact Report (EIS/EIR). Additional analyses and technical studies (i.e., transportation, air, noise) are anticipated to inform the CEQA/NEPA process. An amendment to the existing Port Land Use Plan may be required to authorize the final Project.

To meet offshore wind 2030 deployment goals, Pier 94/96 infrastructure improvements would need to be completed and the project areas available to the OSW industry for development as soon as possible. The environmental review and regulatory agency permitting timeframes for larger capital improvement projects are typically lengthy and involve iterative processes. For larger development projects in the San Francisco Bay Area, planning, design, and permitting can take approximately 5 to 8 years. However, this timeline is influenced by the size and nature of the required site improvements and/or new construction. To meet the needs of the OSW industry, an accelerated planning, design, and regulatory permitting duration of 3 to 4 years is recommended. Assumptions for this accelerated timeline include the following primary Project elements and assumptions: removal and replacement of existing wharf, site development including improvements and operations for OSW site uses, no dredging will be required as existing water depths are sufficient, and NEPA/CEQA lead agencies will be identified in advance.

M&N's rough order magnitude cost for the regulatory applications and approval process is estimated in the $1.5-$4 million range with a number of influencing variables. Challenges to the regulatory approval timeline and approval process include community outreach to address community concerns and impacts, biological resource impacts, ensure adequate project mitigations, and/or legal challenges. Recommendations for timeline acceleration include pursuit of a joint CEQA/NEPA environmental review process, early identification and development of mitigation programs and strategies, agency consultation and permit applications including a USACE Section 408 approval, and community engagement and outreach. A high-level summary of steps involved in moving through the NEPA/CEQA process and securing all required permits and approvals is provided below.

2. Introduction

In May 2021, the federal government announced a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030 and 110 GW by 2050. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind ("OSW") in the U.S. by 2035.

On August 1, 2022, the California Energy Commission (CEC) established a preliminary offshore wind planning goal of 2-5 GW by 2030 and 25 GW by 2045. It is anticipated approximately 1300 turbines at an average capacity of 20 MW each are required to meet this target. Work completed to date in Federal and State OSW studies has identified a need for Bay Area ports to serve as Manufacturing (MF) sites for the offshore wind industry to help meet the CEC planning goals and to maximize job creation and economic impact for the State of California.

The Port of San Francisco (Port) is uniquely positioned to serve the offshore wind industry and has identified the Pier 94/96 maritime wharfs and terminal areas as a strong candidate for the development of five different OSW site uses:

1. Manufacturing / Fabrication Site for offshore wind components including nacelles, towers, blades, etc. (MF OSW Components)
2. Manufacturing / Fabrication Site for floating foundations (MF Foundations)
3. Mooring Line, Anchor, and/or Electrical Cable Manufacturing and Laydown Site
4. Construction Support Facility
5. Operation and Maintenance Site (O&M)

Each of the OSW site types will have varying design criteria including acreage, wharf length and loading capacity, minimum vessel draft at berth, and adjacent uplands/yard loading capacity. The purpose of this memorandum is to identify environmental and permitting considerations that may impact the development options, cost, and schedule for the Pier 94/96 sites to support the offshore wind (OSW) industry.

3. Project Background and Description

The Port is interested in redeveloping the existing Pier 94/96 site to support the OSW industry. The project will evaluate Pier 94/96 as a candidate site for assembly of floating offshore wind foundation systems and components or as a manufacturing site for other OSW components. In addition to supporting the OSW industry, the site may also be used as an emergency response staging area by the Federal Emergency Management Agency (FEMA).

The Pier 94/96 Offshore Wind Study project area selected for evaluation in this conceptual design and planning study is comprised of approximately 95 acres of Port owned land including the Pier 94/96 maritime wharfs, nearshore terminals, and adjacent backland areas (see Figure 1 and 2). Piers 94 and 96, constructed in the mid 1960's and 1970's respectively, include deep draft berths (38 feet), available wharf deck area roughly 1,550 ft long, on-dock rail with freight rail access, four ship-to-shore gantry cranes (abandoned/to be removed), and maintenance and operational buildings. The adjacent backland areas included in the OSW Study project area current uses include construction material storage and staging, sand and rock material handling and truck transfer, and rail.

In 2022, the Port commissioned an initial study of earthquake vulnerability and found the Pier 94/96 wharf and terminal area highly vulnerable to earthquake damage including liquefication of the uplands, slope failures of the shoreline, and damage and collapse of pile supported bulkheads and wharves (Port of San Francisco, Initial Southern Waterfront Earthquake Assessment, January 2022, Parsons/RJSD JV).

Figure 1: Project Location Map

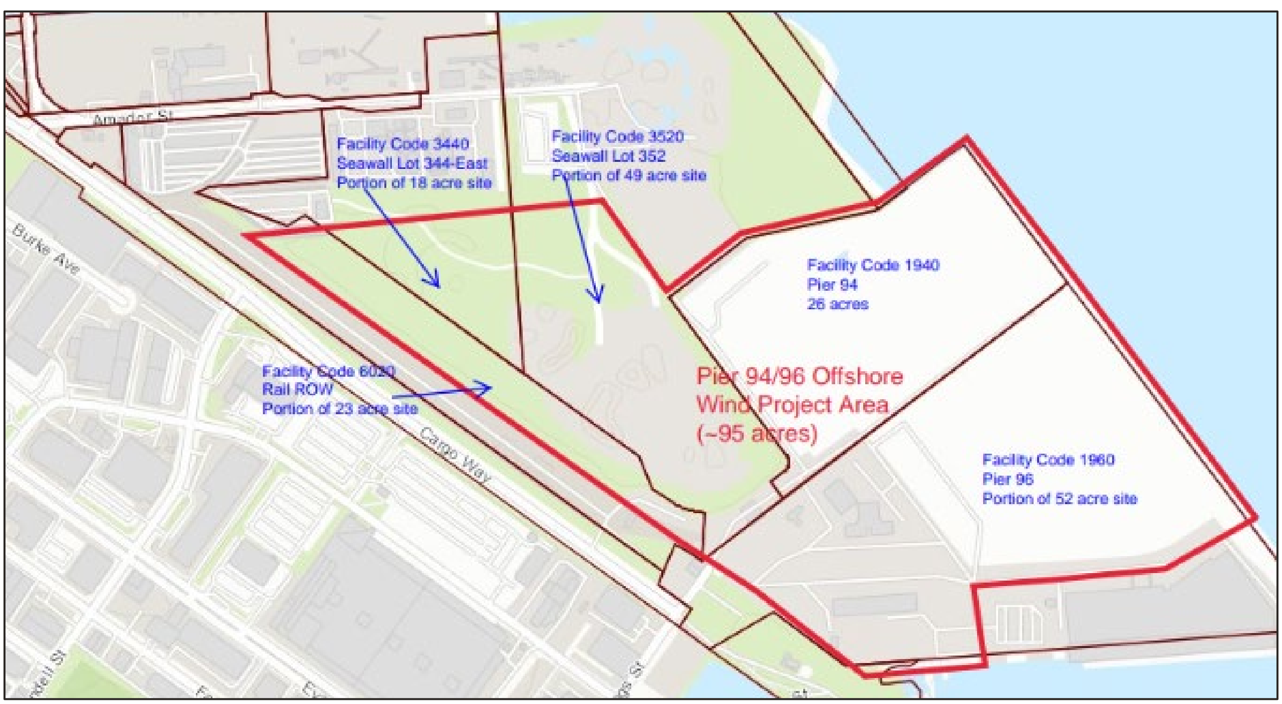

Figure 2: Project Facility Codes and Areas

The following Pier 94/96 infrastructure improvements are required to meet the demands of the OSW site uses including manufacturing facility for OSW components or manufacturing for OSW floating fountains:

1. **Remove and Replace Pier 94/96 Wharf:** Demolition of the existing wharf and construction of a new wharf (~5 acres of area) is required for OSW manufacturing sites that require a heavy lift area.

    - The existing wharf within the project limits is 1550 ft long by 78 ft wide. The existing 18-inch deck concrete structure will be removed. In addition, existing piles will also be removed down to 1 foot above the existing dike. The existing wharf is comprised of 18-inch concrete octagonal piles that are generally spaced 12 ft in the longitudinal direction and 10 feet in the transverse direction, except the two pile rows that support the existing crane rails are spaced 6 ft in the longitudinal direction. The fender system also consists of 16-inch timber piles spaced at 6 ft in the longitudinal direction. Therefore, 1300 concrete piles and 260 timber piles will be removed down to 1 foot above the existing dike.

    - A new pile supported wharf, 1550 ft long by 150 ft wide (~5 acres), supported by new steel pipe piles will be constructed (**see Figure 3**). Piles will be spaced every 12 ft in the longitudinal direction and 14 ft in the transverse direction. A total of 1430 30-inch diameter steel pipe piles (11 piles per bent, at 130 bents) will be driven to approximate elevation of -220 feet or to bedrock (whichever is higher). The wharf deck will consist of a 3 ft thick concrete deck topped with 3 ft of dense graded aggregate. The finish grade of the deck will be +17 ft NAVD88.

2. **Ground Improvements:** Install deep soil mixing (DSM) along the full length of the wharf on the landside to mitigate liquefaction-induced settlement and to mitigate lateral spread due to liquefaction and softening of young bay mud in the design seismic event. The extents of the DSM are 130 ft deep and 75 ft wide towards the landside (see Figure 3).

3. **Working Surface Improvements:** Regrading and installation of additional surface fill may be required in upland areas of the site to improve surfaces and address sea level rise. Approximately 90 acres of existing land behind the wharf area will be regraded and topped with 3 ft of dense grade aggregate.

4. **Civil Site Improvements:** To support the OSW and FEMA Emergency site uses, utility improvements would include stormwater, potable water, communications, sewer, and fire water systems.

5. **New Electrical:** New and improved electrical feeds will be required to provide sufficient capacity for the OSW site requirements. This is included, but not limited to, site lighting, vehicle charging, crane power, and shore power for vessels.

