OCS Study
BOEM 2024-039

Hawai’i Floating Offshore Wind Regional Ports Assessment

U.S. Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region, Camarillo, CA

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DISCLAIMER

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ABOUT THE COVER

Photo Description: Aerial image of Kawaihae Harbor, looking south.

Photo Credit: Google Earth 2024

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List of Abbreviations and Acronyms

ABS	American Bureau of Shipping
ACI	American Concrete Institute
AISC	American Institute for Steel Construction
ASCE	American Society of Civil Engineers
AWH	Alpha Wind Hawai'i Wind, LLC
AWS	American Welding Society
BCC	Birds of Conservation Concern
BOEM	Bureau of Ocean Energy Management
CTV	Crew transfer vessel
dba	doing business as
DI	demographic index
DOBOR	Division of Boating and Ocean Recreation
DoD	Department of Defense
EA	Environmental Assessment
e.g.	*Exempli gratia* (for example)
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
etc.	et cetera
FAA	Federal Aviation Administration
ft	feet
GW	Gigawatts
HAPC	Habitat Areas of Particular Concern
H.B.	House Bill
HDOH	Hawai'i Department of Health
HDOT	Hawai'i Department of Transportation
HEER	Hazard Evaluation and Emergency Response
HI	Hawai'i
HICRIS	Hawai'i Cultural Resource Information System
i.e.	*id est* (that is)
IPaC	Information for Planning and Consultation
m	meter/meters
M&N	Moffatt & Nichol
MF	Manufacturing/Fabrication
MNA	Myounghee Noh & Associates, L.L.C. dba MNA Environmental
MW	Megawatt
N/A	Not applicable

NEPA	National Environmental Policy Act
NFA	No Further Action
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operations & Maintenance
OCS	Outer Continental Shelf
OEM	Original Equipment Manufacturer
Pacific OCS	Outer Continental Shelf off the coasts of California, Oregon, Washington, Hawai'i, and Guam
PIANC	Permanent International Association of Navigation Congresses
PPE	Personal protection equipment
psf	pounds per square foot
RO-RO	Roll-on/roll-off
S&I	Staging & Integration
SCS	Scientific Consultant Services, Inc.
SHPD	State Historic Preservation Division
SME	subject matter expert
SOV	Service operations vessel
T&E	threatened and endangered
TCP	traditional cultural properties
TLP	Tension Leg Platform
UFC	Unified Facilities Criteria
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WEA	Wind Energy Area
Wtd.	Weighted
WTG	Wind turbine generator
yrs	Years

Executive Summary

The Bureau of Ocean Energy Management (BOEM), as mandated by the Outer Continental Shelf (OCS) Lands Act, administers the exploration and development of energy and mineral resources in federal waters. This includes the responsibility of issuing leases, easements, or rights-of-way for offshore energy and mineral resources in federal waters off the coasts of California, Oregon, Washington, Hawai'i, and Guam – the Pacific OCS Region.

On March 29, 2021, the Biden Administration established the goal of deploying 30 gigawatts (GW) of offshore wind power in the U.S. by 2030, which will largely be met using fixed-bottom wind turbines on the East Coast and in the Gulf of Mexico (The White House 2021). However, the water off the Pacific West Coast and Hawai'i is significantly deeper and will require floating wind turbines. Therefore, on September 15, 2022, the Biden Administration announced the goal of deploying 15 GW of *floating* offshore wind power in the U.S. by 2035, building on the existing goal of 30 GW by 2030 (The White House 2022).

In 2015, under House Bill (H.B.) 623, the State of Hawai'i (HI) set a goal of achieving 100 percent renewable energy by the year 2045 (HI H.B. 623 2015). In the last decade, BOEM has received unsolicited wind energy lease requests for areas off the coast of O'ahu. BOEM has identified the need to gather data on the infrastructure required to develop offshore wind energy in the Hawai'i region. Specifically, the infrastructure outside of the offshore energy facility itself, such as ports, navigation, transmission, and supply chains. This study focuses on an assessment of the port and harbor infrastructure in the State of Hawai'i and addresses the needs and requirements to support the construction and operation of offshore wind projects.

The objective of this study is to develop offshore wind deployment scenarios, which include size (gigawatts) and timing (e.g., 2045), and perform a high-level screening study to identify the required type, quantity, and size of offshore wind port facilities needed to support the deployment scenarios. The feasibility of port upgrades and associated cost estimates are not included in this study. The overall goals of this study are to

1. Identify port requirements and deployment scenarios needed to support an offshore wind industry in Hawai'i and
2. Assess physical, operational, and regulatory capabilities and constraints of port facilities and infrastructure in Hawai'i.

On June 24, 2016, BOEM published a *Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS, Offshore the Island of O'ahu, Hawai'i* (BOEM 2016). With this call, BOEM invited the submission of information and nominations from parties interested in obtaining one or more commercial wind energy leases that would allow lessees to propose the construction of wind energy projects on the OCS offshore the island of O'ahu, Hawai'i. Following the Call for Information and Nominations, BOEM published an offshore wind energy call areas map in 2019 identifying two sites off the coast of O'ahu as areas of interest – the North O'ahu Call Area and South O'ahu Call Area (BOEM 2019).

In October 2021, the National Renewable Energy Laboratory (NREL) published a report detailing the cost and feasibility of floating offshore wind energy in the O'ahu region and identified a third study area—the O'ahu East Study Area (Shields et al. 2021).

In May 2023, Hawaiian Electric published their Integrated Grid Plan detailing the pathway to Hawai'i's clean energy future by using 100 percent renewable resources and net-zero carbon emissions by 2045 (Hawaiian Electric 2023). The plan features a broad timeline that integrates more renewable resources, phases out fossil fuel-based generation, and lowers carbon emissions to align with the state's decarbonization objectives. As part of this timeline, there is consideration for potentially adding 400 MW of offshore wind capacity by 2035.

Based on the statewide renewable energy goals and Integrated Grid Plan, a range of offshore wind deployment scenarios and timelines were established for this study in coordination with BOEM and the Hawaii State Energy Office. The deployment scenarios evaluated in this study are 0 GW, 0.5 GW, 1 GW and 2 GW by 2035 and 0 GW, 0.5 GW, 1 GW and 2 GW by 2045. From these deployment targets, the required number port/harbor sites were determined as detailed in **Section 3**.

After the deployment targets and number of required port sites were identified, an inventory of potential port and harbor locations within Hawai'i was taken. Moffatt & Nichol (M&N) and BOEM conducted outreach meetings with the Hawai'i Department of Transportation (HDOT) and the Division of Boating and Ocean Recreation (DOBOR) to identify ports and harbors that should undergo further evaluation for their availability and suitability for offshore wind buildout and maintenance. From these discussions, the following eleven port and harbor sites were selected for more detailed assessment in this study:

- Nawiliwili Harbor (HDOT)
- Nawiliwili Small Boat Harbor (DOBOR)
- Port Allen Small Boat Harbor (HDOT)
- Wai'anae Small Boat Harbor (DOBOR)
- Kalaeloa Barbers Point Harbor (HDOT)
- Ke'ehi Boat Harbor (DOBOR)
- Honolulu Harbor (HDOT)
- Kahului Harbor (DOBOR)
- Kawaihae Harbor (HDOT)
- Kawaihae Small Boat Harbor (DOBOR)
- Hilo Bay (HDOT)

To meet the 0.5 GW, 1 GW, and 2 GW deployment targets by 2035 or 2045, it was determined that at least one staging and integration (S&I) port site is required. S&I sites require large upland space for component storage, deep navigation channels, and no air-draft restrictions such as bridges. With approximately 45 acres of land that could be made available, **Kawaihae Harbor** was the only site that met the established criteria from **Section 2.2** to facilitate the build out of up to 20 megawatt (MW) floating offshore wind turbines and therefore, was identified as a good S&I candidate site. To construct an S&I site in Hawai'i is a relatively large investment for short-term use. For the deployment targets identified, it is estimated the site would be utilized for between 2 to 11 years to support the build-out of offshore wind in Hawai'i. After the build-out of offshore wind, the S&I site would be used as needed by the offshore wind industry as a turbine maintenance site and could potentially be used for other purposes.

With 22 acres of available acreage, **Kalaeloa Barbers Point Harbor** was identified as a moderate S&I candidate site and alternative to Kawaihae Harbor. The navigation channel that enters Kalaeloa Barbers Point Harbor is approximately 400 feet wide and 36 feet deep. Therefore, this channel can only accommodate floating offshore wind turbines of 5 MW to 15 MW rated capacity based on today's technology without significant changes to the width and depth of the channel. This limitation is due to the dimensions of the floating foundations that need to be towed through the channel after the turbine is fully assembled at the S&I site. In addition, use of smaller rated capacity turbines will extend the deployment timeline since more turbines will need to be assembled and installed to reach the desired deployment target. The buildout of this site for S&I activities will also require close coordination with the Federal Aviation Administration (FAA), Department of Defense (DoD), Pacific Air Forces, and Honolulu Control Facility to mitigate any impacts from the turbines on procedures at the Kalaeloa Airport, Daniel K. Inouye

International Airport, and Hickam Air Force Base. Given the site's potential airspace impacts, further evaluation is required to assess the feasibility of developing this site for S&I operations, but for the purposes of this study the site was highlighted as a possibility. All other evaluated sites did not meet the criteria and thus are not considered as S&I candidates.

Manufacturing/fabrication (MF) sites receive raw materials via road, rail, or waterborne transport and create larger components in the offshore wind supply chain. These components are then exported via waterborne transport on a vessel or barge to an S&I site. Developing new MF port sites in Hawai'i is not required for offshore wind development, as turbine components and floating foundations can be imported from abroad or the U.S. mainland if a supply chain is established. Like S&I sites, MF sites require a large amount of acreage. Because of the limited site availability in Hawai'i, the large-acre port sites should be prioritized for S&I activities. Furthermore, given the relatively low offshore wind targets in Hawai'i, original equipment manufacturers (OEMs) may lack sufficient incentive to establish MF facilities for a limited number of projects. Therefore, space for MF facilities in Hawai'i does not need to be made available.

Additionally, one to four Operations & Maintenance (O&M) sites with a minimum of 2 acres are needed depending on the deployment target. O&M sites are critical for supporting Service Operation Vessels (SOV) and Crew Transfer Vessels (CTV) and need to be within 100 nautical miles (nm) of the offshore installation site to minimize travel time and ensure proximity to safe havens. Of the eleven sites evaluated, **Kalaeloa Barbers Point Harbor** was identified as a good O&M candidate site because of its proximity to the offshore Call and Study Areas and because the sufficient acreage can also serve as an installation support site. Sites were categorized as moderate O&M candidate either due to its distance from the North and South O'ahu Call Areas and East O'ahu Study Area, minimal available acreage, and/or if significant amount of dredging was required. Moderate O&M sites include Nawiliwili Harbor, Wai'anae Small Boat Harbor, Ke'ehi Boat Harbor, Kahului Harbor, and Kawaihae Harbor. Sites that did not meet the criteria were not considered to be O&M candidates and include Nawiliwili Small Boat Harbor, Port Allen Small Boat Harbor, Honolulu Harbor, Kawaihae Small Boat Harbor, and Hilo Bay.

Figure 1 summarizes the S&I, MF, and O&M site candidate status for each port/harbor and indicates the locations of the two 2016 BOEM call areas and NREL study area. Based on the study's results, to meet the deployment targets of 0.5 GW, 1 GW, and 2 GW, Hawai'i appears to have enough potential port sites to support an offshore wind build-out. It is important to highlight that any port site necessitating the displacement of port operators or tenants is excluded from the study. In addition, an assessment of military facilities was not included in this study.

