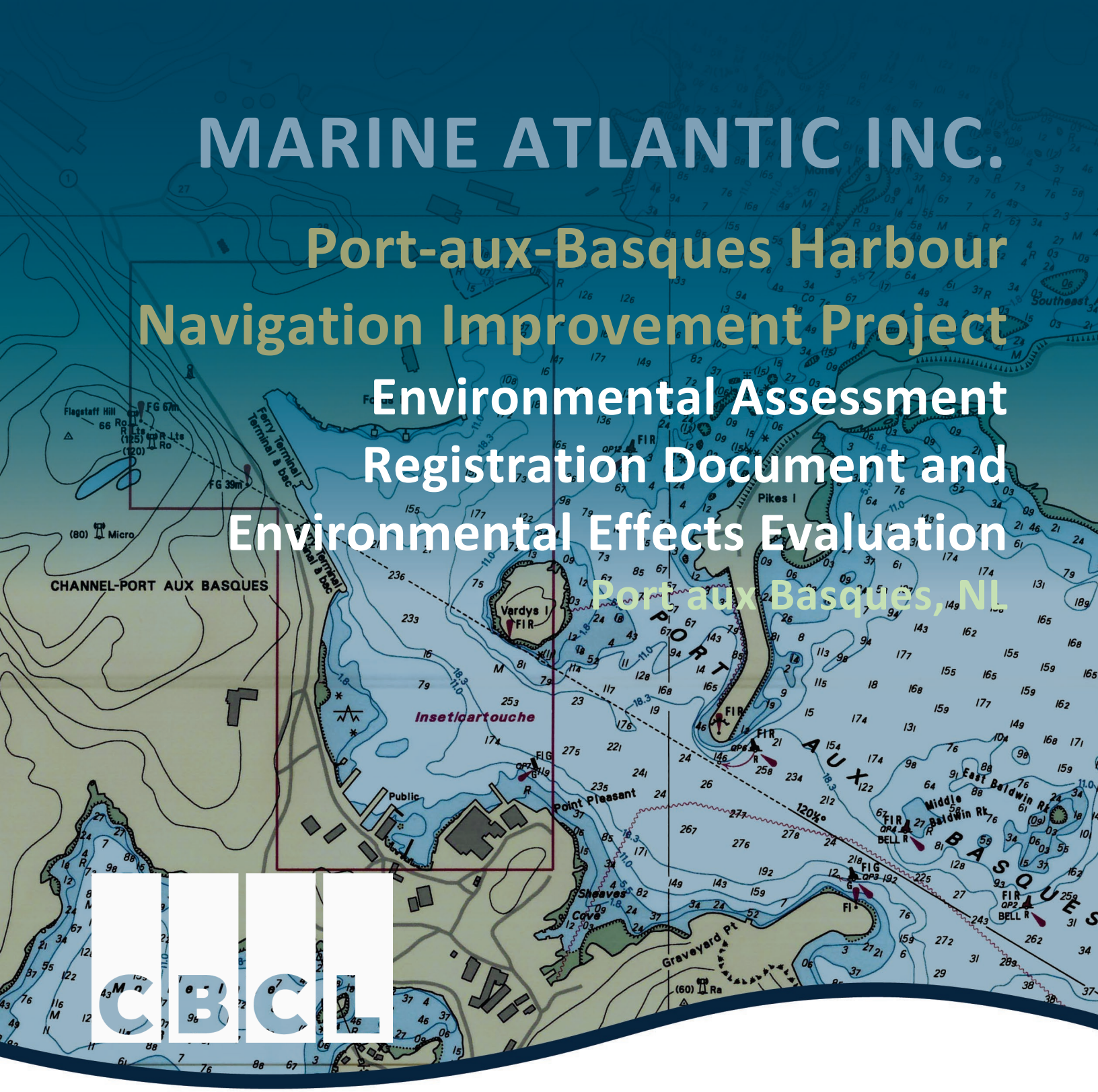
MARINE ATLANTIC INC.

Port-aux-Basques Harbour Navigation Improvement Project

Environmental Assessment Registration Document and Environmental Effects Evaluation

Port aux Basques, NL



CBCL

263022.30 • Report • September 2026

Marine Atlantic
Marine Atlantique

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Final Report 263022.30

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Executive Summary

Marine Atlantic Inc. (MAI) is proposing a navigation improvement project in Port aux Basques Harbour on the southwestern coast of Newfoundland and Labrador (the Project). The Project has been developed to meet international guidelines for navigation to improve maneuverability in the harbour for the MAI Port aux Basques ferry operations, which provide an essential service for travellers and for the transportation of goods to and from the island of Newfoundland.

The primary component of the proposed Project consists of the removal of Vardy's Island (Vardy's Rock) as it poses a significant obstruction to navigation for MAI ferry operations within the inner harbour of Port aux Basques. Pending project funding, this Project will include secondary improvement components that widen and deepen the approach channel and inner harbour turning basin by removing additional rock located south and southwest of Vardy's Rock as well as a portion of Baldwin Rock. The dredged rock may be used to repair and upgrade the existing Pikes Island Breakwater, to create an infill at Pikes Island that may be used to support future economic development by the Town and for creation of new fish habitat in the outer harbour.

MAI is the proponent and owner of the Project. The land on which the Project activities will take place is federal Crown land. The Project will be federally funded.

The Project is subject to the environmental assessment (EA) requirements of the provincial *Environmental Protection Act* (EPA) and Environmental Assessment Regulations (EA Regulations) and the federal *Impact Assessment Act* (IAA). Submission of this EA Registration Document (EARD) and Environmental Effects Evaluation (EEE) will initiate both the provincial and federal EA processes. This document is intended to provide provincial and federal regulators with information on the Project and its potential environmental effects to allow a decision on the EA process before environmental approvals are obtained.

MAI understands the importance of public, stakeholder, and Indigenous engagement for project planning. Key stakeholders have been engaged as part of the preliminary design and assessment process based on the level of impact the Project may have on them and the anticipated level of interest they may have in the Project. Stakeholders engaged to date include the following:

- MAI Captains, who are responsible for the safe transport of passengers and products on the twice-daily sailings year-round
- Local fishers who fish in and around the harbour and use the Town of Channel-Port aux Basques (the Town) docks
- Local business owners
- Representatives of the Town
- Representatives of provincial and federal government departments

Overall, participants indicated support of the Project. The MAI Captains confirmed that, in their opinion, the navigational benefits of the Project will be considerable. Their suggestion for a straight approach to the navigation channel was assessed and adopted into the Project's preliminary design. Other items raised by stakeholders include the potential impact on the Town docks and the impact on fish and commercial fisheries, of which the lobster fishery is a key concern. All of the issues or concerns raised were evaluated and considered in the preliminary design and this EA.

Field studies, reviews of published literature, collection of background information, and modelling were undertaken to support this EARD/EEE. Field studies included surveys to characterize the physical and biological environment in the Project Area; marine water and sediment sampling; soil sampling; archaeological and cultural resource assessment; hydrodynamic modelling; and acoustic modelling. Field surveys for physical characterization included bathymetric and topographic surveys, and geotechnical investigations. Field surveys for biological characterization included underwater benthic habitat surveys, wildlife and bird surveys, as well as vascular plant and lichen surveys.

This EARD/EEE includes an assessment of environmental effects of the Project on valued components (VCs), which include biophysical and socio-economic components and reflect the key issues of concern. Potential interactions between the Project components and activities are identified, pathways or mechanisms of the potential positive and negative environmental effects are described, mitigation measures are outlined to avoid or reduce potential adverse environmental effects, and the residual adverse environmental effects that remain after mitigation measures are applied are characterized to determine their significance. The following VCs are assessed:

- Atmospheric Environment
  - Climate
  - Air quality
  - Acoustic environment
- Marine Environment
  - Marine sediment
  - Marine water quality
  - Fish and fish habitat
  - Marine mammals and turtles
  - Environmentally sensitive areas
- Terrestrial Environment
  - Geology and soils
  - Vegetation, including SAR
  - Wildlife, including migratory birds and SAR
- Socio-economic Environment
  - Land use
  - Economic conditions
  - Infrastructure and services
  - Navigation
  - Fisheries

- Human health
- Archaeological and heritage resources
- Traditional use of lands

In addition to the navigation improvements to the harbour and potential for future economic development, the Project is expected to provide employment for up to 200 individuals during construction. The final employment requirements will be determined by the selected contractor. Other positive effects of the Project include the creation of new fish habitat designed to increase lobster productivity and benefit the local lobster fishery.

The primary adverse environmental effects are associated with noise, both above and below water, that will occur during construction. The environmental effects on fish and fish habitat, as well as safety zones required during construction, will adversely affect the local fishery over the medium term; however, with the implementation of mitigation measures, the adverse effects will be offset over the long term. Based on the results of the environmental effects assessment, the residual adverse environmental effects of the Project will not be significant.

The timing of Project commencement is dependent on the receipt of regulatory approvals. Once started, the marine construction work is expected to take 12 months to complete.

A monitoring program will be developed to verify the effectiveness of mitigation measures and measure compliance with regulatory requirements. Programs implemented during construction will include monitoring the turbidity of marine water, noise and vibration, as well as monitoring the success of the mitigation measures for fish and fish habitat. Post-construction monitoring will include monitoring the success of offsetting measures for fish habitat.

Acronyms and Abbreviations

AC CDC	Atlantic Canada Conservation Data Centre
AQHI	Air Quality Health Index
BMPs	Best management practices
BP	Before present
CAC	Critical air contaminants
CBCL	CBCL Limited
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CD	Chart datum
CH_4	Methane
cm	Centimetre
CO	Carbon monoxide
CO_2	Carbon dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch per unit effort
CSA	Canadian Standards Association
CWS	Canadian Wildlife Service
dB	Decibels
dBA	A-weighted decibel scale
dBZ	Decibels in the Z-weighted scale
DFO	Fisheries and Oceans Canada
DO	Dissolved oxygen
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EBSAs	Ecologically and Biologically Significant Areas
ECCC	Environment and Climate Change Canada
NL ECCC	Newfoundland and Labrador Department of Environment, Conservation and Climate Change
EEE	Evaluation of Environmental Effects
EMP	Environmental Management Plan
EPA	*Environmental Protection Act*
EPP	Environmental Protection Plan
ERP	Emergency Response Plan
ESA	*Endangered Species Act*
FLR	Newfoundland and Labrador Department of Fisheries and Land Resources
GPS	Global positioning system
h	Hour
ha	Hectare
HF	High Frequency
HRIA	Historic Resources Impact Assessment
HROA	Historic Resources Overview Assessment
Hz	Hertz
IAA	*Impact Assessment Act*
IBA	Important Bird Area

ISQG	Interim Marine Sediment Quality Guidelines
INPM	Impulse Noise Propagation Model
km^2	Square kilometre
km/h	Kilometres per hour
kPA	kilopascal
LF	Low frequency
m	Metre
m^2	Square metre
m^3	Cubic metre
m/s	metre per second
MAI	Marine Atlantic Inc.
mbgs	Metres below ground surface
mg/L	Milligrams per litre
mm	Millimetres
MPA	Marine protected area
MT	Metric Tonnes
mV	Millivolts
NAFO	Northwest Atlantic Fisheries Organization
NAPS	National Pollutant Surveillance Program
NAVWARNs	Navigational Warnings
NH_3	Ammonia
NL	Newfoundland and Labrador
NL ESA	Newfoundland and Labrador *Endangered Species Act*
NO	Nitric Oxide
N_2O	Nitrous Oxide
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOC	National Occupational Classification
NOx	Oxides of Nitrogen
NS	Nova Scotia
O_3	Ozone
ORP	Oxidation-Reduction Potential
PAH	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PEL	Probably Effect Level
PHC	Petroleum hydrocarbon
PIANC	World Association for Waterborne Transport Infrastructure
PK	Pressure Levels
PM	Particulate Matter
POE	Pathways-of-effects
ppb	Parts per billion
ppt	Parts per thousand
PPV	Peak particle velocities
PTS	Permanent hearing threshold shifts
SAR	Species at Risk
SARA	*Species at Risk Act*
SCH	Small Craft Harbour

SEDP	Strategic Economic Development Plan
SO_2	Sulphur Dioxide
SoCC	Species of Conservation Concern
sp.	Species
spp.	Multiple species
SQG	Soil Quality Guidelines
TCII	Newfoundland and Labrador Department of Tourism, Culture, Industry & Innovation
TCPAB	Town of Channel-Port aux Basques
TSS	Total suspended solids
TTS	Temporary hearing threshold shifts
UBHS	Underwater Benthic Habitat Survey
$\mu g/m^3$	Micrograms per cubic metre
VC	Valued Component
VHF	Very high frequency
VOC	Volatile organic carbons
°C	Degrees Celsius

Tables of Concordance

Environmental Protection Act / Environmental Assessment Regulations

Checklist for Prescribed Information.
Please see the document sections indicated in the table below to find the required information for registration of an undertaking pursuant to the Newfoundland and Labrador *Environmental Protection Act* and the *Environmental Assessment Regulations*.