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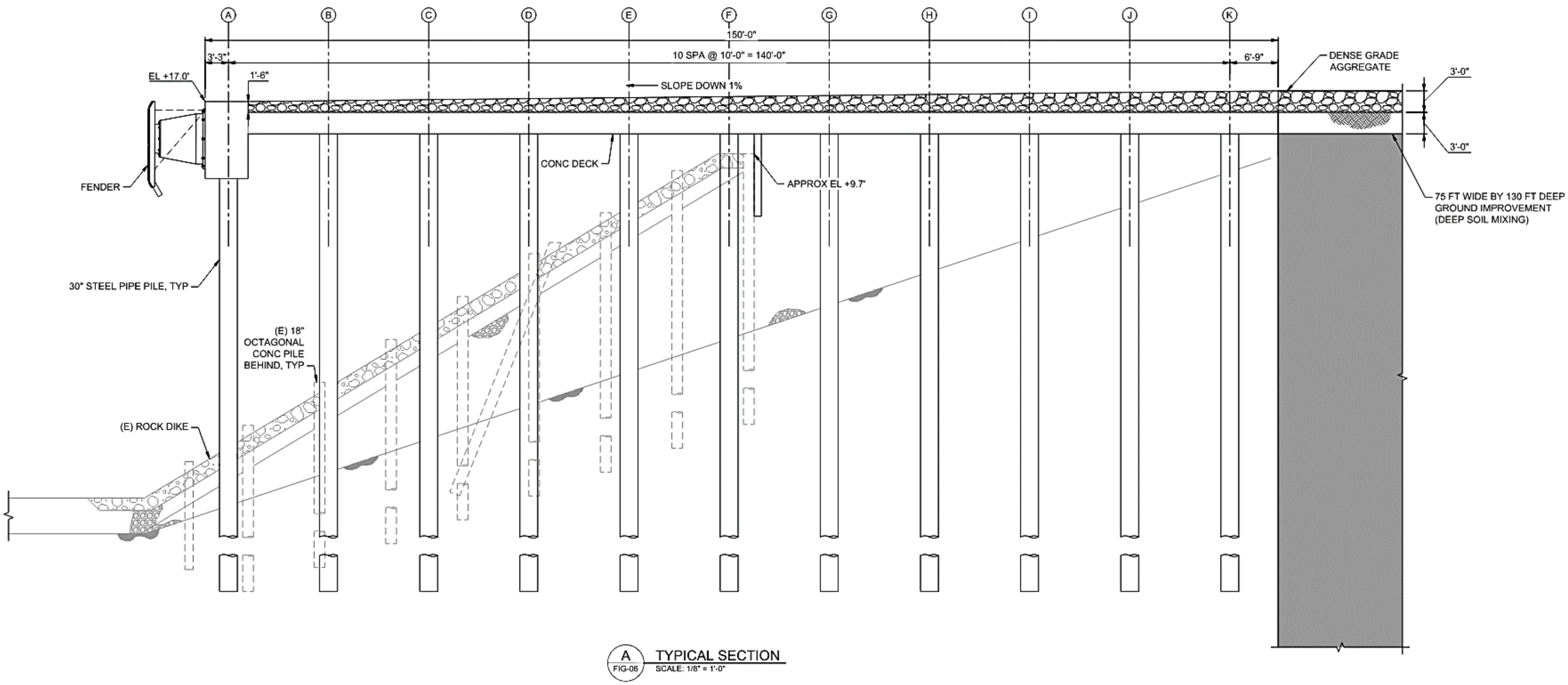

Figure 3: Proposed Wharf Cross Section

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4. Overview of Regulatory Framework

Several federal, state, and local statutes provide the regulatory framework for in-water, shoreline, and upland infrastructure improvement and development activities associated with constructing the OSW support sites at Pier 94/96. This section divides the agencies into federal, state and local categories, details the anticipated applicable federal regulations and agencies with discretionary permitting authority for the Project, and provides notes on Project relevance and considerations for each agency. Table 1 presents this detail for federal agencies, Table 2 presents the regulatory framework for state agencies, and Table 3 presents the regulatory framework for local agencies.

Table 1. Applicable Federal Regulations and Responsible Agencies

Agency	Law, Regulation, or Guidance	Project Relevance and Considerations
United States Army Corps of Engineers (USACE) ***(NEPA Lead Agency to be confirmed)***	National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321 et seq. and Code of Federal Regulations (CFR) 1500 et seq. Council on Environmental Quality Regulations for Implementing NEPA	NEPA environmental document – anticipated to be an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Draft EIS requires a minimum 45-public day review and comment period.
USACE	Rivers and Harbors Act of 1899, Section 10	Requires a permit for work and placement of structures in navigable waters of the U.S.
USACE	Rivers and Harbors Act of 1899, Section 14 as codified in 33 USC 408	Requires a Section 408 permit to modify any USACE structure or navigable waterway. A CWA Section 404 permit (33 U.S.C. §1251 et seq. (1972)) is required for placement of fill in waters of the United States. A Section 10 Rivers and Harbors Act (33 U.S.C. 403; Chapter 425, March 3, 1899; 30 Stat. 1151) permit is required for work within, below, or above navigable waters. Federal Endangered Species Act (FESA) section 7 consultation with National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA NMFS) for the project expected to be required. Resources under NOAA NMFS jurisdiction to be analyzed under separate Biological Assessment.
United States Environmental Protection Agency (USEPA)	Clean Air Act Amendments of 1990	Air Quality Conformity Permits during construction associated with construction equipment

Agency	Law, Regulation, or Guidance	Project Relevance and Considerations
NOAA NMFS, United States Fish and Wildlife Service (USFWS)	Federal Endangered Species Act (ESA) of 1973	ESA species may be present in the Project area. Consultation is required as part of the NEPA review. ESA-listed marine mammals are the species with the most potential to impact the Project in-water activities with respect to noise and turbidity monitoring, resulting in work stoppages during pile installation. Impacts could result in a “Take” that triggers mitigation.
NOAA NMFS	Marine Mammal Protection Act	Non-ESA listed marine mammals may be present in the Project area. Consultation is required as part of the NEPA review. Marine mammals are the species with the most potential to impact the Project in-water activities with respect to noise from pile driving, resulting in work stoppages during pile installation. Impacts could result in a “harassment” that triggers mitigation.
NOAA NMFS, USFWS	Magnuson-Stevens Fishery Conservation and Management Act of 1976	Essential fish habitat designation may require consultation; may trigger Best Management Practices (BMPs) and/or mitigation.
NOAA NMFS	National Invasive Species Act of 1996	If presence of invasive species is detected could trigger BMPs for construction vessels and equipment.
NOAA NMFS	Noise Control Act of 1972	Incorporate reasonable and feasible noise abatement measures to reduce or eliminate noise impact.

Table 2. Applicable State Regulations and Responsible Agencies

Agency	Law, Regulation, or Guidance	Project Relevance and Considerations
San Francisco Bay Regional Water Quality Control Board (SFBRWQCB)	Clean Water Act (CWA) Section 401 and Water Quality Certification of 1972, Porter Cologne Act of 1969	401 Water Quality Certification and/or Waste Discharge Requirement (WDR) required for placement of fill or discharge into navigable waters. This determines water quality considerations including potential groundwater contamination, best management practices (BMPs), and turbidity monitoring.
State Lands Commission (SLC)	Public Trust Doctrine	Confirmation that Project is authorized under existing lease agreement or amendment to the current lease required.
California Department of Fish and Wildlife (CDFW)	California Endangered Species Act	2081 Incidental Take Application and Permit.

Agency	Law, Regulation, or Guidance	Project Relevance and Considerations
CalEPA / CARB	Clean Air Act of 1988	Compliance with CARB regulatory program for emission reduction from stationery and mobile sources.
Bay Area Air Quality Management District (BAAQMD)	State Implementation Plan (SIP)	The BAAQMD is responsible for issuing air quality permits for stationary equipment in the Bay Area and management of the resulting emissions. May require Naturally Occurring Asbestos Upland
San Francisco Bay Conservation and Development Commission (BCDC)	McAteer-Petris Act BCDC exercises authority under Section 307 of the federal Coastal Zone Management Act over projects that require a federal permit (e.g., CWA authorization).	Regulate use of the Bay and its shoreline including placement of fill with Bay waters. Issues five types of permits: Major, Administrative/Minor, Regionwide, Abbreviated Regionwide, or Amendments to existing permits. For Major Permits, the public comment period is a minimum of 10 days and a maximum of 90 days. A public hearing may be required for an Administrative Permit but is not required for a Regionwide Permit application.

Table 3. Applicable Local Environmental Regulations and Responsible Agencies

Agency	Law, Regulation, or Guidance	Project Relevance and Considerations
City of San Francisco, Planning Department is lead agency for CEQA	California Environmental Quality Act (CEQA) 1970	CEQA Environmental Document – lead agency will determine appropriate level of CEQA project review required (Negative Declaration (ND), Initial Study/ Mitigated Negative Declaration (MND), or Environmental Impact Report (EIR)). The Port is Project Applicant for Pier 94/96 Infrastructure Improvements. The Port is anticipated to be Co-Applicant for OSW site development and would conduct engineering and structural review of OSW applicant Project plans. Draft ND or MND requires a minimum 20-day public review and comment period. Draft EIR requires a minimum 30-day and maximum of 60-day public review and comment period.
City of San Francisco	City Municipal Code	Demolition, Grading, Building, Fire, Electrical, Plumbing, Water and Sanitation approvals may be required.

To comply with NEPA, an EA or EIS are anticipated to be required. For CEQA, the lead agency would first prepare an Initial Study (IS) to determine whether an EIR or an ND must be prepared or to identify the significant environmental effects to be analyzed in an EIR. Additional analyses and technical studies needed to inform the CEQA/NEPA process include:

1. Biological Resources Assessment
2. Cultural Resources and Archeological Assessment
3. Hazardous Materials Assessment
4. Noise Analysis associated with pile driving, DSM
5. Air Quality Impact Analysis including greenhouse gas (GHG) Emissions
6. Transportation Study

Although the Port Waterfront Plan (San Francisco Planning 2019-023037ENV) references exploring opportunities to generate and use wind power, there are no specific references to OSW, and as such an amendment to the Plan may be required to authorize the final Project. There may be a CEQA action associated with the Plan modification.

5. Regulatory Approvals Timeline

To meet the offshore wind deployment goals by 2030 and 2045, Pier 94/96 would need to be available to the offshore wind industry for use as soon as possible. To obtain all required approvals for the Project, the following stages are involved:

1. Compliance with the required State (CEQA) and Federal (NEPA) environmental review processes
2. Consultation and application with permitting agencies
3. Outreach and consultation with affected stakeholders.
4. Obtaining Project permits.

The environmental review and permitting timeframes for larger capital improvement projects are typically lengthy and involve iterative processes. The general high-level steps that make up the anticipated permitting process (and which can overlap to some degree) are as follows:

1. Development of Project concept
    a. Site data collection, review and development of conceptual Project Description
    b. Discussions with permitting agency staff
    c. Exploration of joint CEQA/NEPA approach
2. Technical analyses
    a. Engineering support – develop and implement field investigations to support design, e.g., bathymetry, topographic and utility surveys, soil and groundwater characterization, naturally occurring asbestos characterization.
    b. CEQA/NEPA and permitting support – technical studies and analyses including noise, transportation, biological resources, cultural resources, air quality and GHG emissions.
3. Development of Project Description and Alternatives Analysis for Initial Study under CEQA
    a. File Notice of Intent to prepare CEQA document.
    b. Draft CEQA Environmental Document
    c. Receive and respond to public comments.
    d. Final Environmental Document

    e. Notice of Determination
4. Develop and submit applications and supplemental studies for Federal, State and local permits
    a. Permit application deemed complete through to issue
5. As-needed consultations with trustee and partner agencies
6. Completion and approval of all permit prior-to issuance tasks

For larger development projects in the San Francisco Bay Area, planning, design, and permitting can take approximately 5 to 8 years. However, this timeline is influenced by the size and nature of the required site improvements and/or new construction. To meet the needs of the OSW industry, an accelerated planning, design, and regulatory permitting duration of 3 to 4 years is recommended.