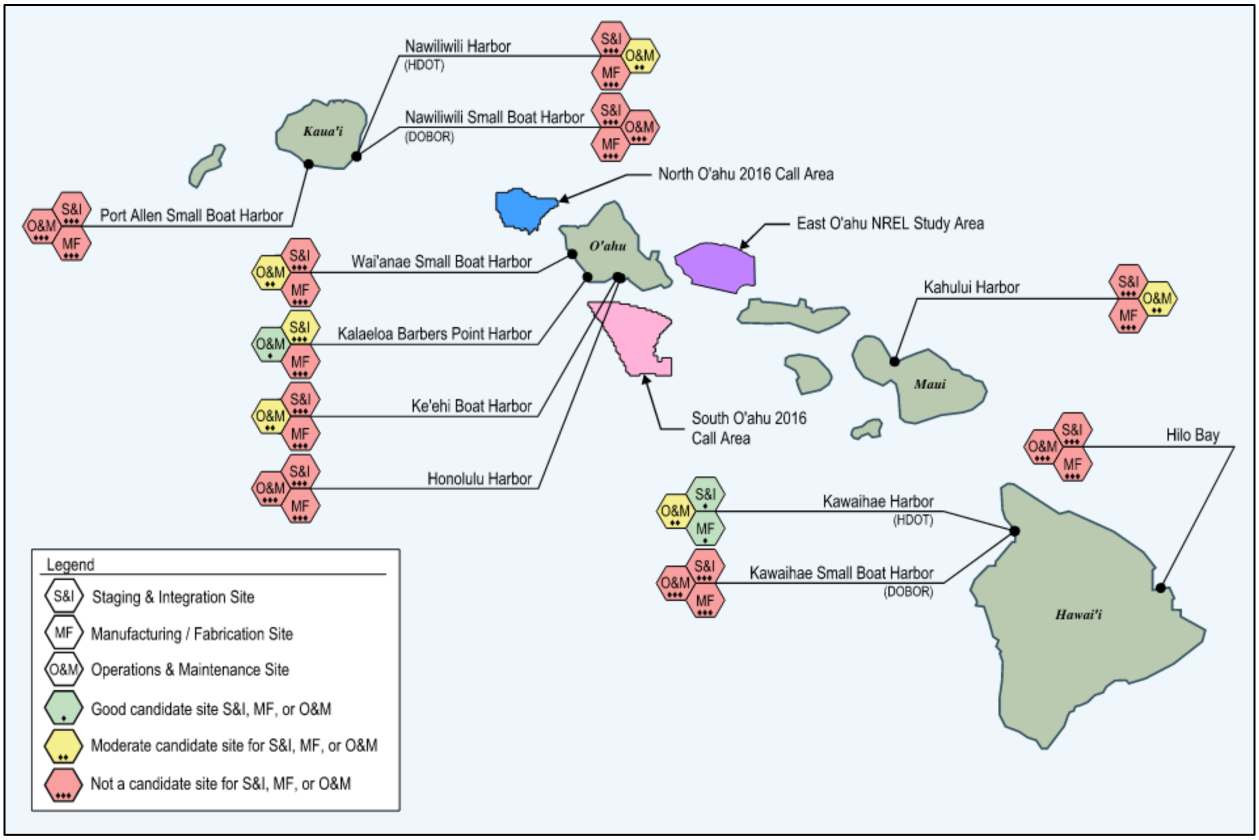

Figure 1. S&I, MF, and O&M site candidate status for each Hawai'i port/harbor

1 Introduction

The United States (U.S.) Department of the Interior, Bureau of Ocean Energy Management (BOEM), as mandated by the Outer Continental Shelf (OCS) Lands Act, administers exploration and development of energy and mineral resources in federal waters. This includes the responsibility of issuing a lease, easement, or right-of-way for offshore energy and mineral resources in federal waters off the coasts of California, Oregon, Washington, Hawai'i, and Guam—the Pacific OCS Region.

The Pacific OCS is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed-bottom offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To construct floating offshore wind turbines, the turbine components will need to be fabricated, assembled, and transported from an onshore port to the offshore wind site. Existing port infrastructure in the Pacific OCS Region, including along the Hawaiian Islands, is not adequate to support these activities, and port investment is required to develop offshore wind port facilities.

Innovative technologies that could potentially reduce the need for ports have started to emerge. However, this technology has not yet been tested or implemented; therefore, the installation methods that have been used to date—which require the use of ports—are assumed for this study to help BOEM and the State plan for potential future offshore wind energy projects.

BOEM is interested in a study of Hawai'i ports and harbors to support offshore wind development: specifically, the infrastructure apart from the offshore energy facility itself, such as ports, navigation, transmission, and supply chain. This study will address the needs and requirements of Hawai'i ports and harbors to support floating offshore wind.

The objective of this study is to develop offshore wind deployment scenarios, which include size (gigawatts [GW]) and timing (e.g., the years 2035 and 2045), as well as a high-level screening study to identify the required quantity and size of various port facilities needed to support the deployment scenarios. The feasibility of port upgrades and associated cost estimates are not included in this study. In addition, the identification of a port site as a potential candidate for offshore wind development does not mean there is a project planned for developing these sites.

The overall goals of the Hawai'i Floating Offshore Wind Regional Ports Assessment are to

1. Identify port requirements and deployment scenarios needed to support an offshore wind industry in Hawai‘i; and
2. Assess physical, operational, and regulatory capabilities and constraints of port facilities and infrastructure.

In 2015, Hawai'i House Bill (H.B.) 623, which sets the clean energy goals for the State of Hawai'i, was passed. The energy goals outlined in H.B. 623 are as follows (HI H.B. 623, 2015).

- Each electric utility company that sells electricity for consumption in the State shall establish a renewable portfolio standard of
    - 40 percent of its net electricity sales by December 31, 2030.
    - 70 percent of its net electricity sales by December 31, 2040.
    - 100 percent of its net electricity sales by December 31, 2045.

In 2015, BOEM received a total of three unsolicited wind energy lease requests from two potential developers:

- 400-MW AWH O'ahu Northwest Project by Alpha Wind Hawai'i Wind, LLC (AWH).

- 400-MW AWH O’ahu South Project by AWH.
- 400-MW Progression South Coast of O’ahu Project by Aukahi Energy LLC, formerly known as Progression Hawai’i Offshore Wind, Inc.

On June 24, 2016, BOEM published a *Call for Information and Nominations for Commercial Leasing for Wind Power on the OCS, Offshore the Island of O’ahu, Hawai’i* (BOEM 2016). With this Call, BOEM invited the submission of information and nominations from parties interested in obtaining one or more commercial wind energy lease that would allow lessees to propose the construction of wind energy projects on the OCS offshore the island of O’ahu, Hawai’i. Following the Call for Information and Nominations, BOEM published an offshore wind energy call areas map in 2019 identifying two sites off the coast of O’ahu as areas of interest – the North O’ahu Call Area and South O’ahu Call Area, refer to **Figure 2** (BOEM 2019).

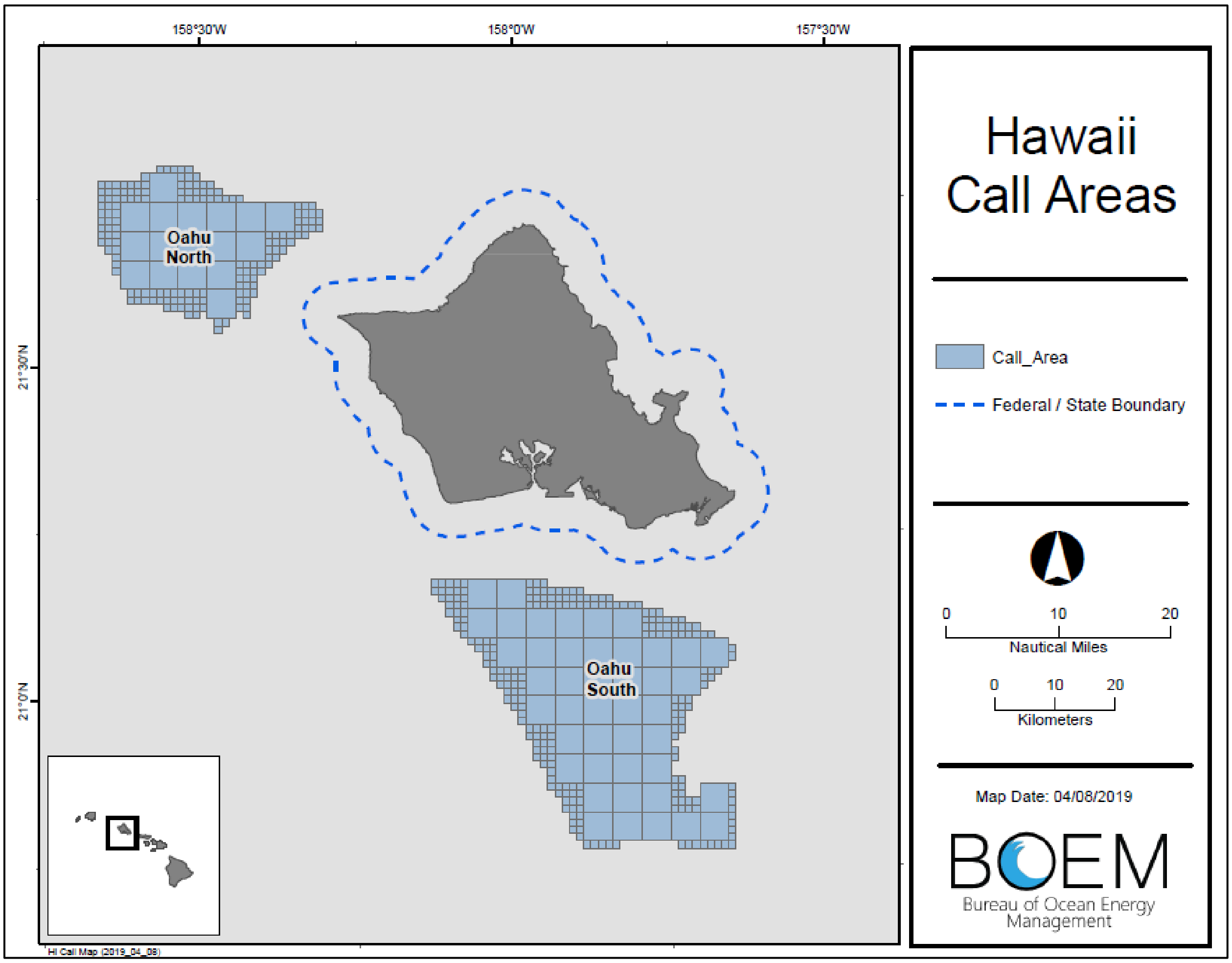

Figure 2. Hawai’i offshore wind call areas (BOEM 2019)

In October 2021, the National Renewable Energy Laboratory (NREL) published a report detailing the cost and feasibility of floating offshore wind energy in the O’ahu region. The report assesses three study areas: O’ahu East, O’ahu North and O’ahu South as shown in **Figure 3** (Shields et al. 2021). The O’ahu North and O’ahu South study areas correspond to the Call Areas identified by BOEM in 2016. The O’ahu East Study Area was defined by NREL and included in their assessment to provide additional geographic diversity in their cost analysis.