Required Information	Section
Name of Undertaking	
(i) Project Name	Section 2.1
Proponent	
(i) Name of Corporate Body	Section 2.2
(ii) Address	Section 2.2
(iii) Chief Executive Officer and contact information	Section 2.2
(iv) Principal Contact Persons for purposes of environmental assessment and contact information	Section 2.2
The Undertaking	
(i) Name of the Undertaking	Section 2.1
(ii) Purpose/Rationale/Need for the Undertaking	Sections 2.1, 2.3 and 2.4
Description of the Undertaking	
(i) Geographical Location	
a. Description of the proposed site	Section 1.1
b. Map at large scale (e.g., 1:12,500) original base map(s) and/or recent air photos. The National Topographic Survey edition should be affixed to the map(s).	Section 1.1 (Figure 1.1)
(ii) Physical Features	
a. Major physical features of the undertaking	Section 3.1
b. Area to be affected by the undertaking	Section 1.1 (Figure 1.2), Section 3.1
c. Conceptual drawing layout	Section 1.1 (Figure 1.2)
d. Physical and biological environments within the area potentially affected by the project	Chapter 6
(iii) Construction	
a. Approximate Construction Stages and total construction period	Section 3.2
b. Date of first proposed physical construction related activity on site	Section 3.4
c. Potential sources of pollutants during the construction period(s)	Sections 3.6, 7.1, 7.2 and 7.3
d. Potential causes of resource conflicts	Sections 7.1, 7.2, 7.3 and 7.4
(iv) Operation	

Required Information		Section
	a. Description of how the undertaking will operate	Section 3.3
	b. Period of operation, if not a permanent facility	Section 3.3
	c. Potential sources of pollutants during the operating period	N/A
	d. Potential causes of resource conflicts	Sections 7.2 and 7.4
(v)	Occupations	
	a. Estimate the number of employees required for the construction and operation of the project, including the expected duration of employment	Section 3.5
	b. Enumeration and breakdown of occupations according to the National Occupational Classification	Section 3.5
	c. Identification of employment type (direct hiring and/or contracting out.)	Section 3.5
	d. Approach to employment equity will be addressed relative to age and gender.	Section 3.5
(vi)	Project Related Documents:	
	a. Bibliography of all project-related documents	Chapter 9
	b. Copies of reports on environmental studies and surveys.	Appendices
Approval of the Undertaking		
(i)	Main permits, licences, approvals and authorizations required for the undertaking, including issuing authorities	Section 2.7
Schedule		
(i)	Project Schedule including construction and operations	Section 3.4
(ii)	Rational for the selection of Project Schedule	Section 3.4
Capital Cost and Funding		
(i)	Government agencies (federal, provincial or other) providing funding, including name and address of the department or agency from which funds have been requested.	Section 2.6
(ii)	Estimate of the capital costs of the project	Section 2.6
Additional Information		**Section**
Descriptions of any consultations undertaken prior to application		Chapter 4

Impact Assessment Act

Checklist for Prescribed Information.
Please see the document sections indicated in the table below to find information required for the environmental effects evaluation (EEE) following the Transport Canada EEE Form pursuant to Section 82 of the federal *Impact Assessment Act.*

Required Information		Section
Project Information and EEE Requirements		
(i)	Project Information	Sections 1.1 and 2.1
(ii)	Environmental Effects Evaluation Requirements	Section 1.2
Proponent Information		
(i)	Proponent Information	Section 2.2
(ii)	Consultant Representative(s)	Section 2.2
Authorities Involved		
(i)	Transport Canada Involvement	Sections 1.1 and 2.7
(ii)	Other Federal Authority Involvement	Section 2.7
Project Background, Description, and Federal Scope		
(i)	Project Location	Section 1.1
(ii)	Project Justification	Sections 2.1, 2.3 and 2.4
(iii)	Legislative Framework	Sections 1.2 and 2.7
(iv)	General Description of the Project	Sections 2.1 and 3.1
(v)	Construction Phase	Section 3.2
(vi)	Operation Phase	Section 3.3
(vii)	Decommissioning Phase	N/A
(viii)	Schedule of Work	Section 3.4
Federal Scope of the Environmental Effects Evaluation		
(i)	Elements to be Examined	Sections 5.1.1 and 7.1.1
(ii)	Valued Components to be Examined	Sections 5.1.2 and 7.1.1
(iii)	Spatial and Temporal Boundaries	Section 5.1.3 and Chapter 7
Description of the Environment		
(i)	Physical Environment	Sections 6.1, 6.2 and 6.3
(ii)	Biological Environment	Sections 6.2 and 6.3
(iii)	Human Environment	Section 6.4
Environmental Effects		
(i)	Interaction of Project Components and the Environment	Section 7.1
(ii)	Interaction Matrix – Project Components and the Environment	Section 7.1
(iii)	Synthesis Table – Negative Environmental Effects	Chapter 8 (Table 8.1)
(iv)	Synthesis Table – Positive Environmental Effects	Chapter 8 (Table 8.1)
(v)	Mitigation Measures	Sections 7.2.2, 7.3.2, 7.4.2 and 7.5.2

Required Information		Section
(vi)	Physical Environment	Sections 7.2.2, 7.3.2 and 7.3.3
(vii)	Biological Environment	Sections 7.3.2 and 7.4.2
(viii)	Human Environment	Section 7.5.2
(ix)	Summary of Residual Effects	Chapter 8 (Table 8.1)
Indigenous Consultation		
(i)	Indigenous Consultation Consideration	Section 4.4
(ii)	Public Engagement	Sections 4.2 and 4.3
Monitoring and Oversight		
(i)	Monitoring and Oversight	Section 3.7
Other Considerations		
(i)	References	Chapter 9
Environmental Determination		
(i)	Determination	Chapter 8

Chapter 1 Introduction

Marine Atlantic Inc. (MAI) is proposing a navigation improvement project in Port aux Basques Harbour (the Project) in Newfoundland and Labrador (NL). The primary objective of the Project is to improve maneuverability in the harbour for the MAI Port aux Basques ferry operations, which provide an essential service for travellers and for the transportation of goods to and from the island of Newfoundland.

The Project is a marine construction project that consists primarily of the removal of Vardy's Rock (also known as Vardy's Island), which poses a significant obstruction to navigation for the MAI ferry operations in Port aux Basques Harbour. The Project also includes secondary components designed to further improve navigation conditions by widening and deepening the approach channel and deepening the inner harbour turning basin. These obstructions to navigation will be removed by drilling, blasting, and dredging. The dredged rock will be beneficially reused to create an infill at Pikes Island which may be used to support future economic development by the Town of Channel-Port aux Basques (the Town). Where possible, dredged rock will also be used to repair and upgrade the existing Pikes Island Breakwater.

CBCL Limited (CBCL) has prepared this document to address the environmental assessment (EA) requirements of the provincial and federal governments (see Section 1.2 for further detail). This document provides a description of the Project and the existing environmental conditions, as well as an evaluation of the potential positive and adverse environmental effects that may occur as a result of carrying out the Project.

1.1 Project Location

The Project is located in Port aux Basques Harbour, in the community of Channel-Port aux Basques (the Town), on the southwestern coast of NL (Figure 1.1). The Project includes improvements to the existing marine navigation channel, which extends from the outer harbour near Shoal Point to the MAI Port aux Basques ferry terminal, and construction of a new turning basin encompassing all of Vardy's Rock within the inner harbour (Figure 1.2). Project plans include the beneficial use of dredged rock to create reclaimed land using a near shore rubble-mound infill adjacent the west side of Pikes Island, and, where possible, to upgrade the existing Pikes Island Breakwater.

Most of the Project Area (Figure 1.2) is in the marine environment of the Port aux Basques Harbour on federal Crown lands administered and controlled by Transport Canada. The federal government owns Vardy's Rock and Pikes Island.

CBCL

MARINE ATLANTIC INC.

Navigation Improvement Project

Port aux Basques, Newfoundland and Labrador

Figure 1.1: Site Location

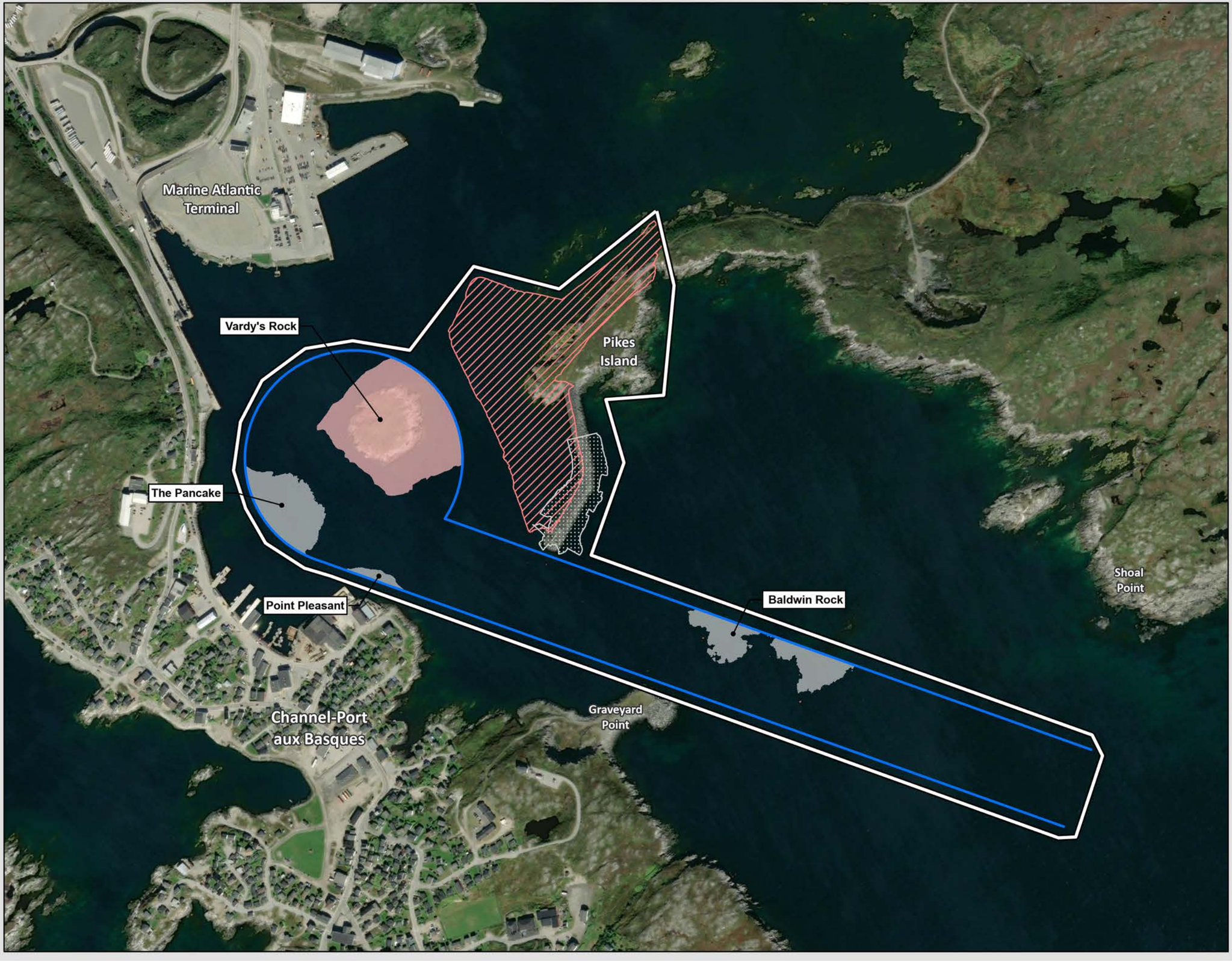
Drawn by: AO/NH	**Date: 2020-11-04**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:40,000

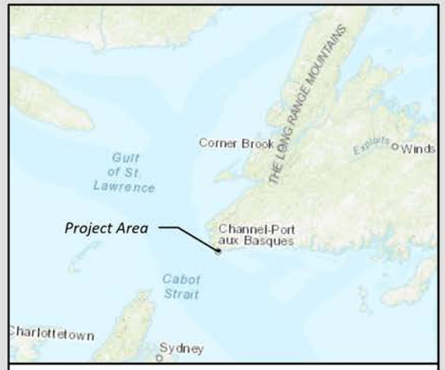
Notes:

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter

0 0.6 1.2 1.8 2.4 km

\\HFXDATA4\Data\31\202479.45 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 1.1 - Site Location.mxd





Project Area

Navigation Channel

Phase 1 Project Components

Pikes Island Infill Area

Phase 1 Dredge Area

Phase 2 Project Components

Pikes Island Breakwater Repairs

Phase 2 Dredge Areas

CBCL

MARINE ATLANTIC INC.

Navigation Improvement Project

Port aux Basques, Newfoundland and Labrador

Figure 1.2: The Project Area and Project Components in Port aux Basques Harbour, NL

Drawn by: AO/NH	**Date: 7/22/2026**
Checked: LM	**CBCL Project #: 263022.30**
Approved: LH	**Scale @ 11" x 17" :** 1:6,600

Notes:

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter

0 75 150 225 300 m

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1.2 Impact / Environmental Assessment Framework

Federal EA requirements are defined under the *Impact Assessment Act* (IAA). The IAA defines the requirements for two separate processes depending on whether the undertaking is a designated project as defined in the Physical Activities Regulations, or a project entails a physical activity carried out on federal lands as defined in Section 81 of the IAA. This Project is not a designated project but will be carried out on federal land and meets the Section 81 definition of a project. Per Section 82 of the IAA, a federal authority must determine whether a project on federal lands will result in significant adverse environmental effects before the Project can proceed.

The provincial EA requirements are defined under the NL *Environmental Protection Act* (EPA) and Environmental Assessment Regulations (EA Regulations). Section 49 of the EPA requires that an undertaking be registered with the NL Department of Environment, Conservation and Climate Change (NL ECCC) to determine whether further information or an EA is required before the undertaking is carried out. The EA Regulations designate undertakings that must be registered, including infilling an underwater area greater than 5 hectares (ha). For this Project, the maximum area of infilling is estimated to be approximately 8 ha.

1.3 Purpose and Organization of this Document

The federal and provincial governments promote cooperation and harmonization of the EA process and allow a single document to address the requirements of each level of government. CBCL has prepared this document as an EA Registration Document (EARD) to meet or exceed the requirements of the NL EPA and EA Regulations, and as an Environmental Effects Evaluation (EEE) to meet the requirements of Section 82 of the federal IAA. This document is organized as follows.

