CENTRE FOR MARINE APPLIED RESEARCH

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WIND AND WAVE CONDITIONS – EASTERN SHORE – REFERENCE SITES 1, 2

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Executive Summary

In support of Centre for Marine Applied Research (CMAR), the following report presents wind and wave conditions at two reference locations on the Eastern Shore in, Spry Bay and Shoal Bay, Nova Scotia, Canada.

In this report, wave and wind conditions are presented for 2 locations, in Spry Bay and Shoal Bay, respectively:

- Eastern Shore - Reference Site 1: 44° 48.137'N, 62° 35.017'W.
- Eastern Shore - Reference Site 2: 44° 45.474'N, 62° 41.950'W.

To determine the wave field evolution closer to shore at a specific site, and to determine more accurate 10- and 50- year return period wave data, near shore wave modelling can be used. For the Eastern Shore reference locations of interest in Spry Bay and Shoal Bay, STWave was used to model the wave conditions inside the area. The results showed reduced wave heights, in comparison to the hindcast source point which is located at the southeast entrance to the Eastern Shore, due to depth induced energy dissipation (bottom friction, breaking). The STWave model results are determined using wind and wave boundary condition data from the MSC50 HindCast model of a nearby offshore location. The extreme wave conditions at the reference locations are determined in part by propagating wave from the offshore hindcast model location into the site of interest.

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1 Introduction

1.1 Overview

For the reference locations in Spry Bay and Shoal Bay on the Eastern Shore shown in Figure 1, wind and wave conditions have been estimated. The following presents data on the predicted 10- and 50- year wind and wave conditions at two reference locations.

Figure 1 Two (2) Reference Site locations in Spry Bay (site 1) and Shoal Bay (site 2) [4]

The locations are protected overall from offshore waves by surrounding lands, but are vulnerable to waves from south and southeast which will travel directly into the area, as can be seen in Figure 2. These waves are expected to lose energy by travelling into shallower waters. Detailed wave modelling is required to determine the amount of energy lost and wave height reduction.