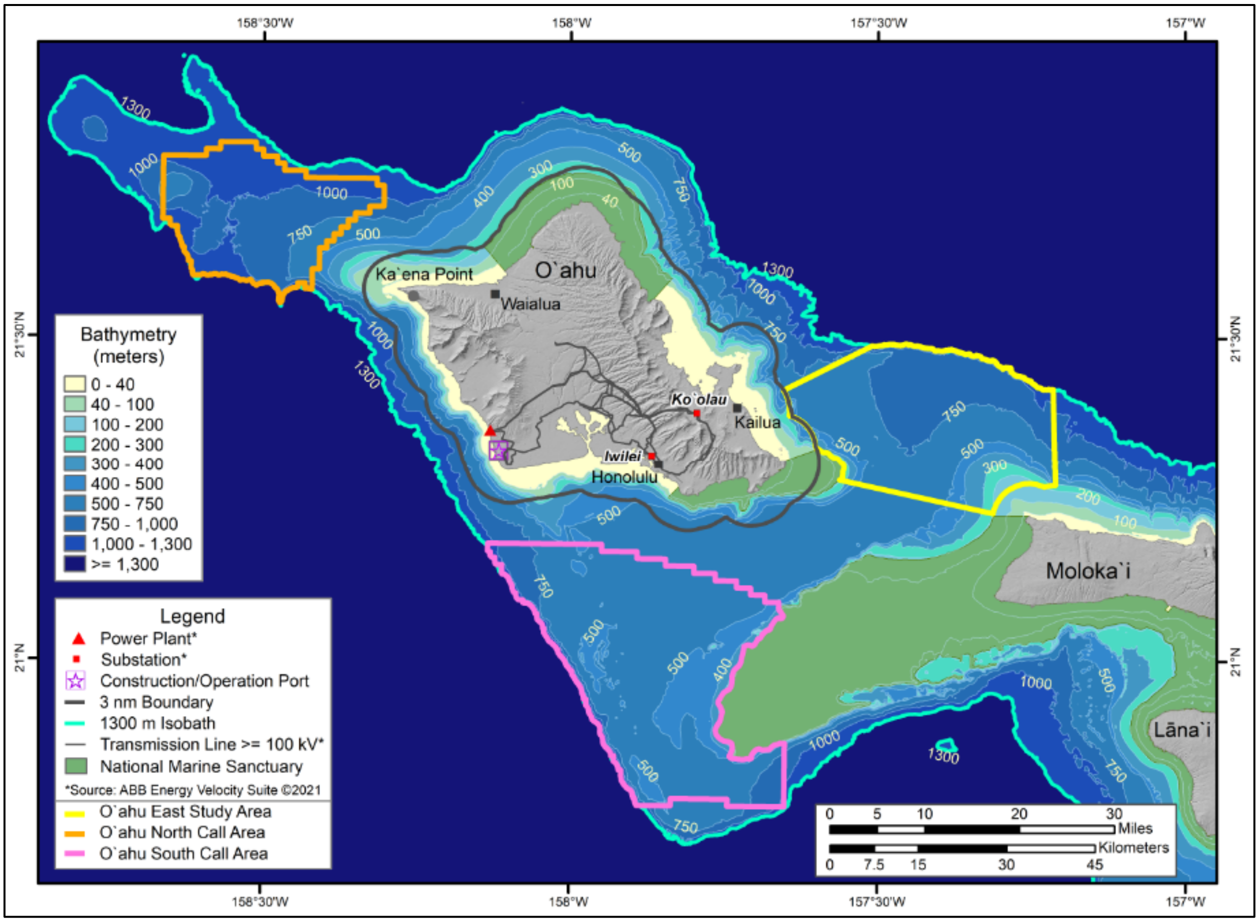

Figure 3. NREL O'ahu offshore wind study areas (Shields et al. 2021)

For this study, the above three O'ahu study areas will be utilized to assess offshore wind port infrastructure. If Hawai'i chooses to implement offshore wind energy to achieve a 100 percent Renewable Portfolio Standard by 2045, as stated in H.B. 623, the buildout of offshore wind port infrastructure is imperative. This study examines the following port development options:

- Utilize a single port (or as few as possible) to support all floating offshore wind fabrication, assembly, and operations (e.g., co-locate integration, fabrication, and operations and maintenance facilities).
- Utilize multiple port facilities to optimize development and operational support at the most ideal locations and to spread the economic impact throughout the State (e.g., separate staging and integration, and operations and maintenance facilities).

2 Offshore Wind Port Requirements

The floating offshore wind industry requires port sites to stage, assemble, and provide ongoing operations and maintenance of the wind turbines. Based on the industry outreach completed for the BOEM study titled *Port of Coos Bay Port Infrastructure Assessment for Offshore Wind Development*, this chapter defines the requirements of this port assessment and the design criteria for the following types of offshore wind port sites (Trowbridge et al. 2022).

- **Staging and Integration (S&I) Site:** a site to receive, stage, and store offshore wind components and to assemble the floating offshore wind turbines to be towed to and deployed at offshore wind areas. This facility is likely to support the following services.
    - **Turbine Maintenance Site:** a facility to perform major maintenance on a fully assembled wind turbine system that cannot otherwise be performed in the offshore wind area without heavy-lift vessels, such as the replacement of a nacelle or blade.
- **Manufacturing/Fabrication (MF) Site:** a port site located on a navigable waterway that receives raw materials via road, rail, or waterborne transport and manufactures components for the offshore wind supply chain. This site typically includes factory and/or warehouse buildings and space for storage of finished components.
- **Operations and Maintenance (O&M) Site:** a base of offshore wind farm operations with warehouses/offices, spare part storage, and marine facility to support vessel provisioning and refueling/charging for the following O&M vessels during the operational period of the offshore wind farm.
    - **Crew Transfer Vessel (CTV):** transfers small crews to the offshore wind turbine installation site for day-trip O&M visits and inspections.
    - **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. This vessel may remain in the vicinity of an offshore wind farm for an extended period with permanent or semi-permanent personnel rotation.

Additional offshore wind port sites that are not included in this study but will be required for offshore wind industry use include the following.

- **Installation Support Site:** a base of construction operations for the fleet of construction vessels necessary for the construction and commissioning of the offshore wind farm.
- **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.
- **End of Life Decommissioning Site:** a site to decommission, disassemble, recycle, and dispose of turbine systems that are at end of life.

2.1 Turbine Size

Based on the information obtained from a previous BOEM study and industry outreach, currently 15 MW and smaller offshore wind turbine systems are commercially available; however, the anticipated size of turbine systems to be installed off the U.S. West Coast and Hawai'i may be 15 MW or larger (Trowbridge et al. 2022). Therefore, when planning for port infrastructure it is important to design facilities that can accommodate future turbine sizes. **Table 1** summarizes the anticipated dimensions for a future floating offshore wind turbine system with rated capacities of up to 20 to 25 MW. 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. However, the actual dimensions of the turbines to be installed off Hawai'i may be dependent on physical constraints (i.e., channel entrance width, etc.) within the S&I port facility. In addition, **Figure 4** shows a depiction of the turbine dimensions.

Table 1. Floating offshore wind turbine dimensions (20 to 25 MW)

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 Turbine Integration)	15 to 25 ft	4.5 to 7.5 m
Draft (After Turbine Integration)	20 to 50 ft	6 to 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

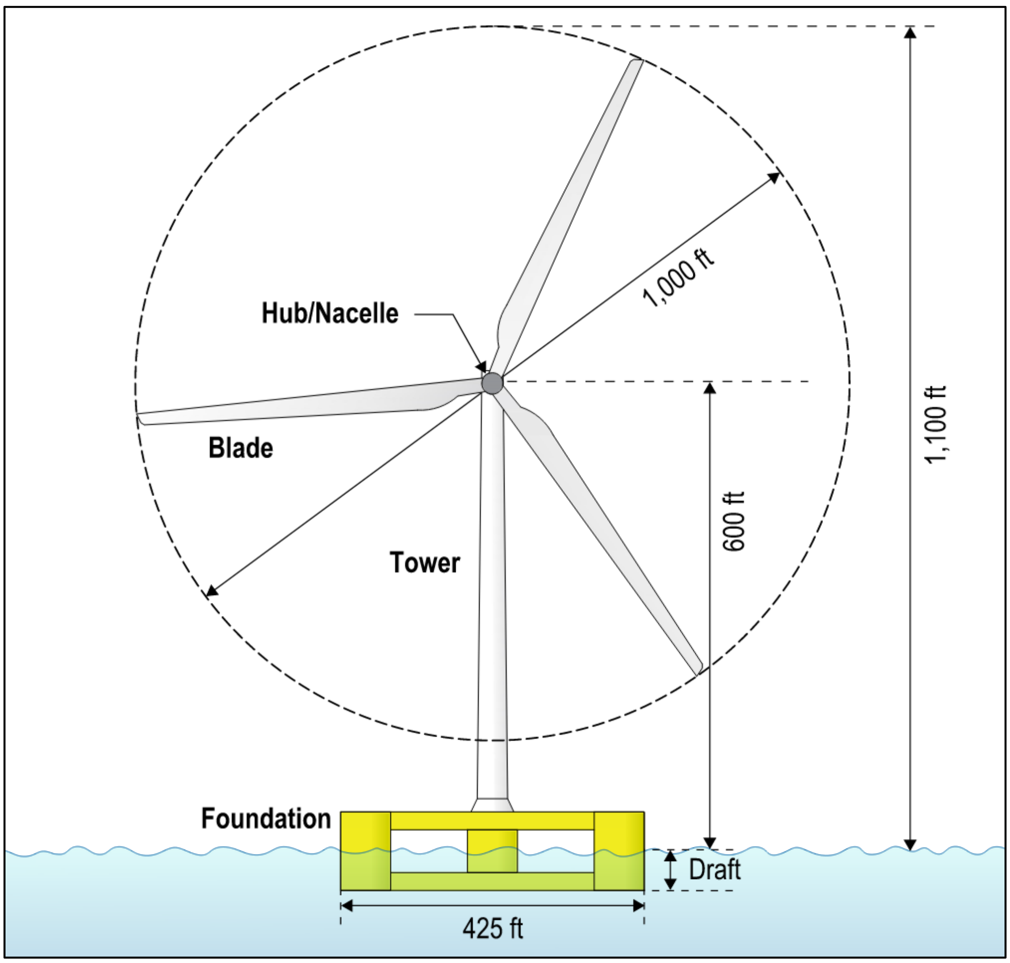

Figure 4. Floating offshore wind turbine dimensions (20 to 25 MW)

2.2 Port Requirements

The following parameters summarize the required port infrastructure to unload, store, and assemble floating offshore wind turbine components, and pre-commission per the BOEM *California Floating Offshore Wind Regional Ports Feasibility Analysis* study (Lim et al. 2023).

2.2.1 Port Wharf and Loading Requirements

Per discussions with industry, the S&I wharf ideally would have the berth length to accommodate the delivery of components and at least two turbine assemblies moored adjacent to one another, resulting in approximately 1,500 feet of quayside space, as summarized in **Table 2**. However, due to constraints within the ports/harbors in Hawai'i, the minimum berth length of the S&I wharf could be 800 feet to accommodate one turbine assembly and a delivery vessel. For O&M and component manufacturing facilities, the length of the wharf is dependent on the vessel type it serves. For example, SOVs and CTVs for O&M facilities and delivery vessels and delivery barges for component manufacturing facilities.

In general, the uplands area for S&I and MF sites shall have a capacity of 2,000 to 3,000 pounds per square foot (psf) to support offshore wind turbine generator (WTG) components. Additionally, the wharf loading at S&I and MF sites will be higher where the crane for turbine assembly and/or loading/unloading of delivery vessels and barges is located. Existing crawler cranes, such as the Liebherr 1300, are not large enough to assemble turbines greater than 15 MW. Thus, ring cranes or larger crawler or mobile cranes will likely be required to integrate components. Because of the significant size and weight of the WTG components, a wharf loading capacity of 6,000 psf is required for both S&I and MF sites. The wharf and uplands loading capacities at O&M facilities are expected to range from 100 to 500 psf.