- Chapter 1 introduces the Project and the regulatory framework for the EARD/EEE process.
- Chapter 2 provides an overview of the Project, the purpose and need for the Project, background on the Project planning, consideration of alternatives, Project funding, and other environmental permits and approvals that may be required.
- Chapter 3 describes the Project in detail, with information on the location, components, construction activities, schedule, potential employment, emissions and wastes, and outlines environmental management commitments.
- Chapter 4 provides a summary of the stakeholder, regulator, Indigenous, and public consultation that has been carried out and is planned for the Project.
- Chapter 5 describes the methods used to complete this EARD/EEE.
- Chapter 6 describes the existing environmental setting of the Project Area and the assessment area, including bio-physical and socio-economic environment components.
- Chapter 7 provides an assessment of the potential environmental effects of the Project.
- Chapter 8 provides a summary of the assessment.
- Chapter 9 provides the references cited in the preparation of this EARD/EEE document.
- Appendix A contains the Project preliminary design drawings.

- Appendix B contains a coastal hydrodynamic modelling report showing the wave climate in Port aux Basques Harbour with and without the Project.
- Appendix C contains a report on the bathymetry profile of Port aux Basques Harbour.
- Appendix D contains a report outlining the results of sediment sampling carried out for the Project.
- Appendix E contains a report on the underwater benthic habitat survey of Port aux Basques Harbour.
- Appendix F contains a report on the fish and fish habitat background information of Port aux Basques Harbour and the surrounding region.
- Appendix G contains a report from the Atlantic Canada Conservation Data Centre (AC CDC) on the species at risk (SAR) within or in proximity to Port aux Basques Harbour.
- Appendix H contains a report on the geotechnical investigation of Port aux Basques Harbour.
- Appendix I contains a report on the soil sampling programs carried out for the Project.
- Appendix J contains a report on the plant and lichen surveys carried out for the Project.
- Appendix K contains a report on the wildlife surveys carried out for the Project.
- Appendix L contains a report on the underwater acoustic modelling carried out for the Project.

Chapter 2 Project Information

2.1 Project Overview

MAI is proposing upgrades to the existing navigation conditions in Port aux Basques Harbour where they operate the Port aux Basques ferry terminal. MAI ferries depart from Port aux Basques two to three times daily, depending on the time of year, and transfer passengers between Port aux Basques, NL, and North Sydney, Nova Scotia (NS). The objective of the proposed navigation improvements is to address current constraints within the harbour that require exceptional vessel maneuvering to access berths during docking and un-docking at the Port aux Basques ferry terminal, particularly in unfavourable weather conditions.

Vardy's Rock (also known as Vardy's Island) is the largest natural obstruction in Port aux Basque Harbour and presents the greatest challenge to safe navigation; its removal would significantly improve navigation conditions for MAI operations. For this reason, the removal of Vardy's Rock is the primary objective of the proposed Project. The dredged material will be beneficially reused for infill on the west side of Pikes Island (Figure 1.2).

MAI is planning to complete navigation improvements over two phases. Phase 1 consists of the removal of Vardy's Rock and using that rock for infill at Pikes Island. Phase 2 will be completed in future pending funding availability and may include any or all of the following: dredging the western portion of the turning basin (the Pancake) and the southern portion of the turning basin (Point Pleasant), the partial removal of Baldwin Rock, and the use of dredged materials to upgrade and repair the existing Pikes Island Breakwater (Figure 1.2).

The navigation improvements over both phases of the Project have been developed to meet World Association for Waterborne Transport Infrastructure (PIANC, 2014) guidelines, and include the following:

- 150 m wide, uniform one-way channel
- Channel deepening to target depth of -10.0 m Chart Datum (CD)
- Turning basin diameter of 400 m

The target dredge depth may be reduced from -10.0m CD to -9.0m CD to reduce capital costs, if required. In addition to the dredge operations, the realignment of the channel and construction of the turning basin will require readjustment of navigation buoys and range markers.

This assessment considers the full Project scope including primary and secondary navigation improvement components.

2.2 Project and Proponent Information

The proposed Project title is the Port aux Basques Navigation Improvement Project. The contact information for the proponent is provided in Table 2.1. Contact information for the consultant on this EARD/EEE is provided in Table 2.2.

Table 2.1 Proponent contact information

Role	Name / Title	Address/Contact Info
Proponent	Marine Atlantic Inc.	10 Fort William Place, Suite 302 Baine Johnston Centre St. John's, NL A1C 1K4
Chief Executive Officer	Murray Hupman President and CEO	Address above Telephone: (709) 695-8507 Email: mhupman@ma.ca
Principal Contact Representative	Jason Godfrey Environmental Technologist	Terminal Road Route 1 Channel-Port aux Basques, NL A0M 1C0 Telephone: (709) 695-2319 or (709) 694-3729 Email: jgodfrey@ma.ca

Table 2.2 Project consultant contact information

Role	Name / Title	Address/Contact Info
CBCL Limited Project Lead	Calvin Hollett Senior Project Manager	187 Kenmount Road St. John's, NL A1B 3P9 Email: calvinh@cbcl.ca
CBCL Limited Regulatory and Environmental Lead	Loretta Hardwick Director, Environmental Science	135 St. Peters Road, Suite 201 Charlottetown, PE C1A 5P3 Email: lhardwick@cbcl.ca

2.3 Background

A rail service was established in Port aux Basque in the late 1900s to meet the steamer service connection to the Canadian National Railway in North Sydney, NS. Since then, transportation and port activity have been important components of the economy in Port aux Basque and NL. When Newfoundland joined confederation in 1949, Newfoundland was accorded special constitutional status under Term 32(1) of the Terms of Union (*Newfoundland Act*) which guarantees ferry service between NS and NL. MAI is a Federal Crown Corporation that exists to fulfill that mandate.

In the 1950s, major upgrades were completed in Port aux Basque to accommodate improvements to the ferry service including dredging of the channel and harbour, infill for construction of the terminal facility, construction of the Pikes Island breakwater, and extension of the Graveyard Point breakwater. Further infrastructure improvements were completed again in the 1970s, including terminal yard expansion work and dredging for the partial removal of Vardy's Rock. More recently,

harbour improvement assessment work has been completed by MAI in collaboration with the Town who recognize that navigation improvement opportunities may also support and benefit economic development opportunities for the Port aux Basque area.

The proposed navigation improvements were developed based on the outcomes of a feasibility study completed in 2018 that evaluated navigation improvements to Port aux Basques Harbour (CBCL, 2019). This study involved a review of the existing navigation conditions and vessel operations in order to understand the current limitations. Available bathymetry data was compiled along with the characteristics of the MAI fleet, specifically, vessel size, draft, manoeuverability, and other key criteria for approach and berthing. Based on an assessment of this data, the feasibility study recommended the following improvements to satisfy the PIANC (2014) design guidelines:

- Construction of a turning basin with a diameter of 400 m (full removal of Vardy's Rock)
- Establishing a 150-m wide, uniform, one-way approach channel (partial removal of Baldwin Rock)
- Deepening of the channel to achieve a target depth of -10.0 m CD along its entirety

The proposed channel depth was established by reviewing vessel draft and requirements for underkeel clearance. The channel width is a function of the vessel beam, manoeuverability, and the environment in which it operates.

2.4 Project Purpose and Need

Currently, the MAI ferry service provides at least two regularly scheduled arrivals and departures per day, year-round from North Sydney, NS to Channel-Port aux Basques, NL. As the main transportation link to the Island of Newfoundland, MAI transports between 360,000 and 380,000 passengers and 90,000 to 100,000 commercial vehicles, annually. It carries approximately 26% of all passengers and approximately 65% of all freight to the Province of NL. Providing safe transportation of people and goods from NS to NL requires ongoing assessment of a wide range of operational concerns, including evaluation of wind and sea conditions that inform daily operational decisions.

The primary objective of this Project is to improve navigation conditions for the MAI fleet with the complete removal of Vardy's Rock; the secondary objective is the realignment of the existing approach to eliminate a narrow and shallow area at Baldwin Rock and additional deepening within the turning basin of inner harbour. The proposed Project will remove significant existing obstructions in the harbour and provide room for vessel maneuverability, mitigating one of the many factors considered when assessing sailing conditions on a daily and sometimes hourly basis. These navigation improvements will enhance marine operations and efficiencies and improve safety and customer service.

2.5 Alternatives to the Project

To be identified as a viable alternative to the Project, the alternative would need to improve both navigation and the level of service while meeting established navigation design requirements. As described in Section 2.4, the Project planning process included a feasibility study of navigation improvements to Port aux Basques Harbour using PIANC design recommendations and guidelines to establish navigation improvement requirements. A range of navigation improvement configurations were considered during project development with the objective of improving vessel manoeuvrability, reducing navigational constraints, and minimizing the extent of dredging required.

Throughout the feasibility assessment, alternatives that retained Vardy's Rock were considered in conjunction with other potential navigation improvements, including modifications to navigation channels and turning areas. Vardy's Rock is located within the inner harbour and represents the most significant physical constraint to vessel manoeuvring in proximity to the Marine Atlantic ferry terminal. Retaining the feature would continue to limit the manoeuvring area available to vessels during turning, berthing, and departure operations and would not adequately address the primary navigational constraint identified through the feasibility assessment. Based on the design evaluation, alternatives that retained Vardy's Rock were determined to provide insufficient navigational improvement and would not consistently satisfy the navigation requirements established through application of PIANC guidance.

The preferred configuration was developed through an iterative design process that considered various channel, turning basin, and dredging arrangements. The final configuration requires the full removal of Vardy's Rock to establish the required turning basin, and a partial removal of Baldwin Rock for the new approach channel. The proposed improvements were presented to, and accepted by, the MAI Captains as positive improvements to navigation conditions in Port aux Basques Harbour, with the removal of Vardy's Rock confirmed to be the primary objective of the Project. The Project, whether it consists of the primary objective only or any combination of the primary and secondary objectives, is the only technically feasible alternative identified that will improve navigation conditions in Port aux Basques Harbour in accordance with PIANC guidelines.

2.6 Project Funding

Funding for the Project will be provided by the Government of Canada.

2.7 Environmental Permits and Approvals

After completion of the EA process, the Project is expected to require federal and provincial environmental permits, approvals, and authorizations. Table 2.3 provides a list of the permits, approvals, and authorizations that may be required, the enabling legislation, the regulatory agency responsible for administration, and the Project activity or component for which the associated approval may be required.

Table 2.3 Permits, approvals, and authorizations that may apply to the Project

Permit, Approval, or Authorization	Legislation	Responsible Agency	Project Activity or Component
Authorization for the death of fish and harmful alteration, disruption or destruction of fish habitat	*Fisheries Act*	Fisheries and Oceans Canada (DFO)	Drilling, blasting, dredging, infilling, breakwater repair
Approval for work on a scheduled navigable water	*Canadian Navigable Waters Act*	Transport Canada	Drilling, blasting, dredging, infilling, breakwater repair, aids to navigation
Approval for work in a public port	*Canada Marine Act*	Transport Canada	Any work on public port lands and water
Disposal at sea permit	*Canadian Environmental Protection Act*	Environment and Climate Change Canada	Disposal at sea (if required)
Permit, licence, or certificate for the storage, transportation, and importation of explosives	*Explosives Act*	Natural Resources Canada	Blasting
Permit for alterations to a body of water (Section 48 Permit)	*Water Resources Act*	NL ECCC	Drilling, blasting, dredging, infilling, breakwater repair
Water Use Licence	*Water Resources Act*	NL ECCC	Any work requiring non-domestic water use from any water source

Chapter 3 Project Description

3.1 Project Phases & Components

To improve navigation in PAB Harbour, the Project will entail the following key components:

- Complete removal of Vardy's Rock
- Dredging within the South Turning Basin (i.e., the Pancake and Point Pleasant Areas)
- The partial removal of Baldwin Rock

The dredged rock will be reused within the Project Area. The areas for rock placement were selected to minimize transportation distances and maximize beneficial reuse opportunities. Bedrock generated from dredging activities associated with the removal of Vardy's Rock will be placed west of Pikes Island, extending from the causeway to the end of the breakwater. Rock material dredged during the partial removal of Pikes Island will be used to repair and upgrade the existing Pikes Island Breakwater.

Project components are proposed to occur in two phases. Phase 1 will involve the complete removal of Vardy's Rock and construction of the Pikes Island infill. Phase 2 will entail dredging within the South Turning Basin, the partial removal of Baldwin Rock, and the Pikes Island Breakwater repair and upgrade.

Associated works include establishing temporary staging/laydown areas, upgrades to existing access road, and the installation of temporary aids to navigation.

The preliminary design drawings are presented in Appendix A. Additional information on Project components for both Project phases is provided in the following sections.

3.1.1 Navigational Improvements—Turning Basin and Navigation Channel

The proposed navigation channel and turning basin will be deepened up to a target depth between -9.0 m and -10.0 m CD along its entirety. To achieve the target depth, the contract will provide an overdredge allowance of 0.5 m, resulting in a maximum dredge depth of -10.5 m CD. All volume estimates provided include the overdredge allowance which represents the upper range of the estimated volume generated by the dredging. Drilling, blasting, and dredging will be conducted in the following locations:

- Vardy's Rock (complete removal)
- South Turning Basin (i.e., the Pancake and Point Pleasant)
- Baldwin Rock (partial removal)

Approximately 418,000 m^3 of in situ material, predominantly bedrock, will be dredged within a total area of approximately 72,900 m^2. Table 3.1 provides a summary of dredge locations with areas, volumes, and types of material expected to be removed in each location.