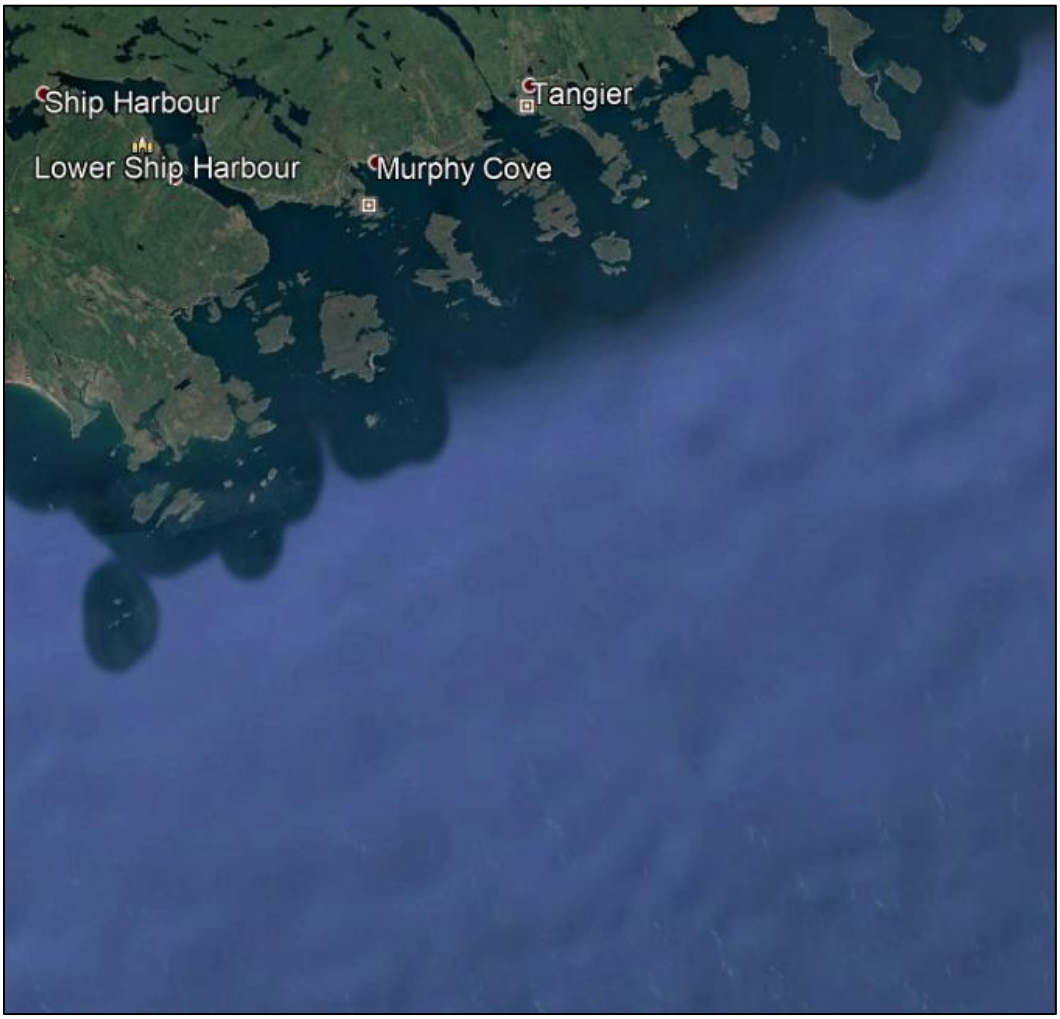

Figure 2 Eastern Shore near Ship Harbour, Nova Scotia, Canada

The context of this project is that extreme wind and wave conditions are needed to select engineering load cases for those wishing to install finfish or shellfish farms in the area. For example, extreme environmental conditions with minimum 10-year and 50-year return periods are required for the design of a marine fish farm site, as per guidance in the Scottish technical standard [2] and NS9415 [3]. While the locations assessed as part of this modeling exercise are not actual aquaculture site locations, the data produced for these locations is useful for understanding the approximate wave climate in the region and can be used to evaluate any proposals for sites in the area. Understanding the wind and wave climates at aquaculture sites is important for mitigating risks.

1.2 Objective(s)

- Determine wave/wind conditions at two reference locations in Eastern Shore and find the conditions with 10- and 50- year return periods.

2 Abbreviations and acronyms

DSA	Dynamic Systems Analysis Ltd.
SMS	Surface-water Modeling System
CMAR	Centre for Marine Applied Research
CHS	Canadian Hydrographic Services

3 Reference documents and drawings

[1]	Report-DSA-CMAR-19EXM-Ship Harbour Wind and Wave Conditions RevB.0.pdf
[2]	Marine Scotland. (2015). A Technical Standard for Scottish Finfish Aquaculture. Ministerial Group for Sustainable Aquaculture's Scottish Technical Standard Steering Group
[3]	Norge, S. (2009). Norwegian Standard NS 9415. E: 2009. Marine Fish Farms—Requirements for Site Survey, Risk Analyses, Design, Dimensioning, Production, Installation and Operation. *Standard Norge, Lysaker*.
[4]	CMAR proposed sites -RevB.kmz

4 Wave conditions

4.1 Overview

SMS version 12.2.13 was used to setup the bathymetric and computational grid. This section provides a description of the grid size, mesh size and offshore environmental conditions. Site bathymetry is provided in Figure 3. Note that a CHS hydrographic chart is used to generate the bathymetric data for wave modeling. More details regarding the wave modeling description, boundary conditions, and the source point are available in Ship Harbour wind and wave modeling report [1].

