8. SITE LAYOUTS AND REQUIRED INFRASTRUCTURE

8.1 General Structural Considerations

This is preliminary assessment based on available info and more information and analysis is needed for final requirements.

Based on the bathymetric and geophysical analysis, the berthing face of both the Mack Point and Sears Island sites will be required to be located between 200 ft and 900 ft from the existing shoreline. This distance in turn creates a large area of square footage that will need to be incorporated into the structural design. Typically, there are two structural options considered to span from the uplands to the berthing face. These are pile supported and earth filled structures.

Installation of a pile supported structure over such a large area was considered to be cost prohibitive. This was amplified by the presence of the shallow rock ledge and the requirement for each of the piles to be drilled into the bedrock (rock socketed) in order to achieve the required lateral capacity. A detailed estimate of this option was not performed; however, based on prior experience with similar sites, $500/sf can be used as a high-level estimate for this type of construction.

Four earth filled structure types were then investigated. These are listed below.

- Tied back bulkhead with pile supported marginal wharf with pile supported relieving platform
- Tied back king pile combination wall (pipe piles and AZ sheets) with pile supported relieving platform
- Ballasted concrete caissons
- Steel cellular cofferdams

The bulkhead structures were ruled out due to the need for a significant pile supported relieving platform required to support the high loading level directly inshore of the bulkhead. In addition, installation of this type of structure on the rock ledge slope at the Sears Island site would present significant issues.

Concrete caissons are a workable option; however, our experience is that the skill set to manufacture and install this type of system resides in Canada rather than the US. This system is used quite often in the eastern Canadian provinces to deal with the extreme tides. However, they are not prevalent in the Northeastern US.

Steel cellular cofferdams were selected as the most efficient and best value option for the two sites. This system performs well seated on rock and can provide the required earth retention as well as handle the significant loading levels. In order to reduce the required length of cellular cofferdams, armored earth embankments will be used for the transverse closure of the system. This structural system can be installed in phases and grow with the need for additional terminal space.

A further advantage of this is system is the ability to incorporate beneficial reuse of site material as fill behind the cofferdam and earth embankment walls. The large area created behind the

structure will need to be filled with earth to create a working surface. This material can be sourced from an upland cut or dredged material from the two proposed sites.

Preliminary calculations were performed in support of this structural system. Steel cells were conservatively sized at 100-ft diameter. At Sears Island the cells were located to the west of the steep rock ledge slope.

8.2 Phased Approach

With only 85 MW installed, the floating OSW market is still in its early stages. It is, therefore, recommended that a phased approach to construction be utilized. This approach would allow the terminal to begin operations with minimal requirements for a demonstration sized project and then grow over time to support a full commercial scale wind farm. It also allows for a smaller capital expenditure to start the development process followed by a larger investment as the industry continues to develop. The time between the initial port installation and full build out should be driven by prevailing market conditions.

Phase 1, to support a research type project, and Phase 2, to support a full commercial scale project, plans were created for both the Mack Point and Sears Island sites.

The following sections describe an approach to phased construction that could be implemented upon completion of environmental review and permitting.

8.3 Sears Island Phase 1 Construction

The Phase 1 cofferdam structure consists of five 100-ft diameter cells with 4 connecting cells, creating a 632-ft berthing face. The 56,058 CY of fill to be placed within the cells will be imported to optimize the coffer cell performance.

Thirty acres of the uplands area will be cleared, graded, and compacted to create a usable area for operations. This will require clearing the trees and cutting into the hillside to remove approximately 755,000 CY of soils. Based on the analysis of the Sears Island geotechnical information and soil classification, these soils will be used as the infill material for the wharf and embankments (both Phase 1 and 2). Extra soil from the cut will be stored in the commercially zoned area on Sears Island.

The transverse earth embankments will also be constructed using soils from the uplands. Approximately 1,600 tons of bedding stone and 25,000 tons of armor stone will be placed on the embankments. On the north side, where wave action is less due to the sheltered harbor, the armor stone may only be placed on the upper half of the embankment.

Approximately 330,000 CY of fill will be placed in the wet behind the cofferdam and earth embankments. This will create approximately 7.2 acres of usable space. Once this fill is in place, the ground improvement program will be implemented. First, wick drains will be installed to provide a drainage path for the compressible soils. Second, a soil surcharge will be placed to accelerate the consolidation of the underlying soils to the proposed loading level (between 3,000 to 5,000 psf). Additionally, the soil may also need to be amended with a binding agent before

placed in the fill area. Once the soil reaches the required consolidation, the surcharge will be removed and placed with the extra soil from the upland cut.