Table 3.1 Dredge locations with approximate areas, estimated volumes, and type of material

Dredge Location	Area (m^2)[1]	Estimated Dredge Volumes[2]			
		Total In Situ (m^3)	% of Total Volume	% Terrestrial Soil	% Marine Sediment
Vardy's Rock	42,700	359,000	86	5	0.05
South Turning Basin (the Pancake)	14,200	20,000	5	n/a	1
South Turning Basin (Point Pleasant)	2,000	6,000	1	n/a	0.2
Baldwin Rock	14,000	33,000	8	n/a	0.1

Notes:
1 Approximate footprint area (plan view)
2 Approximate in situ volume

The removal of Vardy's Rock, the primary Project component, accounts for 86% of the total dredge volume, with the remaining dredge locations (Baldwin Rock and South Turning Basin) accounting for less than 15% of the total volume. Approximately 94% of the total dredge volume consists of rock (predominantly bedrock); the remainder of the dredge volume consists of minor amounts of terrestrial soils and marine sediments (5% and 1.4%, respectively). Volume estimates were developed using data compiled from field programs including a multi-beam bathymetric survey and sub-bottom profile, topographic survey, geotechnical investigation, and diver probes.

3.1.2 Pikes Island Infill

A key component of the Project is the beneficial use of rock from dredging. The nearshore area west of Pikes Island will be used for the placement of dredged rock material. Previous work completed in collaboration with the Town identified the opportunity to use the reclaimed land created with the placement of rock at this location to support future economic development activities. A secondary benefit of the proposed infill is the sheltering effect it provides. The hydrodynamic assessment of Port aux Basques Harbour indicates that the removal of Vardy's Rock will increase the exposure of the Town docks from waves generated during a northeast wind; however, the mass infill adjacent to Pikes Island, as proposed, will return wave exposure conditions to pre-dredge conditions. For further details of the hydrodynamic model assessment, see Appendix B.

The layout of the proposed infill maximizes the length and water depths along the main northwest face for future marginal wharf construction, without encroaching into the proposed turning basin. The limits of the proposed infill were developed to maximize holding capacity for placement of 150% of the estimated in situ rock volume, assuming rubble mound placement and a maximum elevation of 4.0 m CD. Appropriately-sized armour stone will be used to form the outer perimeter of the infill location at a 1.5:1V minimum slope for stability. Based on the current conceptual design, the area of the Pikes Island Infill is approximately 87,000 m^2; this represents the maximum expected area required for infilling based on estimates of in situ material. The final infill area and height depend on dredge volumes and rock size produced from the dredging activity.

3.1.3 Pikes Island Breakwater Repairs

A coastal engineering assessment of the Pikes Island breakwater structure indicated signs of armour stone movement and exposure of core material (CBCL, 2014). Maintaining the integrity of this structure is key to long-term protection of the inner harbour. Suitable dredge rock may be available to repair and upgrade the existing Pikes Island breakwater. Conceptual design of breakwater repairs includes widening the breakwater and raising the height to 8 m CD (Figure 3.1), assuming a berm breakwater design. The size of the material used, assuming this design approach, will be selected considering the hydraulic conditions and expected range of blast rock size that may vary considerably. Rock in the range of 0.3 to 1 tonne and 1 to 3 tonnes (armour stone weight) is expected to be available (i.e., from dredging) for the breakwater repairs. Where possible, existing armour stone will be reused in the works and, if required, additional armour stone will be sourced from a local quarry. The slopes will be constructed to at least a 1.5:1V slope for stability. A typical cross section of the repairs is provided in Figure 3.1.

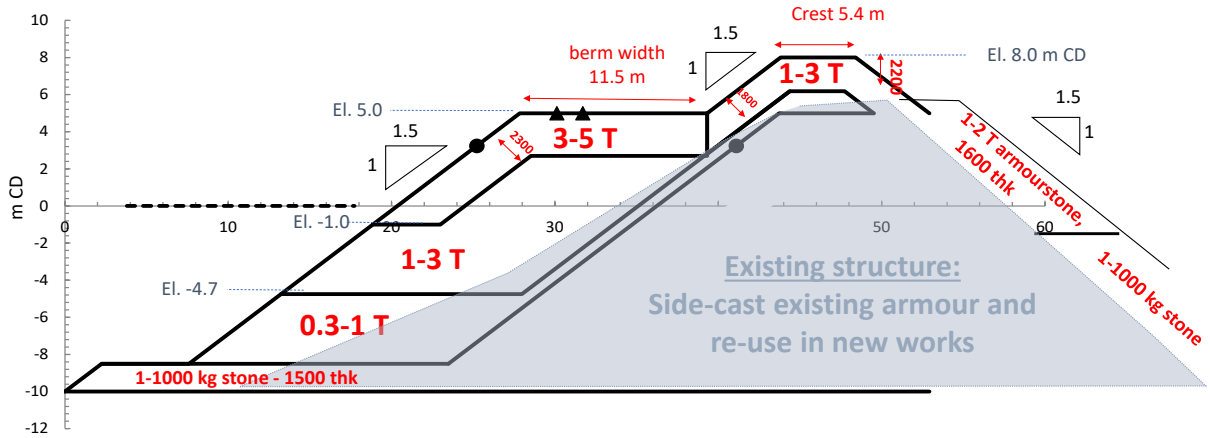


Figure 3.1 Typical cross section of Pikes Island breakwater repair

3.1.4 Temporary Aids to Navigation

The realignment of the navigation channel and development of the turning basin will require that the existing navigation aids be relocated and/or upgraded. The Project includes the installation of temporary aids to navigation at locations in accordance with Transport Canada requirements. Temporary aids to navigation will be installed prior to the removal of any existing aids to navigation. Any permanent changes to navigational aids are the responsibility of the Canadian Coast Guard (CCG) and are outside the scope of this Project; however, consultation with CCG to coordinate requirements is ongoing.

3.1.5 Temporary Staging and Upgrades to Existing Infrastructure

The contractor will require a waterside bulkhead or pier with adequate water depth to support the marine construction activities. It is assumed that one or more of the existing dock facilities within the Port aux Basque harbour will be used by the contractor. The Project will also require a

temporary staging and laydown area to support the construction activity; the staging area will be located on Pikes Island. It is estimated that up to 10,000 m^2 may be required for the staging and laydown areas; however, for the purpose of this assessment, it is assumed that all of Pikes Island may be used for this purpose.

The existing access road to Pikes Island, originally constructed in the 1950s as part of the breakwater construction, will be used to access the staging area. The road that extends from Hwy. 470 to Pikes Island is approximately 1.8 km long and is currently controlled and maintained by the Town, which is responsible for operating an access gate at the entrance.

3.1.6 Temporary Haul Road

Depending on the equipment used and methods employed, the Dredge Contractor may use the rock from dredging to construct a temporary haul road, which will extend from Vardy's Rock to the infill at Pikes Island. Inclusion of the haul road provides the opportunity to maximize use of land-based equipment. As dredge activity on Vardy's Rock nears completion, the western portion of the temporary haul road will be fully removed and the eastern portion of the haul road will remain in place, as it will be located within the footprint of the Pikes Island Infill. The need for a temporary haul road will be determined by the selected contractor, who will also establish the final location and alignment.

3.2 Construction Activities

The Project construction activities are expected to include the following:

- Site preparation
  - Upgrades to existing access road and development of staging/laydown area on Pikes Island
  - Decommissioning of existing infrastructure on Vardy's Rock
  - Excavation and removal of soil overburden on Vardy's Rock
- Marine construction
  - Installation of temporary aids to navigation
  - Drilling, blasting, and dredging
  - Temporary haul road construction and removal (optional)
  - Breakwater repairs
  - Construction of Pikes Island Infill
- Restoration of temporary work areas

3.2.1 Site Preparation

Site preparation activities described in the following sub-sections are expected to be required prior to the commencement of marine construction.

3.2.1.1 Access Road Upgrades and Staging/Laydown Area

The existing access road to Pikes Island will be upgraded to accommodate the proposed staging/laydown area on Pikes Island. Road upgrades to support marine construction activities are expected to include minor improvements such as grading, with gravel added where required. It is assumed that the existing access road width and alignment will not change substantially.

The proposed Pikes Island staging/laydown area will be developed to support construction activities. Gravel will be placed, graded, and compacted to provide a level area for facilities used during construction (e.g., portable office trailers, portable sanitary toilets, portable water supply, temporary oil and fuel storage tanks), as well as construction equipment and surplus material stockpiles. Security measures to provide public and worker safety will be provided. Current use of the access road, which is limited to travel to the Pikes Island breakwater and decommissioned landfill, will be maintained for the duration of construction.

3.2.1.2 Decommissioning of Existing Infrastructure

Site preparation activities will include the permanent decommissioning of infrastructure on Vardy's Rock. This will involve the decommissioning and removal of navigation lighting and associated electrical system, as well as a weather station.

Equipment and materials removed from Vardy's Rock will be returned to MAI as required for reuse. Other salvageable material will be handled following applicable legislation and permitted approvals. Non-salvageable materials will be properly disposed of at approved and licensed facilities following ECCC Guidance.

The proposed upgrades to the Pikes Island breakwater have been designed to avoid the existing aid to navigation located at the end of the breakwater. Although not anticipated, should the existing equipment need to be temporarily decommissioned during construction, it must be reinstated upon completion of the breakwater upgrades. The work is the responsibility of the CCG, however coordination and support as required by the dredge contractor will be a contractual requirement.

3.2.1.3 Overburden Removal (Vardy's Rock)

The excavation of overburden materials including soils, organic substrate, and small boulders from Vardy's Rock will be completed using land-based equipment (e.g., excavators and bulldozers) prior to the commencement of marine construction activities. The estimated in situ volume of overburden to be removed is approximately 14,000 m^3, with areas of exposed rock to variable thickness up to approximately 1 m depth in some areas on the island. The removal of vegetation will be incidental to the excavation work. Materials will be transported using off-road land-based haul trucks to the loading location, where they will then be transported via barges from Vardy's Rock to a land based off-loading location. At the off-loading location, materials will be transferred to trucks for transport to an approved temporary stockpile location where material will be tested to determine if disposal at a licensed disposal facility is required. Land-based off-loading and temporary stockpile locations will be selected and configured to avoid loss of material during transfer. All topsoil,

organics, and waste materials will be disposed of at approved or licensed facilities and in accordance with applicable legislation and regulations.

Based on the results of the soil characterization program and follow-up leachate testing, overburden material excavated during removal of Vardy's Rock is anticipated to meet the acceptance criteria for disposal at the Southwest Coast Waste Disposal Site, operated by Western Regional Waste Management (WRWM), located approximately 15 km northwest of the Project site. Prior to commencement of construction, written confirmation of acceptance will be obtained from the receiving facility. Disposal of the material will be undertaken in accordance with the facility's waste acceptance requirements and applicable regulatory requirements. Should the Southwest Coast Waste Disposal Site be unable to accept the material, an alternative approved disposal facility will be identified, and written confirmation of acceptance will be obtained prior to disposal.

3.2.2 Marine Construction

As previously described, achieving the proposed navigation improvements primarily involve drilling, blasting, and dredging activities to remove Vardy's Rock and underwater rock material that pose an impediment to navigation. For the purposes of this assessment, marine construction activities include the following:

- Installation of temporary navigation aids
- Drilling and blasting
- Dredging (excavation of rock)
- Transport of rock
- Temporary haul road construction and removal (optional)
- Breakwater repairs
- Construction of Pikes Island infill

Marine construction activities are anticipated to take approximately 12 months to complete, pending receipt of project funding, regulatory approvals, and the commencement date. Possible constraints, including other navigation activity in the harbour, winds, and sea state, will be considered when scheduling construction activities. To reduce the overall construction schedule, and in consideration of the potential constraints, marine construction activities may take place seven days a week, 24 hours a day during that period. For the purposes of the assessment, and to further reduce the overall schedule, it is assumed that dredge activity can occur at multiple locations at one time and up to five barges may be in operation at any time. Blasting activities will be limited to occur during daylight hours, following applicable blasting guidelines and the terms and conditions of the Project approvals.

3.2.2.1 Installation of Temporary Aids to Navigation

The relocation of land-based and in-water navigation aids upon completion of the improvements to the navigation channel and turning basin are the responsibility of CCG. Required permanent aids and locations will be determined by CCG, with requirements for temporary aids to be established in

consultation with Transport Canada. The installation of temporary aids to navigation will be a contract requirement. These temporary aids will demark the construction zone and the existing navigation areas used by the ferries and other port users. Buoys will be installed with a weighted anchor in the temporary locations. Permanent aids to navigation, both existing and new aids required for the new channel alignment and turning basin, are the responsibility of CCG.

3.2.2.2 DRILLING AND BLASTING

Drilling and blasting will be required prior to dredging in all locations. The locations to be dredged are mostly composed of bedrock. Blasting will be required in both the marine and terrestrial environments for successful and efficient removal of rock required for this Project. Blasting will be completed by drilling a series of boreholes into the rock substrate from either a floating, spud, or jack-up barge, from mounded blast rock, or on land at Vardy's Rock. The specific equipment to be used is currently unknown and will be determined by the selected contractor.

The most common drilling method employed for blasting involves the use of hydraulic drill towers (sometimes multiple) fitted on rails to a drill barge for marine blasting, or directly on land for land-based blasting. Top hammer rotational units are used to first drill a casing pipe to seat into the bedrock. The drill rod, fitted with down-the-hole hammer, is then inserted into the casing, and the borehole for the explosive is drilled to the required depth. The borehole locations are drilled in a predetermined pattern based on several factors that are considered as part of the blast plan, including the type of rock, required excavation level, fragmentation, and the size of the charges.