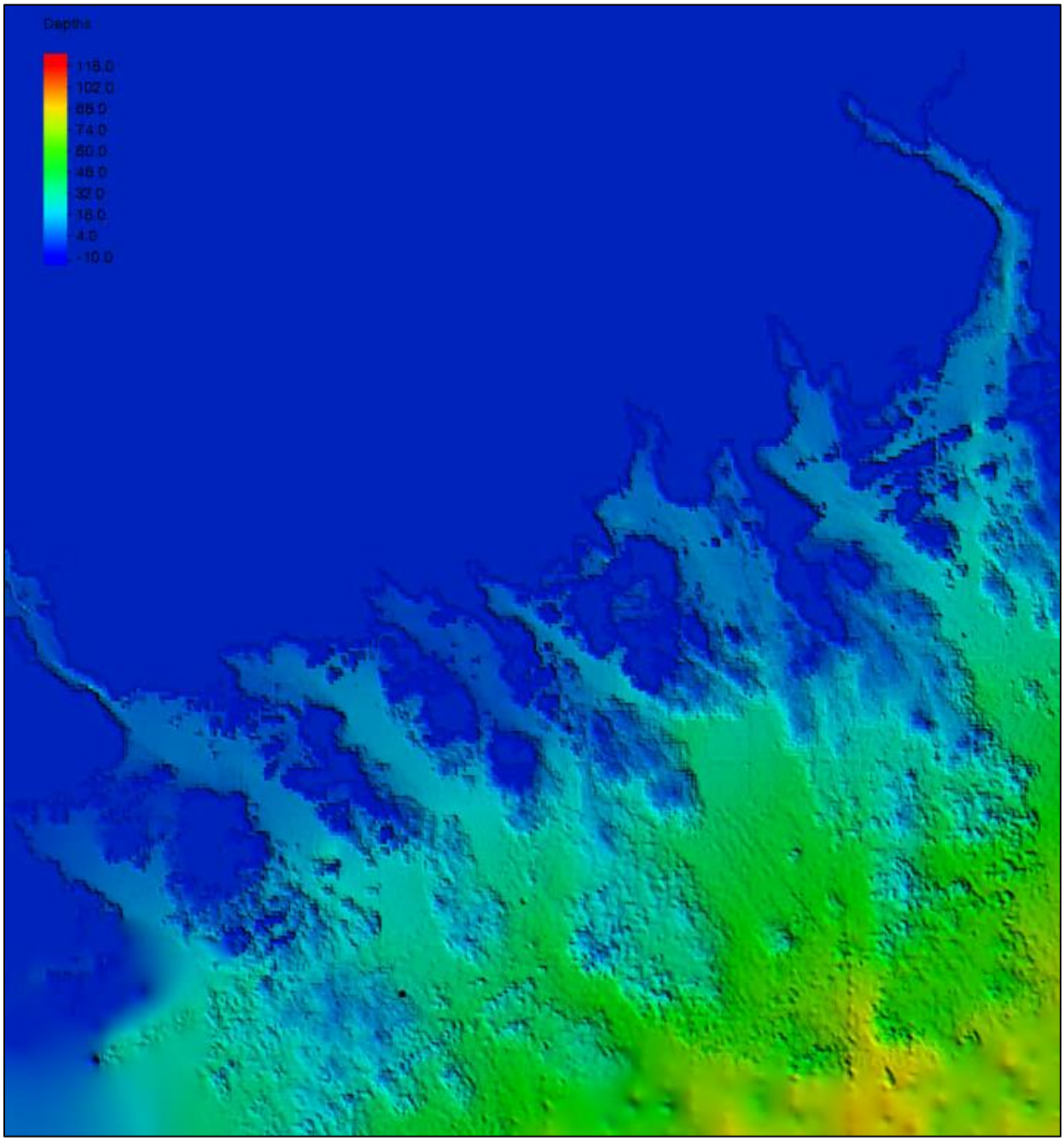

Figure 3 Bathymetry at site on hydrographic charts - Depth reported in meters

4.2 Wave/wind conditions for Eastern Shore - Reference Site 1

The wave and wind results from the STWave model, for the Eastern Shore - Reference Site 1 in Spry Bay, are summarized in Table 1. Note that the results in Table 1 indicate significant wave height (Hs) and peak period (T_P) for the selected site. These represent the extreme wave conditions at this coordinate: 44° 48.137'N, 62° 35.017'W.

