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Humboldt Bay Harbor, Recreation, and Conservation District
October 2022

moffatt & nichol

REDWOOD MULTIPURPOSE MARINE TERMINAL PROJECT

Preliminary Basis of Design

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Glossary

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute for Steel Construction
ASCE	American Society of Civil Engineers
ASD	allowable stress design
AWS	American Welding Society
BFE	base flood elevation
BOEM	Bureau of Ocean Energy Management
CBC	California Building Code
CCR	California Code of Regulations
CEC	California Electrical Code
CGP	Construction General Permit
CMC	California Mechanical Code
CPT	cone penetration test
FAA	Federal Aviation Administration
FIRM	FEMA Flood Insurance Rate Map
GHG	greenhouse gas
GW	gigawatts
Harbor District	Humboldt Bay Harbor, Recreation, and Conservation District
HAT	Highest Astronomical Tide
IES	Illumination Engineering Society
IGP	Industrial General Permit
LAT	Lowest Astronomical Tide
LID	Low Impact Development
LRFD	Load Resistance Factor Design
MBL	minimum breaking load
MEG4	Mooring Equipment Guidelines, 4th Edition
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
OCIMF	Oil Companies International Marine Forum
OCS	Outer Continental Shelf
OSHA	Occupational Safety and Health Administration
PIANC	Permanent International Association of Navigation Congresses
PV	photo-voltaic
RCP	Representative Concentration Pathway
RMT	Redwood Marine Terminal
ROW	right of way
SIC	Standard industrial Classification
SLR	sea level rise
SPMT	self-propelled modular transporter
SWL	safe working load
SWPPp	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
UFC	Unified Facilities Criteria
UHMW	ultra-high molecular weight

US	United States
USACE	United States Army Corps of Engineers
USCS	United States Customary System
WTG	wind turbine generation
WWTP	Wastewater Treatment Plant

1. Introduction

1.1. Background

The offshore wind industry in the Pacific Outer Continental Shelf (OCS) region in the United States (US) 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. The federal government announced in May 2021 a goal to deploy 30 gigawatts (GW) of offshore wind in the US by 2030. California Assembly Bill 525, amended June 17, 2021, directs state agencies to develop a strategic plan and to set statewide goals for offshore wind production by 2030 and 2045. These production goals will drive industry development, including development of port infrastructure, that is purpose built to support the deployment of offshore wind projects in the Pacific Ocean. Due to water depths, traditional fixed foundations of offshore wind turbines are not feasible and floating foundations are to be used.

The project objective is to develop Humboldt Bay marine infrastructure and upland space into a Marshalling and Integration port to support the Offshore Floating Wind Industry in the Pacific OCS region. This project seeks to redevelop the existing Redwood Marine Terminal Berth 1 (RMT1), and its associated uplands so that it can serve as the primary facility for the manufacturing, import, staging, preassembly, and loadout of large offshore wind components, including both wind turbine generation (WTG) components and floating foundation components. RMT1 is located within the Port of Humboldt Bay and is uniquely located with no air draft restrictions and direct access to a federally maintained deep water channel. It is comprised of approximately 160 acres of useable upland space. Upgrades to the existing uplands, utilities, and marine infrastructure are required for RMT1 to serve as the regional WTG staging port and component and foundation manufacturing port.

A new berth, RMT2, is required to accommodate an additional offshore wind energy developer. The facility's existing size, location, and direct unimpeded access to open water, as well as vicinity to the Bureau of Ocean Energy Management (BOEM) offshore wind Humboldt Call Area make it an ideal candidate to serve as an offshore wind hub (co-location of marshalling and manufacturing terminals) in this region. Additionally, the terminal can support future BOEM lease areas in Oregon and Central California, including the Morro Bay and Diablo Canyon call areas.

The RMT1 site was developed as a lumber mill on the Samoa Peninsula in the 1890s. The Samoa Pulp mill was built on the site of the lumber mill in 1965. In 1993 the pulp mill was closed, then reopened in 2000. By that time most of the buildings on the mill site had been demolished. The pulp mill was closed for good in 2008. The Humboldt Bay Harbor, Recreation, and Conservation District (Harbor District) purchased the site in 2013, and much of the facility has since been demolished. (Humboldt Bay Maritime Industrial Use Market Study, 2018).

Once Offshore Floating Wind Industry demand decreases, the terminal would serve as a multi-use or multi-industry facility as other business opportunities arise.

1.2. Existing Site Description and Location

The existing RMT1 is located on the Samoa Peninsula in the Port of Humboldt Bay, California; see Figure 1-1, Figure 1-2, and Figure 1-3. The site has two main areas: the wharf and the uplands. The uplands generally consist of both paved and unpaved surfaces. The existing wharf is constructed of timber and provides an approximately 1,136-foot-long berth. The site was previously used to support the timber industry and currently services commercial fishermen, an aquaponics research facility, and a hagfish processing / shipping operation.

FIGURE 1-1: REDWOOD MARINE TERMINAL LOCATION

FIGURE 1-2: REDWOOD MARINE TERMINAL (RMT) – PROJECT SITE (GOOGLE EARTH 2019)

1.3. Project Description

The proposed RMT Project will serve as an import, storage, pre-assembly, and loadout facility for wind towers, nacelles, and blades to service the offshore wind market. This marshalling port will have the potential to import, stage, pre-assemble, manufacture, and integrate components for offshore wind turbine systems on the order of 15 – 25 MW .

The design effort will include consideration of later development phases of the larger hub with a focus on vertical integration and onsite fabrication of device base. Other uses are developed at a programmatic level and design of those uses (such as manufacturing buildings) would be outlined under a supplemental Basis of Design at a future date..

The proposed site plan for the terminal is shown on Figure 1-2.

This project includes the following site upgrades:

Uplands

- Execution of wetlands mitigation project
- Demolition of various buildings
- Demolition of existing site utilities
- Grading and compaction of soil
- Ground improvement
- Installation of site storm water collection and treatment system
- Installation of potable and fire suppression water systems
- Installation of perimeter fencing and associated lighting and security
- Installation of new high mast lighting grid
- Installation of electrical service to meet site requirements
- Installation of elevated outlet racks for nacelles
- Installation of dense graded aggregate top surface to support operational loading

Marine Infrastructure

- Execution of wetlands mitigation project
- Demolition of 200,000 SF existing timber pile-supported wharf structure
- Installation of two pile-supported wharves (steel piles & concrete superstructure)
- Dredge to accommodate delivery vessels and floating foundations at wharf berth
- Placement of dredge material on southern section of RMT1
- Placement of slope protection (rock revetment)
- Installation of mooring dolphins for vessel berthing
- Installation of mooring dolphins for wet storage of floating foundation and fully integrated devices
- Dredge a sinking basin to accommodate semi-submersible barge
- Dredging the designated wet storage areas around the navigation channels[1]

[1] *The owner and operator or the terminal can choose to eliminate this area from the design and use an off-site location to store the semi-sub barge*

1.4. Scope of Basis of Design

This BOD states the basis for the specific design criteria adopted for the RMT development for incorporation into the basic design. It consists of design data assembled and developed during the preliminary design phase and identifies required codes and references for the design of individual project elements. The BOD is a living document and will be updated as the design matures. RMT project / future development requirements for design life, materials, and operational performance will be added in future revisions of this document. Reference to a value of 'TBD' indicates a design parameter or decision that is still under development.

1.5. Functional Requirements

The following requirements represent the functional aspects that shall be incorporated into the basic design:

1. Site designed for minimum top of subgrade elevation of +17.0 ft NAVD88. Cutting and filling the site will be required to achieve the finished grade elevation. This subgrade elevation is above the FEMA 100 year flood elevation and meets the medium high risk aversion for 2080 as dictated by the State of California Sea-Level Rise Guidance 2018 Update and the California Coastal Commission Recent Update to Best available Science Rising Seas Science Report and OPC State of California Sea-Level Rise Guidance, 2018 Update.

2. Site drainage will be in compliance with the State of California storm water collection and treatment regulations.

3. Site lighting will be in compliance with OSHA and US Coast Guard regulations. It is assumed that high mast lighting will be used. Supplemental lighting will be used where occasional work tasks require additional light greater than what is provided in the area. The lighting must be located or shielded so it is not mistaken for, or interferes with, marine navigational lights.

4. The access road will be designed to meet the county road standards at the connection to existing county roads and in areas outside the Harbor District property. Within the Harbor District property, an alternative road design section may be selected. Three access points to the site will be provided: north access from Vance Avenue, a west entrance from Navy Base Road and a south access point.

5. All areas accessible for crawler cranes shall be designed with a flexible pavement of well graded crushed rock of a minimum thickness of 3 ft (to be confirmed) on the uplands and 3 ft on the wharf.

6. The wharf and uplands shall be designed to accommodate the design vessels and the heavy lifting, transport, and storage loading associated with both WTG components and floating foundations (i.e., cranes and SPMTs). Based on anticipated site use, the design uniform live loading criteria shall be 3,000 psf for the uplands and 6,000 psf (to be confirmed) on the wharf.

7. The berth shall be designed to accommodate the delivery vessel and/or the semi-submersible barge. The berth shall also be designed to accommodate a fully assembled floating foundation. The berth shall be dredged to an elevation of -40 ft MLLW with a 2-ft over dredge allowance to accommodate a 35-ft draft vessel with a minimum under keel clearance of 3 ft at MLLW. Dredging footprint shall extend to the navigation channel.

8. The berth shall accommodate roll-on / roll-off (RORO) vessels for offload of wind components directly from a delivery vessel. The berth shall be designed to accommodate only one RORO vessel at berth at a time and shall have adequate fendering and mooring points to accommodate this operation.

9. The semi-submersible barge lay-by area shall be designed to accommodate only the semi-submersible barge. This area shall be dredged to an elevation of -21 ft MLLW with a 2-ft over dredge allowance to accommodate a 19-ft draft semi-submersible barge with a minimum under keel clearance of 2 ft. This dredge depth is intended to accommodate the semi-submersible barge

only. The turbine foundation will be placed on the semi-submersible barge at the berth. Dredging footprint shall extend to the navigation channel.

10. The marine structures are not designed for vessel or barge impact, vehicular impact, blast loading, or other impact loads.
11. The marine structures shall be designed to minimize environmental impact by minimizing berth deepening and maximizing overlap with existing wharf footprint to minimize impacts on bay bottom habitat.
12. 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. It is recognized that in some instances the spacing will be exceeded as needed to match structural or operational requirements.
13. The site will be designed to prevent local settlement that would inhibit SPMT movement. It is understood that the site will settle over time, and that additional gravel may be required to be placed on site in the future to compensate for settlement over time. The upland bearing capacity, settlement criteria, and differential settlement criteria will be determined in the next design phases, after discussion with the device components manufacturer(s).

2. Datums and Units

The horizontal coordinate system shall be North American Datum of 1983 (NAD83), California State Plane Zone 1.

The vertical coordinate system shall be North American Vertical Datum of 1988 (NAVD88), Geoid 12B.

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

3. Codes, Standards, and References

3.1. Codes & Standards

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

American Association of State Highway and Transportation Officials (AASHTO):

- AASHTO LRFD (Load Resistance Factor Design) Bridge Design Specifications, Ninth Edition, 2020
- AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Sixth Edition, 2013

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 61-14, Seismic Design of Piers and Wharves

American Welding Society (AWS):

- AWS D1.1, Structural Welding Code, 2020

California Code of Regulations (CCR):

- 2019 California Building Code (CBC)
- 2019 California Electrical Code (CEC)
- 2019 California Mechanical Code (CMC)

Illumination Engineering Society (IES):

- The Lighting Handbook, 10th edition

National Fire Protection Association (NFPA):

- 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 WG 33, Guidelines for the Design of Fenders Systems, 2002
- PIANC WG 34, Seismic Design Guidelines for Port Structures, 2001
- PIANC WG 153, Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals, 2016

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

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

3.2. References

Available reports previously prepared for the project site are as follows:

- BST Associates, 2018. *Humboldt Bay Maritime Industrial Use Market Study DRAFT REPORT*.
- LACO, 2013. *Samoa Industrial Waterfront Preliminary Transportation Access Plan*
- LACO, 2021. *Humboldt Bay California's Wind Energy Port – HBHRCD Conceptual Master Plan*
- PB Ports & Marine, Inc., 2003. *Port of Humboldt Bay Harbor Revitalization Plan*
- Shatz Energy Research Center, 2020. *Port Infrastructure Assessment Report*
- SHN Preliminary Geotechnical Data Report, Redwood Multipurpose Marine Terminal, Samoa, California, 09/08/2022
- EMI, Summary of Geotechnical Study, 09/01/2022
- EMI, Preliminary Site-Specific Acceleration Response Spectra Recommended for Seismic Design of Redwood Multipurpose Marine Terminal, Humboldt Bay, Samoa, California, 09/22/2022.