Following drilling, the drilled holes are charged with explosives and detonated to fragment the rock so that it can be dredged. Two types of explosives, nitroglycerine-based explosives and ammonium nitrate-based explosives, are primarily used for underwater drilling and blasting operations. Stemming is used to confine the explosive energy within the drill hole and more effectively fragment the rock.

Approaches to blasting will be determined following the selection of the contractor. The final blasting approach may include staggered/staged blasting, such as benching (removals of layers of material) or, more likely, blasting to full depth. In addition to considering the quantity, quality, and location of rock for removal, the blast plan will need to consider a wide range of influencing factors including environmental conditions, start and completion dates, schedule restrictions, equipment selection, and ongoing harbour activity. Different approaches will have advantages and disadvantages. For example, staged (benched) blasting may require a greater number of blasting days; however, individual blast events would use smaller charge weights, potentially reducing associated effects, such as underwater noise and vibration. Alternately, the use of larger blast charges may reduce the overall number of blasting days but could increase the resulting zone of influence.

For the purpose this assessment, a full depth blasting approach has been assessed; however, the final approach will be determined by the contractor and may include a combination of approaches.

The selected contractor will be required to demonstrate that the preferred approach will comply with approvals and authorizations received for the Project. Should pre-dredge test blast measurements vary substantially from scenarios assessed, an alternate blast approach or additional modelling may be required to confirm the extents of effects with the proposed approach and effectiveness of the proposed mitigation measures.

The proposed blasting operation plan must also adhere to the Government of NL Occupational Health and Safety Regulations pursuant to the *Occupational Health and Safety Act*. Under normal conditions, blasting will only be undertaken during daylight hours. The blast plan is to include a communications protocol that provides a detailed sequence of procedures needed to alert and confirm clearances within the exclusion zone leading up to a blast.

3.2.2.3 Dredging

The removal of minor amounts of marine sediments located within the dredge locations will be incidental to the rock dredge activity. A barge-mounted mechanical dredge unit (e.g., hydraulic excavator) is anticipated to be used to recover the blasted material for reuse. The mechanical dredge unit will advance in a predetermined pattern, typically a dredge line following blasting. Dredging will advance in steps with the barge (spud) advancing using a global positioning system (GPS). The materials will either be transferred into an on-board hopper or an adjacent barge. Dredging will be conducted in a manner so as to not interfere with marine vessel traffic.

3.2.2.4 Transportation of Excavated Materials

Excavated materials will be transported for beneficial reuse to the Pikes Island Infill area, or Pikes Island breakwater, and/or a site selected for fish habitat creation site. The transport of materials will be dependent on blasting and dredging activities and may involve up to five barges. During dredging, the transport of dredge materials will be continuous until the dredge material has been cleared from each of the dredge locations. It is anticipated that spilt scows will be used for marine transportation, and a land-based crawler crane and off-road haul trucks will be used for land-based material movement after bottom dump capacity is exhausted.

3.2.2.5 Construction of Pikes Island Infill

The majority of the dredged material will be placed in the near-shore Pikes Island infill location. The infill is expected to be constructed concurrently with dredging operations and the completion of the breakwater repairs. It is anticipated that the infill construction will take approximately 12 months to complete, depending on a number of factors including the final dredge volume, contractor's methodology, dredge production, and weather impacts.

The infill will be constructed as a rubble mound structure using both land-based and marine equipment. The dredge contractor is expected to maximize the placement of the core material with dredged rock dumped directly within the infill location using split-hull barges. Where water depths limit barge access, material placement will proceed as described in Section 3.2.2.4. Multiple methods of material handling will be used simultaneously on land and from the sea. Amour stone on

the perimeter slopes of the infill is expected to be placed by excavator operating from the reclaimed land.

3.2.2.6 Breakwater Repairs

Similar to the Pikes Island Infill construction, repairs to the breakwater are expected to occur concurrently with dredging operations. The breakwater construction is expected to take approximately six to eight months to complete, depending on the dredge production and availability of specific rock sizes produced from dredging activities.

The breakwater repairs will likely be conducted using both land-based and marine equipment. Land-based operations will involve offloading appropriately sized rock material from barges using excavators, then transporting rock materials using off-road trucks for direct placement within the breakwater repair work area. Although rock placement on the breakwater is expected to be completed primarily using land-based equipment, some material may be placed from split-hull barges dumping directly on the breakwater, depending on water depths. Depending on the chosen sequencing of works, dredged rock material may be added directly to the existing breakwater or dredged rock may need to be transported to the laydown area for temporarily stockpiling. There may also be temporary stockpiling and re-use of existing armour stone to increase the height of the structure and the overall footprint.

Considering the volume of dredged material produced from the blasting operations, it is expected that all breakwater repairs will be completed using materials produced directly from dredge operations. Should additional handling, rock breaking, or crushing be required so that the size is suitable for construction, processing will take place at the laydown area. If required for the purpose of construction, appropriately sized rock will be obtained from an approved and licensed land-based facility.

3.2.2.7 Temporary Haul Road Construction and Removal (Optional)

As an alternative option to an exclusive marine barge transport operation, the Dredge Contractor may infill to construct a temporary haul road to maximize use of land-based transport equipment in combination with barges. The activities for construction of the haul road will be similar to those described in Section 3.2.2.5, with compaction of materials to form a suitable road base. When no longer needed, the removal of the temporary haul road alignment located outside the infill area will follow activities similar to those identified in Sections 3.2.2.3 and 3.2.2.4. The seabed will be restored to pre-placement elevation.

3.2.3 Restoration of Temporary Work Areas

Temporary work areas, specifically the staging/laydown areas on Pikes Island, will be restored prior to the contractor demobilising. Restoration work is anticipated to include dismantling and removal of all facilities used during construction, including portable office trailers, portable sanitary toilets, portable water supply equipment. Temporary oil and fuel storage tanks will be decommissioned and relocated. All construction equipment and surplus material stockpiles will be removed from site

prior to completion of the Project. Any debris or other materials, such as soil, will be excavated and removed from the site unless suitable for revegetation purposes. Should contaminated soil from on-site storage of equipment or material be encountered, it is to be fully excavated and disposed of at a licensed facility.

3.3 Operation Activities

Ongoing MAI operations within Port aux Basques Harbour are not expected to change and are not included in this assessment. Maintenance dredging is not anticipated to be required.

3.4 Project Schedule

The scheduling of the procurement process and award of the dredging contract is currently unknown. The Project construction schedule will be dependent on receipt of all regulatory approvals and Project funding and may be influenced by permit conditions. Construction is anticipated to commence in March 2027 and be completed by March 2028, spanning 12 months in duration. The final schedule must consider many possible constraints including harbour traffic, weather, winds, and sea state. The overall construction schedule will also depend on the contractors selected methods and sequencing.

3.5 Occupations

MAI is committed to maximizing employment benefits associated with the Project by hiring locally and provincially whenever feasible. Although requirements have not been finalized, the proposed Project is anticipated to provide employment opportunities for individuals with varying areas of expertise comprising multiple industry sectors. These will include part-time, full-time, contract and consulting positions. The number, duration, and hiring method will be determined based on the finalization of contract requirements.

3.5.1 Construction

Given the size of the Project and the construction schedule, it is anticipated that up to 200 individuals will be employed for the construction phase of the Project. The final employment requirements will be determined by the selected contractor, and requirements for individuals and positions may vary depending on the schedule and construction methodology. Table 3.2 provides an approximation of positions that may be required during construction and their associated National Occupational Classification (NOC) codes (Statistics Canada, 2026a). Occupational names and NOC codes currently in use are the 2021 NOC version. Occupations and NOC codes may change under the updated NOC 2026 Version 1.0 scheduled for release in December 2026 (Statistics Canada, 2025a).

Table 3.2 Approximate estimate of positions required during Construction Phase

Position	NOC Code	Type[1]	Duration (months)	Number of Positions	Hiring Method [2]	Estimated Quarterly Occupational Requirements				
						2027				2028
						Q1	Q2	Q3	Q4	Q1
Heavy equipment operators	73400	FT	18	30	C	36	36	30	30	30
Contractors and supervisors, heavy equipment operator crews	72021	FT	18	6	C	8	8	6	6	6
Contractors and supervisors, other construction trades, installers, repairers, and servicers	72014	FT	18	8	C	8	8	4	4	4
Construction trades helpers and labourers	75110	FT	18	30	C	20	20	10	10	10
Boat and cable ferry operators and related occupations	75210	FT	18	6	C	6	6	6	6	6
Transport truck drivers	73300	FT	3	6	C	10	10	6	6	6
Drillers and blasters – surface mining, quarrying and construction	73402	FT	18	10	C	10	10	10	10	10
Heavy-duty equipment mechanics	72401	FT	18	6	C	7	7	6	6	6
Other technical trades and related occupations (Commercial divers)	72999	FT	18	6	C	6	6	6	6	6
Land surveyors	21203	PT	18	6	C	8	8	6	6	6
Land survey technologists and technicians	22213	PT	18	6	C	6	6	6	6	6
Civil engineers	21300	FT	18	10	C	14	14	10	10	10
Engineering inspectors and regulatory officers	22231	FT	18	10	C	10	10	10	10	10
Biologists and related scientists	21110	FT	18	10	C	10	10	10	10	10

Notes:

1 FT = full-time; PT = part-time

2 C = contracted; DH = direct hire; ES = existing staff

3 Estimate of employment requirements will be determined following award of contract.

3.5.2 Equal Opportunity Employment

MAI is an equal opportunity employer that is committed to building a diverse and inclusive workplace. MAI has previously received an Outstanding Commitment Employment Equity Award from Employment and Social Development Canada. This award recognizes employers that have demonstrated a commitment to implementing employment equity plans, removing barriers to employment, and establishing company policies and practices that encourage equality within the workplace.

As an initiative of their Diversity and Inclusion Strategy, MAI actively recruits members of designated groups in accordance with Canada's *Employment Equity Act*, 1995. Such members include women, Indigenous peoples, persons with disabilities, and visible minorities. MAI also focuses on inclusion initiatives for members of the 2SLGBTAIA+ community as identified in their Corporate Plan 2024/25 – 2028/29 (MAI, 2024). As such, MAI encourages companies hired to complete the proposed works to have similar policies, will be an equal opportunity employer, and will provide an inclusive work environment for marginalized groups, including members of the 2SLGBTAIA+ community.

3.6 Potential Sources of Pollution

Potential sources of pollution from Project activities are related to emissions, discharges, and wastes, as well as potential accidents and the malfunctioning of equipment. The contractor will be responsible for the development of environmental management plans to address potential sources of pollution and emergency response, including Environmental Protection Plans (EPPs) and Emergency Response Plans (ERPs). The EPPs and ERPs must meet the Project specific requirements detailed in the Environmental Management Plan (EMP). An assessment of the effects as a result of these potential sources of pollution is provided in Chapter 7.

3.6.1 Emissions, Discharge and Waste Management

3.6.1.1 Atmospheric Emissions and Dust

The Project may result in several sources of atmospheric emissions such as:

- Gas emissions from blasting and combustion of fossil fuels used in vessels and equipment
- Dust generated during soil removal, blasting, and the placement of rock
- Dust generated during mobilization of trucks and equipment on access roads and staging areas
- Dust generated from crushing of rock, if required

Emissions may include carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), nitric oxide (N_2O), and particulate matter. Air emissions will mainly be from the use of diesel-or gasoline-powered equipment and dust generated during site preparation and construction.

Potential sources of air emissions will be mitigated and reduced by following industry best practices and maintaining equipment in good working order. The EPP will be developed by the contractor and will identify Project specific mitigation measures, such as the application of water or water-based

dust suppressants on gravel roads and the use of dust control equipment recommended by the manufacturer for rock crushing equipment. Other mitigation measures identified as a result of the effects assessment is provided in Chapter 7.

3.6.1.2 NOISE

Project activities will result in noise generated from the use of equipment, drilling, blasting, dredging, and infilling. Noise is typically defined as unwanted sound that can disrupt normal daily activities, thereby reducing the quality of the surrounding acoustic environment.

3.6.1.3 VIBRATION

Project activities will result in vibration from blasting, drilling, dredging, infilling and the use of equipment and heavy machinery. Post-detonation compression waves are produced following the detonation of explosive charges and include a series of very high amplitude, albeit brief, acoustic events. The extent of the event is dependant on the size of the charge.

3.6.1.4 SUSPENDED SOLIDS

Suspended solids may be generated from blasting, dredging, and the placement of material. Erosion and sediment control (ESC) measures will be implemented. These will include the installation of silt fencing prior to the initiation of land-based site preparation work and conducting visual and turbidity monitoring in the marine environment.

3.6.1.5 WASTE MANAGEMENT

Waste management streams include rock, soil, solid waste, and sewage. The contractor will be responsible to implement waste management practices in compliance with applicable regulatory requirements. Where feasible, approaches to minimize the waste generated by Project activities will be undertaken and may include the reuse and recycling of wastes. All other waste will be removed from site prior to demobilization of the contractor.

Waste reduction efforts have been integrated into the preliminary design and include using dredged material for the Pikes Island Breakwater Repairs and Pikes Island Infill, thereby reducing the overall production of waste as a result of the Project.

Prior to dredging, vegetation and surficial soils will be removed from Vardy's Rock. Surficial soils may contain concentrations of contaminants that exceed various land use requirements. Impacted soil will be collected and disposed of at an approved facility following applicable regulatory requirements.

Solid waste will be generated from the removal of decommissioned equipment and domestic waste. Hazardous waste, such as waste oils, fuels, and contaminated soils from spills may also be generated through Project activities. Solid and hazardous material will be handled, stored, and disposed of in compliance with applicable legislation. Portable hygiene facilities will be required during

construction of the Project. These facilities will be serviced regularly, and waste will be disposed of following applicable guidelines.