6. Timeline Assumptions

The following are potential schedule risks to achieving an accelerated 3 to 4 year permitting timeline:

1. Any additions to the primary Project components which are beyond the currently envisioned scope, e.g. adding dredging activities to the Project may extend the permitting timeline.
2. Delays in performing site investigations or obtaining site data may extend the permitting timeline.
3. Due diligence relating to existing land use, land use plans, and potential covenants and restrictions.
4. Delays in engagement with the utility provider (PG&E) to provide electrical infrastructure for the site.
5. Delays in confirming that SF Planning will act as the CEQA lead agency and USACE will act as the NEPA lead agency.
6. Adding inputs from potential tenants late in the process may extend the timeline for environmental documents and permits.

7. Regulatory Approvals ROM Cost

An ROM cost for the regulatory approval process is estimated to be in the $1.5-$4 million range. This cost will vary according to whether NEPA/CEQA requires an EIS/EIR or IS/MND, whether updated/sufficient biological resource, cultural, hazardous material data exists for the site, and the duration of the regulatory agency liaison process. This ROM cost does not include any agency required project mitigation negotiated during the permitting process.

8. Challenges to the Timeline

The benefit of the Port site is that the area is already zoned for maritime industrial use and has the benefit of existing accessibility, workforce, power availability, and strong Port staff interest.

The Port has created and restored wetlands within the Pier 90-96 area, including a three-acre wetland at Pier 94 and eight acres of natural areas within nearby Heron's Head Park. If Project construction activities or proposed use/traffic are interpreted to pose a challenge to these areas, the timeline could be extended. Eelgrass has been previously observed in the Project vicinity but not documented within the general Project area. Therefore, it is not anticipated to create an impact mitigation need. However, an updated eelgrass survey will likely be required to determine the pre-construction presence or absence.

It is important to note that the Section 408 process with USACE (which would be required if any modifications to a federal navigable waterway are proposed) can involve USACE HQ approval and may take 2-3 years to finalize.

There are several additional factors that have the potential to prolong the regulatory approval and permitting timelines. The factors are listed below for informational purposes only and were not included in determining the best-case timeframes for Project approvals:

1. Potential to impact adjacent sensitive marine habitat or other coastal resources.
2. Ability to adequately mitigate impacts to satisfaction of stakeholders or identification of acceptable compensatory mitigation.
3. Degree of local support or opposition.
4. Any litigation that may be brought against the Project.
5. Availability of Project funding.

9. Recommendations for Timeline Acceleration

The typical timeline associated with securing all required permits and approvals for large in-water and shoreline projects in California can be considerably longer than the timeline which has been identified to meet California's goal of producing 2-5 GW by 2030 and 25 GW by 2045. While the Port is well placed to move expeditiously through the permitting and approvals process, several recommended actions are presented here which could streamline the approval process and accelerate it to meet the industry's goals:

1. A joint CEQA/NEPA environmental review process could help avoid redundancy, improve efficiency and interagency cooperation, and make it easier for applicants and citizens to navigate the Project review and approval process.
2. Allowing the environmental review process to proceed before initiating permit application development and submittal to the pertinent agencies will facilitate any required design refinement as well as public and agency review.
3. The early identification and development of mitigation programs and strategies agreed upon by the agencies in charge of resource protection.
4. Beginning community engagement and outreach as early as possible to develop community support and identify Project effects, alternatives, and mitigation. This has many benefits including reducing the risk of future legal action against the Project.
5. Early identification of need for USACE Section 408 approval.
6. Extension of the Judicial Streamlining provisions of California's Environmental Leadership Development Program[1], as defined in SB 7[2].

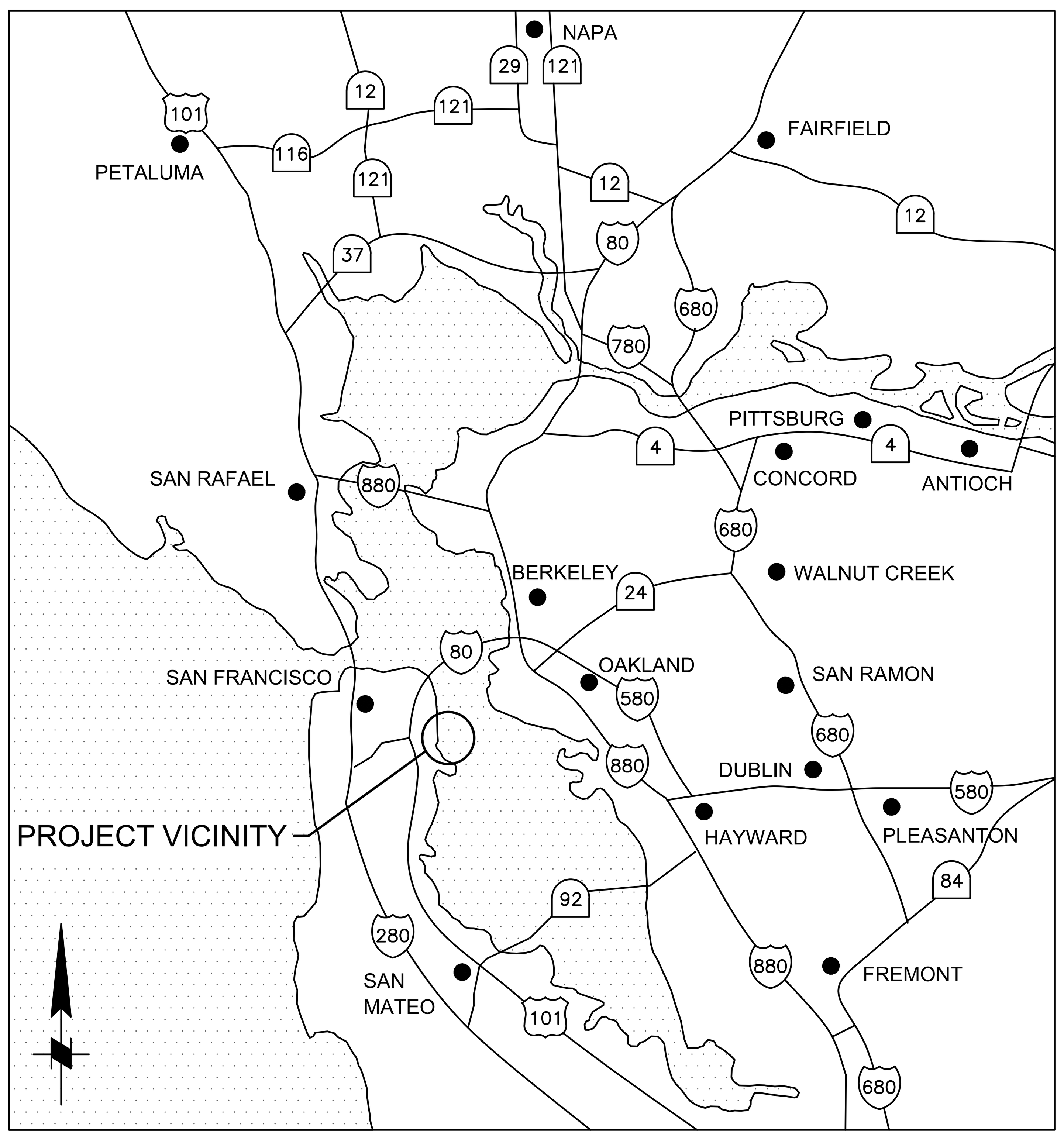
[1] Governor's Office of Planning and Research. Judicial Streamlining. https://opr.ca.gov/ceqa/judicial-streamlining/
[2] Atkins 2021. SB-7 Environmental quality: Jobs and Economic Improvement Through Environmental Leadership Act of 2021. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB7

Attachment H: Conceptual Engineering Drawings

PORT OF SAN FRANCISCO

PIER 94/96 OFFSHORE WIND STUDY

SAN FRANCISCO, CALIFORNIA

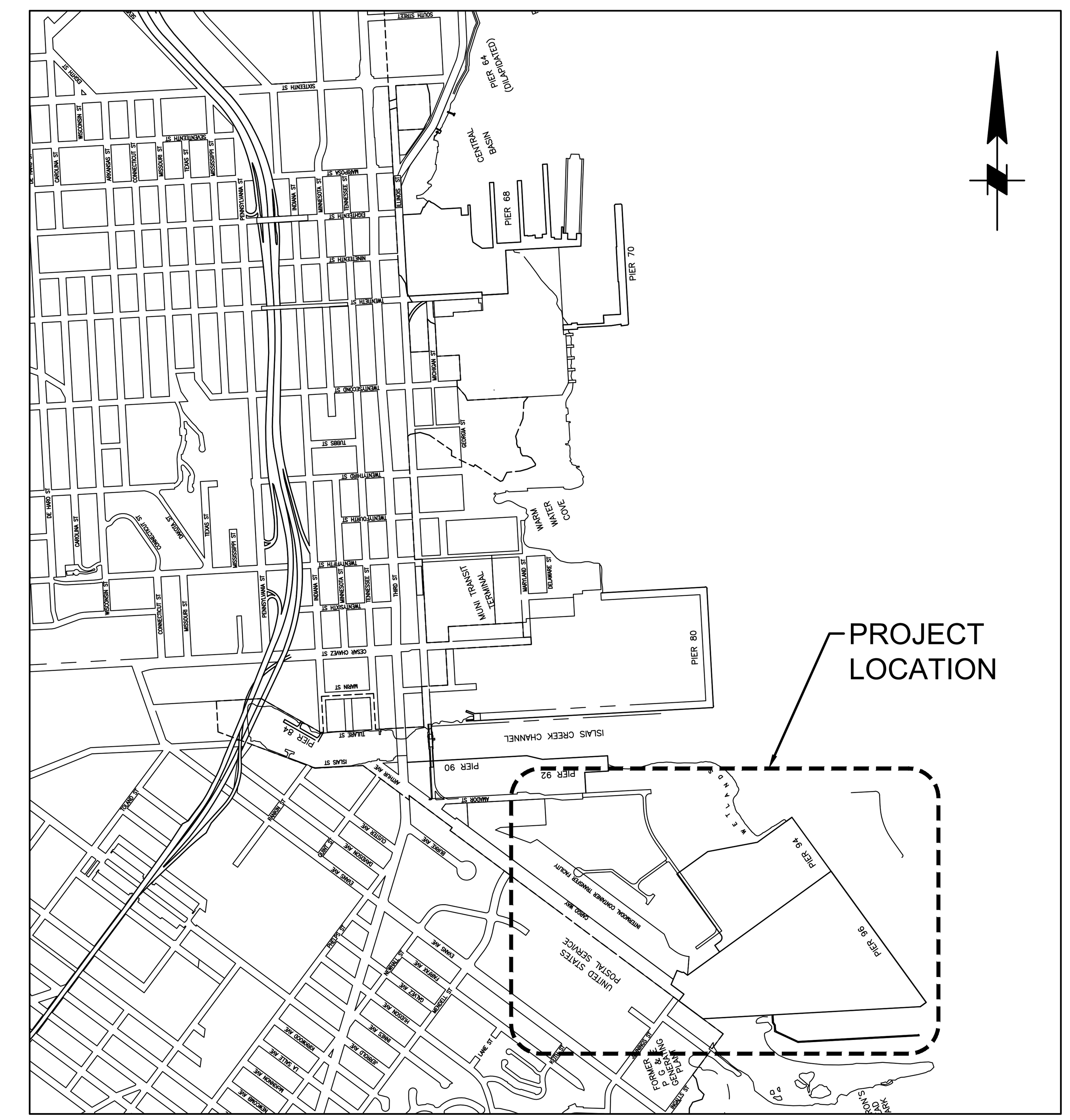


VICINITY PLAN
SCALE: NTS

INDEX OF DRAWINGS	
SHEET NO.	DRAWING TITLE
FIG-01	TITLE SHEET
FIG-02	SITE PLAN
FIG-03	POTENTIAL OFFSHORE WIND SITE LAYOUT - OPTION 1
FIG-04	POTENTIAL OFFSHORE WIND SITE LAYOUT - OPTION 2
FIG-05	EXISTING WHARF SECTION REMOVAL
FIG-06	WHARF PLAN
FIG-07	WHARF SECTION - OPTION 1
FIG-08	WHARF SECTION - OPTION 2