Other references include:

- BOEM, 2016. *Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii (BOEM 2016-011)*
- California Ocean Protection Council & California Natural Resources Agency, 2018. *State of California Sea-Level Rise Guidance: 2018 Update*
- California Coastal Commission, 2018. *Recent Updates to Best Available Science: Memo to Staff, May 7, 2018*
- NOAA, Nautical Chart No. 18622
- USACE, 2021. *Humboldt Bay Samoa Channel Condition Survey, 22 April 2021*

4. Operational Criteria

After construction the site will be turned over to an operator who will be responsible for all activities at the site for the specified term of their contract. The operator may change over the life of the facility. The high-level concept of operations for the site is as follows.

WTG and floating foundation components, including blades, nacelles, tower sections, and foundation elements, are imported at the berth via a delivery vessel. Two methods for transfer from the delivery vessel onto the wharf will be accommodated. The first method consists of using a vessel or wharf-based crane to lift the components from the vessel to the wharf. The second method consists of a RORO operation. This method uses SPMTs to drive onto the vessel, onboard the components, and then transport the components off the vessel and onto the wharf. In both methodologies, SPMTs are used to transport the component from the wharf to the upland storage area.

This methodology is used extensively in the offshore wind industry due to its ability to handle and efficiently spread significant loads to achieve manageable applied loads on the structures and/or subgrade below.

The terminal design will accommodate the fabrication of floating offshore wind turbine foundations on the uplands. This activity can also occur at an alternative site. If the foundation is fabricated at this facility, a serial production line will likely be used. This type of production will start at the western extent of the terminal and move east as structural elements are added to the unit. When the foundation unit is complete, it is stationed at the southern end of the wharf for roll-out onto a semi-submersible barge. The foundation can be loaded out using a ramp system or a semi-submersible barge. In this study, the semi-submersible barge option is used as it provides maximum flexibility. The semi-submersible barge will be moored at the berth. The completed foundation unit is moved onto the semi-submersible barge via SPMTs, an example of this procedure is shown in Figure 4-1. The semi-submersible barge then transports the foundation to a predetermined deep water area and performs a “float-off” operation in which the semi-submersible barge ballasts down until the foundation becomes buoyant. The foundation is towed back to the berth area, where it is outfitted with the WTG components (tower, nacelle, and blades), an example of this procedure is shown in Figure 4-2. These components are typically placed onto the foundation using a large land-based crawler crane. The fully assembled wind turbine (foundation and WTG components) is towed out to the wind farm installation site and anchored in place.

FIGURE 4-1: SEMI-SUBMERSIBLE FOUNDATION BEING LOADED ONTO A SEMI-SUBMERSIBLE BARGE USING SPMTS
(Source: Wilson Offshore & Marine)

FIGURE 4-2: WTG COMPONENTS ASSEMBLED ON SEMI-SUBMERSIBLE FOUNDATION AT QUAYSIDE
(Source: Principle Power)

5. Environmental Criteria

5.1. Metocean Conditions

Figure 5-1 presents the location of metocean gauges discussed in this section.

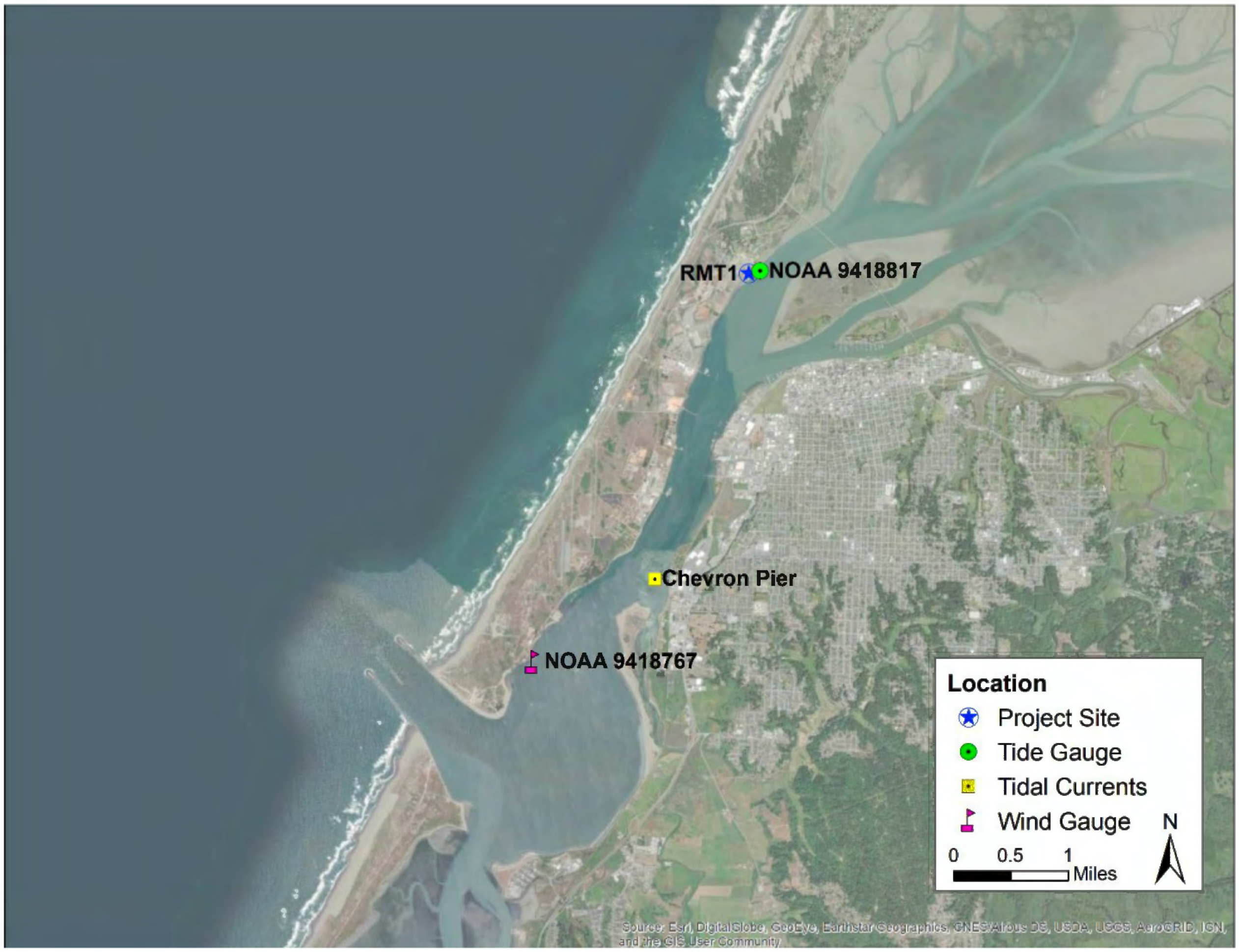


FIGURE 5-1: LOCATION OF METOCEAN GAUGES

5.1.1. Tides

The National Oceanic and Atmospheric Administration (NOAA) Station 9418817 at Samoa, Humboldt Bay, CA is the closest tidal station to the project site. The location of this gauge is shown in Figure 5-2. Tidal datums are provided in Table 5-1 and are based on the National Tidal Datum Epoch 1983-2001.

FIGURE 5-2: LOCATION OF NOAA TIDE STATION 9418817

TABLE 5-1: TIDAL DATUMS

Tidal Parameter	Elevation (ft MLLW)	Elevation (ft NAVD88)
Highest Astronomical Tide (HAT)	+9.36	+8.64
Mean Higher High Water (MHHW)	+7.37	+6.65
Mean High Water (MHW)	+6.65	+5.93
Mean Low Water (MLW)	+1.30	+0.58
North American Vertical Datum of 1988 (NAVD88)	+0.72	0.00
Mean Lower Low Water (MLLW)	0.00	-0.72
Lowest Astronomical Tide (LAT)	-2.43	-3.15

5.1.2. FEMA Flood Levels

Per FEMA Flood Insurance Rate Map (FIRM) Number 06023C0835G, effective June 21, 2017, a portion of the existing site is in an AE zone. The upland section of this facility has a base flood elevation (BFE) of +10 ft NAVD88. The existing wharf has a BFE of +12 ft NAVD88.

5.1.3. Sea-Level Rise Projections

Table 5-2 summarizes sea level rise (SLR) projections at the North Spit. The columns reflect varying risk levels, including the 50% probability, the likely range, the 5% probability (equivalent to 1-in-20 chance), the

0.5% probability (1-in-200 chance), and the extreme H++ scenario. The rows reflect two emissions scenarios, called Representative Concentration Pathways (RCPs). Low emission scenarios represent RCP 2.6, a scenario that leads to very low greenhouse gas (GHG) concentration levels. High emissions represent RCP 8.5, a business-as-usual scenario that leads to high GHG concentration levels.

Under the high emission scenarios, the 0.5% probability of SLR projection for year 2080 is 5.1 feet. Year 2080 is selected because the marine structures shall be designed for a 50-year service life.

TABLE 5-2: SEA-LEVEL RISE PROJECTIONS AT NORTH SPIT

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					*H++ scenario (Sweet et al. 2017) *Single scenario*
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	*66% probability sea-level rise is between...*		*5% probability sea-level rise meets or exceeds...*	*0.5% probability sea-level rise meets or exceeds...*	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.6	0.5 -	0.7	0.8	1	1.2
	2040	0.9	0.7 -	1.1	1.2	1.6	2.0
	2050	1.2	0.9 -	1.5	1.7	2.3	3.1
Low emissions	2060	1.3	1.0 -	1.7	2	2.8	
High emissions	2060	1.5	1.2 -	1.9	2.2	3.1	4.3
Low emissions	2070	1.6	1.2 -	2	2.4	3.5	
High emissions	2070	1.9	1.4 -	2.4	2.9	4	5.6
Low emissions	2080	1.8	1.4 -	2.4	2.9	4.4	
High emissions	2080	2.3	1.7 -	2.9	3.5	5.1	7.2
Low emissions	2090	2.1	1.5 -	2.7	3.4	5.3	
High emissions	2090	2.7	2.0 -	3.5	4.3	6.2	8.9
Low emissions	2100	2.3	1.7 -	3.1	3.9	6.3	
High emissions	2100	3.1	2.3 -	4.1	5.1	7.6	10.9
Low emissions	2110*	2.5	1.9 -	3.3	4.2	7.1	
High emissions	2110*	3.3	2.6 -	4.3	5.2	8	12.7
Low emissions	2120	2.7	2.0 -	3.7	4.8	8.2	
High emissions	2120	3.7	2.9 -	4.9	6.1	9.4	15.0
Low emissions	2130	3	2.1 -	4	5.3	9.4	
High emissions	2130	4.2	3.1 -	5.5	6.9	10.9	17.4
Low emissions	2140	3.2	2.3 -	4.4	5.9	10.7	
High emissions	2140	4.6	3.4 -	6.2	7.8	12.5	20.1
Low emissions	2150	3.4	2.3 -	4.8	6.6	12.1	
High emissions	2150	5	3.7 -	6.8	8.7	14.1	23.0