The size of a site is also dependent on the facility type. For an O&M facility, the site shall be approximately 2 to 10 acres. For component MF and S&I sites, a range of 30 to 100 acres is requested depending on the developer and their use.

Table 2. Hawai'i port infrastructure requirements for floating offshore wind turbines

Port Infrastructure Requirement	Approx. Criteria for S&I Sites in HI	Approx. Criteria for MF Sites in HI	Approx. Criteria for O&M Sites in HI
Acreage, minimum	30 to 100 acres	30 to 100 acres	2 to 10 acres
Wharf Length, minimum[1]	800 ft	800 ft	300 ft
Draft at Berth, minimum	38 ft	38 ft	20 to 30 ft
Draft at Sinking Basin[2]	40 to 100 ft	N/A	N/A
Wharf Loading	> 6,000 psf	> 6,000 psf	100 to 500 psf
Uplands / Yard Loading (WTG components)	> 2,000 to 3,000 psf	> 2,000 to 3,000 psf	100 to 500 psf

[1] Per discussions with industry, the ideal wharf length for S&I sites is 1,500 ft. However, due to constraints within the ports/harbors in Hawai'i, the minimum wharf length for S&I sites could be 800 ft.

[2] Options for transfer of floating foundations from land to water include the use of a semi-submersible barge and sinking basin, ramp system, or direct transfer methods (lifting portions or complete foundation units from land into water).

2.2.2 Floating Foundation Type and Launching

Currently, there are three main types of floating foundations for floating offshore wind turbines, as shown in **Figure 5**:

- **Spar:** A spar floating foundation, constructed of either concrete, steel, or a hybrid combination, is a cylinder that floats vertically in the water.
- **Semi-submersible:** A semi-submersible floating foundation, constructed of either concrete, steel, or a hybrid combination, is composed of a submerged hull with multiple pontoons and columns.
- **Tension Leg Platform (TLP):** A TLP floating foundation, constructed of steel, comprises multiple columns and pontoons. Its mooring system requires vertical tensioned tendons, which provide stability to the structure.

Figure 5. Illustration of floating foundation types (left to right: spar, semi-submersible, TLP) (Kreider et al. 2022 and illustration by Joshua Bauer, NREL)

Semi-submersible floating foundations are the most probable technology to be used on the Pacific West Coast and off Hawai'i, as indicated by offshore wind developers. By assuming semi-submersible foundations will be utilized for offshore wind development on the Pacific West Coast and off Hawai'i, the port requirements developed in **Table 2** are also suitable for TLP foundations. Spar foundations are not feasible on the Pacific West Coast or off Hawai'i, due to the draft requirements that far exceed a feasible limit within our ports.

A major challenge the industry identified is the transfer of the completed floating foundation from the assembly wharf into the water (i.e., launching). Several options are available to overcome this challenge and each developer may prefer a different option; however, a few common approaches were identified.

- **Semi-Submersible Barge:** The floating foundation is moved from the wharf onto the barge and the barge is moved to a 40- to 100-foot-deep sinking basin where the barge is partially submerged by taking on ballast and the foundation is floated off the barge.

- **Ramp System:** The floating foundation is moved onto a rail system and travels down a sloped ramp into the water. This methodology is similar to that of a marine railway ship launching system.
- **Direct Transfer:** These are methods that include lifting the floating foundation directly from the wharf into the water (includes methods that involve placing pieces of the foundation into the water and finalizing the construction in the water).

2.2.3 Wet Storage Requirements

Wet storage space is also required in addition to the waterfront and upland acreage. Ports must have locations where floating foundations or integrated floating offshore wind turbines can be safely moored and stored prior to tow-out operations to mitigate the risk of weather downtime, vessel traffic, entrance channel congestion, and other transportation risks. This also allows the developers to store and test the assembled units, as well as ensure they can be transported to the lease area safely and on schedule. The required size of the wet storage area is dependent on the developer's installation strategy, deployment schedule, equipment availability, and project capacity.

2.2.4 Additional Port Requirements

Several additional port requirements include the following:

- **Roll-on/Roll-Off (RO-RO) Capabilities:** port sites shall have RO-RO capability built into the wharf to accommodate delivery vessels for component delivery.
- **Shoreside Vessel Services:** port sites will require all standard ship services (e.g., potable water), shore power, and security requirements.
- **Buildings:** indoor storage/warehouses are required for some items (e.g., floating foundation mechanical equipment, painting, welding, etc.).

2.3 Design Life

All new marine structures at the port shall be designed for a minimum 50-year service life. Design service life is generally considered the period during which a properly built and maintained structure is expected to operate as designed without requiring major replacement or rehabilitation.

2.4 Governing Codes, Standards, and References

The following codes, standards, and references govern the design of port infrastructure and offshore wind vessels.

American Bureau of Shipping (ABS):

- Guide for Building and Classing Floating Offshore Wind Turbines, updated July 2020

American Concrete Institute (ACI):

- ACI 318-19(22), Building Code Requirements for Structural Concrete (reapproved 2022)

American Institute for Steel Construction (AISC):

- AISC 303-22, Code of Standard Practice for Steel Buildings and Bridges
- AISC 341-22, Seismic Provisions for Structural Steel Buildings

- AISC 360-22, 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, 2015

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 MarCom WG 145, Berthing Velocity Analysis of Seagoing Vessels over 30,000 dwt, 2022
- PIANC WG 121, Harbor Approach Channels – Design Guidelines, 2014
- PIANC WG 211, Guidelines for the Design of Fenders Systems, 2024
- PIANC WG 34, Seismic Design Guidelines for Port Structures, 2001

Unified Facilities Criteria (UFC):

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

United States Army Corps of Engineers (USACE):

- USACE EM 1110-2-1100, Coastal Engineering Manual, 2002
- USACE EM 1110-2-1613, Hydraulic Design of Deep-Draft Navigation Projects, 2006
- USACE EM 1110-2-2502, Retaining and Flood Walls, 1989

3 Deployment Scenarios

This chapter provides an overview of the different offshore wind deployment scenarios examined in this study. In accordance with the H.B. 623 renewable energy objectives aiming for a 100 percent Renewable Portfolio Standard by 2045 and aligned with the Hawaiian Electric Integrated Grid Plan, this study assessed various deployment scenarios for both 2035 and 2045 in Hawai'i. This chapter outlines these scenarios, identifies the number of port sites required, and describes the operational timelines necessary to meet the State's targets.

3.1 Deployment Targets and Planning Goals

To identify the various offshore wind deployment scenarios for this study, available reports, assessments, and documents related to Hawai'i energy production and power usage were reviewed. Below is a high-level summary of the relevant material used to determine the deployment scenarios for this study.

In 2015, BOEM received a total of three unsolicited wind energy lease requests from two potential developers:

- 400-MW AWH O'ahu Northwest Project by AWH
- 400-MW AWH O'ahu South Project by AWH
- 400-MW Progression South Coast of O'ahu Project by Aukahi Energy LLC, formerly known as Progression Hawai'i Offshore Wind, Inc.

In 2021, NREL published a study that assessed the value proposition of offshore wind and other potential technologies to better understand how Hawai'i can achieve a 100 percent renewable portfolio standard by 2045 (Shields et al. 2021). This study focuses on the island of O'ahu, as it comprises about 70 percent of the State's total energy demand. A tradeoff analysis was performed between solar PV and offshore wind to meet the anticipated electricity demand for O'ahu in 2045. This analysis assessed a range of 0, 0.6, and 1.2 GW of offshore wind generation to meet 2045 electricity demands.

In May 2023, Hawaiian Electric published their Integrated Grid Plan detailing the pathway to Hawai'i's clean energy future by using 100 percent renewable resources and net-zero carbon emissions by 2045 (Hawaiian Electric 2023). In the plan is a high-level timeline that adds renewable resources, retires fossil fuel-based generation, and reduces carbon emissions to meet the state's decarbonization goals. In this timeline, 400 MW of offshore wind by 2035 is included as a potential additional resource.

Based on the NREL report, Hawaiian Electric Integrated Grid Plan, and discussions with BOEM and the Hawai'i State Energy Office, the offshore wind deployment scenarios of 0 GW, 0.5 GW, 1 GW, and 2 GW by 2035 and 0 GW, 0.5 GW, 1 GW, and 2 GW by 2045, as shown in **Table 3** were identified to cover a range of energy production from offshore wind. The deployment scenarios were discussed on November 3, 2023 between BOEM, NREL, and Moffatt & Nichol (M&N) and further finalized with the Hawai'i State Energy Office on November 15, 2023.

These scenarios were further assessed to determine the required needs for port sites to meet these targets. It should be noted that the deployment targets of 0.5 GW, 1 GW, and 2 GW, in combination with other renewable energy sources, are anticipated to meet the State's electricity demands for 2045, as extrapolated from the NREL report.

Table 3. Hawai'i offshore wind deployment scenarios

Year	No Deployment Scenario	Low Scenario	Medium Scenario	High Scenario
2035	0 GW	0.5 GW	1 GW	2 GW
2045	0 GW	0.5 GW	1 GW	2 GW

3.2 Required Number of Offshore Wind Port Sites

To develop offshore wind and meet the deployment scenarios for 2035 and 2045, Hawai'i would require a minimum of one S&I site to operate the floating offshore wind turbine supply chain delivery, staging, and integration tasks. While innovative technologies that could potentially reduce the need for ports have started to emerge, this technology has not yet been tested or implemented. Therefore, the installation methods that have been used to date—which require the use of ports—are assumed for this study to help BOEM and the State plan for potential future offshore wind energy projects.

Developing new MF port sites in Hawai'i is not required for offshore wind development, as turbine components and floating foundations can be imported from the U.S. mainland or abroad. Like S&I sites, MF sites require a large amount of acreage. Because of the limited site availability in Hawai'i, the large-acre port sites should be prioritized for S&I activities. Furthermore, given the relatively low offshore wind targets in Hawai'i, original equipment manufacturers (OEMs) may lack sufficient incentive to establish MF facilities for a limited number of projects.

To meet and support the deployment scenarios for 2035 and 2045, Hawai'i would require a number of O&M sites. Each O&M facility would have the ability to support one or more offshore wind lease areas, and the extent of support capabilities will vary with the number of SOVs and CTVs hosted at the terminal, as well as support the capabilities of each SOV (Lim et al. 2023). For the purposes of this assessment, it was assumed that each O&M facility would have at least one berth that would support one to two SOV vessels that can maintain floating wind farms up to 1 GW capacity. Refer to **Table 4** for the required number of sites needed to meet each deployment scenario.