ABBREVIATIONS

AC	ASPHALT CONCRETE
CONC	CONCRETE
(E)	EXISTING
EL	ELEVATION
FT	FOOT OR FEET
MIN	MINIMUM
NAVD88	NORTH AMERICAN VERTICAL DATUM 1988
NTS	NOT TO SCALE
PSF	POUNDS PER SQUARE FOOT
TYP	TYPICAL



LOCATION PLAN
SCALE: NTS

FOR CONCEPT STUDY
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PORT OF SAN FRANCISCO

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

DESIGNED: J. LIM	DATE: 08/02/2023
DRAWN: C. DONOHOE	DATE: 08/02/2023
CHECKED: M.TROWBRIDGE	DATE: 08/02/2023

APPROVED BY
SAN FRANCISCO PORT COMMISSION
DATE: ________

CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

TITLE SHEET

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-01
1 OF 8

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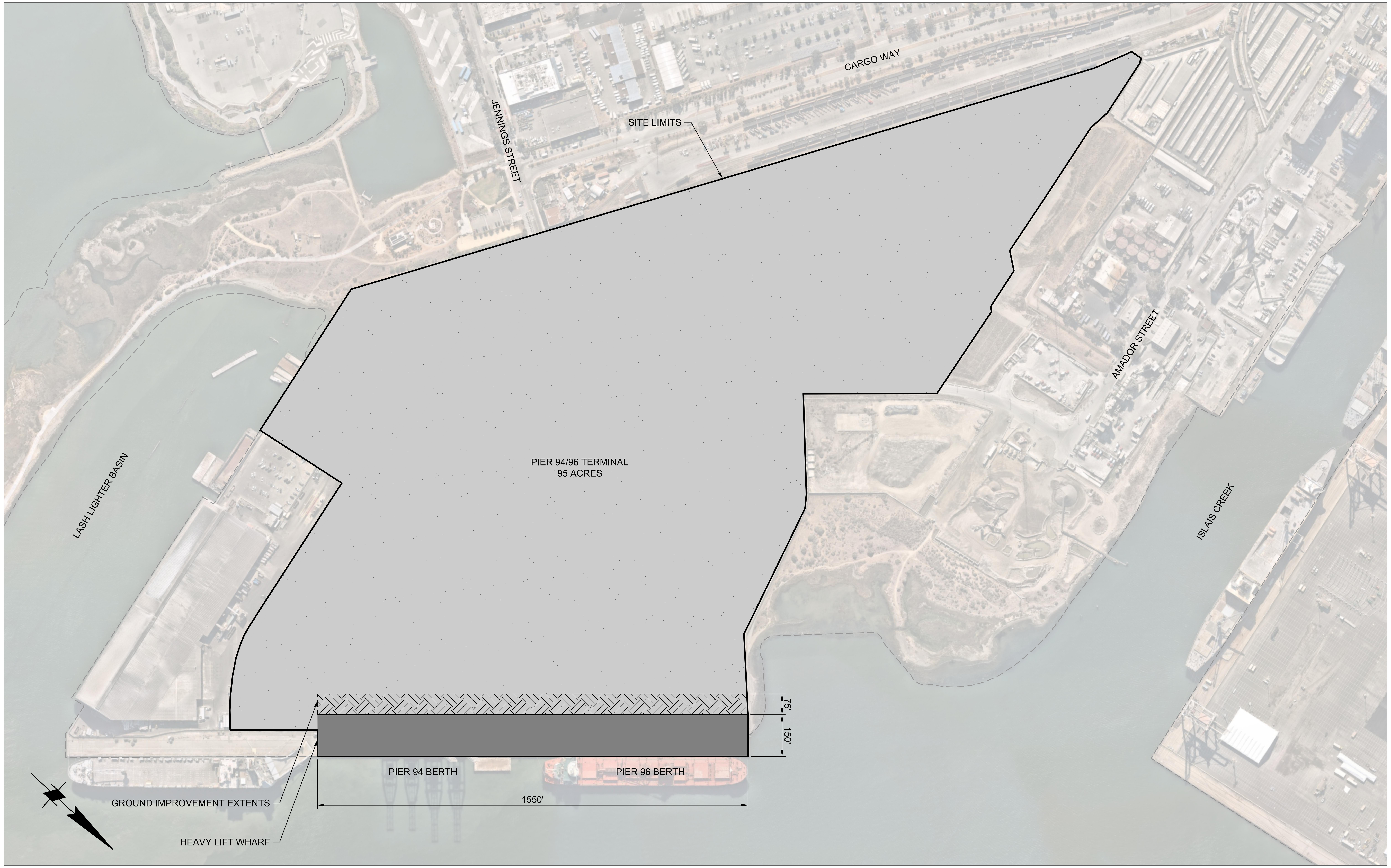

1 - SITE PLAN
SCALE: 1" = 200'

SITE PLAN LEGEND

- HEAVY LIFT UPLANDS
- HEAVY LIFT WHARF
- GROUND IMPROVEMENT

NOTES

1. THESE CONCEPTUAL PLANS DOCUMENT THE PORT OF SAN FRANCISCO PIER 94/96 OFFSHORE WIND STUDY THAT PROVIDE SITE IMPROVEMENTS TO SERVE THE OFFSHORE WIND INDUSTRY.
2. SITE IMPROVEMENTS SHOWN ARE TO SUPPORT AN OFFSHORE WIND MANUFACTURING/FABRICATION SITE. SITE USE IS FLEXIBLE TO SERVE OFFSHORE WIND INDUSTRY NEEDS.
3. EXISTING WATER DEPTH AT PIER 94/96 BERTHS ARE APPROXIMATELY 38-40 FEET.

200' 0' 200' 400'
SCALE: 1"=200'

FOR CONCEPT STUDY
ISSUED: 2023-08-14
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DEPARTMENT OF ENGINEERING

DESIGNED: J. LIM	DATE: 08/02/2023
DRAWN: C. DONOHOE	DATE: 08/02/2023
CHECKED: M. TROWBRIDGE	DATE: 08/02/2023

APPROVED BY
SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

SITE PLAN

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-02
2 OF 8

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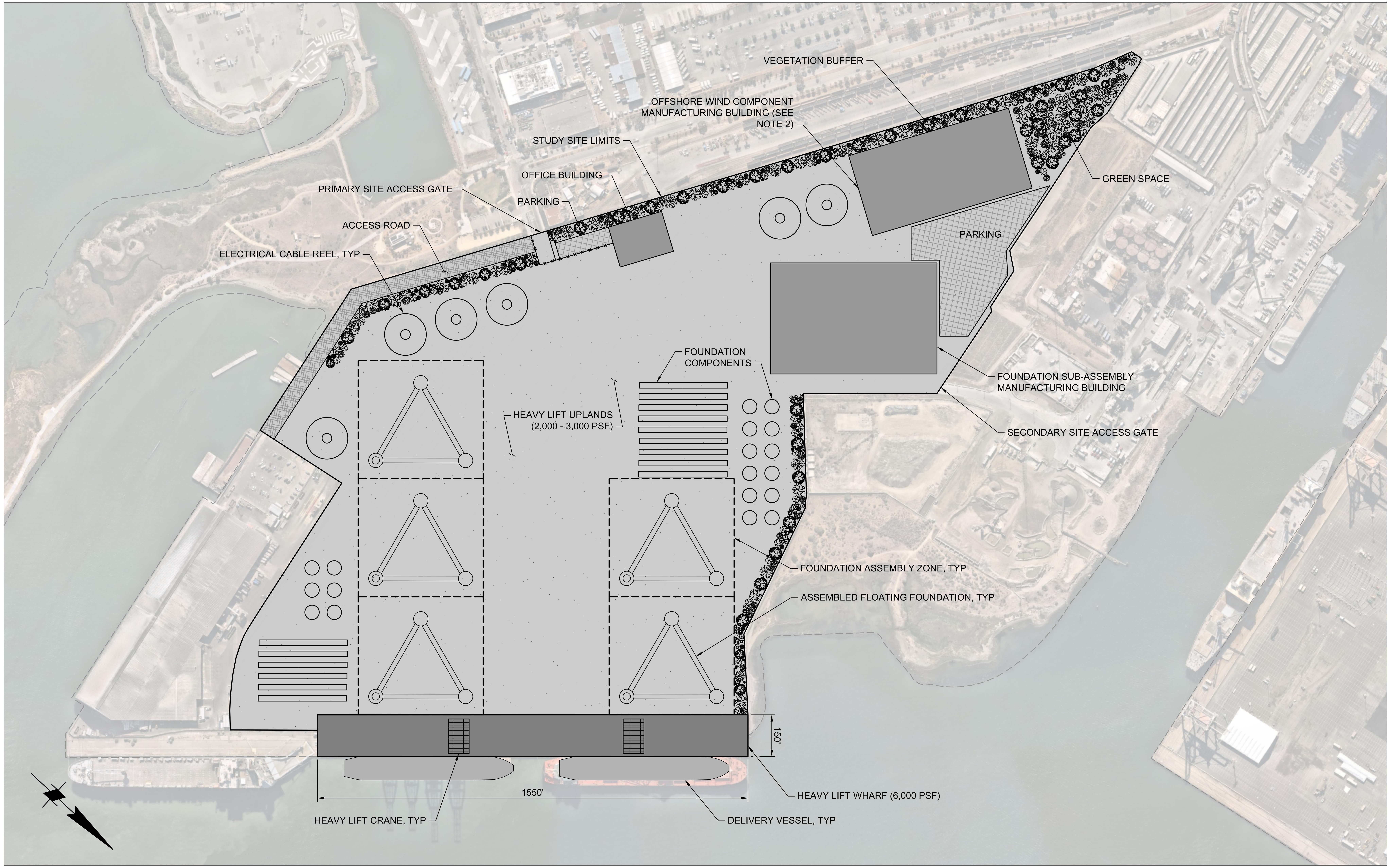

SITE PLAN LEGEND

- HEAVY LIFT UPLANDS
- HEAVY LIFT WHARF
- ACCESS ROAD
- PARKING
- VEGETATION BUFFER
- FENCE
- FLOATING FOUNDATION
- FLOATING FOUNDATION COMPONENTS
- DELIVERY VESSEL
- HEAVY LIFT CRANE
- BUILDING

NOTES

1. OFFSHORE WIND COMPONENT SIZES ARE REPRESENTATIVE.
2. ELECTRICAL CABLE MANUFACTURING SHOWN. ALTERNATIVELY, THE SITE MAY BE USED FOR OTHER MANUFACTURING OPPORTUNITIES INCLUDING FLOATING FOUNDATIONS AND SUB-ASSEMBLIES, BLADES, TOWERS, NACELLES, ANCHORS, CHAINS, AND MOORING LINE.