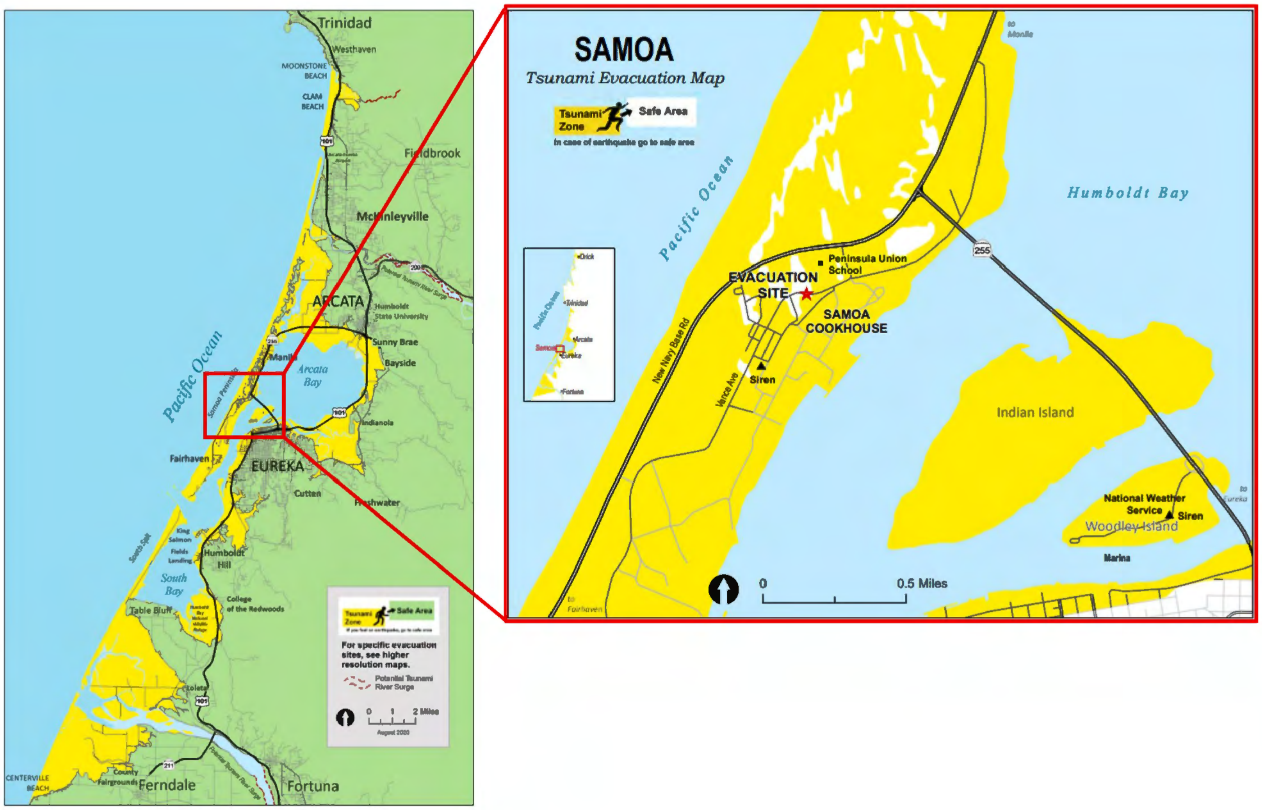
5.1.4. Tsunamis

Publicly available tsunami hazard assessments for the Humboldt Bay area were compiled. Figure 5-3 illustrates the tsunami hazard and evacuation map in the project area. Based on these assessments, several conclusions were made, including:

- Tsunami inundation depths could vary between 0 and 3 ft at the RMT1 project area.
- Tsunami waves come from the Pacific Ocean, over-wash the Samoa Peninsula, then flow into Humboldt Bay.

- Tsunami travel time depends on the location of earthquake sources and can vary from 10 to 20 minutes.
- The official Samoa evacuation site is located on high ground, near the Peninsula Union School.

FIGURE 5-3: TSUNAMI HAZARD AND EVACUATION MAP



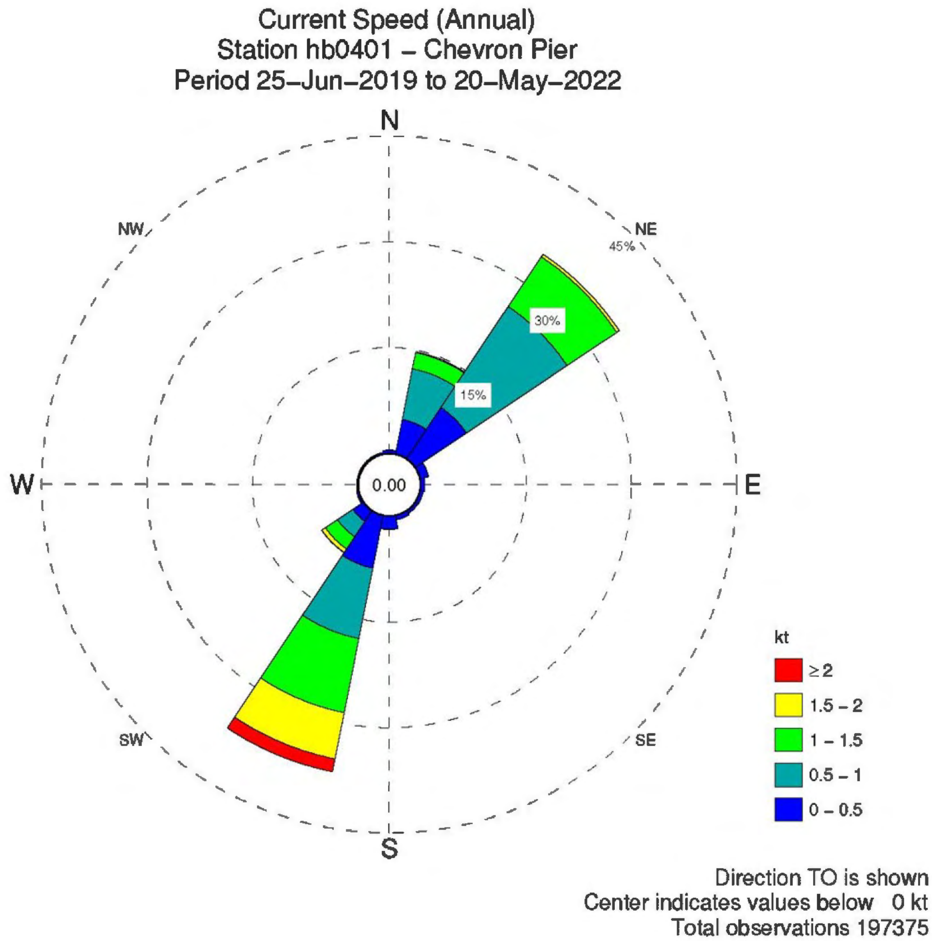
5.1.5. Currents

Tidal current measurements inside Humboldt Bay were analyzed at the Chevron Pier in North Bay (see Figure 5-1), which is located between the bay entrance and RMT1 and represents the general flow field to/from the project site. Figure 5-4 illustrates the annual current rose at Chevron Pier. The prevailing flood currents flow in the northeast direction and ebb currents in the southwest direction. Ebb currents are stronger, with a maximum of up to 3.4 knots. Maximum flood currents can reach 1.9 knots.

TABLE 5-3: TIDAL CURRENTS AT CHEVRON PIER

Parameter	Current Velocity (knots)
Max. Ebb	3.4
Mean Ebb	0.9
Max. Flood	1.9
Mean Flood	0.7

FIGURE 5-4: ANNUAL SURFACE CURRENT ROSE AT CHEVRON PIER

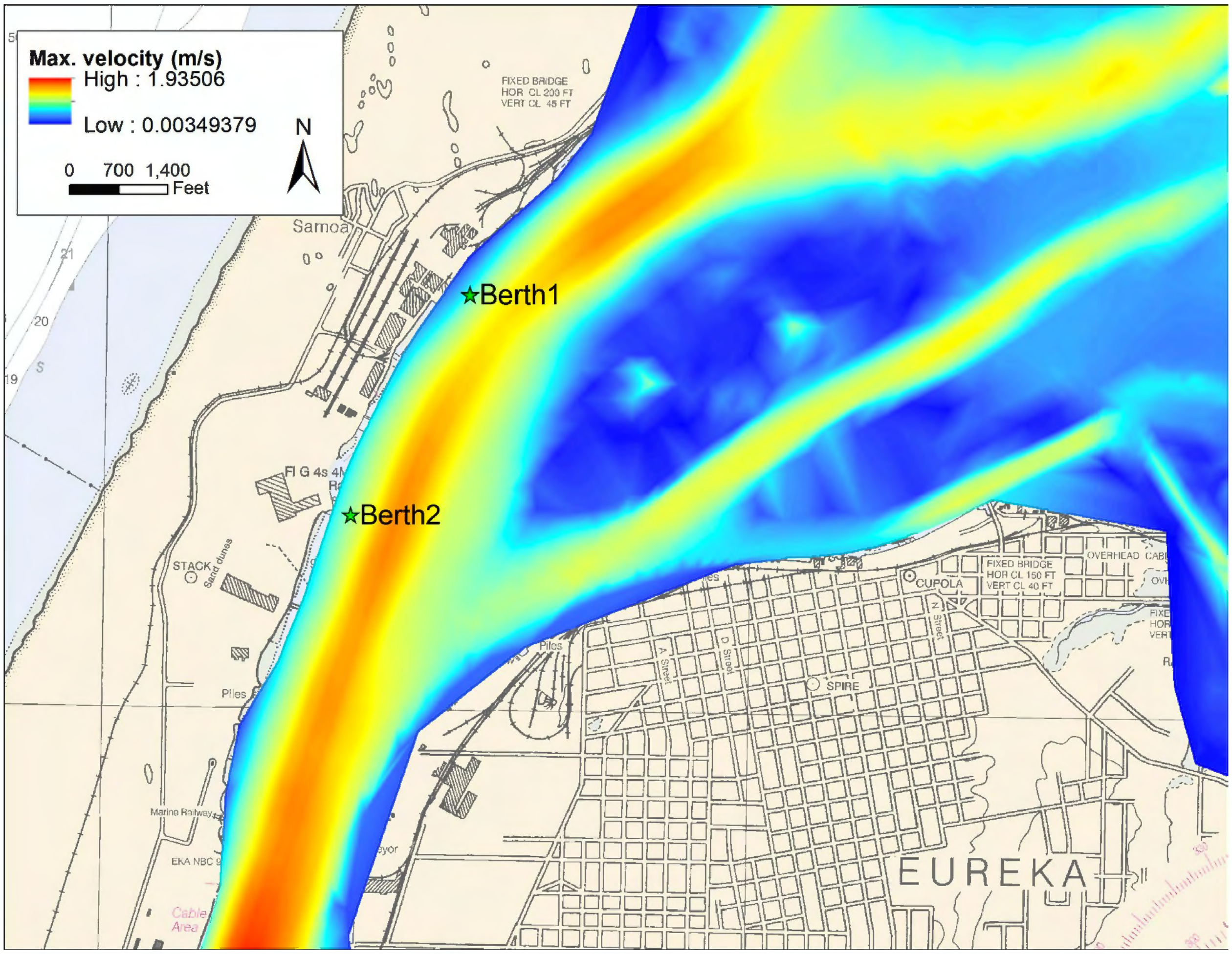


% of Occurrence

Current Speed, kt	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	0.45	14.76	34.88	1.19	0.55	0.41	0.39	0.59	1.85	37.04	7.09	0.27	0.13		0.12	0.18	100.00
≥2										1.86							1.90
1.5–2		0.15	0.44							6.69	0.62						7.90
1–1.5		2.31	8.50							10.72	2.07						23.60
0.5–1		7.34	17.23							10.20	2.62						37.50
0–0.5	0.43	4.97	8.71	1.18	0.55	0.41	0.39	0.58	1.80	7.56	1.76	0.26	0.13		0.12	0.18	29.11

A hydrodynamic model simulates tidal circulation inside Humboldt Bay during the strong El Niño year of 1982/83. Figure 5-5 illustrates a raster interpolation of the maximum current velocity that shows stronger currents generally follow the deeper channel. The maximum current velocity at RMT 1 and RMT 2 are 1.0 and 1.3 knots, respectively.

FIGURE 5-5: HYDRODYNAMIC RESULTS AT RMT1 DURING 1982/83 EL NINO



5.1.6. Wind Statistics

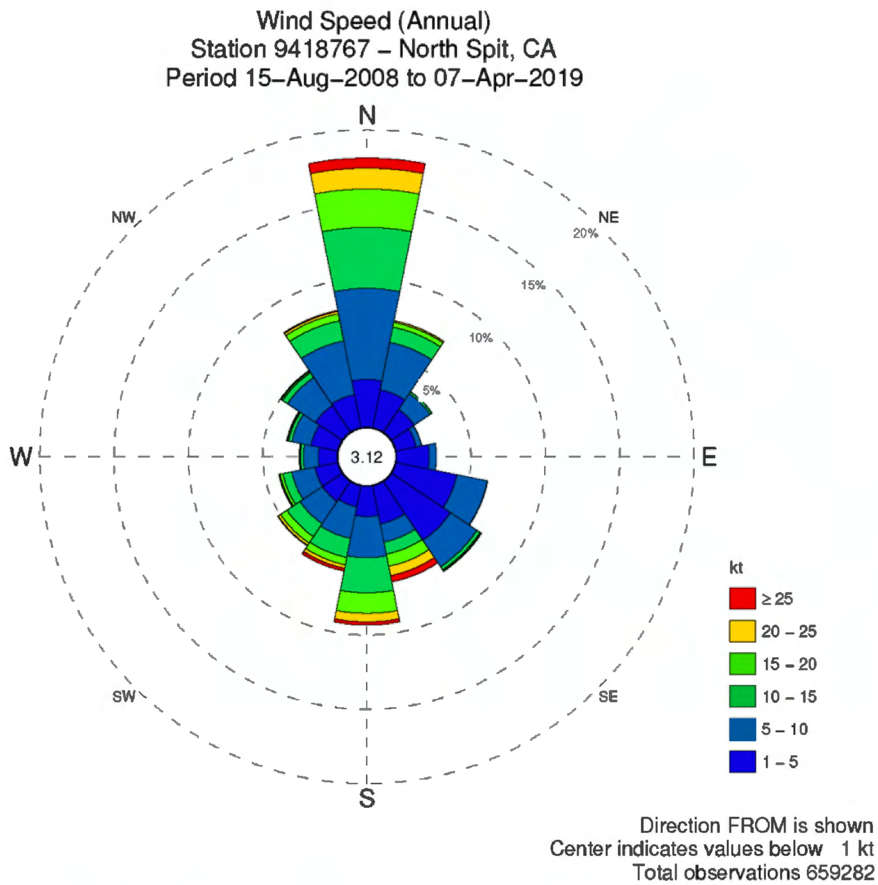
NOAA's 9418767 North Spit gauge is the most representative wind station for the RMT1 due to their close proximity and similar bay water exposure. The annual wind rose is presented in Figure 5-6. The results show that the prevailing and strongest winds are aligned well with the Bay orientation.

