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## **WIND AND WAVE CONDITIONS – MAHONE BAY – MARINE FINFISH LEASE 1006**

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## Revision history

Revision	Revision description	Date	Summary of changes / additions	Revisions by	Checked by	Approved for release by	Issued to
A	IFR	2020-04-15	Initial report release	MK	DS	DS	CMAR
B	IFR	2020-04-20	CMAR comments applied, Approved for public release	MK	DS	DS	CMAR

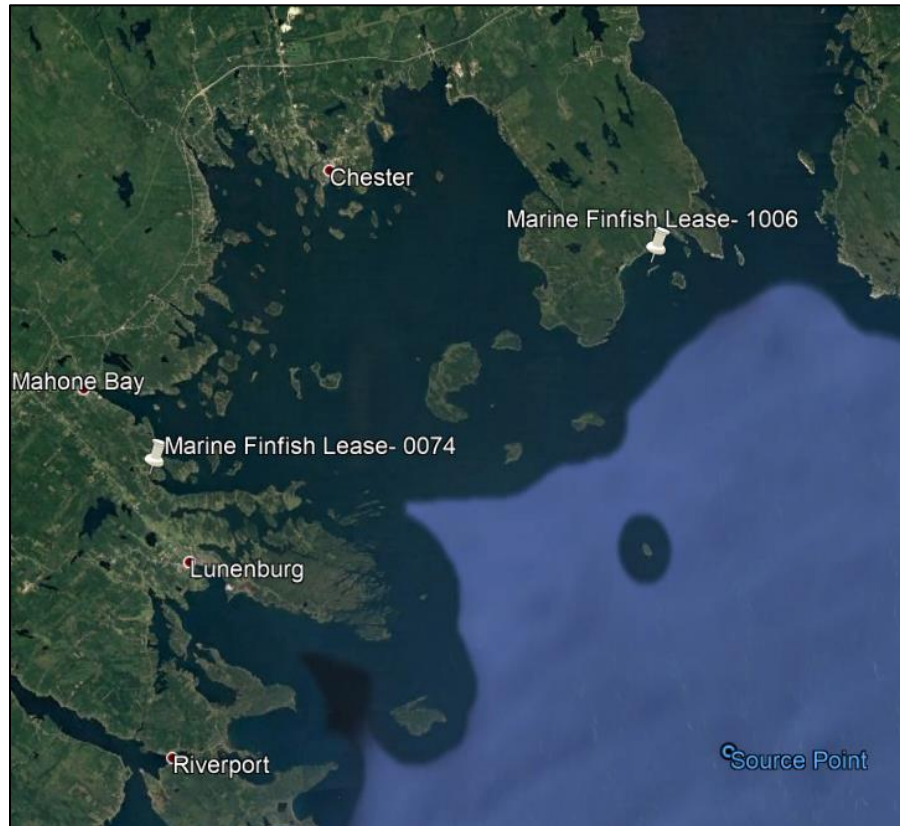
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## Executive Summary


In support of Centre for Marine Applied Research (CMAR), the following report presents wind and wave conditions in Mahone Bay, Nova Scotia, Canada.

In this report, wave and wind conditions are presented for one lease:

- Marine Finfish Lease- 1006: 44° 30.256'N, 64° 2.928'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 Mahone Bay area, STWave was used to model the nearshore wave conditions. The results showed reduced wave heights, in comparison to the hindcast model source point, 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 interested.

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## 1 Introduction

### 1.1 Overview

For the location (Marine Finfish Lease- 1006) in Mahone Bay, 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 this location.