Table 4. Required number of sites to meet 2035 and 2045 deployment targets

Type of Site	0 GW	0.5 GW	1 GW	2 GW
S&I Sites	0	1	1	1
MF Sites	Not required in HI	Not required in HI	Not required in HI	Not required in HI
O&M Sites	0	1	1 to 2	2 to 3

3.3 Analysis of Port Installation Durations and Operational Start Dates

Several simulations were conducted to determine how long it would take to build out the offshore wind deployment targets detailed in **Table 3**; specifically focusing on how long an S&I port is actively needed to support the assembly operations of the wind turbines and tow-out operations to the offshore installation sites off O'ahu. This assessment does not include the duration for construction of onshore transmission or offshore substations, or the installation of subsea cables, anchors, or mooring lines; however, if the S&I site is also utilized for these purposes (i.e., installation support), the durations presented would be extended. The simulation incorporated an assessment of weather windows and occurrence frequencies by using historical metocean data such as significant wave height and wind speed at the wind turbine hub height to inform any delays in industry-standard floating offshore wind installation processes. With these inputs and the following assumptions on the supply chain, the operational duration of an S&I port needed to support the deployment scenarios using 5 MW, 10 MW, 15 MW, 20 MW, and 25 MW rated capacity turbines was estimated. Supply chain and S&I site assumptions are as listed below, and results are shown in **Table 5.**

- Turbine components (i.e., blades, nacelles, and tower sections) delivered every 1 to 2 weeks from the U.S. West Coast, Europe, or Asia, as site availability for manufacturing in Hawai'i is limited and shall be prioritized for S&I activities.
- Foundations assembled or delivered every four weeks from the U.S. West Coast, Europe, or Asia, as site availability for manufacturing in Hawai'i is limited and shall be prioritized for S&I activities. If foundations are imported fully assembled via ocean-going semi-submersible vessels, only one foundation can fit on these vessels and the round trip can take approximately four weeks. If foundation subcomponents are imported for assembly within a port site, complete assembly of a floating foundation could take around 4 weeks depending on the available space.
- The S&I site is approximately 20 to 45 acres based on the port assessment in **Chapter 6.** This is assumed to be sufficient space to maintain a turbine assembly pace of one turbine per month – assuming 5 to 15 MW rated capacity turbines are utilized at the 22-acre S&I site in Kalaeloa Barbers Point Harbor and 15 to 20 MW turbines are utilized at the 45-acre S&I site in Kawaihae Harbor – to align with the foundation delivery timeline.
- Wet storage in Kawaihae Harbor can store two fully assembled turbines. There is no space available for wet storage in Kalaeloa Barbers Point Harbor.

Note that the S&I site was modeled for storing turbine components, subcomponents of floating foundations, and space for assembling the floating foundations. If the S&I site is also utilized for the laydown and staging of other components, such as anchors, mooring lines, or other station-keeping components or subsea system accessories, this could extend the deployment times shown in **Table 5** by reducing space for staging of turbine and floating foundation components. Nevertheless, the site could still sufficiently support the deployment of 0.5 to 1 GW by 2035 or 2045, provided it is ready for operations by the early to mid-2030s.

Table 5. Hawai'i offshore wind deployment scenarios and port installation durations

WTG Capacity	0 GW	0.5 GW	1 GW	2 GW
5 MW	0 months	100 months (~8.5 yrs)	200 months (~17 yrs)	400 months (~33.5 yrs)
10 MW	0 months	50 months (~4.5 yrs)	100 months (~8.5 yrs)	200 months (~17 yrs)
15 MW	0 months	33 months (~3 yrs)	67 months (~6 yrs)	133 months (~11 yrs)
20 MW	0 months	25 months (~2.5 yrs)	50 months (~4.5 yrs)	100 months (~8.5 yrs)
25 MW	0 months	20 months (~2 yrs)	40 months (~3.5 yrs)	80 months (~7 yrs)

With limited port acreage available, M&N anticipates an S&I site to have a turbine assembly rate of approximately one turbine per month. This is mainly set by the assembly rate of a floating foundation taking up to four weeks. This duration is similar if floating foundations were imported fully assembled from overseas, such as from Asia or Europe, considering the remote location of the island and the U.S. West Coast's supply chain needs for floating foundations. Note that the use of smaller capacity rated turbines (i.e., 5 to 15 MW) will extend the deployment timelines since more turbines have to be assembled and installed to reach the same deployment target.

The deployment durations in **Table 5** highlight the significance of wind turbine unit rated capacity selection (5 MW versus 10 MW versus 15 MW versus 20 MW versus 25 MW), which affects the number of unit installations and the complexity of deployment operations. Laydown space availability and supply chain risks will also impact deployment timelines, given the relatively small acreage of the S&I site. Larger wet storage capacity, additional waterfront laydown and storage space, and a dedicated floating foundation assembly site could increase the offshore wind installation pace.

Based on the results in **Table 5**, the operational start dates required for the S&I and O&M sites are listed in **Table 6** and **Table 7**. Not applicable (N/A) is assigned when it is not feasible to meet the deployment target with the corresponding WTG capacity because not enough S&I sites are available for industry use or when OSW port sites are not required to achieve 0 GW.

Table 6. Operational start date required for S&I and O&M sites to meet 2035 deployment targets

WTG Capacity	0 GW	0.5 GW	1 GW	2 GW
5 MW	N/A	N/A	N/A	N/A
10 MW	N/A	2030	N/A	N/A
15 MW	N/A	2032	2029	N/A
20 MW	N/A	2033	2030	N/A
25 MW	N/A	2033	2031	N/A

Note: The operational start dates for S&I and O&M sites are rounded down to the nearest year to ensure readiness for timely execution and achievement of each target, factoring in WTG unit capacities.

Table 7. Operational start date required for S&I and O&M sites to meet 2045 deployment targets

WTG Capacity	0 GW	0.5 GW	1 GW	2 GW
5 MW	N/A	2036	N/A	N/A
10 MW	N/A	2040	2036	N/A
15 MW	N/A	2042	2039	2034
20 MW	N/A	2043	2040	2036
25 MW	N/A	2043	2041	2038

Note: The operational start dates for S&I and O&M sites are rounded down to the nearest year to ensure readiness for timely execution and achievement of each target, factoring in WTG unit capacities.

4 Port/Harbor Owner Outreach

Following the identification of the deployment targets, strategies, and number of required port sites, M&N conducted workshops with BOEM, the Hawai'i Department of Transportation (HDOT), the Division of Boating and Ocean Recreation (DOBOR) on January 22, 2024 and January 25, 2024 to identify sites for potential offshore wind development. During the workshops, the attendees scoured the coasts of all the islands for potential sites and each site was discussed. Sites with air draft restrictions, no land availability, military, or other existing tenants, were immediately eliminated. The workshops resulted in the following list of eleven Hawai'i ports/harbors which were identified to be further assessed.

Kaua'i:
- Nawiliwili Harbor (HDOT)
- Nawiliwili Small Boat Harbor (DOBOR)
- Port Allen Small Boat Harbor (HDOT)

O'ahu:
- Wai'anae Small Boat Harbor (DOBOR)
- Kalaeloa Barbers Point Harbor (HDOT)
- Ke'ehi Boat Harbor (DOBOR)
- Honolulu Harbor (HDOT)

Maui:
- Kahului Harbor (DOBOR)

Hawai'i:
- Kawaihae Harbor (HDOT)
- Kawaihae Small Boat Harbor (DOBOR)
- Hilo Bay (HDOT)

It should be noted that two of the Hawaiian Islands—Moloka'i and Lana'i—did not have any sites identified for further assessment for potential offshore wind development because of the assessment criteria listed above and in **Chapter 6**. Additionally, the islands of Ni'ihau and Kaho'olawe were not considered for offshore wind development as Ni'ihau is privately owned and Kaho'olawe has restricted access because of the unexploded ordnance hazards and is only permitted for specific uses, such as restoration, education, and culture.

The following topics were discussed in the outreach meetings to determine interest in offshore wind development and assess the availability of potential sites without pushing out existing uses (e.g., container, rail, etc.).

- Offshore wind port types and port requirements for component delivery and integration of finished components
- Type and size of offshore wind components/equipment
- Device integration operational requirements
- Installed wind farm operational and maintenance needs
- Interest in offshore wind development
- Physical, operational, and regulatory capabilities and constraints of existing port facilities and infrastructure
- Available sites within the port

Feedback provided by HDOT and DOBOR during outreach meetings is summarized in **Table 10** in **Chapter 6**.

5 Environmental Considerations

During January through May 2024, Myounghee Noh & Associates, L.L.C., dba MNA Environmental (MNA), completed a desktop environmental review of the eleven candidate sites under consideration for potential development of offshore wind port infrastructure in Hawai'i. This high-level assessment included review of publicly available environmental information and datasets, except for cultural resources research, which was conducted by a cultural resources subject matter expert (SME) using the restricted-access Hawai'i Cultural Resource Information System (HICRIS).

5.1 Environmental Factors

MNA evaluated each of the eleven candidate sites and ranked using a standard set of environmental parameters resulting in a comparative analysis, which considered each site type (S&I, MF, and O&M), the conceptual extent of construction at each location, and existing conditions and constraints. The eleven sites under consideration for offshore wind infrastructure were then ranked according to the relative presence of various environmental factors in or near the project site, detailed below.

Environmental factors considered at each site included natural resources (threatened and endangered terrestrial and marine species critical habitat), cultural resources, wetlands, protected land, site contamination, infrastructure requirements, sensitive land uses, viewsheds, birding hotspots, and environmental justice.

5.1.1 Natural Resources

The potential presence of terrestrial and marine natural resources within each site boundary was determined using the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool and the National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat (EFH) Mapper. For this study, natural resources included three types:

- Critical habitat and threatened and endangered (T&E) species.
- USFWS Birds of Conservation Concern (BCC).
    - Non-BCC Vulnerable species were included under BCC.
- EFH as defined by NOAA Fisheries.
    - Habitat Areas of Particular Concern (HAPC) were counted as separate EFH.

MNA tallied total positive hits within each natural resources type for each site. All types were weighted equally, as all the species and habitats considered under the natural resources factor are federally protected. Critical habitat and T&E species are protected under the 1973 Endangered Species Act, BCC under the 1918 Migratory Bird Treaty Act, and EFH under the 1996 Magnuson-Stevens Fishery Conservation and Management Act.

Weighted scores were added into a final score for the natural resources factor at each site. A higher natural resources score indicates a higher number of species/habitats within the site boundary. The scores were normalized to fit within a 0-1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.1.2 Cultural Resources

Scientific Consultant Services, Inc. (SCS) was retained to review the HICRIS, provided by the State of Hawai'i State Historic Preservation Division (SHPD), for general information regarding the presence of cultural resources at or near each candidate site. Cultural resources of interest included known historical, archaeological, and/or cultural sites within half mile of each site. Additionally, MNA identified shipwrecks located within a half mile of the site using NOAA's Wrecks and Obstructions Database.

Cultural resources sites were divided into five types: burials, traditional cultural properties (TCP), prehistoric sites, historic sites, and shipwrecks. A description of each type along with the weight assigned to it is shown in **Table 8**.

Table 8. Cultural resource types and weights

Site Type	Description	Weight
Burials	Sites where human remains were found.	3
TCP	Sites of traditional and/or cultural importance to native Hawaiians, including *wahi pana* and *heiau*.	2
Pre-Historic	Sites dating to pre-contact times, but that are not designated as *wahi pana* or *heiau*.	1
Historic	Sites of post-contact historic significance.	1
Shipwrecks	NOAA-recognized shipwrecks.	1

SCS assigned additional weight to any cultural resources site if it (1) was eligible for listing on the National Register of Historic Places (NRHP) or (2) was located on site. These weights are summarized in **Table 9**.

Table 9. Additional weight for cultural resources sites

Criterion	Weight
On-site location	3
NRHP eligible	2

A higher cultural resources score indicates a higher number of historical, archaeological, and/or cultural sites in the candidate site's vicinity. Cultural resources scores for each site were normalized to fit within a 0-1 range for comparative analysis with other categories. Total positive hits were tallied within each cultural resources type for each site. Refer to **Appendix A** for the full score breakdown.

5.1.3 Wetlands

The potential presence of wetlands at each site was determined using the USFWS National Wetlands Inventory (NWI). The percentage of wetland cover was calculated within each site boundary and represented the wetlands score.

A higher wetlands score indicates a higher percentage of wetland cover. Wetlands scores for each site were normalized to fit within a 0-1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.1.4 Protected Land

Protected land included federal and state protected areas as well as local and regional parks. Protected lands were identified on Google Earth Pro Version 7.3.6.9796 in the vicinity of the site with potential to affect the project. Federal and State protected areas were assigned twice as much weight as local and regional parks due to stricter regulations. Weighted scores were summed for each site. Refer to **Appendix A** for the full score breakdown.