200' 0' 200' 400'

SCALE: 1"=200'

1 SAMPLE SITE LAYOUT
SCALE: 1" = 200'

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

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DRAWN: C.DONOHOE	DATE: 06/19/2023	
CHECKED: M. TROWBRIDGE	DATE: 06/19/2023	

APPROVED BY
SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

POTENTIAL OFFSHORE WIND SITE LAYOUT - OPTION 1

CONTRACT NO.
DRAWING NO.
SHEET NO. FIG-03
3 OF 8

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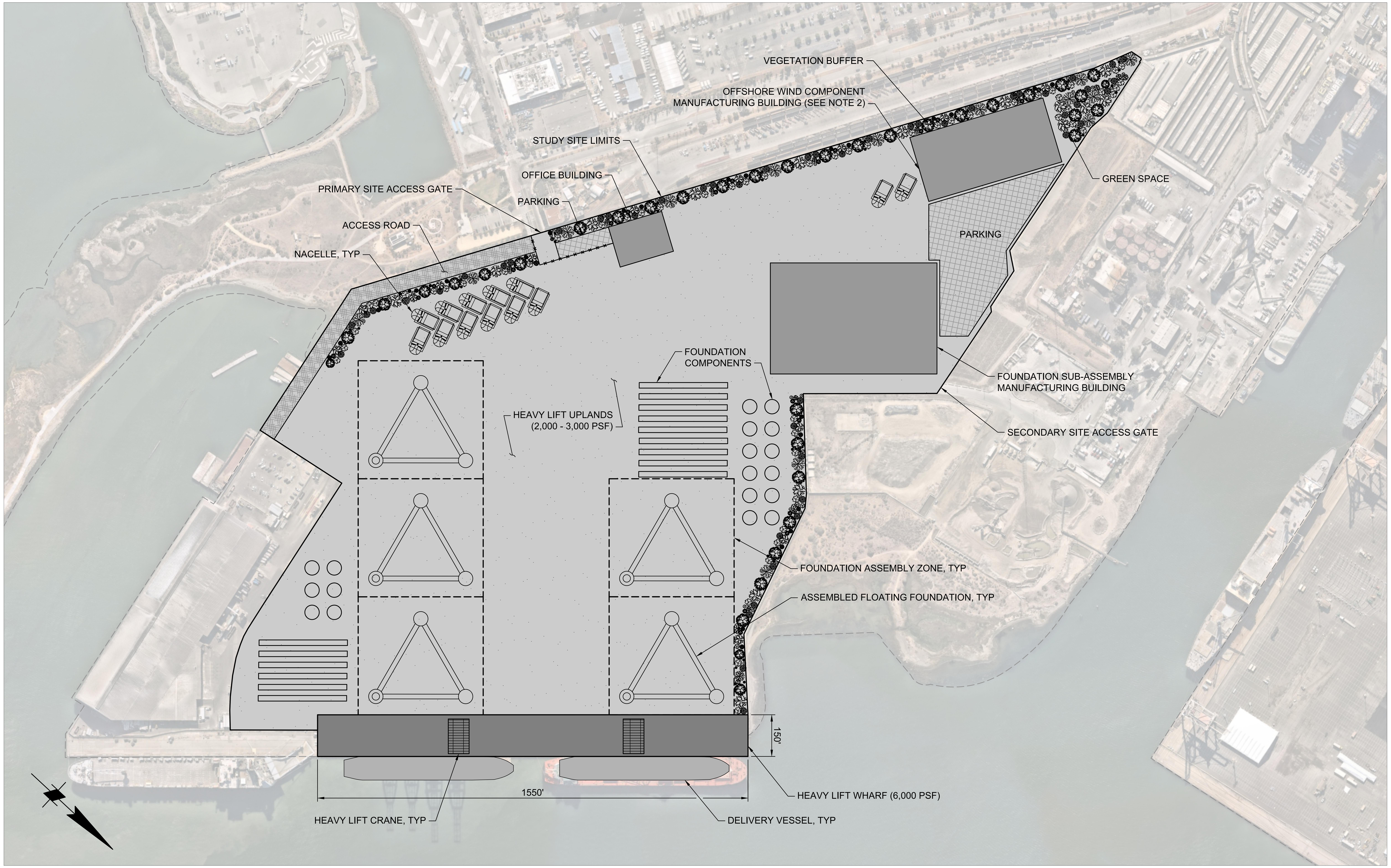

1 SAMPLE SITE LAYOUT
SCALE: 1" = 200'

SITE PLAN LEGEND

- HEAVY LIFT UPLANDS
- HEAVY LIFT WHARF
- ACCESS ROAD
- PARKING
- VEGETATION BUFFER
- FENCE
- FLOATING FOUNDATION
- NACELLE
- DELIVERY VESSEL
- HEAVY LIFT CRANE
- BUILDING

NOTES

1. OFFSHORE WIND COMPONENT SIZES ARE REPRESENTATIVE.
2. NACELLE ASSEMBLY SHOWN. ALTERNATIVELY, THE SITE MAY BE USED FOR OTHER MANUFACTURING OPPORTUNITIES INCLUDING FLOATING FOUNDATIONS AND SUB-ASSEMBLIES, BLADES, TOWERS, NACELLES, ANCHORS, CHAINS, AND MOORING LINE.

200' 0' 200' 400'
SCALE: 1"=200'

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS
CHECK WITH TRACING TO SEE IF YOU HAVE LATEST REVISION

CONSULTANT:
moffatt & nichol
1300 Clay Street, Suite 350
Oakland, CA 94612

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

DESIGNED: J. LIM	DATE: 07/31/2023
DRAWN: C. DONOHOE	DATE: 07/31/2023
CHECKED: M. TROWBRIDGE	DATE: 07/31/2023

APPROVED BY SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

POTENTIAL OFFSHORE WIND SITE LAYOUT - OPTION 2

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-04
4 OF 8

FILE NAME: Q:\WC\220388-01 POSF Pier 94 & 96\20 CADD_Active_SheetSet\ConceptStudy\22038801S-FIG04.dwg
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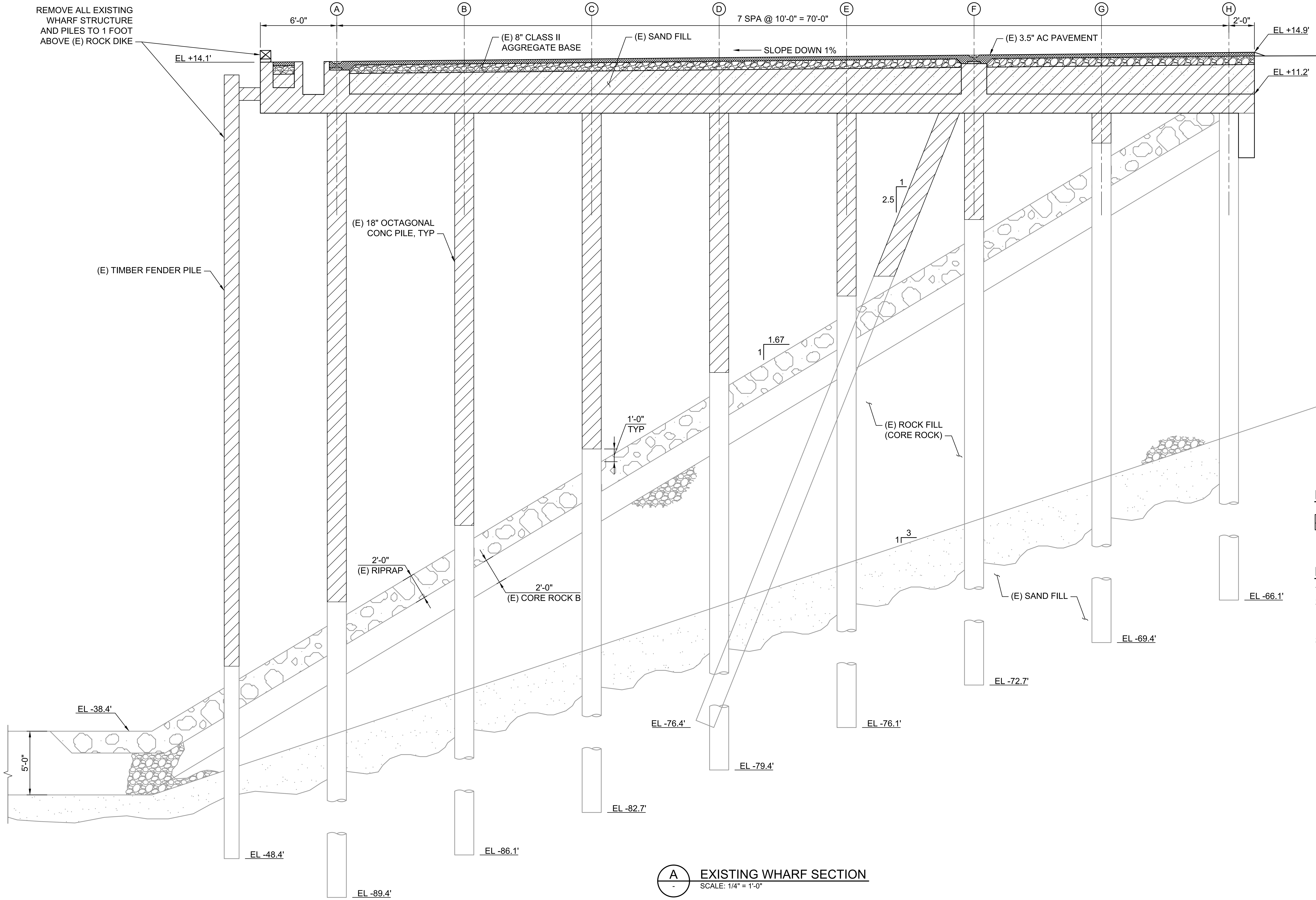

A EXISTING WHARF SECTION

SCALE: 1/4" = 1'-0"

REMOVAL LEGEND

REMOVAL LIMITS

NOTES

1. ELEVATIONS ARE SHOWN IN NAVD88.
2. ALL DIMENSIONS AND ELEVATIONS SHALL BE FIELD VERIFIED PRIOR TO ANY CONSTRUCTION.
3. DECK REINFORCEMENT NOT SHOWN FOR CLARITY.