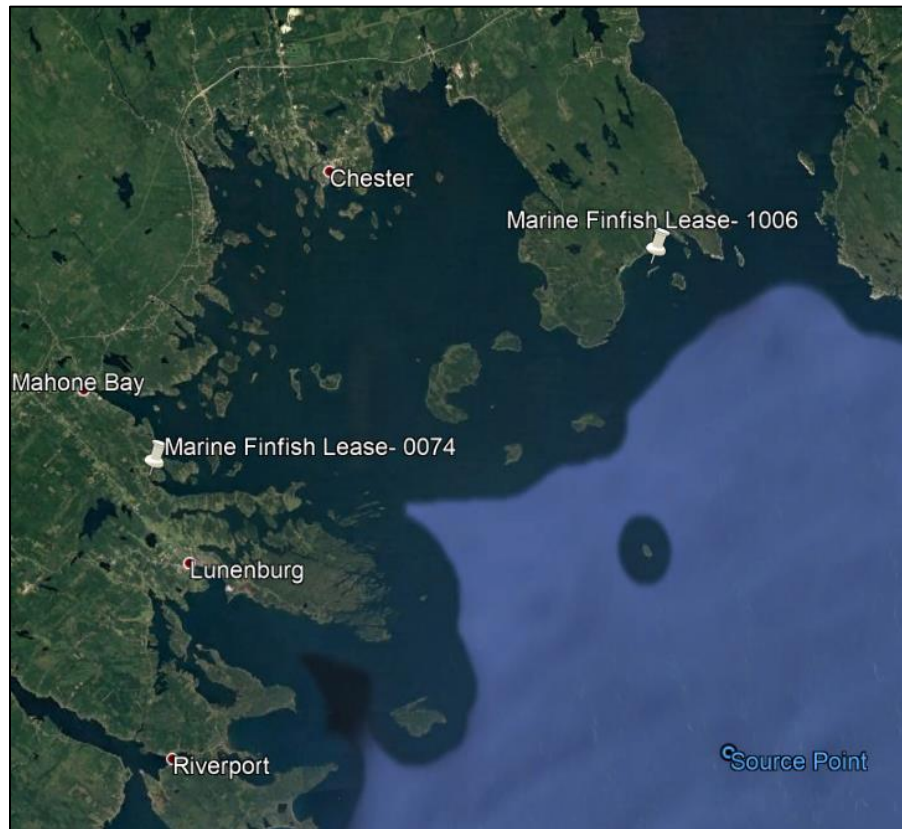



Figure 1 Two (2) site locations at Mahone Bay [4]. Note that the hydrographic data for Marine Finfish Lease- 0074 is not available

Mahone Bay is overall protected from offshore waves by bay lands, but is somewhat vulnerable to waves from the east and southeast which will travel into the bay, as can be seen in Figure 2 – although the bay is largely protected by headlands and islands. Due to the degree of protection, waves are expected to lose energy by travelling into shallower waters. Detailed wave modeling is required to determine the amount of energy lost and wave height reduction.



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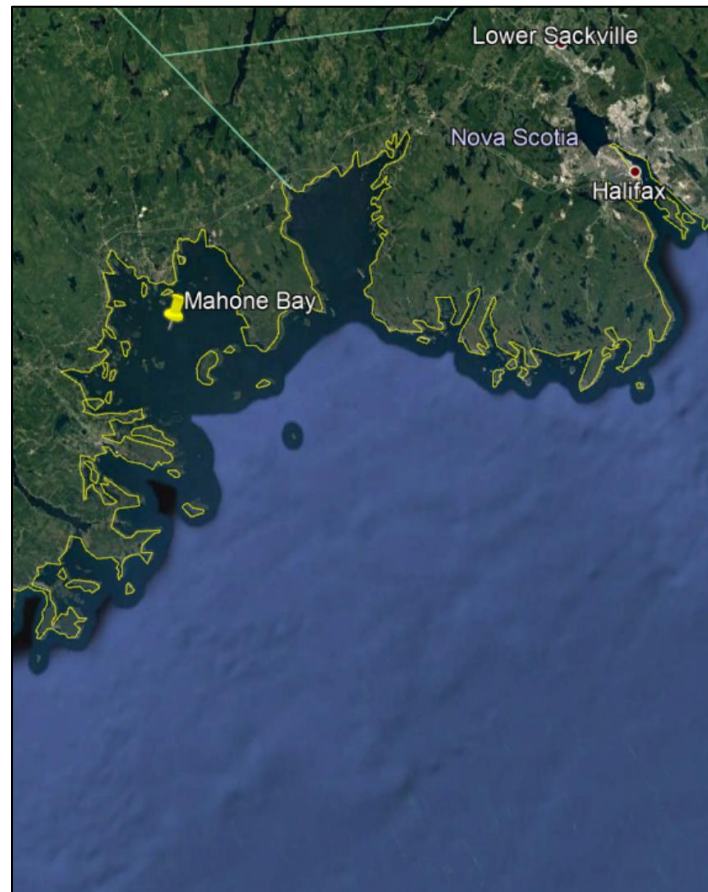



Figure 2 Mahone Bay, Nova Scotia, Canada

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 location assessed as part of this modeling exercise is the actual aquaculture site location, the data produced for this location 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 one location in Mahone Bay and find the conditions with 10 and 50 year return periods.

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## 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-Mahone Bay Wind and Wave Conditions RevB.1.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. <i>Standard Norge, Lysaker</i> .
[4]	CMAR approved 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 Mahone Bay wind and wave modeling report [1].