3.6.2 Accidents and Malfunctions

Accidents and malfunctions during construction have the potential to affect the environment, the public, and workers. To mitigate the possibility of accidents and malfunctions, the Project will be designed following applicable standards, industry best management practices (BMPs) and Project-specific environment and safety management plans. Environmental and safety management plans and practices will be developed by the contractor and included in work method statements, ERPs, EPPs, occupational health and safety plans, training, and other contingency plans. All plans will be reviewed for compliance prior to construction.

Potential accidents and malfunctions that could occur during the Project may include the following and are further described in the following sections:

- Spills and leaks of hazardous substances
- Fires and explosions
- Stockpile and infill slope failure
- Erosion and sediment control failure
- Vehicle and vessel collisions

3.6.2.1 Spills and Leaks of Hazardous Substances

The Project will require the use of equipment, blasting materials, and the storage of fuels. Spills and leaks could occur as a result of equipment failure, storage tank failure, accidents involving equipment, or failure to follow proper procedures related to material handling. The environmental severity of the spill is dependant on the location, volume, and time of year of a release.

In the case of spills, leaks, and releases of hazardous or deleterious substances, immediate action will be undertaken following emergency response procedures. When safe to do so, the spill will be contained, cleaned up, disposed of, and reported following applicable guidelines and regulations. MAI and the approved contractor will take necessary precautions to prevent spills and leaks of hazardous substances, including the implementation of BMPs and environmental management plans. Measures to reduce the potential for spills and leaks, and to address occurrences of spills, may include the following:

- Development of procedures to minimize spills and overfilling of equipment and storage tanks.
- Storage areas for chemicals and fuels will be greater than 30 m away from a watercourse or waterbody.
- Equipment will be maintained in good working order.
- Storage tanks will conform to government regulations and guidelines.
- Bulk storage of materials will be stored in above ground storage with secondary containment in compliance with provincial regulations.
- Spills will be cleaned up and disposed of following the provincial Waste Management Regulations.

- Spill kits will be available on-site.

3.6.2.2 Fires and Explosions

There is potential that the use of industrial equipment, equipment malfunctions, blasting activities, or human error could result in accidental fires or explosions leading to emissions such as particulate matter, CO_2, CO, nitrogen oxides (NOx), sulfur dioxides (SO_2), volatile organic carbons (VOCs), polycyclic aromatic hydrocarbons (PAHs), or other contaminants.

Blasting and explosives management will follow applicable legalisation and include requirements for handling, storage and use of explosives. Only trained and qualified personnel will be authorized to handle or use explosives. The contractor will be required to prepare and implement a blasting plan, which will include notification procedures and will be integrated into the ERP. With the implementation of mitigation and control measures, the likelihood of fires and unplanned explosions would be low.

In the event of a fire or explosion, immediate action will be undertaken following emergency response procedures. When safe to do so, the fire(s) will be contained. The approved contractor will take necessary precautions to prevent fires and unplanned explosions, including the implementation of BMPs and environmental management plans.

3.6.2.3 Stockpile and Infill Slope Failure

Temporary stockpiles and infill slope failure may result in the release of aggregate material into the marine environment. Infill slopes will be designed following engineering standards of stability to minimize the potential for failure. Following best management practices, temporary stockpiles will be maintained at angles that promote stability. Infill slopes will be monitoring during construction, and as required following construction. Slopes will be repaired as required.

3.6.2.4 Erosion or Sediment Control Failure

Failure of ESC measures may result in the potential release of deleterious materials, such as sediment into the marine environment. This may result in suspended sediment concentration in the aquatic environment above background concentrations. ESC measures implemented will be regularly inspected to monitor their effectiveness. As required, damaged structures will be repaired, and other remedial action will be undertaken as required. Structures will also be monitored during and following extreme precipitation or weather events.

3.6.2.5 Vehicle and Vessel Collisions

Vehicle and vessel collisions may occur on land and on the water as a result of Project activities. The contractor will be required to develop and implement procedures to minimize collisions in both environments. On land, these procedures may include site orientation, defined traffic patterns, speed limits, and appropriate signage. In the marine environment, the contractor will be responsible for coordination with the CCG and other harbour users, such as ferries, fishing boats, tug boats, fuel vessels, and other vessels. Mitigation measures may include vessel speed requirements as well as scheduling and coordinating drilling, blasting, dredging, and infilling activities with other marine

users. Navigational warnings (NAVWARNs) will be issued by CCG for marine construction operations. Additional postings may be required for other navigation hazards during construction. Aids to navigation will need to be relocated; MAI and the contractor will work with Transport Canada and CCG to relocate navigation aids as a result of the work. In the event of a collision on the water, emergency response will be coordinated with CCG.

3.7 Emergency Response Plan

Environmental management will include approaches to reduce or avoid potential effects to health, safety, and the environment. Approaches will aim to minimize the likelihood of occurrence, potential environmental and safety hazards, and reduce cleanup cost and property damage.

Environmental management will include an ERP for the Project. The main purpose of the ERP is to document predetermined courses of action in case of emergency. The ERP will be developed by the contractor following applicable legislation and guidance, including the federal Environmental Emergency Regulations and the Canadian Standards Association (CSA) Emergency Preparedness and Response for Petroleum and Natural Gas Industry Systems (CSA-Z246.2:18 (R2023); CSA Group 2018). The ERP will include key information for the following items that may occur as a result of the Project:

- Identification of emergency situations
- Response to emergency situations including procedures to be followed
- Responsibility of key personnel

The ERP will be followed by Project personnel, and training on the ERP will be required prior to commencement of work.

3.8 Potential Resource Conflict

Potential resource conflicts have been identified through ongoing stakeholder engagement (Chapter 4) and include both terrestrial and marine considerations. Where possible, Project design and mitigation measures will be used to address concerns of potential resources conflict. Descriptions of the main potential conflicts and further assessment is provided in Chapter 7.

Chapter 4 Consultation and Engagement

A key requirement of an effective environmental assessment is to provide opportunities for public, stakeholder, and Indigenous participation in the process. During the early planning stages of the Project, MAI carried out informal stakeholder consultation. As the design progressed and the environmental assessment process was initiated, more formal engagement activities have commenced and are planned. Throughout the development of the Project, MAI and CBCL have involved key stakeholders as part of the design process. This consultation has served the following main purposes:

- To inform stakeholders about the Project and the need for the Project
- Provide a forum to obtain information about the harbour and input on the overall Project
- Identify concerns that can be mitigated through Project design, or considered and incorporated into the assessment
- Obtain information that may assist in carrying out the assessment

Consultation and engagement completed to date are outlined below, as well as additional consultation and engagement initiatives planned for 2026 and 2027. Consultation and engagement with regulators, key stakeholders, the public, and Indigenous groups will coincide with the following three planning phases of the Project:

- Early planning prior to EARD submission (May – June 2026)
- Follow-up engagement to discuss feedback received during the EARD review process (September 2026)
- Pre-construction (early 2027)

4.1 Regulator Consultation

Communication with government agencies has been ongoing throughout the preliminary design and assessment of the Project. This included formal presentations and informal communications regarding regulatory requirements, environmental baseline data collection, and feedback on the methods and approach to the EARD/EEE from regulatory agencies.

On July 16, 2020, MAI and CBCL hosted a joint regulatory meeting. The purpose of this meeting was to introduce the Project team, provide an overview of proposed Project, summarize work completed to date, identify upcoming studies, and determine next steps. Regulatory agencies in attendance included:

- NL ECCC – EA Division
- Transport Canada – Indigenous Relations Branch (formerly named the Environmental Affairs and Aboriginal Consultation Unit)
- DFO – Fisheries Protection Program
- Environment and Climate Change Canada (ECCC) – Disposal at Sea Program

- Canadian Coast Guard
- Transport Canada – Navigation Protection Program
- Transport Canada – Ports Program

Follow-up meetings with federal and provincial regulators have been held with regulators in May 2026 and will continue through the regulatory review period. The intent of the meetings is to update regulators on the status of the Project, confirm expectations for the EARD and approvals, and identify potential issues associated with the Project.

4.2 Stakeholder Engagement

As part of the planning and preliminary design process, CBCL completed a series of stakeholder engagement sessions with the MAI Captains in June and July 2020. MAI Captains are responsible for the safe transport of passengers and product on each sailing, two times a day throughout the year, to Port aux Basques and Argentia, NL. As key stakeholders, the input from the MAI Captains was critical to confirm the understanding of local conditions and operational constraints and to verify preliminary findings of the hydrodynamic model used to inform the engineering design. CBCL conducted five interview sessions in June and July 2020 involving nine MAI Captains and two Chief Officers. The key components of the Project and findings of the hydrodynamic study of Port aux Basques Harbour were presented for detailed discussion at each session.

The participants indicated support of the Project. The MAI Captains confirmed that, in their opinion, the navigational benefits of the island removal would be considerable and not diminished by the marginal increased wave exposure at the terminal docks with the removal of Vardy's Rock. The captains accepted the proposed alignment as presented but suggested a straight approach to the navigation channel with the elimination of bend radius at Baldwins Rock. This change was assessed and adopted into the Project preliminary design. The participants also communicated the need for further assessment of impact on the Town docks to establish if mitigation measures may be required to address local concerns. This issue was also evaluated with results provided in Section 7.4.1 and further details provided in the Hydrodynamic Modelling report contained in Appendix B.

In addition to the MAI Captains, local fishers who fish in and around the harbour and use the Town docks, business owners, representatives of various provincial and federal government departments as well as representatives of the Town were identified as key stakeholders with a vested interest in future plans for the Port aux Basques Harbour. These stakeholders were extended an invitation to attend one of two information sessions held on September 22, 2020.

During the stakeholder sessions, representatives from the Project team presented an overview of the Project, including details on the proposed Project components, coastal engineering assessment, and overview of environmental studies, specifically related to fish and fish habitat, completed to date to solicit feedback to inform the design and assessment process. Questions and concerns raised by stakeholders include the following:

- Potential impacts of blasting and dredging on marine fish and fisheries in the harbour
- Duration of impacts to the fish habitat and fisheries
- Potential impacts on Town floating docks as a result of removing Vardy's Rock and potential increase in wave exposure as a result of northeast winds
- Potential increase in suspended sediment and impact on water quality for intake to lobster holding facility
- Importance of safety for all harbour users

Questions and concerns raised have been included in the assessment of effects presented in Chapter 7. Further stakeholder consultation will occur in conjunction with public consultation efforts, and throughout the permitting and approval process.

Three stakeholder engagement sessions are planned: June 2026, September 2026, and early 2027.

4.3 Public Consultation

A public consultation meeting planned for the fall of 2020 was cancelled due to COVID-19 restrictions. The intent of this session was to inform the general public of the Project and provide information to respond to anticipated questions and concerns with the Project. The meeting was then deferred as the Project was put on hold.

At least two public open houses sessions are planned: the first is planned for September 2026 and another will be held in early 2027. Each engagement session will include a meeting in each the afternoon and evening. During the open house session, participants will be guided through a presentation of various subject matters providing a thorough overview of the proposed Project. Questions and two-way dialogue will be encouraged, and issues/concerns recorded by the Project team for tracking and reporting purposes. Any issues identified will be assessed and, if required, additional mitigation measures will be integrated into the Project.

4.4 Indigenous Engagement and Consultation

MAI, with support from CBCL, will implement a range of Indigenous engagement and consultation in 2026 and 2027, which may include the following activities:

- Introductory letters provided via mail or email
- Introductory virtual or in-person meetings
- Community presentations, where appropriate
- Invitations to open house sessions
- Ongoing updates via letter and/or email

Chapter 5 Methods for Environmental Effects Analysis

The methods applied to complete the environmental effects analysis for the Project were developed by CBCL to meet the combined requirements of an EA Registration under the NL Environmental Assessment Regulations and Section 82 of the IAA for a project on federal lands, and include the following steps:

- Establish scope of EA
    - Describe the Project (i.e., Undertaking) components and activities
    - Identify issues
    - Select valued components of the environment (VCs)
    - Establish boundaries
- Describe existing environment
- Evaluate environmental effects
    - Identify potential Project-environment interactions through analysis of pathways of effects
    - Identify mitigation strategies to avoid or reduce potential adverse environmental effects
    - Characterize the residual environmental effects after mitigation strategies are incorporated
    - Determine the significance of residual adverse environmental effects

The following sections describe the approach to scoping and evaluating the environmental effects. A description of the methods used to gather information to describe the existing environment are provided in Chapter 6 for each VC.

5.1 Scoping

Establishing the scope of the environmental effects analysis is an important step that identifies the scope of the Project and issues raised by regulators and stakeholders. The goal of scoping is to select valued components (VCs) on which to focus the analysis; i.e., those VCs that are considered to be important and likely to be substantially affected by Project components or activities.

5.1.1 Defining Scope of the Project

The scope of the Project to be assessed is based on the requirements of the relevant environmental assessment processes, in this case, the federal IAA and the provincial EPA. To meet the federal requirements, the scope of the Project includes the physical activities associated with physical works and occurring on federal lands (i.e., activities associated with infill, breakwater, and aids to

navigation). To meet the provincial requirements, the scope of the Project includes the Project components, and associated activities, that are identified as undertakings in the EA Regulations (i.e., infilling an underwater area greater than 5 ha). The Project components and activities are described in Chapter 3 of this document.