4'-0" 0'-0" 4'-0" 8'-0"
SCALE: 1/4"=1'-0"

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

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moffatt & nichol
1300 Clay Street, Suite 350
Oakland, CA 94612

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

DESIGNED: J. LIM DATE: 08/02/2023
DRAWN: C. DONOHOE DATE: 08/02/2023
CHECKED: M. TROWBRIDGE DATE: 08/02/2023

APPROVED BY SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

EXISTING WHARF SECTION REMOVAL

CONTRACT NO.
DRAWING NO.
SHEET NO. FIG-05
5 OF 8

FILE NAME: Q:\WC\220388-01 POSF Pier 94 & 96\20 CADD_Active_SheetSet\ConceptStudy\22038801S-FIG05.dwg
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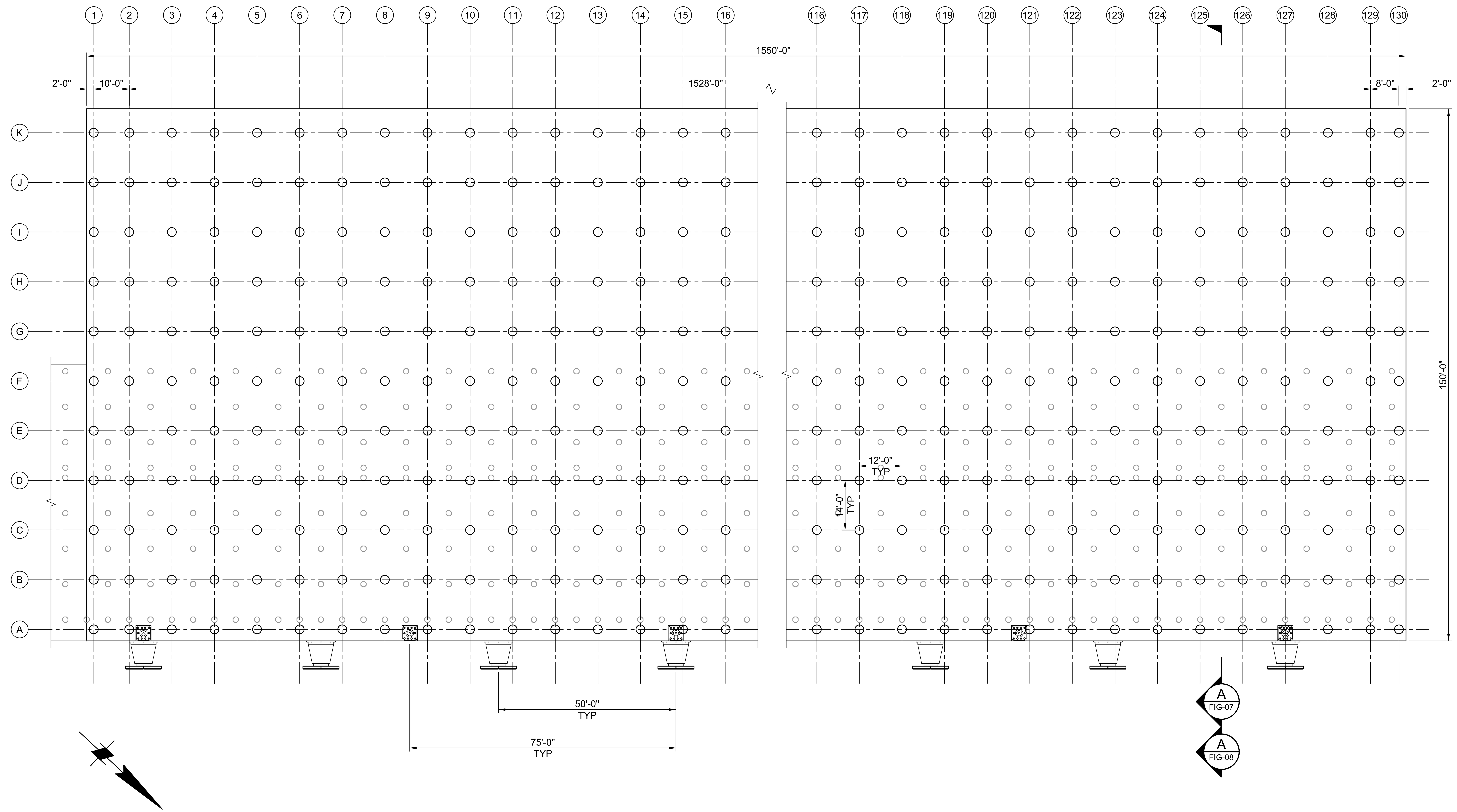

1 - WHARF PLAN
SCALE: 1/16" = 1'-0"

WHARF PLAN LEGEND

- EXISTING PILES
- NEW PILES
- FENDER
- BOLLARD

NOTES

1. THE PILE LAYOUT IS PRELIMINARY AND BASED ON A LIVE LOAD OF 6,000 PSF.
2. PILE TYPE CONSIDERED IS 30 INCH DIAMETER STEEL PIPE PILES.
3. EXPANSION JOINT LAYOUT IS PRELIMINARY.
4. FENDER SYSTEM SHOWN IS PRELIMINARY AND REQUIRES FURTHER EVALUATION FOR PROPOSED SITE USE.

16'-0" 0'-0" 16'-0" 32'-0"
SCALE: 1/16"=1'-0"

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS
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CONSULTANT:
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1300 Clay Street, Suite 350
Oakland, CA 94612

PORT OF SAN FRANCISCO

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

		DATE:
DESIGNED:	J. LIM	08/09/2023
DRAWN:	C. DONOHOE	08/09/2023
CHECKED:	M. TROWBRIDGE	08/09/2023

APPROVED BY
SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

WHARF PLAN

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-06
6 OF 8

FILE NAME: Q:\WC\220388-01 POSF Pier 94 & 96\20 CADD_Active_SheetSet\ConceptStudy\22038801S-FIG06.dwg
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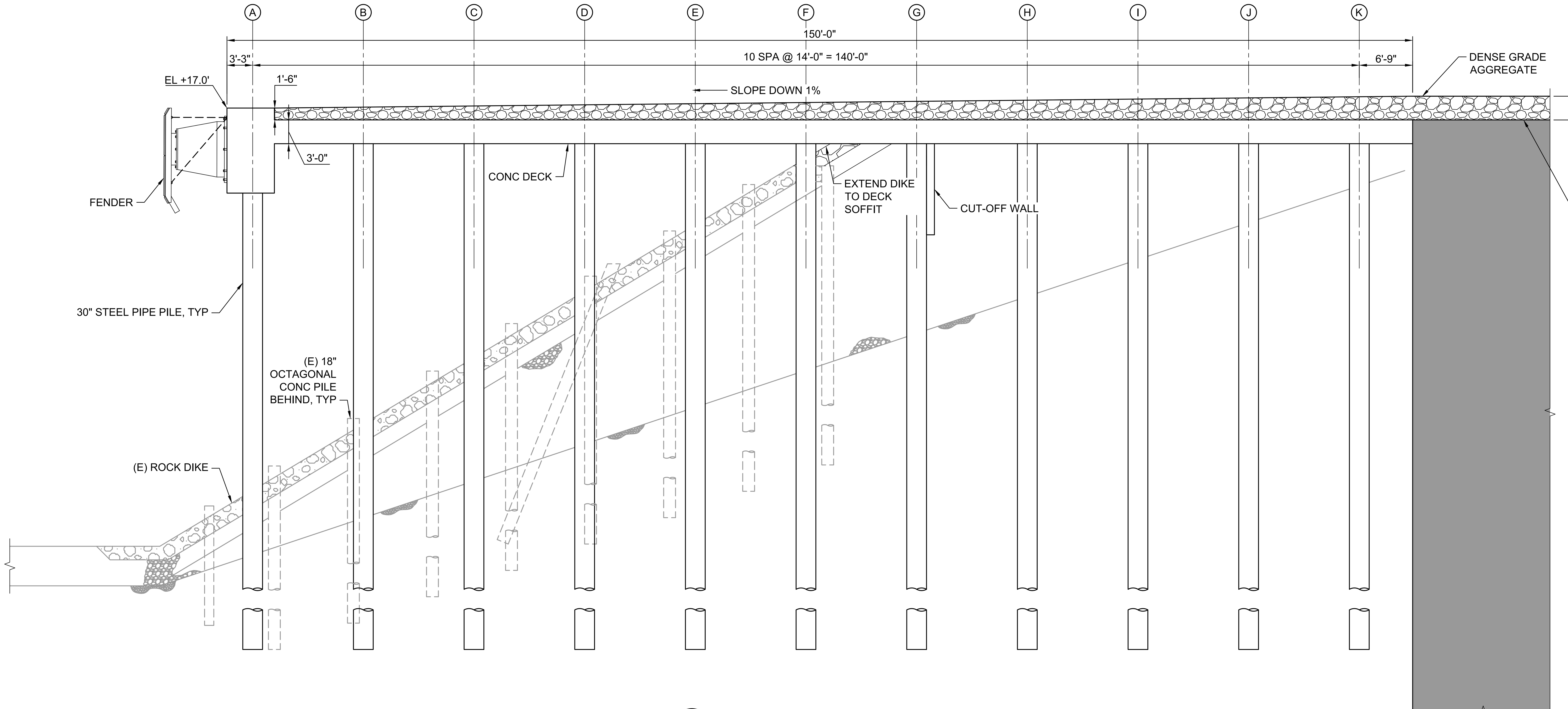

A / FIG-06 TYPICAL SECTION
SCALE: 1/8" = 1'-0"

NOTES

1. DECK SLOPE MAY BE TOWARD THE WATER OR TOWARD LAND. TO BE CONFIRMED IN A FUTURE PHASE.
2. FENDER SYSTEM SHOWN IS PRELIMINARY AND REQUIRES FURTHER EVALUATION FOR PROPOSED SITE USE.