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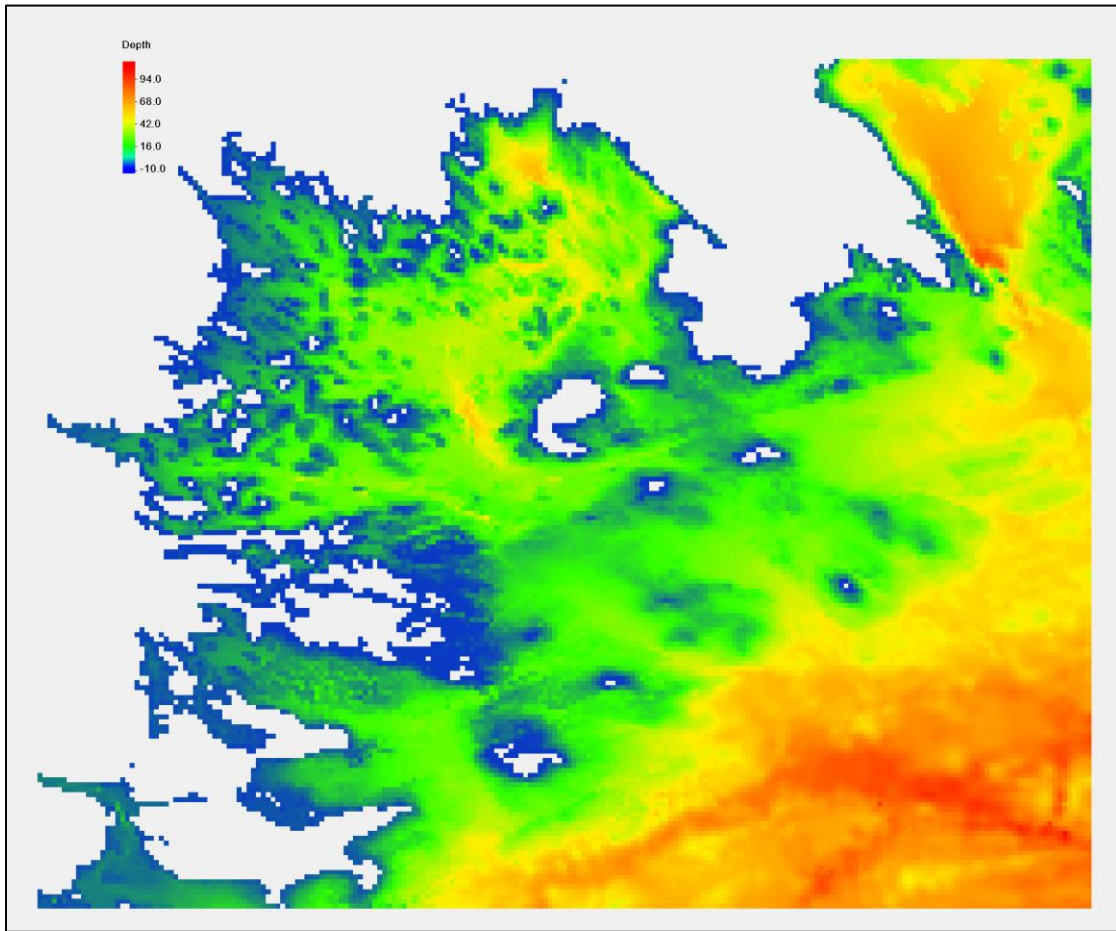



Figure 3 Bathymetry at site on hydrographic charts- Depth reported in meters

## 4.2 Wave/wind conditions for Mahone Bay- Marine Finfish Lease- 1006

The estimated wave and wind results from the STWave model, for the Mahone Bay- Marine Finfish Lease- 1006, summarized in Table 1. Note that the results in Table 1 indicate significant wave height ( $H_s$ ) and peak period ( $T_p$ ) for the selected site. These represent the extreme wave conditions at this coordinate: 44° 30.256'N, 64° 2.928'W.


Table 1 Estimated wave and wind design conditions for Mahone Bay- Marine Finfish Lease- 1006

Wave/Wind conditions	Direction [from] [°]		Wind (m/s)	$H_s$ (m)	$T_p$ (s)
	0	N	20.86	0.4	1.82
	23	NNE	21.25	0.4	2
	45	NE	21.11	0.48	2.62

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10yr wave/wind	68	ENE	23.3	0.61	2.7
	90	E	20.63	0.93	3.6
	113	ESE	20.72	0.83	3.88
	135	SE	19.93	0.24	1.79
	158	SSE	20.52	0.2	2.02
	180	S	21.01	0.24	2.22
	203	SSW	20.59	0.31	2.04
	225	SW	20.75	0.41	2.1
	248	WSW	21.99	0.5	1.92
	270	W	21.45	0.4	1.82
	293	WNW	21.17	0.23	1.6
	315	NW	20.7	0.26	1.61
	338	NNW	20.51	0.28	1.75
50yr wave/wind	0	N	24.2	0.47	1.9
	23	NNE	25.01	0.5	2.16
	45	NE	24.56	0.58	2.8
	68	ENE	28.42	0.76	2.95
	90	E	24.4	1.07	3.64
	113	ESE	24.3	0.96	3.85
	135	SE	23.02	0.27	1.72
	158	SSE	23.82	0.22	1.92
	180	S	24.59	0.28	2.16
	203	SSW	23.77	0.37	2.14
	225	SW	23.87	0.5	2.2
	248	WSW	25.76	0.61	2.05
	270	W	24.56	0.47	1.9
	293	WNW	24.06	0.28	1.7
	315	NW	23.33	0.3	1.7
	338	NNW	23.32	0.33	1.82

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.