A higher protected land score indicates a greater number of protected areas in the site vicinity and/or a shorter distance between protected areas and the site. Protected land scores were normalized to fit within a 0-1 range for comparative analysis with other categories.

5.1.5 Site Contamination

SCS identified contaminated areas by using the State of Hawai'i Department of Health (HDOH) Hazard Evaluation and Emergency Response (HEER) Office's online system, iHEER. The analysis included any contamination in the vicinity of the site with potential to impact the project. Contaminated areas listed as having completed remediation efforts, such as a No Further Action (NFA) determination, were assigned half as much weight as areas that may not have been fully remediated. An NFA does not guarantee that contamination is not present on site; however, it indicates that the contamination has been managed to the satisfaction of regulatory agencies. Therefore, it is assumed that sites with an NFA have a reduced potential to introduce contamination to the candidate site over time. Weighted scores were summed for each site. Refer to **Appendix A** for the full score breakdown.

A higher site contamination score indicates a greater number of contaminated areas in the site vicinity and/or a shorter distance between contaminated areas and the site. Site contamination scores were normalized to fit within a 0 to 1 range for comparative analysis with other categories.

5.1.6 Infrastructure Requirements

Infrastructure requirements included any features that would need to be added to the site to meet its purposes for offshore wind activities. The number of features that would need to be added were totaled for each site and represented the infrastructure requirements score. Refer to **Appendix A** for the full score breakdown.

A higher infrastructure requirement score indicates that a greater number of features need to be added to the site to be fully functioning for its purpose. Infrastructure requirements scores for each site were normalized to fit within a 0 to 1 range for comparative analysis with other categories.

5.1.7 Sensitive Land Uses

Sensitive land uses were tallied within a 1-mile radius of the project site using Google Earth Pro 7.3.6.9796. Sensitive land uses included residences, schools, recreational facilities, churches, and other similar facilities. Residences were grouped into a subdivision, community, or development prior to tallying.

A higher sensitive land use score indicates a higher number of sensitive land uses in the project area's vicinity. Sensitive land uses scores for each site were normalized to fit within a 0-1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.1.8 Viewsheds

Potential obstruction of viewsheds was determined using Google Earth Pro Version 7.3.6.9796. For sites that required construction of a new building, scenic viewing areas were identified within 1 mile of the site, and the potential for the building to obstruct public view was determined using the Google Earth Viewshed and Street View tools. Scenic viewing areas could include scenic roads or public spaces. Based on these factors, each site was assigned a subjective score. A higher viewsheds score indicates greater potential to obstruct scenic viewing areas. Viewsheds scores for each site were normalized to fit within a

0-1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.1.9 Birding Hotspots

Birding hotspots were identified using the online birding platform, eBird. Birding hotspots within a 1-mile radius of each site boundary were tallied and summed for each site.

A higher birding hotspots score indicates a higher number of hotspots near the site boundary. Birding hotspots scores for the sites were normalized to fit within a 0-1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.1.10 Environmental Justice

The environmental justice score was derived from the demographic index (DI) listed on the EJScreen tool from the Environmental Protection Agency (EPA). EJScreen's DI represents the average of percent low-income and percent minority populations, the two socioeconomic factors explicitly named in Executive Order 12898 on environmental justice (Executive Order No. 12898, 1994). The DI is defined for a specific geographic area. The geographic area for S&I and MF sites was defined as a 5-mile radius from the site boundary. O&M sites were assigned a 1-mile radius from the site boundary.

A higher environmental justice score indicates a greater presence of low-income and/or minority populations that could be affected by the project and would require additional considerations. Environmental justice scores were normalized to fit within a 0 to 1 range for comparative analysis with other categories. Refer to **Appendix A** for the full score breakdown.

5.2 Comparative Analysis

Each environmental factor was scored within a 0 to 1 range for each candidate site. Weight was then assigned to each factor according to its perceived potential to impact the project. Factors involving significant regulation, or that are major determinants of the project's cost and schedule, were assigned more weight. Natural resources, cultural resources, wetlands, protected land, site contamination, and infrastructure requirements were assigned twice as much weight as sensitive land uses, viewsheds, birding hotspots, and environmental justice.

Weighted scores were added across the environmental factors into one summed score for each candidate site. The summed scores were then normalized into a final impact score. The scores for each candidate site are summarized in **Table 10**. A full breakdown of each factor is shown in **Appendix A**.

Table 10. Summary of environmental assessment scores

Potential Harbor	Site Type	Owner	Natural Resources	Cultural Resources	Wetlands	Protected Land	Site Contamination	Infrastructure Requirements	Sensitive Land Uses	Viewsheds	Birding Hotspots	Environmental Justice	*SUMS OF SCORES*	*IMPACT SCORE*
Kaua'i														
Nawiliwili Harbor	O&M	HDOT	1	0.03	0.18	0.85	0.7	0.67	0.11	0	0.06	0.17	3.77	**0.84**
Nawiliwili Small Boat Harbor	O&M	DOBOR	0.93	0.29	0.04	0.91	0.65	1	0.11	0	0.1	0.13	4.16	**1**
Port Allen Small Boat Harbor	O&M	HDOT	0.68	0.1	1	0.4	0.36	0.67	0.19	0	0.5	0.21	4.11	**0.98**
O'ahu														
Wai'anae Small Boat Harbor	O&M	DOBOR	0.04	0.21	0.02	0.84	0.36	1	0.5	0	0	0.5	3.47	**0.72**
Kalaeloa Barbers Point Harbor	O&M	HDOT	0.43	0.19	0	0.4	1	0.67	0.1	0	0.08	0	2.86	**0.47**
Ke'ehi Boat Harbor	O&M	DOBOR	0.8	0	0	0.04	0.79	0.67	0.1	0	0	0.32	2.72	**0.41**
Honolulu Harbor	O&M	HDOT	0.28	0.11	0	0	0.69	0	0.22	0	0.09	0.34	1.72	**0**
Maui														
Kahului Harbor	O&M	DOBOR	0.12	0.32	0	0.78	0	0.67	0.34	0	0	0.24	2.46	**0.3**
Hawai'i														
Kawaihae Harbor	S&I/O&M	HDOT	0	1	0.14	1	0.01	0.67	0	0.5	0.23	0.03	3.58	**0.76**
Kawaihae Small Boat Harbor	O&M	DOBOR	0	0.5	0.02	1	0.01	1	0	0.5	0.23	0.04	3.3	**0.65**
Hilo Bay	O&M	HDOT	0.86	0.03	0	0.4	1	0.33	0.17	0	0.25	0.32	3.35	**0.67**

Note: Weighted scores were added across the environmental factors into one summed score for each candidate site. The summed scores were then normalized to fit within a 0 to 1 range for the final impact score to use for comparative analysis. A higher final score indicates greater project restrictions due to the various environmental factors considered and suggests that additional measures may be required to mitigate adverse impacts to the environment, whereas a lower score does not necessarily indicate no environmental impacts, just significantly less than the other identified sites.

5.3 Discussion

Final scores are indicative of the level of consideration of environmental factors that a candidate site may require, prior to and during development, relative to other candidate sites. Scores are not absolute and are not intended to indicate whether a candidate site should or should not be selected. A higher final score indicates greater project restrictions due to the various environmental factors considered and suggests that additional measures may be required to mitigate adverse impacts to the environment.

Candidate sites on Kaua'i, including Port Allen Small Boat Harbor, Nawiliwili Harbor, and Nawiliwili Small Boat Harbor, demonstrated the three highest scores of all candidate sites. These scores were largely due to high scores in the natural resources, wetlands, and protected land categories.

Hawai'i Island generally demonstrated higher scores, compared to sites on O'ahu or Maui. Notably, Hilo Bay earned high scores in the natural resources and site contamination categories. Kawaihae Harbor and Kawaihae Small Boat Harbor had the two highest scores of all sites in the cultural resources and protected land categories.

The Kawaihae area demonstrated significantly higher cultural resources sensitivity than all other categories. However, no more than one cultural resource was identified on site at any of the candidate sites. Among the many cultural resources in the Kawaihae area is Puukohola Heiau to the immediate southeast, a National Historic Landmark with significant cultural value to native Hawaiians to this day. The two harbors are located outside of the buffer zone established by the National Park Service around this heiau; however, development will still likely require additional consideration of cultural and public values and mitigation of any adverse impacts.

Kahului Harbor on Maui demonstrated a low score relative to other sites, with a relatively high score noted in the protected land category alone.

Candidate sites on O'ahu demonstrated low final scores, except for Wai'anae Small Boat Harbor, which earned a high score in the protected land category. Honolulu Harbor, Kalaeloa Barbers Point Harbor, and Ke'ehi Boat Harbor scored relatively high in the site contamination categories but had low final scores overall. Honolulu Harbor scored the lowest of all candidate sites.

5.4 Limitations

5.4.1 Constraints

The environmental review was limited to online publicly available information (except for cultural resources, which required review of the restricted-access HICRIS) and did not involve any in-depth assessments or site visits. The review is not intended to serve as due diligence for the project, but rather as a preliminary study of potential environmental site constraints. Further analysis is required to determine whether the environmental considerations listed above are necessary for the individual sites, and whether additional environmental considerations are present that were excluded from the reviewed databases. Future project phases may require on-site assessments; additional desktop research; consultations with federal, state, and county agencies or local organizations; and public meetings. As a federally funded project, adherence to the National Environmental Policy Act (NEPA) is required and would necessitate additional budget and schedule considerations. Agency consultations under Section 106 of the National Historic Preservation Act and Section 7 of the Endangered Species Act would be required, and completion of an environmental assessment (EA) or environmental impact statement (EIS) may be necessary.

5.4.2 Environmental Factors Not Considered

Environmental factors not considered in this study include the following:

- Potential cumulative and indirect effects to the environment.
- Robust analyses, often performed for natural resources, cultural resources, scenic resources (viewsheds), and environmental justice.
- Site visits or on-site surveys, often performed for natural resources, wetlands, and site contamination (hazardous materials and soil screenings).
- Public involvement concerns.
- Cost and schedule restraints due to permitting requirements, such as the Clean Water Act and Clean Air Act.
- Cost and schedule restraints due to consultations with federal, State, and county agencies or applicable organizations.
- Sound impacts.
- Aggravated impacts and additional considerations due to in-water work.

Consideration of the above impacts and more would be required to satisfy NEPA and other environmental regulations.

6 Port Inventory and Assessment

Following outreach efforts with HDOT and DOBOR to discuss potential sites that are available or could be made available for the offshore wind industry, M&N performed an assessment of the ports/harbors for suitability to support offshore wind development. It is important to note that currently, existing port and harbor sites along the coasts of the Hawaiian Islands are not ready to serve the offshore wind industry from a port infrastructure perspective (i.e., wharf, navigation channel, backlands, etc.). All potential port sites will require some level of investment to upgrade existing facilities, such as constructing a new dock for operation and maintenance vessels, a wharf to withstand heavier loading, or dredging the navigation channel and/or berth pockets. It should also be noted that this study does not consider the displacement of any port operators/tenants. An assessment of military facilities was not included in this study.

This assessment focuses on S&I, MF: specifically floating foundation assembly, and O&M sites. The following general criteria were used to assess each port:

- Distance to approximate center of BOEM call/study areas.
- Availability of adequate acreage in uplands area with capability to support or be improved to support heavy loading operations.
- Adequacy of existing navigation channel, including entrance channel depth and width, navigable channel depth and width for both existing and planned conditions including maintenance dredging requirements.
- Air draft at bridges or other overhead obstructions (e.g., overhead power lines).
- Existing harbor sheltering (e.g., breakwaters).
- Environmental concerns (refer to **Chapter 5** for more details).