Table 5-4 summarizes the extreme wind speeds for varying return periods. The 100-year return period wind is 52.1 knots.

TABLE 5-4: EXTREME WIND SPEEDS AT NORTH SPIT

Return Period (years)	Wind Speed (knots)
1	39.8
5	43.5
10	45.3
25	47.9
50	50.0
100	52.1

FIGURE 5-6: ANNUAL WIND ROSE AT NORTH SPIT



% of Occurrence

Wind Speed, kt	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	18.12	7.34	3.28	1.76	2.69	6.29	7.28	6.59	9.33	5.85	5.21	4.04	2.56	3.50	4.99	8.05	96.88
≥ 25	0.69							0.43	0.22	0.21							1.79
20–25	1.40	0.11						0.63	0.56	0.23	0.19					0.16	3.50
15–20	2.58	0.32						0.83	1.38	0.51	0.52	0.18				0.48	7.12
10–15	4.11	1.05	0.15				0.25	0.83	2.37	1.30	1.05	0.61	0.20	0.23	0.39	1.39	14.00
5–10	6.12	3.26	1.29	0.37	0.49	2.09	2.15	1.25	2.77	2.16	1.81	1.59	1.00	1.30	2.26	3.68	33.59
1–5	3.21	2.59	1.83	1.38	2.19	4.17	4.76	2.60	2.02	1.44	1.60	1.56	1.26	1.84	2.16	2.27	36.89

5.1.7. Waves

The project site is sheltered from ocean swells and exposed to local wind waves. Preliminary analysis indicates a peak wave height (H_{mo}) of 2.2 Ft and period (T_p) of 2.7 seconds.

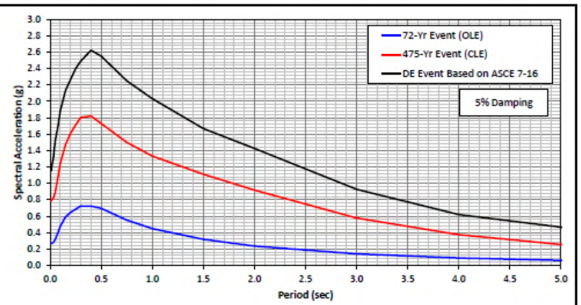
5.2. Earthquake Design

Wharf seismic design shall comply with CBC-ASCE 7-16 for wharf structure accessible by general public which include life safety and no collapse requirements under rare ground motion. For wharves structures not accessible to general public, the wharf seismic design shall comply with ASCE-61. ASCE-61 specifies two levels of ground motions: Operating Level Earthquake (OLE) with 72-year return period and Contingency Level Earthquake with 475 return period. The structure performance criteria under each ground motion level depends on the structure's classification.

Structure classifications and acceptable performance criteria under each level of ground motion will be confirmed by the District during the next phase of the project.

EMI has developed a preliminary site-specific response spectrum for the specified ground motion levels. Figure shows the preliminary acceleration response spectra (SRA). Detailed seismic hazard analyses will be performed and the findings will be documented in a complete seismic hazard study report during the next phase of the project.

FIGURE 5-7: RECOMMENDED PRELIMINARY ACCELERATION RESPONSE SPECTRA



Period	72-Yr Event (OLE)	475-Yr Event (CLE)	DE Event Based on ASCE 7-16
(sec)	SA (g)	SA (g)	SA (g)
0.010	0.271	0.787	1.151
0.020	0.270	0.807	1.233
0.030	0.277	0.813	1.296
0.050	0.314	0.889	1.517
0.075	0.395	1.066	1.686
0.100	0.478	1.246	1.888
0.150	0.590	1.471	2.133
0.200	0.647	1.611	2.267
0.250	0.685	1.713	2.400
0.300	0.724	1.803	2.491
0.400	0.722	1.822	2.624
0.500	0.694	1.729	2.550
0.750	0.551	1.500	2.250
1.000	0.448	1.332	2.033
1.500	0.316	1.112	1.668
2.000	0.235	0.917	1.425
3.000	0.139	0.577	0.927
4.000	0.089	0.373	0.619
5.000	0.060	0.255	0.466
7.500	0.029	0.122	0.312
10.000	0.016	0.071	0.186

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Recommended Preliminary Acceleration Response Spectra
Humboldt Redwood Multipurpose Terminal Redevelopment	
EMI Project No: 22-120 Date: September 2022	Figure 1

6. Geotechnical and Survey Criteria

6.1. Geotechnical

The initial information used to establish existing subsurface conditions and soil properties for design was obtained from SHN's preliminary subsurface investigations draft report, issued on 23 August 2022. The investigation was completed to inform conceptual planning for the proposed terminal and is intended as the first of multiple phases of geotechnical investigation. Additional geotechnical investigation will follow conceptual planning and preliminary design and will become increasingly focused as specific design elements become more refined.

The preliminary geotechnical investigation was focused along the Humboldt Bay shoreline, where little existing geotechnical data is available. Previous geotechnical investigations for neighboring sites provide useful data relative to upland portions of the site, but data along the waterfront has not been developed to date.

6.1.1. Subsurface Investigations

The preliminary geotechnical field investigation consisted of 10 cone penetration tests (CPTs) and three machine borings. CPT and drilled boring locations are shown on Figure 1-1. The geotechnical boring locations are also shown on Figure 6-2 to show their location relative to the historic shoreline (note that all but CPT 22-C10 occurred within filled areas bay-ward of the historic shoreline). The CPTs were completed first, between April 19 and 22, 2022, followed by the machine borings, which occurred between May 31 and June 3, 2022. Based on conceptual development plans, the preliminary geotechnical field exploration was focused in the central and northern parts of the site; a single exploration site occurs at the southern end of the site.

Exploration locations were developed collaboratively with the RMT geotechnical team and staffed in the field by SHN geologists.

FIGURE 6-1: CPT AND DRILLED BORING LOCATIONS

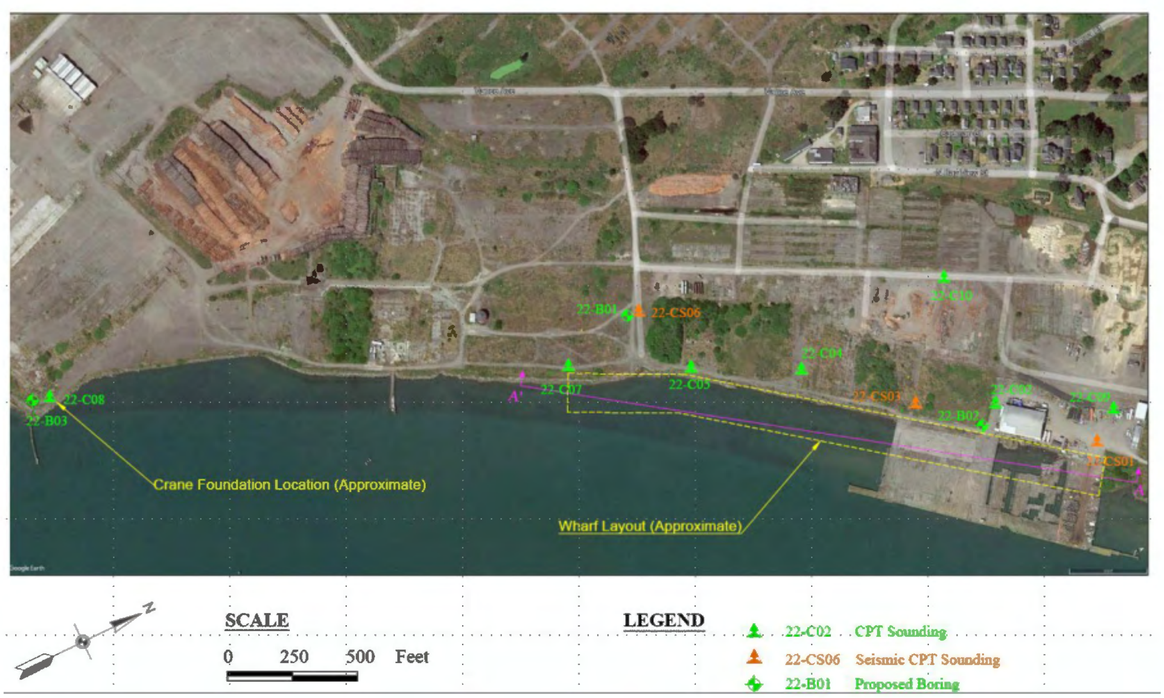


FIGURE 6-2: GEOTECHNICAL BORING LOCATION

6.1.2. Geologic Setting

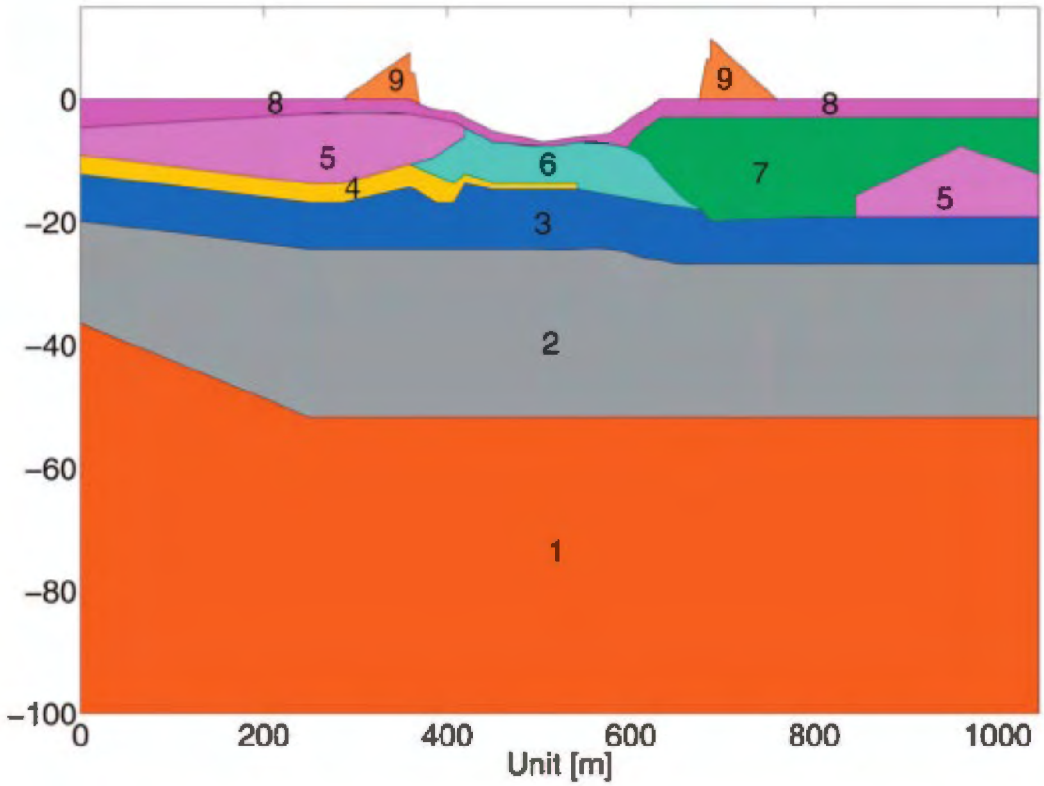
This summary of site geologic conditions is based on review of the recent CPT investigations in the context of other previous geotechnical investigations in the area. The 1994 Geomatrix report for the Samoa bridges is particularly useful, as it compiles all the Caltrans drill data across the bay into a series of profiles. For reference, see below a colorful soil profile across the “middle” channel of the three bay channels crossed by the Samoa bridges (note the metric scale).