Due to the limited length of the quay, two mooring dolphins will be installed south of the berth to provide a storage area for the semi-submersible barge when not in use.

A storm water drainage system will be installed, and electric and water utilities will be brought onto the site from the mainland. Sewage can also be brought from the mainland, or a localized pump-out system can be used.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.4 Sears Island Phase 2 Construction

It is assumed in that the Phase 2 wharf will be built as an addition to the Phase 1 wharf. The Phase 2 structure will add 7 coffer cells to the south to create a cofferdam structure that consists of twelve, 100-ft diameter cells with 11 connecting cells, creating a 1,563-ft berthing face. The additional 96,000 CY of cell fill will be imported to optimize the coffer cell performance.

Fourteen additional acres of the uplands area will be cleared, graded, and compacted to create a usable area for operations, for a total of approximately 44 uplands acres in Phase 2. This will require clearing the trees and cutting into the hillside to remove an additional approximately 460,000 CY of soils.

Approximately 509,000 CY of additional fill will be placed in the wet behind the cofferdam, on top of the south embankment and extend south, integrating Phase 1 into Phase 2. This will create approximately 10 additional acres of usable space. Once the fill is placed, the same ground improvement program as discussed in Phase 1 will be implemented.

The existing southern embankment is buried in the fill and a new southern embankment will be built from the soil from the uplands. This new southern embankment requires approximately 1,100 tons of bedding stone and 25,000 tons of armor stone.

In order to facilitate the installation of the additional berth length, the two Phase 1 mooring dolphins will be demolished.

The storm water drainage, electrical, water, and sewage systems will be upgraded to meet the Phase 2 requirements.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.5 Mack Point Phase 1 Construction

The Phase 1 cofferdam structure consists of five, 100-ft diameter cells with 4 connecting cells, creating a 632-ft berthing face. The 56,058 CY of cell fill will be imported to optimize the coffer cell performance.

Approximately 614,000 CY of dredging will be performed to create an access channel and berthing pocket for the vessels calling on the terminal. The dredge materials will then be dewatered and amended with a binding agent, such as cement, and placed within the infill area.

The embankments will also be constructed from imported soils. This will help ensure a sealed infill area. Approximately 1,400 tons of bedding stone and 23,000 tons of armor stone will be placed on the embankments. The fill placed behind the coffer cells and the embankments will create approximately 8 acres of useable space.

The approximately 236,000 CY of leftover dredge spoils in Phase 1 could be dewatered, amended, and placed in a storage area on site. This material can be used as fill in the Phase 2 infill area.

Due to the limited length of the quay, two mooring dolphins will be installed east of the berth to provide a storage area for the semi-submersible barge when not in use.

Thirty acres of the existing facilities in the uplands will be demolished, graded, and compacted. Additionally, 1,500 linear feet of a rail spur along the existing southern shoreline will need to be relocated to provide access to the newly created infill area.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.6 Mack Point Phase 2 Construction

It is assumed that the Phase 2 wharf will be built as an addition to the Phase 1 wharf. The Phase 2 structure will add 5 coffer cells to the west and 2 coffer cells to the east to create a cofferdam structure that consists of twelve, 100-foot diameter cells with 11 connecting cells, creating a 1,563-ft berthing face. An additional approximately 96,000 CY of cell fill will be imported to optimize the coffer cell performance.

Approximately 235,000 CY of additional dredging for Phase 2 will be performed to allow access to the additional berthing area and create a dedicated vessel turning basin. The vessel traffic in and out of the terminal once Phase 2 is in service may cause the existing maneuvering area in the federal channel, to the south of the existing pier, to become congested. Therefore, this additional turning basin was added. The dredge materials will then be dewatered and amended with a binding agent, such as cement, and placed within the new infill areas. The remaining dredge materials from Phase 1 will also be placed in the newly created infill areas. This will create approximately 17 acres of additional usable area.

The existing Phase 1 embankments will be buried in the fill and new eastern and western embankments will be constructed using the amended dredge material. Approximately 1,400 tons of bedding stone and 23,000 tons of armor stone will be placed on the new embankments

The existing facilities within an additional 10 acres of uplands will be demolished and the soils re-graded and compacted.

In order to facilitate the installation of the additional berth length, the two Phase 1 mooring dolphins will be demolished.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.