Table 1 Estimated wave and wind design conditions for Eastern Shore - Reference Site 1

Wave/Wind conditions	Direction [from] [°]		Wind (m/s)	Hs (m)	Tp (s)
10yr wave/wind	*0*	N	20.97	0.6	2.34
	23	NNE	21.37	0.39	1.96
	45	NE	20.88	0.45	2.1
	68	ENE	22.28	0.5	2
	90	E	22.01	0.48	1.97
	113	ESE	20.85	0.42	2.28
	135	SE	21.67	0.97	9.6
	158	SSE	20.68	1.2	8.11
	180	S	21.78	1.17	10.38
	203	SSW	21.55	0.47	2.01
	225	SW	21.18	0.47	2.26
	248	WSW	22.12	0.53	2.14
	270	W	20.94	0.5	2.05
	293	WNW	21.52	0.41	2.01
	315	NW	21.67	0.63	2.35
	338	NNW	20.8	0.55	2.2
50yr wave/wind	*0*	N	22.64	0.65	2.41
	23	NNE	23.83	0.45	2.1
	45	NE	23.53	0.52	2.2
	68	ENE	24.42	0.56	2.1
	90	E	25.33	0.57	2.1
	113	ESE	22.04	0.45	2.34
	135	SE	24.75	0.99	9.3
	158	SSE	22.37	1.22	7.83
	180	S	25.37	1.22	9.54
	203	SSW	24.25	0.53	2.12
	225	SW	23.7	0.53	2.36
	248	WSW	25.86	0.64	2.28
	270	W	22.21	0.54	2.1
	293	WNW	22.71	0.44	2.1
	315	NW	23.7	0.7	2.44
	338	NNW	22.51	0.6	2.27

It should be noted that the return periods indicated for each wave parameter in Table 1 are representative of the boundary condition used to derive that value, not the value itself. Polar plots for maximum wave heights are presented in Figure 4 and Figure 5.

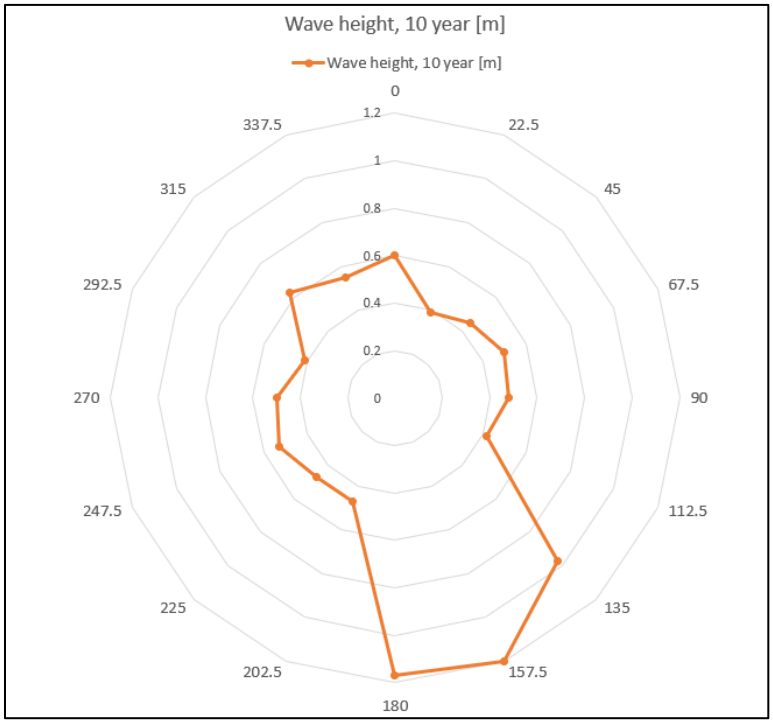

Figure 4 Maximum wave height at 10-year return period and direction [from]- Eastern Shore - Reference Site 1