The figure and table presented in **Chapter 6.4** use a symbol and color-coding system to represent a port's/harbor's potential for offshore wind development for the various facility types—S&I, MF, and O&M:

♦ (green): Port/harbor is a good candidate site for offshore wind development and meets criteria in **Table 2**

♦♦ (yellow): Port/harbor is a moderate candidate for offshore wind development and meets most of the criteria in **Table 2**

♦♦♦ (red): Port/harbor is not a candidate for offshore wind development and does not meet the criteria in **Table 2**

6.1 Staging and Integration (S&I) Sites

S&I sites are where the turbine components—such as tower sections, nacelles, blades, and the floating foundations—are received via waterborne transport, stored in the uplands area, and then assembled and erected by a large crane at the wharf. These sites are more difficult to identify within existing ports because they require a large amount of space, need deep draft channels, and cannot have any air draft restrictions since the fully assembled turbine systems, which can be 1,100 feet above water, need to be towed out to the offshore installation site. Only one harbor – **Kawaihae Harbor (HDOT)** – was identified to have a **good S&I candidate** site with adequate acreage.

With 45 acres of land and a 37-foot-deep navigation channel, Kawaihae Harbor, owned by HDOT, is the only location with enough potentially available acreage and adequate navigation channels to support an S&I site and meets the criteria from **Table 2**. Because of the approximately 525-foot-width of the channel entrance, Kawaihae Harbor may only be able to accommodate up to 20 MW turbines, but this would need to be confirmed with a navigation study. This S&I port location can also potentially be combined with a floating foundation assembly site or an O&M site, if space allows.

Regarding the environmental concerns, Kawaihae Harbor was determined to have an overall Impact Score of 0.76. The Kawaihae area demonstrated significantly higher cultural resources and protected lands sensitivity than all other categories. To the immediate southeast of the site is Puukohola Heiau, a National Historic Landmark with significant cultural value. The harbor is located outside of the buffer zone established by the National Park Service around this heiau; however, development will still likely require additional consideration of cultural and public values and mitigation of any adverse impacts.

6.1.1 Alternative S&I Site

An alternative **moderate S&I candidate** site was identified at **Kalaeloa Barbers Point Harbor (HDOT)**. Kalaeloa Barbers Point Harbor has a potential port site with 22 acres of available waterfront space, up to 1,000 feet for a wharf, and 36 feet of water depth at the berth. The navigation channel that enters Kalaeloa Barbers Point Harbor is approximately 400 feet wide and 36 feet deep. Because of the smaller acreage and narrower navigation channel, this site would not be able to accommodate the 20 to 25 MW turbines shown in **Table 1**. However, the site could accommodate smaller capacity turbines – approximately rated 5 to 15 MW capacity based on today's technology – to fit within the channel and make 22 acres work for operations and storing WTG components.

Note that the use of smaller capacity rated turbines will also extend the deployment timelines since more turbines have to be assembled and installed to reach the same deployment target. Additionally, because the available acreage cannot accommodate floating foundation assembly activities with S&I activities, fully assembled floating foundations must be imported. Given the limited wet storage space within the harbor, the supply of fully assembled floating foundations will be a bottleneck for deployment operations at this site and will potentially limit the installation pace of floating offshore wind turbines to approximately one turbine installed per month.

The development and operations of this site for S&I activities will also require close coordination with the Federal Aviation Administration (FAA), Department of Defense (DoD), Pacific Air Forces, and Honolulu Control Facility to mitigate any impacts from the turbines on procedures at the Kalaeloa Airport, Daniel K. Inouye International Airport, and Hickam Air Force Base. Given the site's potential airspace impacts, further evaluation is required to assess the feasibility of developing this site for S&I operations, but for the purposes of this study the site was highlighted as a possibility.

Regarding the environmental concerns, Kalaeloa Barbers Point Harbor scored relatively high in the site contamination, natural resources, and infrastructure requirements categories but had a low final score overall of 0.47.

No other port/harbor location identified in this study has enough potential acreage available and/or the navigable channels to accommodate floating foundations, even with dredging. **Figure 6** and **Table 11** summarize the mentioned S&I candidate status for each port/harbor and potentially available sites.

6.2 Manufacturing/Fabrication (MF) Sites

MF sites receive raw materials via road, rail, or waterborne transport and create larger components in the offshore wind supply chain that will be exported via waterborne transport on a vessel or barge. However, because of the relatively low offshore wind deployment capacity in Hawai'i, OEMs may not have the incentive to develop a MF facility for only a few offshore wind projects. The supply chain for WTG components (blades, nacelles, tower sections) has already been established through previous offshore wind projects installed to date. Therefore, importing these components for offshore wind projects in Hawai'i is feasible and a component MF site in Hawai'i is not required.

Unlike the supply chain for WTG components, the supply chain for floating foundations is not as well established, as there are only a few pilot and demonstration projects installed to date. Therefore, the logistics around importing fully assembled foundations at a constant rate may be challenging, especially with the increasing demand in other regions of the global market. In addition, importing fully assembled foundations requires unique ocean-going semi-submersible vessels that can only carry one foundation at a time. To minimize logistical risks involved in importing fully assembled foundations, a developer may choose to import foundation subcomponents from Asia, Europe, or another site along the U.S. West Coast and assemble them at a port site in Hawai'i. Once assembled, the foundation would be transferred into the water and moved to the assembly berth for turbine integration or to a wet storage area located near the S&I site.

Only one harbor – **Kawaihae Harbor (HDOT)** – was identified to be a **good MF (floating foundation assembly only) candidate** site with adequate acreage and navigation channels to support floating foundation assembly activities. If foundation subcomponents are imported for assembly within a port site, complete assembly of a floating foundation could take around 4 weeks depending on the available space. This matches the delivery pace if foundations were imported fully assembled via ocean-going semi-submersible vessels, as the round trip for one foundation could take approximately four weeks. However, assembling the foundations in Hawai'i would help mitigate any supply chain disruptions caused by high market demand as well as the logistical risks of importing fully assembled foundations.

As discussed in **Chapter 6.1**, Kawaihae Harbor was determined to have an overall Impact Score of 0.76 and demonstrated significantly higher cultural resources and protected lands sensitivity than all other categories. Though the harbor is located outside of the buffer zone established by the National Park Service, development will still likely require additional consideration of cultural and public values and mitigation of any adverse impacts.

No other port/harbor location identified in this study has enough potential acreage available and/or the navigable channels to accommodate the turbine dimensions in **Table 1**, even with dredging. **Figure 6** and **Table 11** summarize the MF candidate status for each port/harbor and potentially available sites.

6.3 Operations and Maintenance (O&M) Sites

O&M sites serve as the home port site for O&M vessels and support warehouses/offices during the operation period of the offshore wind farm. Ideally, these O&M sites that transfer crew to and from the offshore wind farm shall be close to the wind farm location to minimize travel time. Other maintenance activities, where the turbine system needs to be towed back to port from the offshore wind farm, would be performed at the S&I sites – Kawaihae Harbor or Kalaeloa Barbers Point Harbor – where the large assembly cranes are located. Only one harbor – **Kalaeloa Barbers Point Harbor (HDOT) –** was identified as a **good O&M candidate** site.

Kalaeloa Barbers Point Harbor is ideal for both CTVs and SOVs because of its proximity to both the North and South O'ahu Call Areas, as well as the East O'ahu Study Area, and deep draft navigation channels. Additionally, Kalaeloa Barbers Point Harbor has a significant amount of available acreage at 22 acres, more than is typically required for O&M activities; therefore, the site could also potentially be utilized for Installation Support activities (i.e., a base of construction operations for the fleet of construction vessels necessary for the construction and commissioning of the offshore wind farm). Regarding the environmental concerns, Kalaeloa Barbers Point Harbor scored relatively high in the site contamination categories but had a low final score overall of 0.47.

A port categorized as a moderate O&M candidate can be due to its distance from the North and South O'ahu Call Areas and East O'ahu Study Area, minimal available acreage, and/or significant amount of dredging required. The following ports/harbors, ordered north to south, were identified to have **moderate O&M candidate** sites.

- Nawiliwili Harbor (HDOT)
- Wai'anae Small Boat Harbor (DOBOR)
- Ke'ehi Boat Harbor (DOBOR)
- Kahului Harbor (DOBOR)
- Kawaihae Harbor (HDOT)

Ke'ehi Boat Harbor is ideal for CTVs because of its proximity to both the North and South O'ahu Call Areas, as well as the East O'ahu Study Area. Nawiliwili Harbor could also support CTV operations to the North O'ahu Call Area; however, it is too far to support the South O'ahu Call Area or the East O'ahu Study Area. Both harbors can also accommodate SOVs because of their deep-draft navigation channels. However, it should be noted that Ke'ehi Boat Harbor is not completely sheltered, leaving it partially exposed to waves.

Kahului Harbor and Kawaihae Harbor can each only accommodate SOV operations due to the significant distance from the call/study areas. Because of the distance from the site, Kahului Harbor could only support SOV operations to the South O'ahu Call Area and East O'ahu Study Area. Although Kawaihae Harbor is outside the 100 nm radius for SOVs, there is potential to co-locate an O&M site with an S&I site, if space allows.

The width of the channel entrance and overall geometry of the harbor makes Wai'anae Small Boat Harbor not able to accommodate SOVs. Therefore, Wai'anae Small Boat Harbor can only accommodate CTV operations.

Regarding the environmental concerns, Nawiliwili Harbor demonstrated one of the highest Impact Scores of all candidate sites, with a score of 0.84. This score was largely because of the high scores in the natural resources, wetlands, and protected land categories. Ke'ehi Boat Harbor scored relatively high in the site contamination categories but had a low final score overall of 0.41. Wai'anae Small Boat Harbor had a relatively high overall Impact Score of 0.72, due to a high score in the protected land category. Kahului Harbor demonstrated a low overall Impact Score of 0.3 relative to other sites, with a relatively high score noted in the protected lands category alone. As discussed in **Chapter 6.1**, Kawaihae Harbor was determined to have an overall Impact Score of 0.76 and demonstrated significantly higher cultural resources and protected lands sensitivity than all other categories.

All other sites not listed are considered not ideal for O&M activities due to the substantial distance to the study areas and/or infeasible port/harbor infrastructure. **Figure 6** and **Table 11** summarize the O&M candidate status for each port/harbor and number of potentially available sites.

6.4 Summary

A map that combines the S&I, MF, and O&M candidate status at each port/harbor is shown in **Figure 6**. **Table 11** summarizes the following.