A fundamentally important horizon within the bay is the contact between Pleistocene and Holocene sediments, which is typical in a coastal setting such as this. During the late Pleistocene, during the most recent glaciation, sea level was much lower and the shoreline was far to the west. Not much would have been happening in the area during this interval (geologically speaking!), with the exception of the drainage of the paleo-Mad River, which likely flowed through the Samoa channel (the westernmost of the three bay channels; closest to the site). The Pleistocene/Holocene boundary occurs on Figure 6-3 between Units 2 and 3; it occurs around the bay at an elevation of about -60 feet (+-20m, Figure 6-1). Below this horizon, across most of the bay is a stiff silt/clay unit (Unit 2 on Figure 6-1) and the Hookton Fm. (Unit 1), a thick dense sand unit. The Pleistocene clay unit (Unit 2) appears to have been present in the recent CPT’s as the “lower” clay unit, below about 65 feet Below Ground Surface (BGS). The Hookton Fm. occurs below about 80 feet BGS; it is several hundred feet thick and all the recent CPT’s bottomed out in this material. We can expect a continuation of the dense sandy conditions to the intended boring depth (150 feet).

During the latest Pleistocene and early Holocene marine transgression, the bay filled in with a variety of sediments, illustrated on the figure by Unit 3 and the laterally discontinuous lenses of sediment above (Units 4 through 8). At the RMT site, the CPT’s identified sandy intervals consistent with other areas of the bay, but also indicated a relatively thick clay deposit that appears localized to the subject site and the adjacent Town of Samoa. This “upper” clay unit is very soft, organic-rich, and occurs between about 22 feet BGS and 50 to 60 feet BGS; it is 20 to 42 feet thick across the site, except at CPT-08, where it thins extensively. The “upper” clay unit was thickest in CPT-04 and -05.

The entire Samoa Peninsula is covered with a veneer of windblown dune sand, much of which has been reworked during previous industrial developments. See the historic photo below to see what the RMT and Samoa Peninsula looked like in the 1930s.

FIGURE 6-3: TWO-DIMENSIONAL SOIL PROFILE OF HBMC BRIDGE SITE



Two-dimensional soil profile of HBMC Bridge site (layer 1: Tertiary and Quaternary Alluvial deposits; layer 2: medium dense organic silt, sandy silt and stiff silty clay; layer 3: dense sand; layer 4: silt; layer 5: medium dense to dense silty sand and sand with some organic matter; layer 6: dense silty sand and sand; layer 7: soft or loose sandy silt or silty sand with organic matter; layer 8: soft to very soft organic silt with clay; and layer 9: abutment fill. Layers 5 and 7 are susceptible to soil liquefaction (Geomatrix, 1994).

SHN note: the Pleistocene/Holocene unconformity occurs between Units 2 and 3.

6.1.3. Subsurface Conditions

A subsurface investigation program to support the conceptual design effort was performed. Figure 6-1 shows the locations of CPT and drilled borings. Figure 6-4 and Figure 6-5 show a preliminary soil profile at RMT1, as projected form the shoreline geotechnical data.

FIGURE 6-4: PRELIMINARY SOIL PROFILE AT NORTH WHARF SITE

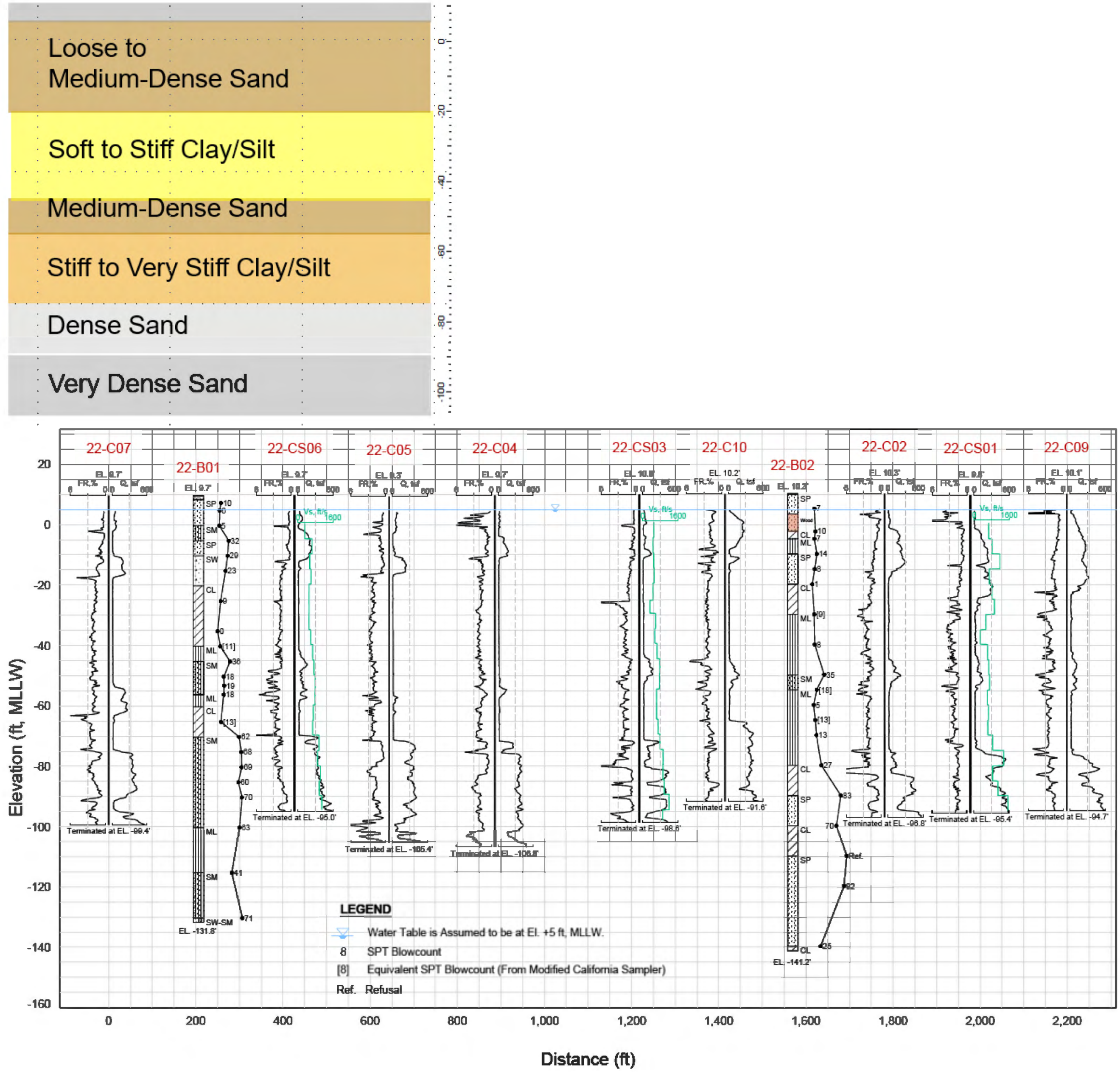
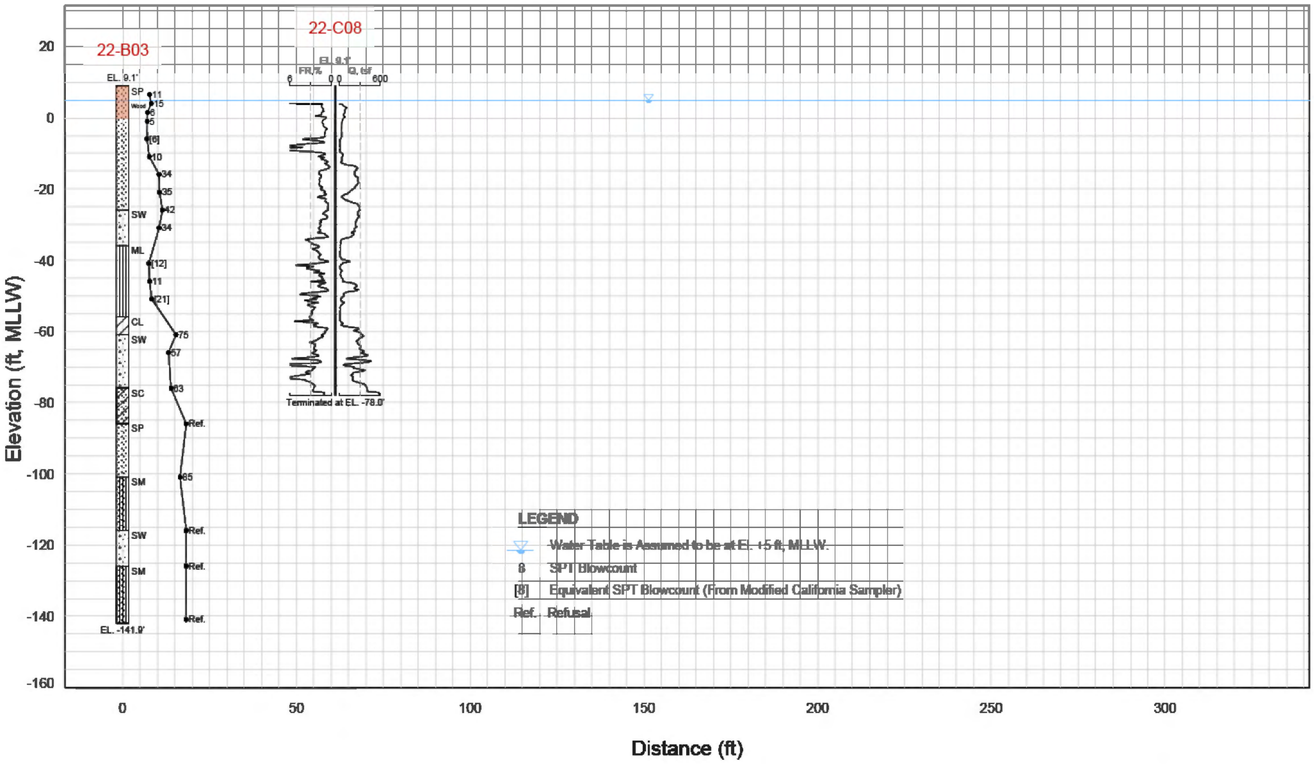


FIGURE 6-5: PRELIMINARY SOIL PROFILE AT SOUTH WHARF SITE



6.1.4. Geotechnical Design Considerations

6.1.4.1. Dredging

The material within the proposed dredge prism is expected to be soft silts and loose to medium dense sands/silty sands. Dredge materials characteristics and viable dredging method will be included in new versions of this document based on the future marine geotechnical investigation program.

6.1.4.2. Yard Area

The calculated maximum uniform pressure imposed by a 60-t SPMT axle is 3,000 psf. The settlement criteria will be evaluated in the subsequent phases of the project. The short term and long term settlement criteria will be discussed with OEMs to define the maximum applied bearing pressure, storage method, heavy components storage durations and acceptable settlement/differential settlement.

6.1.4.3. Site Stabilization (Ground Improvement)

Given the applied high live loads on the upland area, site stabilization will be required. Preloading is the preferred option to reduce the long term settlement for most of the upland area. The use of wick drains will be examined after discussing its impact on the construction schedule and the rate of settlement at the early stages of port operation. Ground improvement for the area directly behind the wharf structure and along the shoreline will be assessed in future phases of this project.

6.2. Hydrographic Surveys

Hydrographic survey was performed by eTrac. The bathymetric data will be included in the next revision of this document.

6.3. Topographic and Boundary Surveys

Topographic survey based on Lidar was performed by SHN, Sea Attachment 1.

6.4. Humboldt Bay Navigation Channel

Humboldt Bay navigation channel provides marine access up to the vicinity of the project site with the following minimum dimensions:

- Width = 400 feet (Samoa Channel)
  = 400 to 600 feet (North Bay Channel)
- Depth = -38 feet MLLW (Samoa Channel) or -48 feet MLLW (Outer/Entrance Channel)

The channel is currently maintained by USACE.

7. Navigation, Dredging, Mooring and Berthing Criteria

7.1. Design Vessels

The vessels expected to call on the proposed port facility will consist of delivery vessels and semi-submersible barges. Delivery vessels will consist of bulk carriers and/or 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.

7.1.1. Delivery Vessel

The design delivery vessel is the S2L-type heavy cargo vessel with the characteristics shown in Table 7-1.