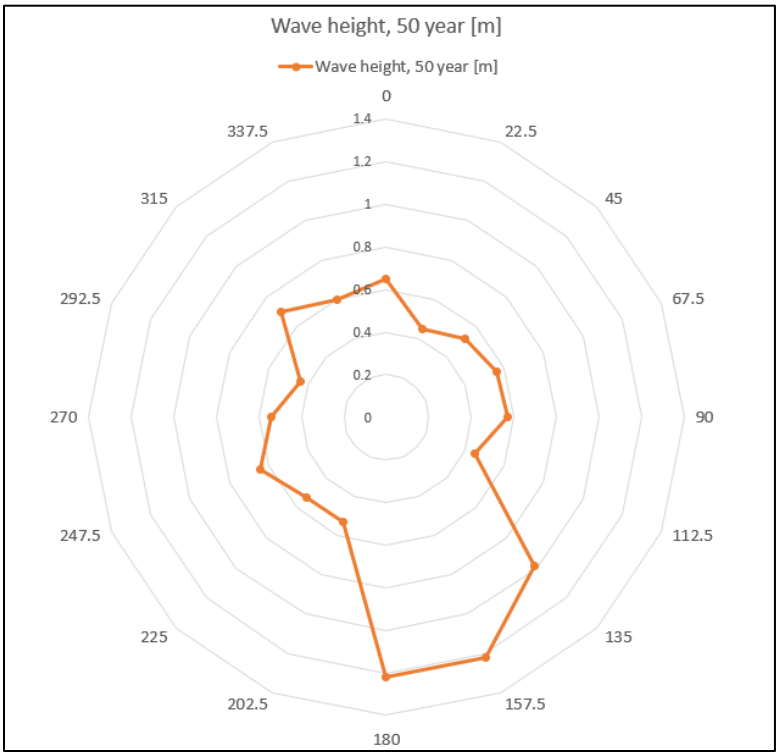

Figure 5 Maximum wave height at 50-year return period and direction [from] - Eastern Shore - Reference Site 1

4.3 Wave/wind conditions for Eastern Shore - Reference Site 2

The wave and wind results from the STWave model, for the Eastern Shore - Reference Site 2 in Shoal Bay, are summarized in Table 2. Note that the results in Table 2 indicate significant wave height (Hs) and peak period (T_P) for the selected site. These represent the extreme wave conditions at this coordinate: 44° 45.474'N, 62° 41.950'W.

Table 2 Estimated wave and wind design conditions for Eastern Shore - Reference Site 2

Wave/Wind conditions	Direction [from] [°]		Wind (m/s)	Hs (m)	Tp (s)
10yr wave/wind	*0*	N	20.97	0.54	2.16
	23	NNE	21.37	0.36	1.9
	45	NE	20.88	0.37	2.62
	68	ENE	22.28	0.53	2.47
	90	E	22.01	0.86	2.87
	113	ESE	20.85	2.08	10.35
	135	SE	21.67	2.98	10.6
	158	SSE	20.68	3.27	11.25

	180	S	21.78	0.9	3.1
	203	SSW	21.55	0.36	1.9
	225	SW	21.18	0.4	2.17
	248	WSW	22.12	0.46	2.1
	270	W	20.94	0.47	1.98
	293	WNW	21.52	0.44	2.14
	315	NW	21.67	0.67	2.45
	338	NNW	20.8	0.66	2.28
50yr wave/wind	*0*	N	22.64	0.6	2.23
	23	NNE	23.83	0.42	1.97
	45	NE	23.53	0.43	2.76
	68	ENE	24.42	0.59	2.57
	90	E	25.33	0.99	3
	113	ESE	22.04	2.09	10.35
	135	SE	24.75	3.01	10.51
	158	SSE	22.37	3.3	11.2
	180	S	25.37	1.05	3.24
	203	SSW	24.25	0.42	1.97
	225	SW	23.7	0.46	2.28
	248	WSW	25.86	0.55	2.2
	270	W	22.21	0.51	2.1
	293	WNW	22.71	0.47	2.2
	315	NW	23.7	0.74	2.54
	338	NNW	22.51	0.72	2.35

It should be noted that the return periods indicated for each wave parameter in Table 2 are representative of the boundary condition used to derive that value, not the value itself. Polar plots for maximum wave heights are presented in Figure 6 and Figure 7.