- Available upland acreage
- Distance to North and South O'ahu Call Areas, as well as to East O'ahu Study Area
- Channel depth
- Feasible O&M vessels

- S&I, MF, and O&M candidate status
- Environmental impact score
- Number, size, and type of potential sites at each port/harbor

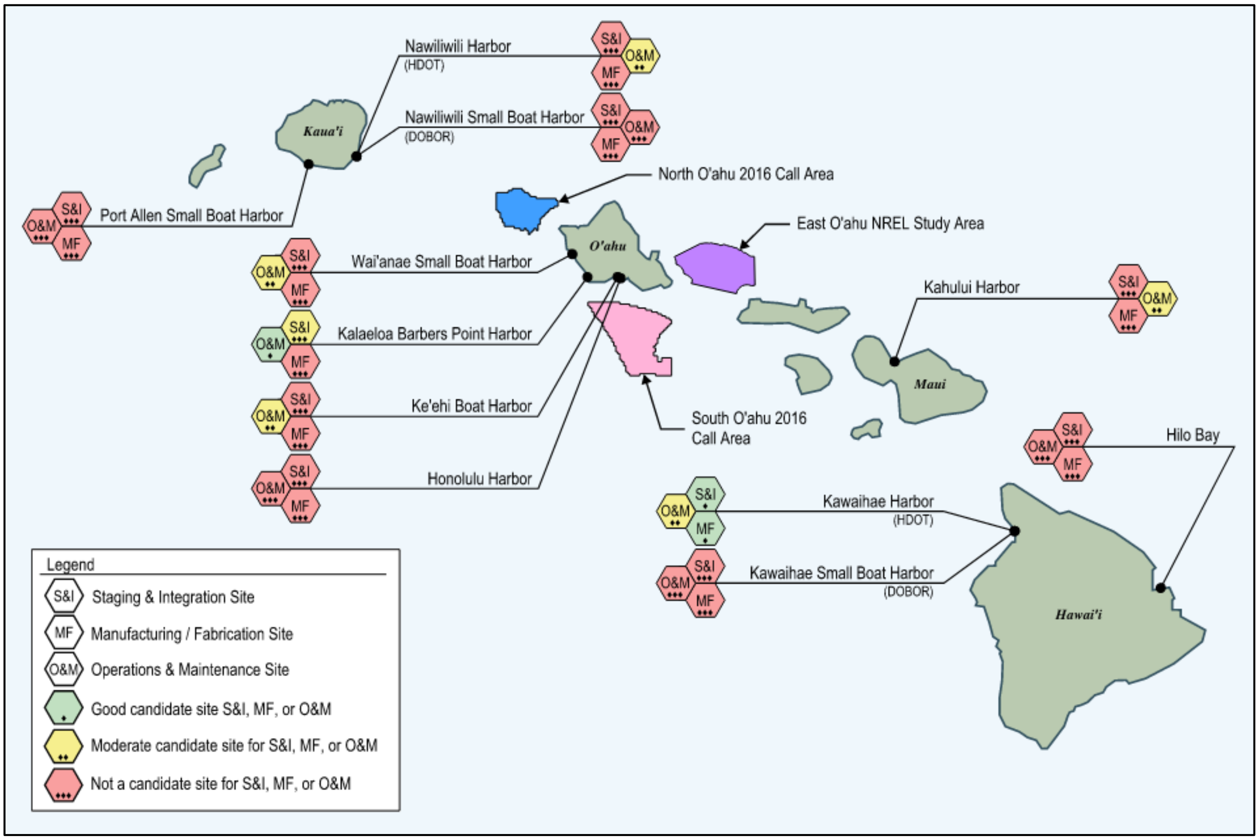

Figure 6. S&I, MF, and O&M site candidate status for each Hawai'i port/harbor

Table 11. Summary of potential Hawai'i offshore wind port/harbor sites

Island	Port Location	Land Availability *(acres)*	Distance to North O'ahu 2016 Call Area *(nm)*	Distance to South O'ahu 2016 Call Area *(nm)*	Distance to East O'ahu NREL Study Area *(nm)*	Channel Depth *(ft)*	Feasible O&M Vessels[1]	S&I	MF	O&M	Environmental Impact Score[2]	Potential Sites
Kaua'i	**Nawiliwili Harbor** (HDOT)	2	50	100	115	40	SOV & CTV (CTV to North O'ahu Call Area only)	♦♦♦	♦♦♦	♦♦	0.86	(1) 2-acre O&M site
Kaua'i	**Nawiliwili Small Boat Harbor** (DOBOR)	0.6	50	100	115	8	None	♦♦♦	♦♦♦	♦♦♦	1	Not feasible (cannot accommodate SOV, requires significant berth & channel dredging, & limited land availability)
Kaua'i	**Port Allen Small Boat Harbor** (HDOT)	0.7	65	115	130	30	SOV only (North O'ahu Call Area only)	♦♦♦	♦♦♦	♦♦♦	0.81	(1) 0.7-acre O&M site
O'ahu	**Wai'anae Small Boat Harbor** (DOBOR)	3.5	25	35	50	10	CTV only	♦♦♦	♦♦♦	♦♦	0.76	(1) 3.5-acre O&M site (cannot fit SOV in harbor)
O'ahu	**Kalaeloa Barbers Point Harbor** (HDOT)	22	35	30	45	38	SOV & CTV	♦♦	♦♦♦	♦	0.48	(1) 22-acre site (could potentially be used as an S&I site for smaller turbines, as an O&M site, or for Installation Support)
O'ahu	**Ke'ehi Boat Harbor** (DOBOR)	1.3	50	20	30	35	SOV & CTV	♦♦♦	♦♦♦	♦♦	0.45	(1) 1.3-acre O&M site (partially exposed to waves)
O'ahu	**Honolulu Harbor** (HDOT)	None	50	20	30	23 to 45	CTV only	♦♦♦	♦♦♦	♦♦♦	0	Not feasible (no land available, shared berth access)
Maui	**Kahului Harbor** (DOBOR)	5	140	85	75	35	SOV only (East & South O'ahu Study & Call Areas only)	♦♦♦	♦♦♦	♦♦	0.34	(1) 5-acre O&M site
Hawai'i	**Kawaihae Harbor** (HDOT)	45	185	130	135	37	SOV only	♦	♦	♦♦	0.71	(1) 45-acre site (S&I / MF - foundation assembly). (1) O&M site (>100 nm from Call/Study Areas, but could co-locate with S&I / MF site)
Hawai'i	**Kawaihae Small Boat Harbor** (DOBOR)	6.5	185	130	135	15	None	♦♦♦	♦♦♦	♦♦♦	0.59	Not feasible (>100 nm from Call/Study Areas & cannot accommodate SOV)
Hawai'i	**Hilo Bay** (HDOT)	2	265	210	190	40	None	♦♦♦	♦♦♦	♦♦♦	0.61	Not feasible (>100 nm from Call/Study Areas)

[1] CTVs typically travel within a maximum radius of 50 nm as they transfer crew to and from the offshore wind farm daily. SOVs typically travel within a maximum radius of 100 nm as they stay out at the offshore wind farm for 2 to 3 weeks at a time.

[2] The environmental impact scores were normalized to fit within a 0 to 1 range to use for comparative analysis. A higher final score indicates greater project restrictions due to the various environmental factors considered and suggests that additional measures may be required to mitigate adverse impacts to the environment, whereas a lower score does not necessarily indicate no environmental impacts, just significantly less than the other identified sites.

7 Conclusion and Next Steps

Based on the study's results, to meet the deployment targets of 0.5 GW, 1 GW, and 2 GW, Hawai’i appears to have enough potential sites to support an offshore wind build-out. All identified offshore wind port/harbor sites require a significant amount of investment to upgrade and improve the existing infrastructure prior to serving the offshore wind industry. The next steps to continue planning for offshore wind deployment in Hawai’i include developing cost estimates and schedules for potential infrastructure improvements at **Kawaihae Harbor** and **Kalaeloa Barbers Point Harbor** to assess their feasibility of supporting the offshore wind industry. Note, identifying these sites as potential candidates for use in offshore wind deployment does not imply that there are plans to develop projects at these sites.

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Appendix A: Environmental Considerations Data

Table A.1. Environmental Considerations – Full Scoring Breakdown

Candidate Site	Site Type	Owner	1. Score	1. Weight	1. Wtd. Score	2. Score	2. Weight	2. Wtd. Score	3. Score	3. Weight	3. Wtd. Score	4. Score	4. Weight	4. Wtd. Score	5. Score	5. Weight	5. Wtd. Score	6. Score	6. Weight	6. Wtd. Score	7. Score	7. Weight	7. Wtd. Score	8. Score	8. Weight	8. Wtd. Score	9. Score	9. Weight	9. Wtd. Score	10. Score	10. Weight	10. Wtd. Score	SUM OF SCORES	NORMALIZED IMPACT SCORE
Kaua'i																																		
Nawiliwili Harbor	O&M	HDOT	1	1	1	0.03	1	0.03	0.18	1	0.18	0.85	1	0.85	0.7	1	0.7	0.67	1	0.67	0.22	0.5	0.11	0	0.5	0	0.12	0.5	0.06	0.33	0.5	0.17	**3.77**	**0.86**
Nawiliwili Small Boat Harbor	O&M	DOBOR	0.93	1	0.93	0.29	1	0.29	0.04	1	0.04	0.91	1	0.91	0.65	1	0.65	1	1	1	0.22	0.5	0.11	0	0.5	0	0.2	0.5	0.1	0.25	0.5	0.13	**4.16**	**1**
Port Allen Small Boat Harbor	O&M	HDOT	0.68	1	0.68	0.1	1	0.1	1	1	1	0.4	1	0.4	0.36	1	0.36	0.67	1	0.67	0.37	0.5	0.19	0	0.5	0	1	0.5	0.5	0.42	0.5	0.21	**4.11**	**0.81**
O'ahu																																		
Wai'anae Small Boat Harbor	O&M	DOBOR	0.04	1	0.04	0.21	1	0.21	0.02	1	0.02	0.84	1	0.84	0.36	1	0.36	1	1	1	1	0.5	0.5	0	0.5	0	0	0.5	0	1	0.5	0.5	**3.47**	**0.76**
Kalaeloa Barbers Point Harbor	O&M	HDOT	0.43	1	0.43	0.19	1	0.19	0	1	0	0.4	1	0.4	1	1	1	0.67	1	0.67	0.19	0.5	0.10	0	0.5	0	0.15	0.5	0.08	0	0.5	0	**2.86**	**0.48**
Ke'ehi Boat Harbor	O&M	DOBOR	0.8	1	0.8	0	1	0	0	1	0	0.04	1	0.04	0.79	1	0.79	0.67	1	0.67	0.19	0.5	0.10	0	0.5	0	0	0.5	0	0.64	0.5	0.32	**2.72**	**0.45**
Honolulu Harbor	O&M	HDOT	0.28	1	0.28	0.11	1	0.11	0	1	0	0	1	0	0.69	1	0.69	0	1	0	0.44	0.5	0.22	0	0.5	0	0.17	0.5	0.09	0.67	0.5	0.34	**1.72**	**0**
Maui																																		
Kahului Ramp	O&M	DOBOR	0.12	1	0.12	0.32	1	0.32	0	1	0	0.78	1	0.78	0	1	0	0.67	1	0.67	0.67	0.5	0.34	0	0.5	0	0	0.5	0	0.47	0.5	0.24	**2.46**	**0.34**
Hawai'i																																		
Kawaihae Harbor	S&I / O&M	HDOT	0	1	0	1	1	1	0.14	1	0.14	1	1	1	0.01	1	0.01	0.67	1	0.67	0	0.5	0	1	0.5	0.5	0.46	0.5	0.23	0.06	0.5	0.03	**3.58**	**0.71**
Kawaihae Small Boat Harbor	O&M	DOBOR	0	1	0	0.5	1	0.5	0.02	1	0.02	1	1	1	0.01	1	0.01	1	1	1	0	0.5	0	1	0.5	0.5	0.46	0.5	0.23	0.08	0.5	0.04	**3.3**	**0.59**
Hilo Harbor	O&M	HDOT	0.86	1	0.86	0.03	1	0.03	0	1	0	0.4	1	0.4	1	1	1	0.33	1	0.33	0.33	0.5	0.17	0	0.5	0	0.49	0.5	0.25	0.64	0.5	0.32	**3.35**	**0.61**

Legend:

1. Natural Resources
2. Cultural Resources
3. Wetlands
4. Protected Land
5. Site Contamination
6. Infrastructure Requirements
7. Sensitive Land Uses
8. Viewsheds
9. Birding Hotspots
10. Environmental Justice

U.S. Department of the Interior (DOI)
DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)
BOEM's mission is to manage development of U.S. Outer Continental Shelf energy, mineral, and geological resources in an environmentally and economically responsible way.