TABLE 7-1: DELIVERY BERTH DESIGN VESSEL

Vessel Characteristic	S2L-TYPE
Length Overall	608.3 ft
Summer Draft	34.8 ft
Beam	83.0 ft

7.1.2. RORO Vessels

The design RORO vessel is the ST-Class RORO vessel and the design delivery barge is the 455 Series Barge with the characteristics shown in Table 7-2.

TABLE 7-2: RORO DESIGN VESSELS AT DELIVERY BERTH

Vessel Characteristic	ST-CLASS RO-RO	455 SERIES BARGE
Length Overall	496.9 ft	400.0 ft
Summer Draft	18.6 ft	19.0 ft
Beam	83.3 ft	105.0 ft

7.1.3. Semi-Submersible Barge

The semi-submersible barge will be a purpose-built semi-submersible barge with the characteristics shown in Table 7-3.

TABLE 7-3: PURPOSE-BUILT SEMI-SUB VESSEL

Name	Purpose Built Semi-Sub
Length Overall	350.0 ft
Summer Draft	19.1 ft
Beam	350.0 ft

7.1.4. Wind Turbine Device – Base Only

The wind turbine device base is expected to be a semi-submersible, floating steel structure. Delivery of wind turbine base could be relative to the following scenarios:

- Fully Assembled on a semi-submersible vessel. A fully assembled device base manufactured outside of and transported to Humboldt Harbor. This scenario requires either an in-harbor sinking basin or out of harbor (in-ocean) sinking and dead ship tow to the marine terminal or wet storage location. A sinking basin will be provided at the RMT 1 location for in-harbor use. If size is not sufficient for ocean transport vessels, alternative sinking basin locations will need to be proposed by the terminal operator or will require use of sinking out of harbor in the ocean.

- Partially Assembled on RORO Vessel. Subcomponents are manufactured at locations outside of Humboldt Harbor and delivered to the marine terminal for transfer to the marine terminal yard. Subcomponents are assembled into an entire device base that is transferred across the wharf using SPMTs to a semi-submersible barge (Figure 4-1) that would utilize the in harbor sinking basin located in the berth pocket of marine terminal 1.
- Device Base Fully Manufactured in Humboldt. Steel materials would be delivered by combination of vessel and truck to fully fabricate the device base onsite. Completed base would be transferred to the wharf using SPMTs to a semi-submersible barge (Figure 4-1) that would utilize the in harbor sinking basin located in the berth pocket of marine terminal 1.

Based on discussion with wind industry developers, the following geometric parameters were developed for the design of the new wind terminal facility.

- Near Term Size (Estimated 12 MW Turbine Size)
  - Beam: 325 ft x 325 ft
  - Draft: 19 ft Min, 23 ft Max
- Future Size (Estimated 20 MW Turbine Size)
  - Beam: 400 ft x 400 ft
  - Draft: 20 ft Min, 25 ft Max

7.1.5. Wind Turbine Device – Fully Integrated

Outreach with Wind Industry Developers, the following geometric parameters were developed for the design of the new wind terminal facility for fully integrated devices.

- Near Term Size (Estimated 12 MW Turbine Size)
  - Beam: 325 ft x 325 ft
  - Draft: 32 ft Min, 38 ft Max
- Future Size (Estimated 20 MW Turbine Size)
  - Beam: 400 ft x 400 ft
  - Draft: 32 ft Min, 45 ft Max

It should be noted the draft stated is assumed for safe navigation through the navigation channels to open ocean conditions. The draft required for mooring stability will likely be greater once installed at the wind farm. There could be device base technologies that are stable during transport under lower ballasted condition or that utilize supplemental flotation to navigate through the confined navigation channels to the open ocean and then adjusted in deeper water. The actual navigation channel parameters needed to support a specific technology type is specific to each type of technology and dependent on the results of detailed maneuvering analysis and bridge simulation work for the tow out environmental conditions and operational plan. A navigation risk assessment will be required for each type of technology that will be subject to review and approval by the US Coast Guard. The US Coast Guard may require a moving channel closure when transporting fully integrated wind turbine devices.

7.2. Channel and Berth Pocket Requirements

7.2.1. Berth Pocket & Sinking Basin

A berth pocket and sinking basin are required at the RMT1 location with the following criteria.

- Moored Device Location Relative to Navigation Channel: 50 ft offset for maximum turbine dimension.
- Mooring & Maneuvering Area Depth. El -40 ft MLLW with 2 ft over dredge allowance to account for extreme low tides.
- Sinking Basin Area Depth is 450 ft by 450 ft, dredged to elevation El -60 ft MLLW.
- Side Slopes: Estimated to be 2H:1V with rock armoring and 2.5H:1V without armoring. To be verified after completion of marine geotechnical investigation.

7.3. Navigation and Dredging

Navigation. Vessel maneuvering and simulations for fully integrated devices will be needed to better refine the navigation procedures, tug assist, ballasting plans and other elements for a deployment of the device to the wind farm. Additional information on the characteristics of the fully integrated device will be needed to conduct a first step desktop analysis to evaluate the navigation and maneuvering to determine the need for any localized out of USACE navigation channel dredging needs.

Dredging. Dredging will be required for the berth and approach areas for the proposed RMT1 and RMT2 wharf structures. Dredging may be needed for the wet storage areas depending on location and device technology type and whether it is a fully integrated or a device foundation base. A dredged material management plan will need to be developed based on the results of sediment characterization, types and location of material by volume and relative to a range of disposal and beneficial reuse options (offshore at HOODS, onsite for fill to raise grades to mitigate SLR, and other disposal and reuse options).

7.4. Device Wet Storage

The following criteria were developed to assist in planning for the harbor-wide improvements that are needed to meet the needs of offshore wind developers and to meet the long terms needs for California to implement the goals for offshore wind power (2-5 GW by 2030 and 25 GW by 2045). The following criteria were developed based on outreach with a range of offshore wind developers, terminal operators, and device technology developers.

- Wet Storage.
  - Industry Needs Assumptions. The number of units required in wet storage is dependent on the developer, their supply chain strategy, size of the offshore wind project (GW and # of units), and required timeline to install the units offshore. However, for the purpose of developing a basis for size and quantity of wet storage required in Humboldt for the RMT project, the following assumptions were made to identify a conservative wet storage case.
    - Assumptions: Each unit is 15 MW, project size is 1.3 GW
      - Number of units = 1300 MW / 15 MW = ~90 units
    - Construction Time Period: Wind farm must be constructed in 1 year
    - Production Rate: Developer needs to deliver approximately 2 units / week to deliver 1.3 GW in 1 year

- Number of Devices for Wet Storage. Due to the distance from the port, transit times, and weather risk, developers will need more units in wet storage to serve the Morro Bay call area. Based on the assumptions above, the following quantity of units is conceivable:
  - Humboldt Call Area only (1.3 GW project, 90 units, 1 year installation window)
    - 4 floating foundations in wet storage (waiting for integration)
    - Minimum of 4 additional floating foundations in dry storage (e.g., on uplands) or in wet storage (waiting for integration)
    - Up to 8 fully integrated (waiting for good weather window to tow)
  - Morro Bay Call Area (1.3 GW project, 90 units, 1 year installation window)
    - 8 floating foundations in wet storage (waiting for integration)
    - Minimum of 7 additional floating foundations in dry storage (e.g., on uplands) or in wet storage (waiting for integration).
    - Up to 15 fully integrated (waiting for good weather window to tow)
  - Marine Vessel Operations. For these scenarios, the following tug fleet is envisioned:
    - Port tugs = 5 total
      - 2 tugs for semi-sub moves
      - 3 tugs for foundation moves and delivery vessel moves
    - Transit tugs
      - Humboldt Call Area = 3 tugs (2 for the move and 1 on stand-by at the call area)
      - Morro Bay Call Area = 7 or 9 tugs (need 2 + 2 for moves and 1 on stand-by at the call area, but will likely need an additional set of tugs to hit weather windows)
  - Device Water Depth Requirements (for wet storage).
    - Device Foundation for Wet Storage. Draft requirements.
    - El -28 ft MLLW with additional 2-ft over dredge allowance.
    - Device Fully Integrated for Wet Storage. Deeper draft requirements than the device foundation by itself.
    - El -38 ft MLLW with additional 2 ft over dredge allowance.

8. Marine Structures Design Criteria

8.1. Risk Category

The marine facilities shall be designed to Risk Category II per ASCE 7-10 Table 1.5-1.

8.2. Design Life

The design life of the marine facilities shall be 50 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.

8.3. Deck Elevation

Top deck elevation for the marine structures is assumed to be +17.1 ft NAVD88. The deck top elevation will be refined in the next design phases based on further refinement of SLR prediction and sea wave analyses.

8.4. Design Loads

Dead Load (D)

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. All new structures shall be designed to be submerged in an extreme event.

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
- Dolphins and Walkways: 100 psf

Vehicular loads include an AASHTO HS-20 truck with a 15% impact factor applied to design and a lateral load equal to 10% of the vertical load.

Wind Load (W)

Wind loads, on structural components when berth is vacant, shall comply with ASCE 7-16 requirements. Design wind speed shall be 92 mph (3 second gust at 33 feet above ground).

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 as well as 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)

Earthquake loads will be determined per CBC 2019 based on the site classification. The seismic performance criteria for the project, under Level 2 ground motion, is collapse prevention. Under Level 1 ground motion, post-event inspection and repair may be required (to be confirmed in future phases).

Load Combinations

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 8-1: 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 8-2: 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)*

8.4.1. Durability

Calculation of concrete crack width shall comply with ACI 224R. Maximum design crack width under service loads shall comply with the following:

- Concrete exposed to seawater or seawater spray = 0.01 inch
- Buried structures = 0.012 inch

8.4.2. Corrosion

Steel piles exposed to salt water shall be protected using a minimum of two of the following strategies. Regardless of approach selected, steel piles shall be regularly inspected, maintained, and repaired as required to prevent section loss.

- Marine grade coating applied with strict conformance to specifications including inspection and repair of all coating defects and damages
- Cathodic protection anodes
- Pile wrap or jacket
- Additional "sacrificial" wall thickness

Corrosion rates for steel elements were obtained from the Waterfront Facilities Inspection and Assessment, ASCE Manuals and Reports on Engineering Practice No. 130, 2015; Section 4.6.2:

- Soil embedded zone (mudline down): 0.001 in./year;
- Immersed zone (between LAT and mudline): 0.004 in./year; and
- Splash and tidal zone (LAT up): 0.005 in./year.
- Steel elements located away from the water shall be designed for an atmospheric zone rate of 0.0004 in./year.

8.4.3. Serviceability

High Mast Light Pole: Maximum lateral deflection of foundation during service loading is 1/2 inch.

8.4.4. 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.

9. Civil Design Criteria

9.1. Heavy Lift Area and Uplands

9.1.1. Site Preparation

Demolition of existing at grade and below grade concrete structures, cultural protection considerations (minimize cut in areas of original upland areas) and consideration of other site preparation requirements will need to be considered in the site grading design and prior to conducting any grading work.

9.1.2. Stormwater Design

Stormwater systems will be designed to:

- Use the Rational Method for calculating runoff (Q)
- Convey the 10-yr, 24-hr storm event (Q10)
- Use NOAA14 or other local source of rain data
- A 10-minute time of concentration (Tc) minimum
- Provide 1 ft of freeboard to building pads for the (Q100)

9.1.2.1. Stormwater Compliance

The project site lies within the County of Humboldt's jurisdiction, but it is outside the regulated Municipal Separate Storm Sewer System (MS4) permit boundaries. Therefore, MS4 stormwater mitigation requirements do not apply to this project. However, this project will disturb over an acre of ground and will be required to meet the post-construction stormwater requirements for the State Water Resources Control Board's (SWRCB) Construction General Permit (CGP). The CGP specifies post-construction runoff reduction requirements for all sites not covered by a Phase I or Phase II MS4 NPDES permit. The CGP post-construction standards require that the project replicate the pre-project water balance (runoff) for the smallest storms up to the 85th percentile storm event.

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 US.

9.1.3. Parking

Project will provide on-site parking for all employees, contractors, visitors, etc. No off-site parking will be allowed.

9.1.4. Access Roads

Access roads include both access points to the site from the county New Navy Base Road and Cookhouse Road. The railroad right of way (ROW) will need to be retained and the west access road will be located adjacent to and not within the rail ROW corridor. Additional right of way or easements may be needed within the west access road corridor to provide access and utilities through the Phase 3 area and into the Phase 2 area.

Access roads connecting to the site will have a minimum surface elevation of 16.00 ft. The maximum longitudinal slope of the access roads will be 5%. Access roads will have 12-ft paved lanes, 8-ft paved shoulders, 2-ft gravel shoulders, and 4:1 max side slopes for fill prisms.