8'-0" 0'-0" 8'-0" 16'-0"
SCALE: 1/8"=1'-0"

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS
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CONSULTANT:
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1300 Clay Street, Suite 350
Oakland, CA 94612

PORT OF SAN FRANCISCO

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

DESIGNED: K. PHAM DATE: 08/08/2023
DRAWN: C. DONOHOE DATE: 08/08/2023
CHECKED: M. TROWBRIDGE DATE: 08/08/2023

APPROVED BY SAN FRANCISCO PORT COMMISSION
DATE: ________
CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

WHARF SECTION - OPTION 1

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-07
7 OF 8

FILE NAME: Q:\WC\220388-01 POSF Pier 94 & 96\20 CADD_Active_SheetSet\ConceptStudy\22038801S-FIG07.dwg
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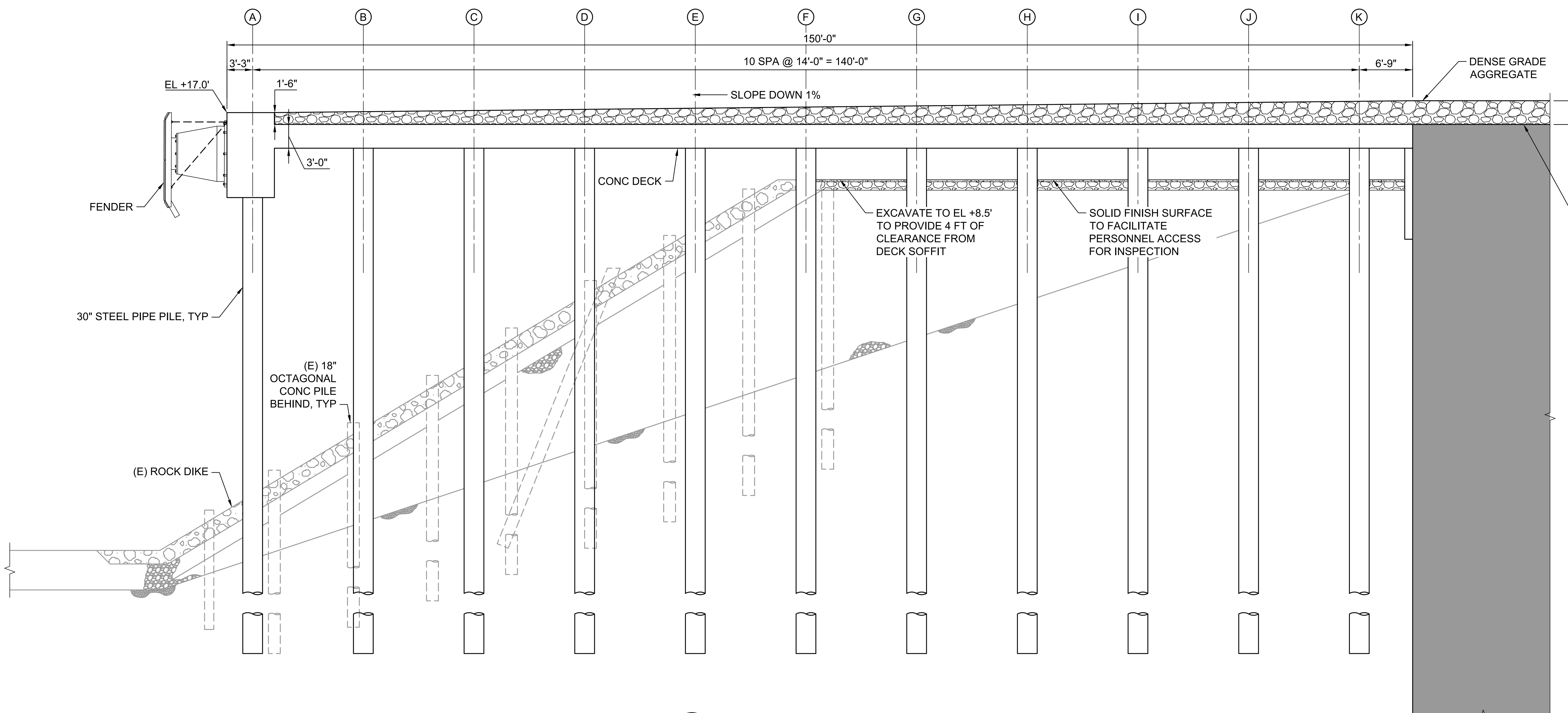

A FIG-06 TYPICAL SECTION
SCALE: 1/8" = 1'-0"

NOTES

1. DECK SLOPE MUST BE TOWARDS THE WATER TO PROVIDE A MIN 4 FT ACCESS AREA FOR PILE INSPECTION.
2. FENDER SYSTEM SHOWN IS PRELIMINARY AND REQUIRES FURTHER EVALUATION FOR PROPOSED SITE USE.

8'-0" 0'-0" 8'-0" 16'-0"
SCALE: 1/8"=1'-0"

FOR CONCEPT STUDY
ISSUED: 2023-08-14
NOT TO BE USED FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS
CHECK WITH TRACING TO SEE IF YOU HAVE LATEST REVISION

CONSULTANT:
moffatt & nichol
1300 Clay Street, Suite 350
Oakland, CA 94612

PORT OF SAN FRANCISCO

SAN FRANCISCO PORT COMMISSION
PORT OF SAN FRANCISCO
DEPARTMENT OF ENGINEERING

		DATE:
DESIGNED:	J. LIM	08/08/2023
DRAWN:	C. DONOHOE	08/08/2023
CHECKED:	M. TROWBRIDGE	08/08/2023

APPROVED BY
SAN FRANCISCO PORT COMMISSION
DATE:

CHIEF HARBOR ENGINEER

PIER 94/96
OFFSHORE WIND STUDY

WHARF SECTION - OPTION 2

CONTRACT NO.
DRAWING NO.
SHEET NO.
FIG-08
8 OF 8

FILE NAME: Q:\WC\220388-01 POSF Pier 94 & 96\20 CADD_Active_SheetSet\ConceptStudy\22038801S-FIG08.dwg
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Attachment I: Project Schedule Memorandum

moffatt & nichol

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www.moffattnichol.com

PROJECT SCHEDULE MEMORANDUM

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Brian Watts & Jennifer Lim (Moffatt & Nichol)
Cc:	Azadeh Bozorgzadeh, Matt Trowbridge, & Carolyn Donohoe (Moffatt & Nichol)
Date:	August 2, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study** **Project Schedule Memorandum**
M&N Job No.:	220388-01

This memorandum documents the concept phase project schedule developed for the Port of San Francisco (Port) Pier 94/96 site. The site layout, shown in Figure 1, illustrates the extents of the project site and their expected use.

Figure 1: Pier 94/96 Concept Phase Site Plan

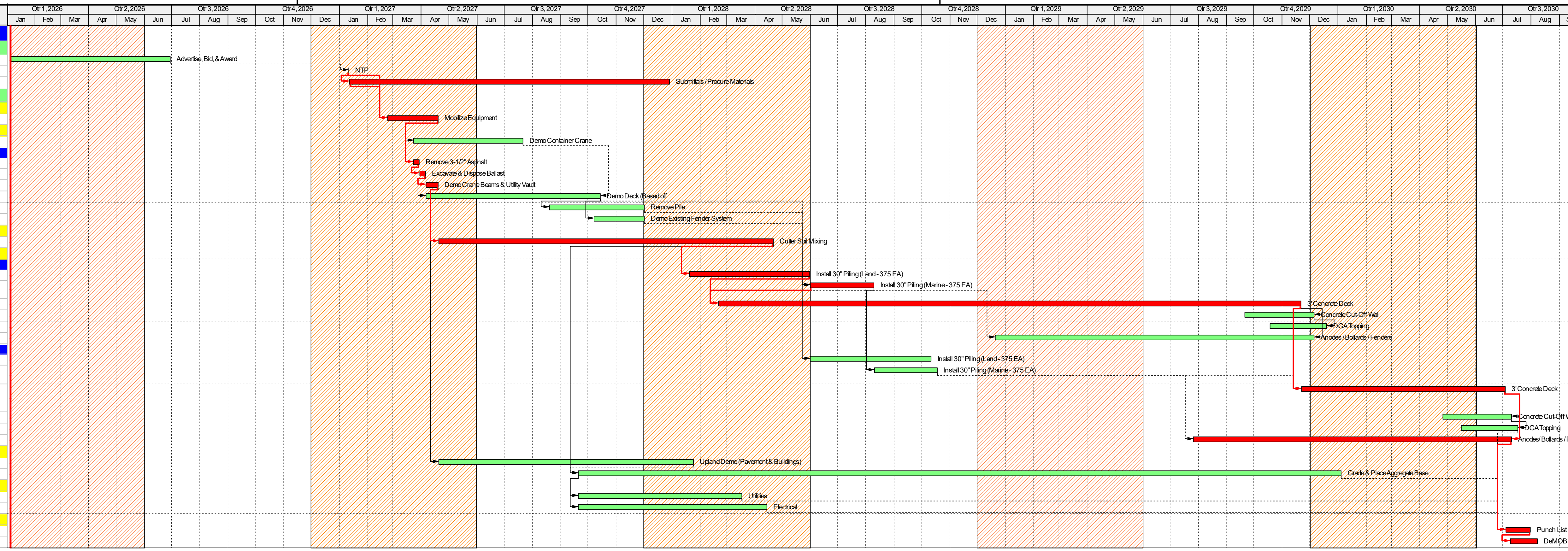
The project schedule was developed to a Level 1 detail, a high-level schedule that reflects the key milestones of the project. Based on a notice to proceed date in January 2027, it is expected that the project would be completed by August 2030. A summary of the key project phases is shown in Table 1. Note, for pile driving, in-water work restrictions are assumed from December 1st through May 31st every year.

Table 1. Pier 94/96 Level 1 Project Schedule Summary

Milestone	Start Date	End Date
Notice to Proceed	January 2027	-
Mobilization	February 2027	April 2027
Demolition	March 2027	December 2027
Ground Improvements	April 2027	April 2028
Wharf Construction	January 2028	July 2030
Uplands Construction	April 2027	January 2030
Utilities and Electrical	September 2027	April 2028
Demobilization	July 2030	August 2030
Site Completion	August 2030	-

1. Note that some activities are completed in parallel.
2. This schedule assumes a work schedule of 5 days per week, 10 hours a day, and accounts for assumed in-water work restrictions.