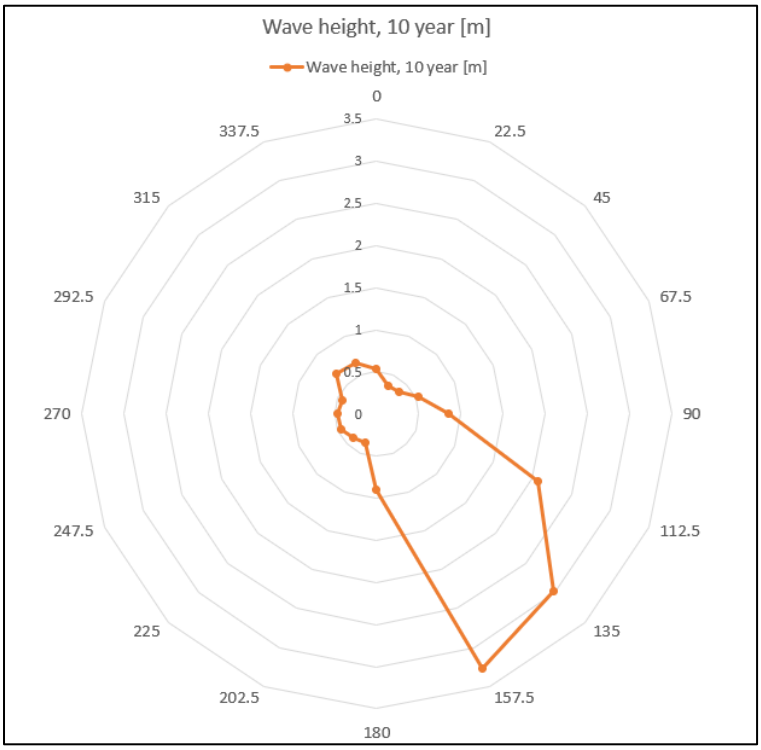

Figure 6 Maximum wave height at 10-year return period and direction [from]- Eastern Shore - Reference Site 2

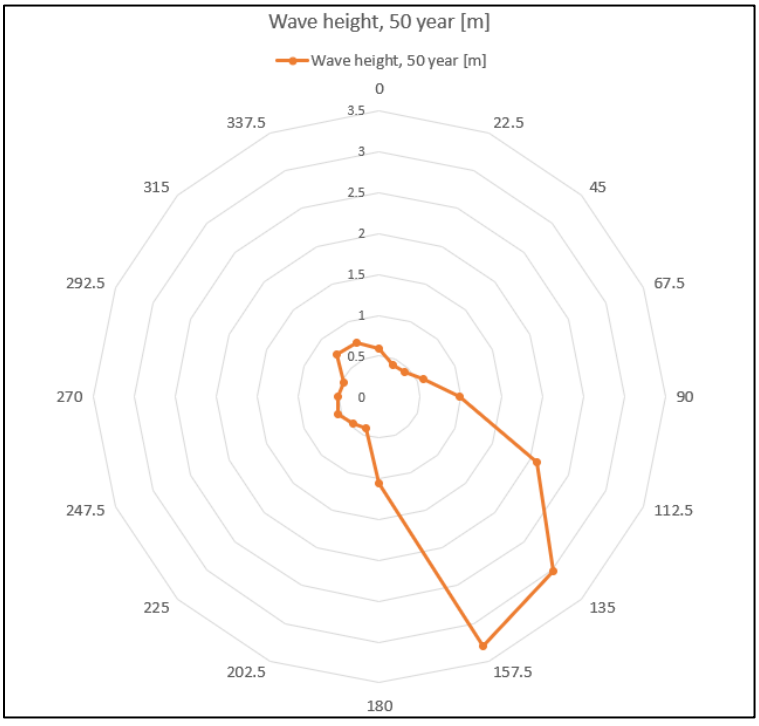

Figure 7 Maximum wave height at 50-year return period and direction [from]- Eastern Shore - Reference Site 2