Roadway access to the project site outside of Harbor District property shall meet AASHTO and Humboldt County Public Works standards.

North Site Access - The north access road will need to be routed within the available property parcel boundaries and easements, raised to mitigate flooding from SLR, and an alignment that considers wetland impacts and stormwater management. Peak stormwater flood routing will need to consider utilizing the existing low level outlet culvert, tide gate and discharge to the bay.

Intersection Site Access - Based on preliminary transportation analysis, signaling of intersections for the connection to Navy Base Road (both north and west access road) and to Vance Avenue will not be needed. A 3- or 4-way stop at the north road intersection with Vance Avenue will be the needed improvement.

Access roads within the site will follow the criteria in Site Grading Design.

9.1.5. Site Grading Design

Redevelopment of the site will require consideration for future SLR and flood protection. SLR criteria is outlined in Section 5.1.3. 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 17.00 ft, and the minimum finish floor elevations (FFE) for the buildings will be 18.00 ft. The minimum elevations for storm drain inverts and the bottom of bioretention basins (bottom of gravel layer) will be 13.00 ft.
- 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.

9.1.6. Design of Erosion, Sedimentation, and Pollution Control

The project shall develop a Stormwater Pollution Prevention Plan (SWPPP) to satisfy the 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 see Stormwater Design.

9.1.7. 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. The northern end of the site (early phase construction) will likely receive fire water from the Town of Samoa's water main. The southern end of the site (late phase construction) will receive fire water from Humboldt Bay Municipal Water District's industrial water main. A new fire water storage tank will be needed on site to replace the existing red tank.

9.1.8. Potable Water

Potable water will be needed for the various buildings to be constructed on the site. Potable water will be needed for general office use (restrooms, kitchens, etc.). Depending on the activities within each building, there may be additional potable water demands. The northern end of the site (early phase construction) will likely receive potable water from the Town of Samoa's water main. The southern end of the site (late phase construction) will receive potable water from Humboldt Bay Municipal Water District's potable water main.

9.1.9. Seawater Withdrawals

Seawater withdrawals for the offshore wind port are not needed for the intended operations. Other future terminal uses (aquaculture) for the site may require a salt water withdrawal. Additionally, the proposed Nordic Aquafarm development (immediately south of the project site) has a sea water withdrawal at red tank dock and a supply line running through the nearshore marine terminal shoreline. The Nordic seawater supply line will need to be re-routed into a utility corridor as part of the marine terminal redevelopment project. Consideration for sizing the pipeline and points of connection for potential future Phase 4 area aquaculture operations should be considered in the design of the new seawater withdrawal and pipeline. Red tank dock may be replaced as part of the marine terminal redevelopment. If a new pier or dock is proposed, the seawater withdrawal will need to be accommodated on that new pier.

9.1.10. 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. On-site treatment and disposal of domestic wastewater is not expected for this site. It is expected that wastewater will be treated at the Samoa Wastewater Treatment Plant (WWTP), which discharges treated wastewater to the existing ocean outfall pipe. Wastewater from the site will need to be pumped to tie-in to the Town of Samoa's sewer main or directly to the Samoa WWTP.

9.1.11. Finished Surface Materials

The site surfacing material will be crushed 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 site. 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

9.1.12. Signage

The project shall be designed to meet the Federal Highway Administration Manual on Uniform Transportation Control Device standards.

10. Electrical Design Criteria

10.1. Port Operations Electrical Demands

Operations at the RMT port facility will be continuous and varied for all phases of the build-out, and will require significant power. 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 buildings, warehouse buildings, assembly buildings, office space, on-site material heavy transport, on-site light material transport, manufacturing/construction equipment and tools, cranes, site lighting, vessel shore power and battery charging, along with a number of miscellaneous electrical loads.

Power will be distributed to the site at medium voltage (12,000 volts) and transformed down to utilization voltages of 480V, 208V and 120V, all at 60 Hz.

10.2. Estimated Electrical Loads

The terminal build-out will be completed in phases, with four phases currently being considered. The estimated loads are detailed in the Electrical Load Estimate, which indicates a total power requirement of 9.7 MVA at full build-out. The estimate relies on information that may change, including, for example, the size and number of buildings, the number of cranes, the number of battery chargers, etc. Because of this uncertainty, a conservative contingency of 50% has been included in the Electrical Load Estimate for power supply planning purposes.

10.3. Power Supply Sources and Distribution

The Samoa peninsula is currently fed by two PG&E 60kV circuits, the Humboldt #1 circuit and the Essex Junction-Fairhaven circuit, both of which terminate 1/2-mile south of the site at PG&E's Fairhaven Substation.

The proposed supply to the facility will be from two sources, the Harbor District's substation and directly from the Fairhaven substation. The Harbor District substation will supply Phases 1 and 2 of the project, and the Fairhaven substation will supply power for Phases 3 and 4. Further details on these two supply sources are located in the *Electrical Infrastructure and Green Port Conceptual Engineering Assessment Memorandum.*

Power will be distributed to the site at 12KV, on overhead lines, with some locations brought below grade in ductbanks. The lines would be routed along the western side of the facility within an established utility corridor. Further details of the incoming distribution lines are in the *Electrical Infrastructure and Green Port Conceptual Engineering Assessment Memorandum.*

10.4. Green Port Development

The goal for the terminal redevelopment is to provide a focus on electrification and zero-emissions equipment through the use of renewable energy supplies. The intent is for the facility to operate with reduced net carbon emissions for ongoing normal terminal operations.

A potential strategy for providing power from renewable sources is the development of a photo-voltaic (PV) system to generate and store power, to be used by the facility. This solar panel concept and options of a PV system are discussed in depth in the *Electrical Infrastructure and Green Port Conceptual Engineering Assessment Memorandum.*

10.5. Backup Power

The RMT facility will require some level of backup emergency power, which will likely include the installation of at least one standby generator. Although diesel generation is an option, natural gas fired backup generator(s) are preferred and will provide backup power for critical systems. At a minimum, the backup generator system will provide power to life safety systems, emergency lighting, and other equipment and systems considered critical. The extent of equipment, lightings, systems, and building components that would be included as critical will be determined once details of the facility installation are finalized.

Backup generators, or other emergency power supply systems such as battery storage may also be required for continuity of operations during a loss of utility power. This might include orderly shutdown of systems, or perhaps some level of ongoing production or other operations during loss of power. The extent of backup power for operational continuity will be determined once details of facility equipment is finalized.

11. Security

11.1. Background

The RMT facility will require certain security measures in order to comply with federal law. The following table illustrates the applicable federal codes to be used for terminal security for US ports.

TABLE 11-1: RELATIVE SECURITY CODES

Codes and Standards	Description/Use
33 CFR 101	Maritime Security - General
33 CFR 105	Maritime Security - Facilities
33 CFR 101.514 33 CFR 105.255	TWIC Requirements

12. Aids to Navigation & Lighting

12.1. Background

Aids to navigation and lighting requirements will apply to aspects of the project as follows in accordance with requirements outlined by the US Coast Guard and Federal Aviation Administration (FAA).

- Lighting. Navigation lighting for cranes and fully integrated wind turbine devices will be required. Lighting requirements will be outlined in consultation with the appropriate federal and state agencies.
- Aids to Navigation. Federal navigation aid structures and buoys may require relocation in localized areas such as the proposed marine terminal berth and wet storage locations. Relocation of aids to navigation will require coordination with the US Coast Guard. Additional private aids to navigation may be needed to mark wind turbine device wet storage area. The need for and type, size of private aids to navigation will be determined in coordination with the US Coast Guard.

13. Green Port Development

13.1. Background

The redevelopment of the RMT presents an opportunity to develop the new facility and operation following a goal to create a Green Port Development. The focus of the Green Port Development emphasizes minimizing impacts on the environment as part of the construction and long-term operations of the facility. The Green Port Development has goals and criteria relative to resource consumption and environmental quality as outlined in the subsequent sections.

13.2. Resource Consumption

- Construction Materials Selection – Building type, use of beneficially reused materials (dredged material), durable construction materials for longevity, and reduced GHG reduction measures as part of the materials sourcing and construction.
- Waste Management – Onsite recycling of materials for re-use on project site (such as concrete foundations crushed for fill needs), WWT treatment utilizing existing waste treatment systems and minimizing load demands, and minimizing waste generated as part of the development and site operations.
- Energy Use, Efficiency, Resiliency – Consider and develop the use of alternative fuels, renewable power, on-site solar, on-site microgrid, and backup power systems to reduce carbon footprint and improve resiliency of the facility operations.
- Transportation – Consider a range of modes of transportation for workers (walk, bus access, electric car, worker parking), and marine transportation alternative fuels or electrification, and shore power for vessels.

13.3. Environmental Quality

- SLR/Climate Change – Accommodate future water levels in accordance with California State Lands Commission guidance and to plan and build a facility that is resilient and adaptable to a changing environment.
- Air Quality – Site operation emissions reductions, near zero carbon goals, shore power for vessels, electrification or alternative fuel equipment operations will be pursed.
- Water Quality – Stormwater management for compliance with water quality discharge for the range and type of proposed uses.
- Ecosystem Restoration & Mitigation – Minimize impacts (to wetlands, eelgrass, habitat, and species of concern) through strategic, informed planning and design of the proposed improvements.
- Light & Noise – Development of site layouts and operations will be considerate of outdoor light and need for noise abatement needs for the project area.

Attachment 1 -Topographic and Boundary Surveys

EXPLANATION

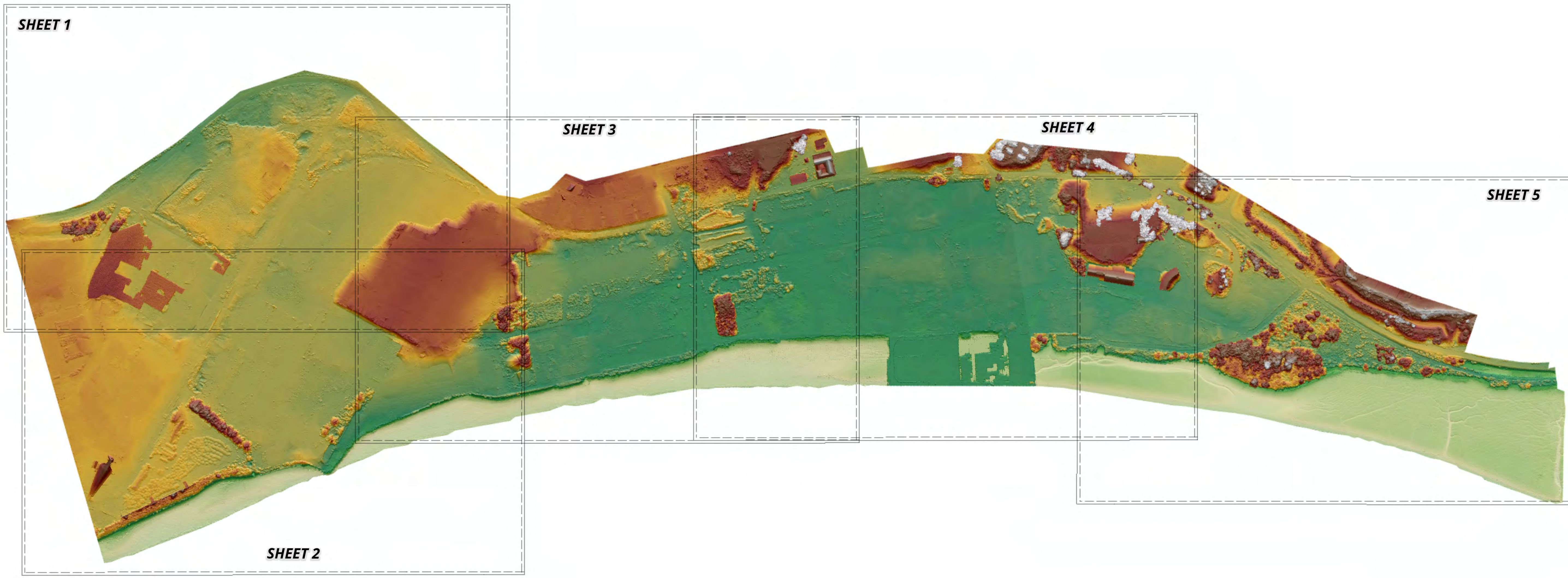
SHEET INDEX

DIGITAL ELEVATION MODEL

ELEVATION (FEET, NAVD88)

60'

-10'



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1" = 600'±

Humboldt Bay Harbor, Res. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model
Key Sheet Index
May 2022 - 022054.400