5.1.2 Identifying Issues and Selecting VCs

VCs refer to biophysical, socio-economic, or cultural components that could be affected by the Project. Based on the scope of the Project and the Project location, the following information was considered to identify issues and select VCs:

- Understanding of the characteristics of the Project and anticipated work methods
- Consultation with regulatory authorities
- Community and stakeholder concerns about the Project
- Indigenous rights and resource use
- Knowledge of the environment
- Characteristics of potential impacts and environmental effects of the Project
- Professional judgement and lessons learned from similar projects

5.1.3 Establishing Boundaries

Temporal and spatial boundaries refer to the time periods and geographic extent in which a Project may interact with (or affect) a VC. Direct and indirect environmental effects were evaluated within these temporal and spatial boundaries. Boundaries were selected for each VC, as they may have the potential to vary based on the following considerations:

- Geographic range of the VC
- Zone of influence of the Project on the VC
- Timing and schedule of Project phases
- Known ranges and natural variations of each VC
- Timing of VC occurrence or presence in the Project zone of influence
- Known timing required to recover from an environmental effect
- Administrative boundaries
- Availability and quality of data and information

The boundaries of the Project Area (Figure 1.2) are defined as the perimeter within which the Project components and activities will occur. An assessment area is established for each VC; however, some VCs may share the same assessment area. The assessment area, also called the zone of influence, is the area within which Project-related effects can be reasonably predicted. For acoustic and marine environment VCs, modelling was conducted to define the zone of influence of the Project on the relevant VCs.

5.2 Existing Environment

Existing baseline conditions and characteristics of the Project Area are highlighted in Chapter 6. Descriptions of the physical, biological, socio-economic, and cultural environments provide context

for the assessment of effects by providing an understanding of the receiving environment in the Project Area and the assessment area. The approach to describing the existing (baseline) environment includes a combination of field surveys, modelling, background information, and literature review. The description in Chapter 6 is supported by appending technical reports and referencing relevant existing reports or literature.

5.3 Evaluation of Environmental Effects

5.3.1 Identification of Project-Environment Interactions and Pathways of Effects

Potential interactions between the Project and VCs are presented using a matrix approach to systematically identify which Project activities could substantially interact with which VCs. Potential interactions are described as positive or negative, depending on whether the interaction will be beneficial or adverse for the respective VC. In some cases, there is potential for both positive and negative interactions to occur.

Where negative interactions could occur, a more detailed assessment of the potential adverse environmental effects is completed. Each effect is analyzed qualitatively and quantitatively, when feasible. The assessment is based on existing knowledge, professional judgement, and analytical tools, when possible. Further analysis is not conducted for activities that are determined not likely to interact with the VC, based on existing knowledge.

A pathways-of-effects (POE) approach is used to describe the mechanisms by which Project activities or components may lead to environmental effects on a VC. POE models that are used to support the analysis of environmental effects include those developed by DFO to identify potential environmental effects of activities on fish and fish habitat (DFO, 2018).

5.3.2 Identification of Mitigation Strategies

The POE approach used to identify mechanisms of potential environmental effects is also used to identify mitigation measures or strategies to avoid or reduce adverse Project effects on the VCs. Mitigation measures must be technically and economically feasible and are considered where there is a reasonable expectation that they will be effective. Mitigation strategies include effective and established measures, if applicable. Where adverse environmental effects cannot be completely avoided or adequately reduced, additional measures are considered, including habitat offsetting, organism relocation, timing, and monitoring.

For each interaction where a mitigation measure is applied, the effectiveness of each mitigation measure applied will be assessed in order to identify any remaining residual effects. Residual effects are effects to VCs that are anticipated to remain following the implementation of mitigation measures.

5.3.3 Characterization of Residual Environmental Effects

Determining the significance of the likely adverse residual environmental effects is a core requirement of the IAA for a project on federal land. The determination of significance is based on the following key criteria: magnitude, reversibility, geographic extent, timing, duration, and frequency. The adverse residual environmental effects that are identified as likely to occur as a result of the Project are characterized for each of these criteria as described below:

Magnitude - the amount of change in a VC as a result of the effect

- **Small:** the effect is at, or nominally above, baseline conditions
- **Moderate:** the effect exceeds baseline conditions but does not exceed established regulatory criteria or published guidelines
- **Large:** the effect exceeds established regulatory criteria or published guidelines

Geographic Extent - the area within which an effect of a defined magnitude will occur

- **Immediate:** the effect is limited to the Project Area
- **Local:** the effect extends beyond the Project Area but is within the municipal boundaries
- **Regional:** the effect will occur on a regional scale, extending out of the municipal boundaries

Timing - when the effect occurs relative to the sensitive time period for the VC

- **Low:** the effect occurs during low or non-sensitive time periods for the VC
- **Moderate:** the effect occurs during moderately sensitive time periods for the VC
- **High:** the effect occurs during highly sensitive time periods for the VC

Duration - the period of time the effect persists (i.e., until the VC returns to baseline conditions)

- **Short-term:** the effect occurs only during the site preparation or a portion of the construction phase
- **Medium-term:** the effect occurs throughout construction phases
- **Long-term:** the effect will persist beyond the construction phase of the Project

Frequency - how often the effect occurs over during the Project or a specific Project phase

- **Once:** the conditions or activities causing the effect to occur once
- **Intermittent:** the conditions or activities causing the effect to occur intermittently
- **Continuous:** the conditions or activities causing the effect to occur continuously throughout the Project phases

Reversibility - whether a VC will recover from an effect and return to baseline conditions

- **Reversible:** the effect is readily reversible
- **Irreversible:** the effect is permanent

5.3.4 Determination of Significance

The significance of an effect will be determined using established or generally accepted benchmarks for each VC, where available. Benchmarks are described for each VC that is carried forward for further analysis. Regulatory standards, guidelines, targets, or objectives will be used, when appropriate, to determine benchmarks (Canadian Environmental Assessment Agency, 2018). Considering the characteristics of the adverse residual environmental effects and comparison to available benchmarks, reasoned argumentation and professional judgment are applied to determine the significance of the effect.

Chapter 6 Existing Environment

Information on existing baseline conditions of the atmospheric, marine, terrestrial, and socio-economic environment, both within and surrounding the Project Area, was collected through a combination of desktop evaluations and field programs. A description of the baseline conditions for each VC are presented in the following subsections.

6.1 Atmospheric Environment

6.1.1 Climate

The Project is in Channel-Port aux Basques, which is within the Maritime Barrens Ecoregion. This ecoregion is characterized by cold summers with frequent fog and strong winds. Winters are mild with intermittent snow cover along the coastline (ECCC, 2014). Climate data for Port aux Basques is collected at Climate Station 8402980, which is operated by the Meteorological Service of Canada (ECCC). The station is located at 47°34'26.000" N and 59°09’17” W and has been active since 2017 to present (ECCC, undated). Prior to 2017, climate data was collected at Station ID 8402975. Canadian climate normals published by the Government of Canada are available for the period between 1991 and 2020. Table 6.1 provides temperature, precipitation, and wind normals for Port aux Basques from 1991 to2020, along with monthly averages.

The data presented in Table 6.1 illustrate that most precipitation (mm) in Port aux Basques occurs in December. The warmest months in Port aux Basques are July and August and the coldest months are January and February. From March to August, the winds typically prevail from the east and shift to west and northwest for the remainder of the year. Throughout the year, there is an average of 78.5 days with winds greater than or equal to 52 km/h and 36.2 days with winds greater than or equal to 63 km/h. The average annual wind speed is 25.0 km/h.

Table 6.1 Historic climate data from Environment Canada Weather Station nearest the Project Area (1981-2020)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals													
Daily Average (°C)	-4.6	-5.3	-2.9	1.2	5.9	10.0	14.6	16.2	12.5	7.9	3.4	-0.8	4.8
Daily Maximum (°C)	-1.5	-2.1	0.1	4.1	9.2	13.3	17.6	19.5	15.8	10.9	6.1	1.8	7.9
Daily Minimum (°C)	-7.6	-8.5	-5.9	-1.6	2.5	6.7	11.5	13.0	9.1	4.9	0.7	-3.4	1.8
Precipitation Normals													
Rainfall (mm)	48.7	41.8	57.6	118.9	115.7	127.4	112.5	118.5	125.4	143.3	127.1	92.9	1229.9
Snowfall (cm)	101.9	81.7	49.1	17.4	2.4	0	0	0	0	2.2	21.8	78.6	355
Precipitation (mm)	124.8	103.7	103.3	111.8	104.6	112.6	117.8	103.1		112.9	127.8	142.9	
Wind Normals													
Speed (km/h)	33.5	32.8	28.2	25.8	22.3	20.8	18.5	17.3	20.2	25.1	27.9	32.4	25.4
Most Frequent Direction	W	W	W	E	E	E	E	E	W	W	W	NW	E
Maximum Gust Speed (km/h)	137	154	148	126	124	113	100	106	128	135	137	143	
Direction of Maximum Gust	S	W	E	N	E	NW	SE	NW	W	W	NW	W	
Days with Winds ≥ 52 km/h	18.1	15.1	13.1			2.8					11.9	17.5	
Days with Winds ≥ 63 km/h		9.3	7.9			0.50					7.1	11.4	
Days with Winds ≥ 90 km/h	5.9	5.4	3.3	2.3	0.57	0.18	0.06	0.12	0.53	2.0	2.9	6.6	29.9

6.1.2 Air Quality

The island of Newfoundland has six ambient air quality monitoring stations that monitor air pollutants and air quality as part of the National Pollutant Surveillance Program (NAPS). Corner Brook is the NAPS monitoring station closest to the Project Area, located approximately 166 km north of Channel-Port aux Basques (NL ECCC, undated). Ambient air quality data collected at the Corner Brook NAPS Monitoring Station (NAPS ID: 10602) was, therefore, used to characterize baseline air quality for the Project Area.

Air pollutant concentrations reported for the Corner Brook NAPS station in recent years are summarized in Tables 6.2 and 6.3. Provincial and federal threshold concentrations are outlined in Table 6.4. The most recent provincial report on air quality in the province (2024) indicated that the maximum hourly air contaminant concentrations for the Corner Brook NAPS station are well below the provincial regulatory thresholds. During 2024, the provincial 1-hour criteria O_3, NO_2, CO, SO_2 and $PM_{2.5}$ were not exceeded on any occasion; however, the 8-hour O_3 standard was exceeded on one occasion in March 2024 (NL ECCC, 2025). No annual exceedances were reported in 2024 (NL ECCC, 2024).

Table 6.2 Maximum concentrations of air contaminants for Corner Brook NAPS Monitoring Station (2023-2024)

Air Contaminant	Maximum Concentration*	
	2023	2024
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	23.3 µg/m³	16.4 µg/m³
Carbon Monoxide (CO)	0.5 ppm	0.8 ppm
Ozone (O_3)	53.6 ppb	46.0 ppb
Sulfur Dioxide (SO_2)	1.7 ppb	10.2 ppb
Nitrogen Dioxide (NO_2)	30.3 ppb	29.1 ppb
Nitric Oxide (NO)	--	--
Nitrogen Oxides (NO_x)	46.8 ppb	50.3 ppb

*All results are based on Maximum 1-hour Concentration, with the exception of $PM_{2.5}$, which is based on Maximum 24-hour Concentration

**Based on limited data

Table 6.3 Average concentrations of air contaminants for Corner Brook NAPS Station (2023-2024)

Air Contaminant	Average Annual Concentrations *	
	2023	2024
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	4.4 µg/m³	3.5 µg/m³
Carbon Monoxide (CO)	0.2 ppm	0.2 ppm
Ozone (O_3)	28.0 ppb	27.2 ppb
Sulfur Dioxide (SO_2)	0.2 ppb	0.5 ppb
Nitrogen Dioxide (NO_2)	2.2 ppb	2.2 ppb
Nitric Oxide (NO)	--	--
Nitrogen Oxides (NO_x)	2.7 ppb	2.9 ppb

Table 6.4 Federal and provincial thresholds for air contaminants

Air Contaminant	Averaging Period	Regulatory Threshold		
		Federal* 2022 Criteria	Federal* 2025 Criteria	Provincial**
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	24-hour	27 µg/m³	--	25 µg/m³
	Annual	8.8 µg/m³	--	8.8 µg/m³
Carbon Monoxide (CO)	1-hour	--	--	--
	8-hour	--	--	--
Ozone (O_3)	1-hour	--	--	82 ppb
	8-hour	62 ppb	60 ppb	44 ppb
Sulphur Dioxide (SO_2)	1-hour	70 ppb	65 ppb	65 ppb
	Annual	5 ppb	4 ppb	4 ppb
Nitrogen Dioxide (NO_2)	1-hour	60 ppb	42 ppb	42 ppb
	Annual	17 ppb	12 ppb	12 ppb

*Based on Canadian Ambient Air Quality Standards (CCME, 2025). Thresholds for all contaminants except fine particulate matter is reported as ppb by CCME (2025

**As outlined in the Air Pollution Control Regulations (Schedule A) pursuant to Section 22 and 111 of the *Environmental Protection Act*

The Air Quality Health Index (AQHI) is a numerical scale that indicates the human health risk associated with air quality, where the lower the AQHI, the lower the risk to human health. For example, an AQHI between 1 and 3 is considered a low health risk, and an AQHI between 4 and 6 is considered a moderate risk. Average annual AQHI readings for Corner Brook in 2023 and 2024 were both 1.8. The AQHI was below 3 for 99.8% of the time in 2024 and 99.2% of the time in 2023 (NL ECCC, 2024, 2025), indicating that air quality is generally good and presents a low health risk to the public.

The primary existing sources of emissions influencing air quality in Port aux Basques Harbour are from transportation (i.e., fuel-burning marine vessels and land-based vehicles) and fuel burning for heating.