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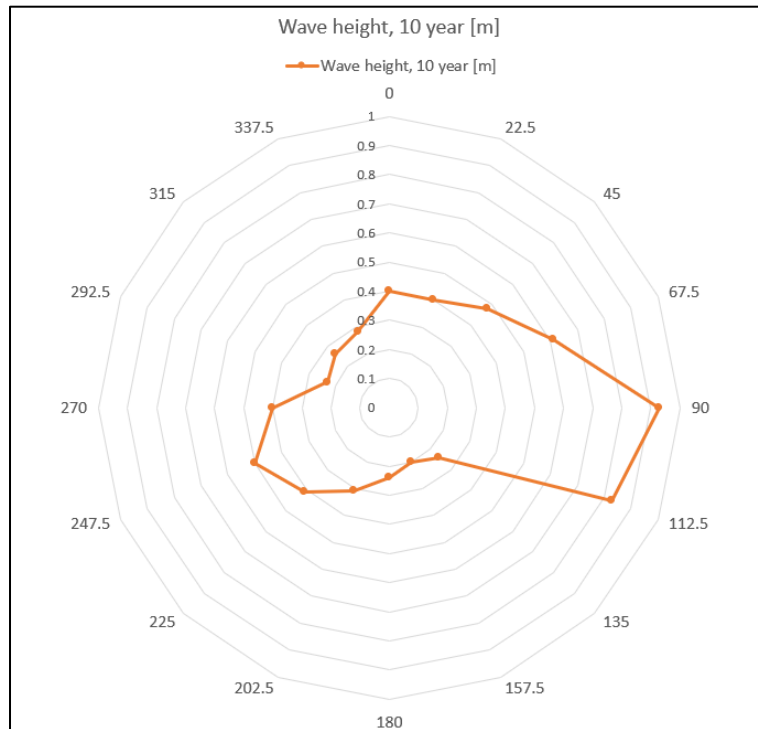


Figure 4 Maximum wave height at 10 year return period and direction [from]- Mahone Bay- Marine Finfish Lease- 1006

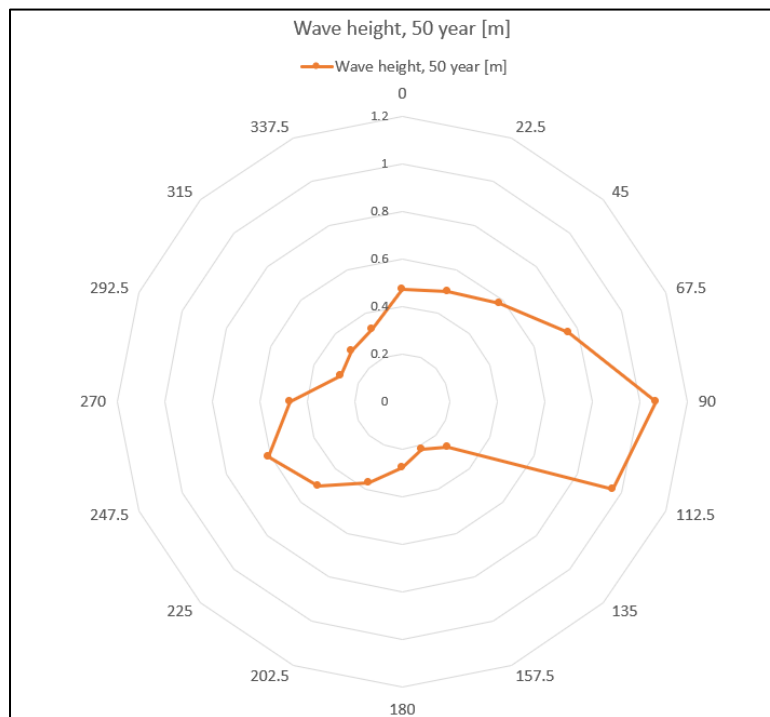


Figure 5 Maximum wave height at 50 year return period and direction [from]- Mahone Bay- Marine Finfish Lease- 1006