Figure
1

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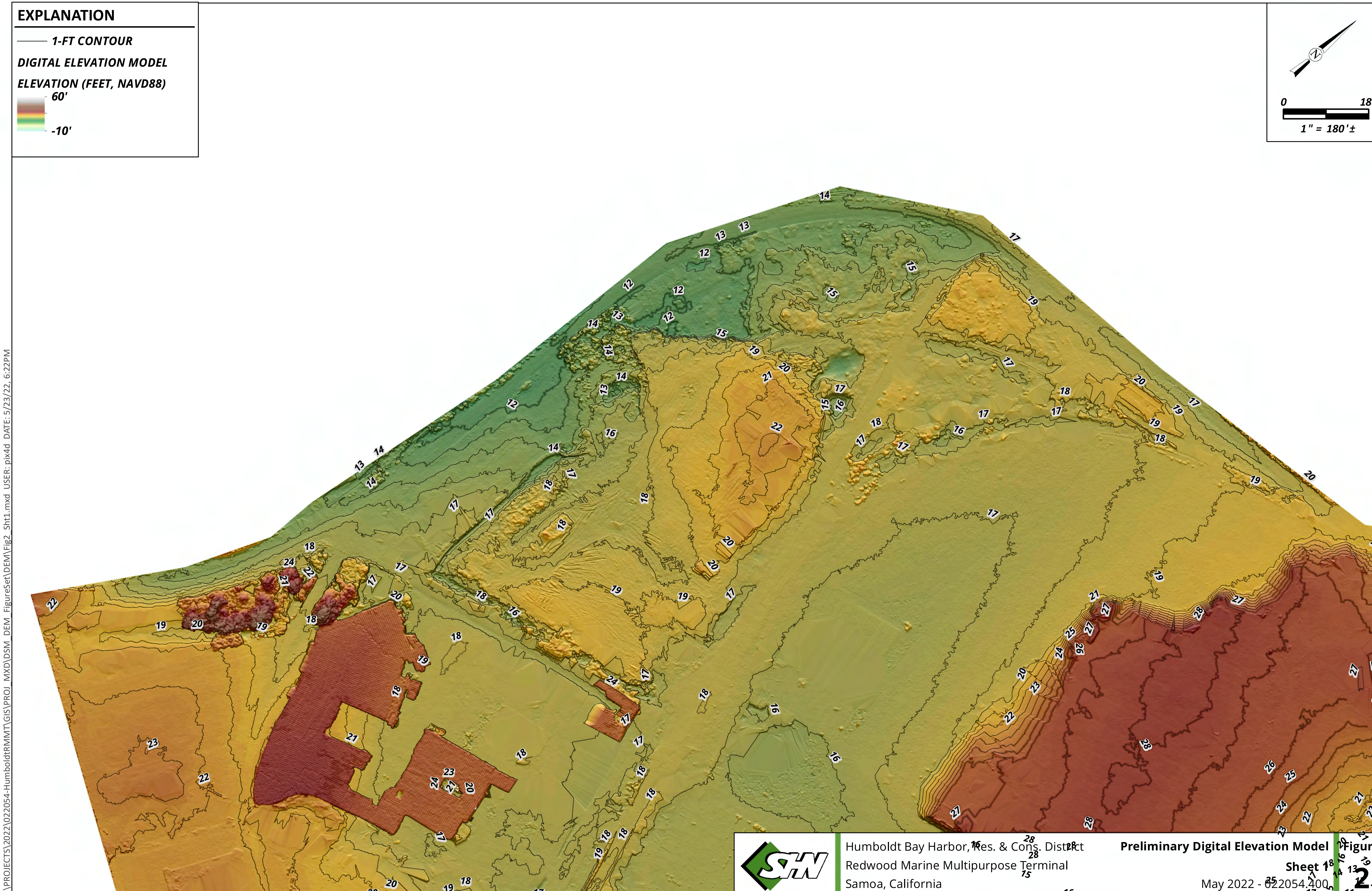

Humboldt Bay Harbor, Rec. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model
Sheet 1
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Figure 2

EXPLANATION

1-FT CONTOUR

DIGITAL ELEVATION MODEL

ELEVATION (FEET, NAVD88)

60'

-10'

SHEET 2

SHN

Humboldt Bay Harbor, Res. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model

Sheet 2

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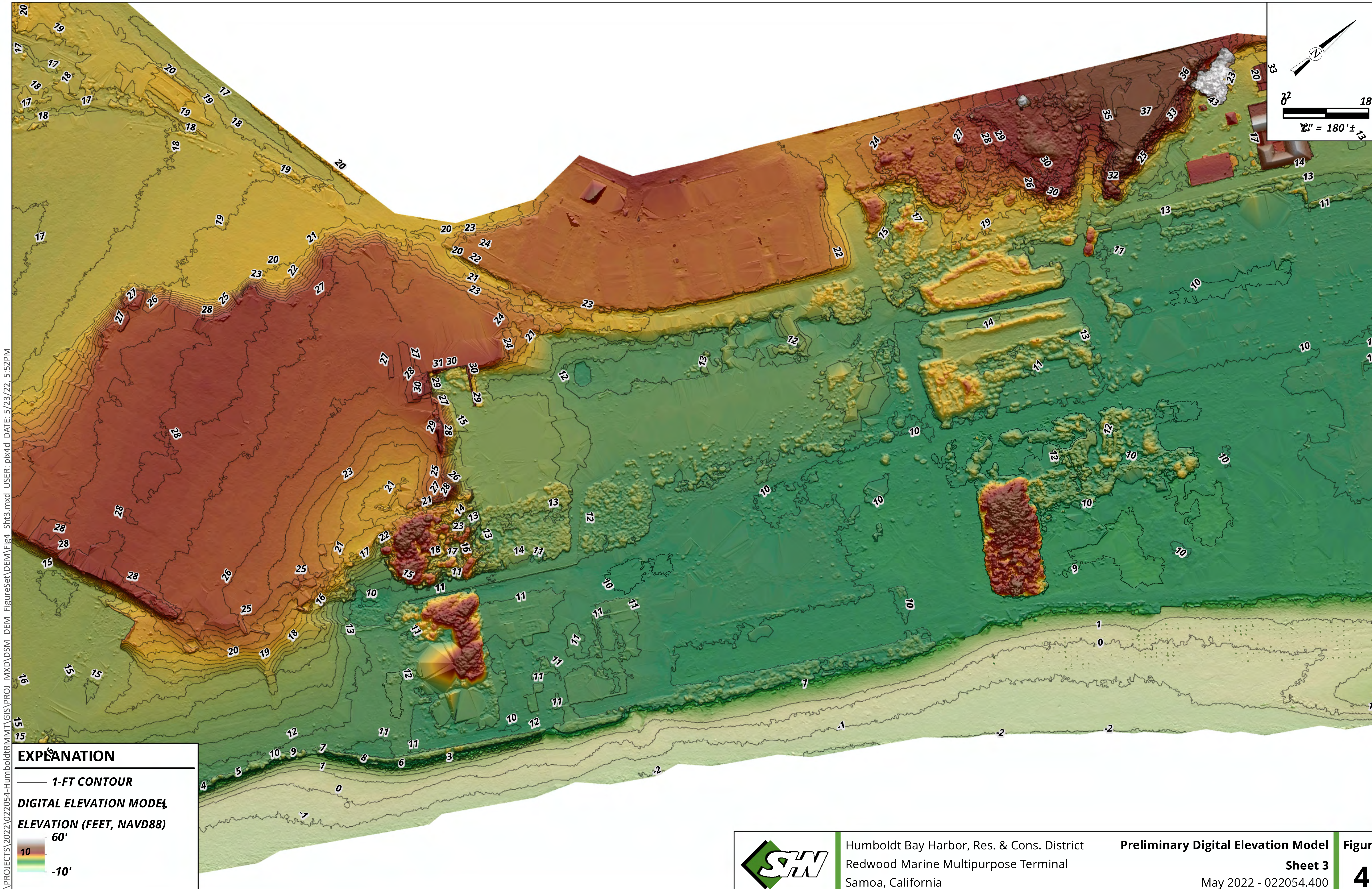
Figure

3



Humboldt Bay Harbor, Res. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model

Sheet 3

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Figure

4

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EXPLANATION

1-FT CONTOUR

DIGITAL ELEVATION MODEL

ELEVATION (FEET, NAVD88)

60'

-10'

Humboldt Bay Harbor, Res. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model
Sheet 4
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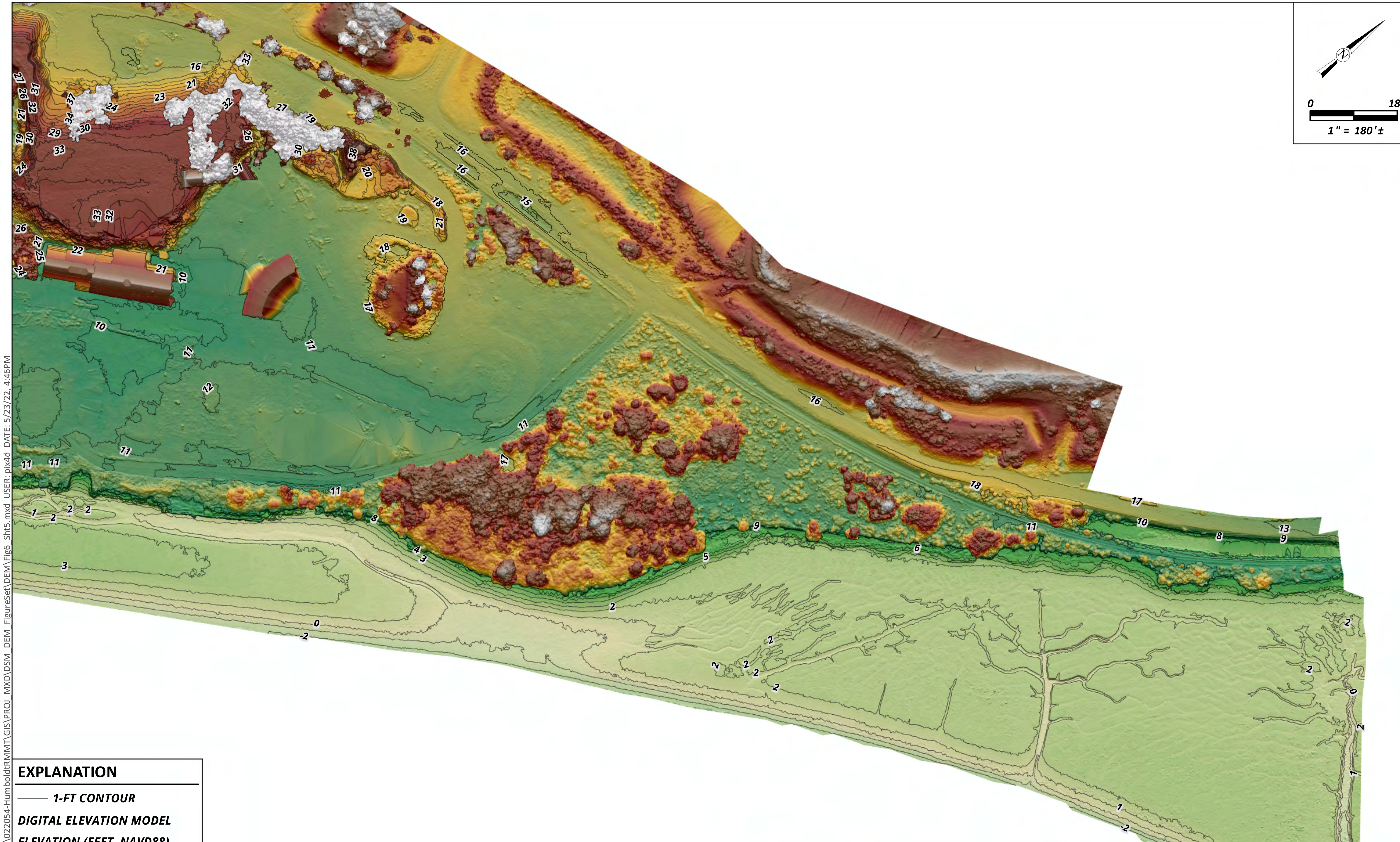
Figure
5



EXPLANATION

1-FT CONTOUR

DIGITAL ELEVATION MODEL

ELEVATION (FEET, NAVD88)

60'

-10'

Humboldt Bay Harbor, Res. & Cons. District
Redwood Marine Multipurpose Terminal
Samoa, California

Preliminary Digital Elevation Model

Sheet 5

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Figure

6

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