Activity ID	Activity Name	Planned Duration	Start	Finish	Resources
2023-60F	POSF - Pier 94 & 96 Offshore	1198	05-Jan-26	07-Aug-30	
2023-60F.1	PreConstruction	518	05-Jan-26	29-Dec-27	
A1000	Advertise, Bid, & Award	126	05-Jan-26	29-Jun-26	
A1010	NTP	1	11-Jan-27*	11-Jan-27	
A1020	Submittals / Procure Materials	252	12-Jan-27	29-Dec-27	
2023-60F.2	Construction	902	23-Feb-27	07-Aug-30	
2023-60F.2.1	Mobilization	40	23-Feb-27	19-Apr-27	
A1030	Mobilize Equipment	40	23-Feb-27	19-Apr-27	
2023-60F.2.2	Demolition	182	23-Mar-27	01-Dec-27	
A1040	Demo Container Crane	87	23-Mar-27	21-Jul-27	
2023-60F.2.2.1	Existing Wharf Demo	182	23-Mar-27	01-Dec-27	
A1050	Remove 3-1/2" Asphalt	5	23-Mar-27	29-Mar-27	
A1060	Excavate & Dispose Ballast	5	30-Mar-27	05-Apr-27	
A1070	Demo Crane Beams & Utility Vault	10	06-Apr-27	19-Apr-27	
A1080	Demo Deck (Based off	138	06-Apr-27	14-Oct-27	Rig 1 Crew,
A1090	Remove Pile	75	19-Aug-27	01-Dec-27	Rig 3 Crew
A1100	Demo Existing Fender System	40	07-Oct-27	01-Dec-27	Rig 1 Crew,
2023-60F.2.3	Ground Improvements	264	20-Apr-27	21-Apr-28	
A1110	Cutter Soil Mixing	264	20-Apr-27	21-Apr-28	
2023-60F.2.4	Wharf Construction	650	20-Jan-28	17-Jul-30	
2023-60F2.4.1	Pier 94	500	20-Jan-28	19-Dec-29	
A1115	Install 30" Piling (Land - 375 EA)	95	20-Jan-28	31-May-28	
A1120	Install 30" Piling (Marine - 375 EA)	50	01-Jun-28*	09-Aug-28	Rig 1 Crew, Rig 2 Crew
A1140	3' Concrete Deck	458	21-Feb-28	21-Nov-29	Rig 3 Crew
A1150	Concrete Cut-Off Wall	54	21-Sep-29	05-Dec-29	
A1160	DGA Topping	45	18-Oct-29	19-Dec-29	
A1170	Anodes / Bollards / Fenders	250	21-Dec-28	05-Dec-29	
2023-60F2.4.2	Pier 96	555	01-Jun-28	17-Jul-30	
A1175	Install 30" Piling (Land - 375 EA)	95	01-Jun-28	11-Oct-28	
A1180	Install 30" Piling (Marine - 375 EA)	50	10-Aug-28	18-Oct-28	Rig 1 Crew, Rig 2 Crew
A1190	3' Concrete Deck	160	22-Nov-29	03-Jul-30	Rig 1 Crew, Rig 2 Crew, Rig 3 Crew
A1200	Concrete Cut-Off Wall	54	26-Apr-30	10-Jul-30	
A1210	DGA Topping	45	16-May-30	17-Jul-30	
A1220	Anodes/ Bollards / Fenders	250	26-Jul-29	10-Jul-30	
2023-60F.2.5	Uplands Construction	709	20-Apr-27	04-Jan-30	
A1230	Upland Demo (Pavement & Buildings)	200	20-Apr-27	24-Jan-28	
A1240	Grade & Place Aggregate Base	600	20-Sep-27	04-Jan-30	
2023-60F.2.6	Utilities & Electrical	150	20-Sep-27	14-Apr-28	
A1250	Utilities	130	20-Sep-27	17-Mar-28	
A1260	Electrical	150	20-Sep-27	14-Apr-28	
2023-60F.2.7	DeMobilization	25	04-Jul-30	07-Aug-30	
A1270	Punch List	20	04-Jul-30	31-Jul-30	
A1280	DeMOB	22	09-Jul-30	07-Aug-30	



Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work

TASK filter: All Activities

Attachment J: Cost Estimate Memorandum

moffatt & nichol

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Oakland, CA 94612

(510) 645-1238
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COST ESTIMATE MEMORANDUM

To:	Rod Iwashita & Simon Betsalel (Port of San Francisco)
From:	Brian Watts & Jennifer Lim (Moffatt & Nichol)
Cc:	Azadeh Bozorgzadeh, Matt Trowbridge, & Carolyn Donohoe (Moffatt & Nichol)
Date:	August 2, 2023
Contract:	FSP Contract ID: 1000027731 Contract Service Order #: MN-01
Subject:	**Pier 94/96 Offshore Wind Study** **Cost Estimate Memorandum**
M&N Job No.:	220388-01

This memorandum documents the concept phase construction cost estimate developed for the Port of San Francisco (Port) Pier 94/96 site. The site layout, shown in Figure 1, illustrates the extents of the project site and their expected use.

Figure 1: Pier 94/96 Concept Phase Site Plan

1. AACE Class 4 Cost Estimate

The cost estimate was developed to an AACE International Class 4 level with an accuracy of -20% / +30%. The estimate was developed using historical and current data using in-house sources, and information from previous studies. The cost estimate is broken up into the following main line items:

1. Contractor Mobilization / Demobilization
    - Item 1 includes costs for contractor mobilization and demobilization.
2. Heavy Lift Wharf
    - Item 2 includes infrastructure for the 150-feet wide heavy lift wharf with 30" concrete-filled steel pipe piles concrete piles, 3-feet thick deck, additional appurtenances such as a fender and bollard system, and 3-feet of dense grade aggregate on top to create the working surface.
3. Uplands
    - Item 3 includes grading and compaction, 3 feet of dense grade aggregate, and water quality measures for the uplands area once the fill and surcharge are completed.
4. Deep Soil Mixing (DSM) Ground Improvement
    - Item 4 includes landside ground improvement 75-feet wide and 130-feet deep along the length of the heavy lift wharf.

Table 1 provides a summary of the cost estimate. The total construction cost for Pier 94/96 is approximately $910 million and can range from $728 million to $1.18 billion. This includes indirect costs from the Contractor, 40% contingency, and 15% soft costs.

A more detailed breakdown that includes quantities and unit prices is provided as an attachment to this memorandum.

Table 1. Pier 94/96 AACE Class 4 Cost Estimate (-20% / +30%)

Item	Description	Total Direct Cost	Total Construction Cost [1]	Total Construction Cost (with Contingency) [2]
1	Contractor Mobilization / Demobilization	$ 15,537,000	$ 20,312,000	$ 28,437,000
2	Heavy Lift Wharf	$ 272,185,000	$ 355,834,000	$ 498,167,000
3	Uplands	$ 112,748,000	$ 147,397,000	$ 206,356,000
4	Ground Improvement	$ 58,982,000	$ 77,108,000	$ 107,951,000
Sub-Total		**$ 459,452,000**	**$ 600,651,000**	**$ 840,911,000**
Soft Costs (15%)				$ 68,917,000
Total Project Cost				**$ 909,829,000**

Footnotes:
[1] Total Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision (General Conditions), Corporate Overhead and Profit, and Bonds and Insurance costs.
[2] Total Construction Cost (with Contingency) includes a project contingency of 40%. The contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.

2. Notes and Assumptions

Below is a summary of additional notes and assumptions that were made to determine the cost.

1. This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing, or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.
2. The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors. All costs are in 2023 US Dollars. Estimate does not include escalation.
3. Total Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision (General Conditions), Corporate Overhead and Profit, and Bonds and Insurance costs.
4. Total Construction Cost (with Contingency) includes a project contingency of 40%. The contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.
5. This cost estimate represents an AACE 18R-97 Class 4 Estimate.
6. Estimate assumes a single mobilization and demobilization for each scope of work.
7. Estimate assumes mobilization and demobilization of contractors’ equipment comes from within a 250-mile radius.
8. Volumes for uplands site preparation are based on currently available topographic information. Additional surveys and exploration will be required. Results of this additional exploration program may require quantity and price updates.
9. Estimate does not include any costs for construction site property lease or acquisition expenses.
10. No extreme weather risk included (force majeure).
11. Estimate is based on currently available geotechnical information.
12. Price does not include any associated costs due to hazardous waste.
13. Price does not include any costs for post construction site remediation or reconstruction.
14. Estimate does not include locating, protecting, or moving any existing underground utilities.
15. Estimate assumes a work schedule of 5 days per week, 10 hours per day.
16. For pile driving, in-water work restrictions are assumed from December 1st through May 31st every year.
17. Costs assume there is adequate space for contractor laydown and staging areas.
18. Crane demolition cost is based on "*POSF – Crane Demo Specification Review And Budget Estimate*" Report prepared by Liftech for POSF, September 16,2022

moffatt & nichol	CLIENT: Port of San Francisco	JOB NO	220388/01		
	PROJECT: Pier 94/96 Offshore Wind Study	SHEET	1	OF	1
	DESIGN FOR: Port of San Francisco MF Site	DESIGNER	BW	DATE	7/28/23
	Opinion of Probable Cost	CHECKER	EZ	DATE	7/28/23

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$15,537,100**
1.1	Construction Mobilization	1	LS	$15,537,016	$15,537,100	
2	**Wharf**					**$272,185,500**
2.01	Demolition of Existing Concrete Wharf	232,500	SF	$60	$13,950,000	
2.02	Crane Demolition	4	EA	$710,000	$2,840,000	
2.03	30" Closed-End Steel Pipe Piles (1" thick walls)	337,200	LF	$460	$155,112,000	
2.04	Install Piles	1,500	EA	$16,750	$25,125,000	
2.05	Coating on Piles	794,500	SF	$10	$7,945,000	
2.06	Concrete Fill for Wharf Pile Plugs (15')	3,500	CY	$1,300	$4,550,000	
2.07	Concrete Deck (3' thick)	25,900	CY	$1,650	$42,735,000	
2.08	Cut-Off Wall (14" Thick, 10' Tall)	700	CY	$3,850	$2,695,000	
2.09	Dense Graded Aggregate (DGA) Topping Surface (3' thick)	50,600	TON	$60	$3,036,000	
2.10	Anodes	3,000	EA	$3,200	$9,600,000	
2.11	Bollards	37	EA	$34,500	$1,276,500	
2.12	Fenders	27	EA	$123,000	$3,321,000	
3	**Uplands**					**$112,747,600**
3.1	Demo of Existing Buildings	41,300	SF	$150	$6,195,000	
3.2	Demo of Existing Pavement	4,138,300	SF	$1	$4,138,300	
3.3	Grading and Compaction of Uplands Soils	4,138,300	SF	$1	$4,138,300	
3.4	Dense Graded Aggregate (DGA) Topping Surface (3' thick)	900,100	TON	$60	$54,006,000	
3.5	Site Stormwater system	95	AC	$45,000	$4,275,000	
3.6	Site Water system	95	AC	$56,000	$5,320,000	
3.7	Site Electrical system	95	AC	$365,000	$34,675,000	
4	**Deep Soil Mixing**					**$58,981,650**
4.01	Landside DSM	168,519	CY	$350	$58,981,650	
	Direct Costs Subtotal					**$459,451,850**
5	**Construction Indirects**					**$141,198,900**
5.1	Supervision (General Conditions)	12	%		$55,134,300	
5.2	Bonds & Insurance	1.5	%		$7,718,800	
5.3	Corporate Overhead & Profit	15	%		$78,345,800	
	Total Construction Costs					**$600,650,750**
6	**Contingency**					**$240,260,500**
6.1	Design Contingency	15	%		$90,097,700	
6.2	Owner Contingency	10	%		$60,065,100	
6.3	Construction Contingency	15	%		$90,097,700	
	Total Construction Costs with Contingency					**$840,911,250**
7	**Soft Costs**					**$68,917,800**
7.1	Soft Costs	15	%		$68,917,800	
	Total Project Cost					**$909,829,050**
					AACE Expected Acuracy Range (min) -20%	**$727,863,000**
					AACE Expected Acuracy Range (max) +30%	**$1,182,778,000**