6.1.3 Acoustic Environment

The acoustic environment within a community is influenced by several factors, including sound, noise, and vibration. Human perception determines the difference between sound (what we hear) and noise (unwanted sound). The way sound is perceived, and its effects on humans, depends on several factors, including the frequency, duration, loudness, and variability of noise levels with exposure. Frequency refers to the number of vibrational cycles per second; it is perceived by the ear as high and low sounds, and its unit of measurement is Hertz (Hz). Duration is the length of time that a sound persists and is often categorized as impulse or continuous. Intensity is the level of noise (sound pressure level) and is measured in decibels (dB). Since the human ear cannot perceive all frequencies, the A-weighted decibel (dBA) scale is used to evaluate ambient or community noise

(e.g., noise from construction activities) and its effects on humans. A dBA of 0 coincides with the threshold of human hearing, while a dBA of 130 coincides with the threshold of human pain (Health Canada, 2017).

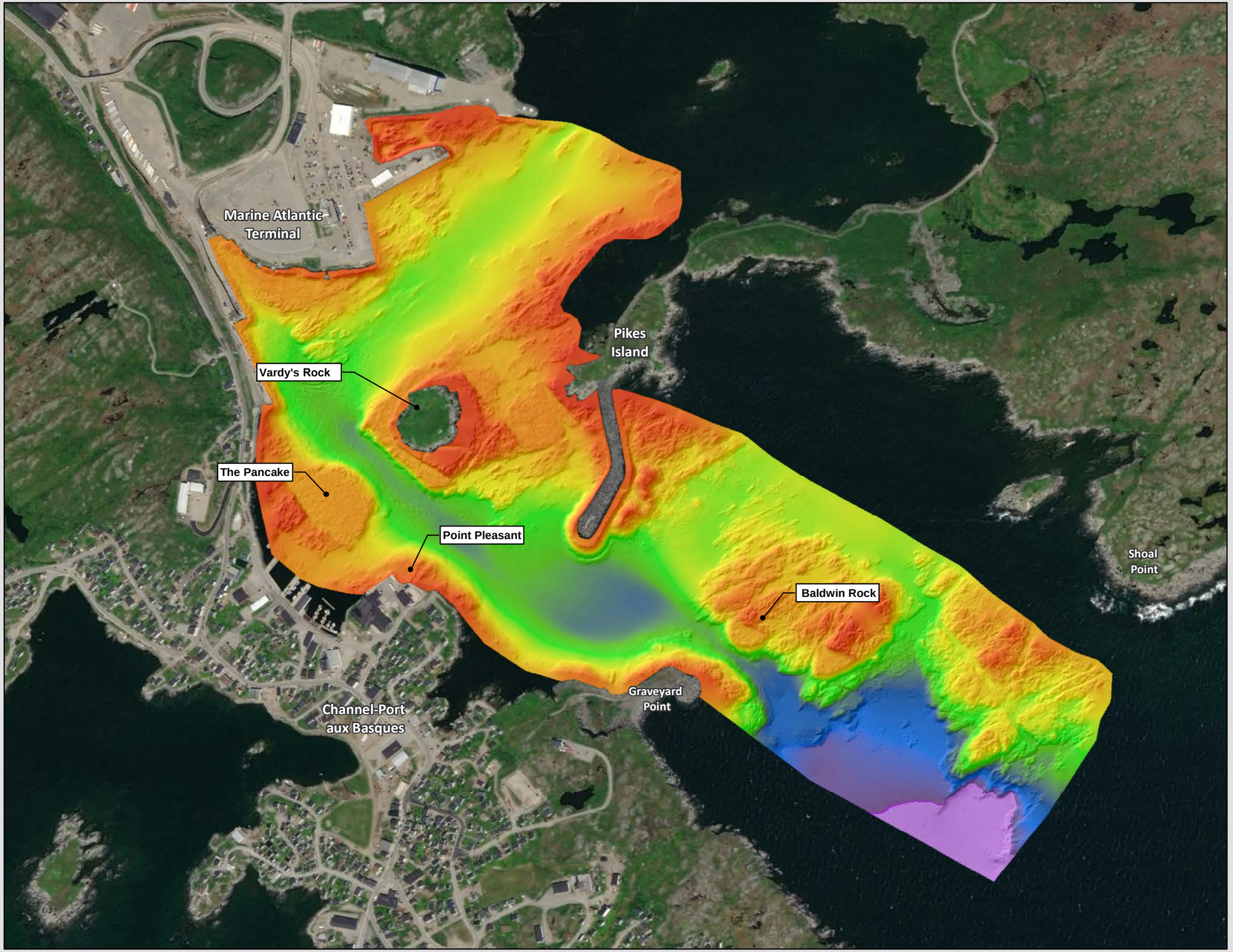
Estimates of baseline noise levels in Channel Port-aux Basques were determined using guidance provided by Health Canada (2023) and the population density (number of people per square kilometre) within the community. The population density in Channel-Port aux Basques during the most recent census in 2021 was 91.3 people/km^2 for the Town Centre and 0.7 people/km^2 for municipal census area (Statistics Canada, 2023). Based on these parameters, baseline noise levels for the Town Centre are estimated to correspond with sound levels characteristic of a quiet to normal suburban residential area with estimated baseline sound levels ranging between approximately 48 and 57 dBA (Health Canada, 2023).

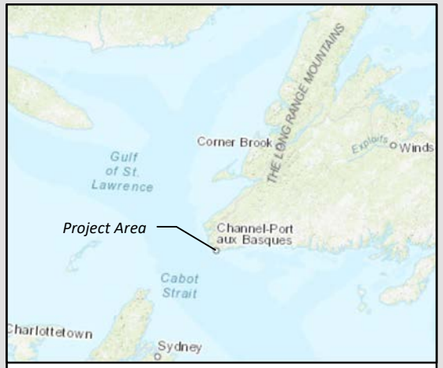
6.2 Marine Environment

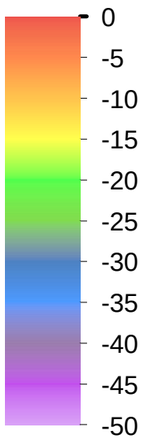
6.2.1 Bathymetry and Currents

Baseline data collection for this Project included a bathymetric survey program completed to Canadian Hydrographic Service standards within the inner harbour and approach channel in January 2020 (Figure 6.1, Appendix C). Additional bathymetry surveys is underway in summer 2026 to inform design and future permitting. Port-aux Basques Harbour ranges from 0.5 m to 51 m in water depth. The inner harbour reaches a maximum depth of approximately 18 m north of Vardy's Rock. The maximum depth within narrowest sections of the navigation channel reaches approximately 25 m west of Middle Baldwin Rock and 27 m west of Vardy's Rock. The maximum depth increases to approximately 29 m where the navigation channel widens between Sheaves Cove and the Pikes Island breakwater. The bathymetric survey program also included a sub-bottom profile survey which further defined bottom conditions and detected evidence of previous dredge and rock dumping activity within the harbour. Further information on the bathymetry and sub-bottom profile survey of Port aux Basque Harbour of Port aux Basques Harbour is provided in Appendix C.

Currents below the top 1 m of the water surface in Port-aux Basques Harbour have been characterized based on data collected by CBCL between December 9, 2019, and January 23, 2020 (Appendix B). Current speeds were relatively low, peaking during a wave event on December 17, 2019. Several events where surficial currents reached at least 0.6 metres per second (m/s) were recorded. The currents within the lower part of the water column are largely dominated by tidal forcing. Near-surface currents exhibit stronger variability due to influence from winds and waves. Low-frequency harbour oscillations (i.e., seiche) are triggered within Port-aux Basques Harbour during storm events. The seiche manifests itself as a long-period wave (0.2 to 0.4 m high) within a typical 20-minute period. The seiche affects the inner area of the harbour behind the Pikes Island Breakwater, causing peak current speeds in excess of 0.2 m/s. Such speeds are still relatively low, albeit much higher than the tidal component of the current, which is negligible inside the harbour.







Shaded Relief Multibeam Bathymetry (m)

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Figure 6.1: Port aux Basques Harbour Bathymetry

Drawn by: MD/ AO	**Date: 2020-10-28**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:7,000

Notes:

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter

0 100 200 300 400 m

W:\PROJECTS\202479.05 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.1 - Port aux Basques Harbour Bathymetry.mxd

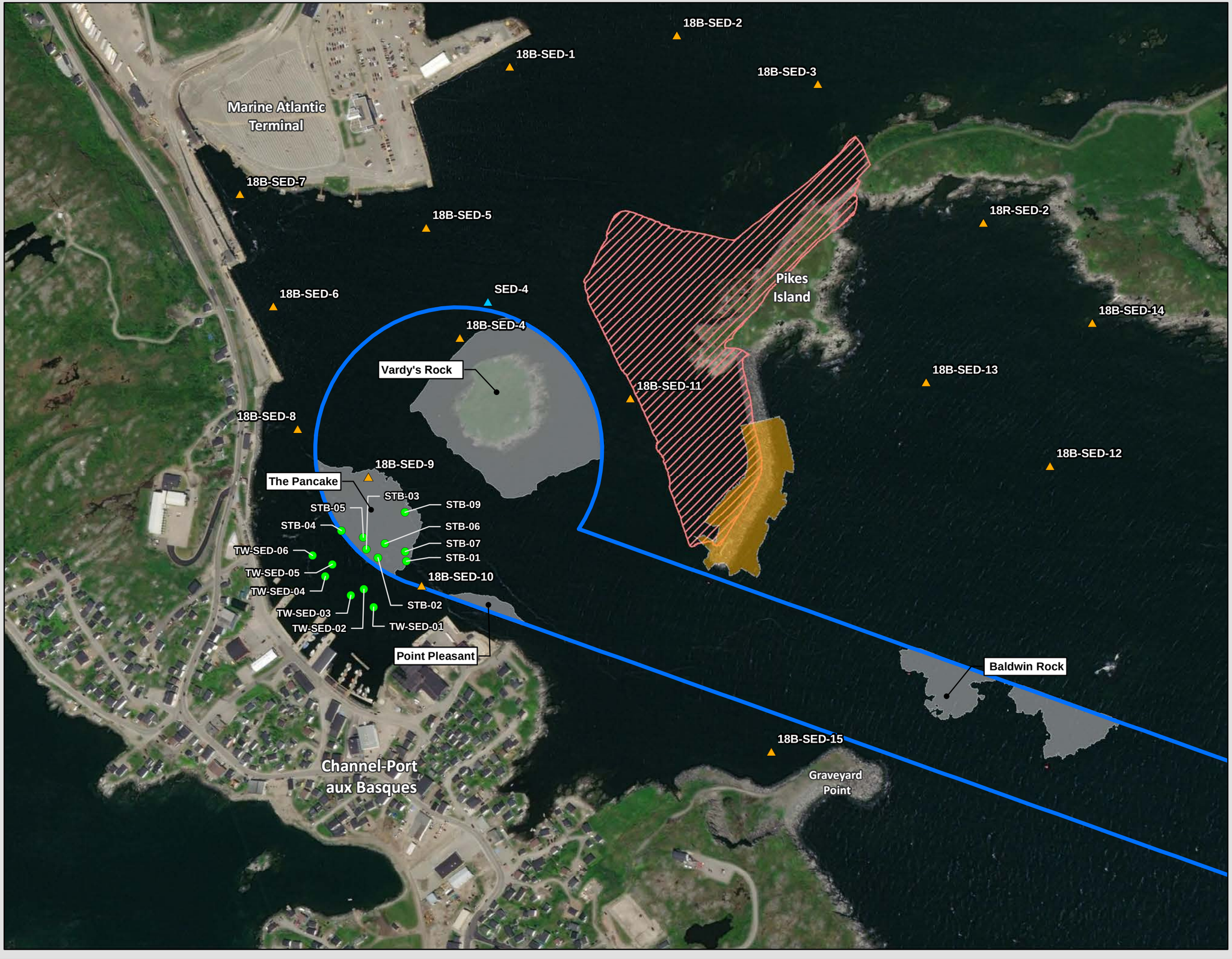
6.2.2 Marine Sediment

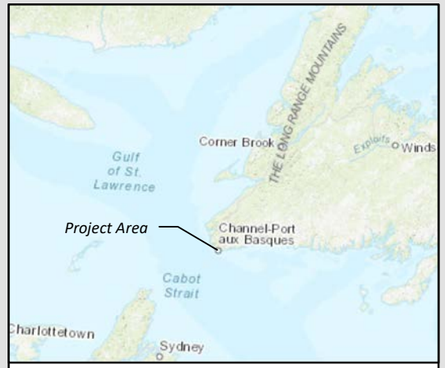
The distribution of marine sediment was assessed as part of the sub-bottom profile data collection discussed in Section 6.2.4. Marine sediment distributions were also assessed in the Project Area in the winter and summer of 2020 as part of the underwater benthic habitat survey (UBHS) program (Appendix E). Surveys were completed in Port aux Basques Harbour using multiple in situ methods including diver and drop-camera surveys, and visual assessment of substrates in shallow water from shore or a boat. The surveys were conducted in water depths ranging from intertidal to 40 metres.

Surficial substrate in the harbour is predominantly rocky and consists of varying compositions of bedrock, boulder, cobble, and gravel. Fine sediment was also observed in the harbour, primarily outside the dredge and infill locations in deeper water in the navigation channel and the more sheltered inner harbour around Money Island (Appendix E). Intertidal bedrock habitats extend outward from the intertidal shoreline into subtidal habitats of exposed bedrock, boulder, cobble, gravel, and fines. Subtidal rocky habitat is present throughout the harbour. The outer harbour, southeast of the Pikes Island Breakwater, is exposed to weather and storms, and consequently the shallow depths were primarily exposed bedrock with little to no fines. Accumulated fines in the outer harbour were observed only on the harbour bottom in deeper waters that are not subject to wind and wave action. Fines were more prevalent in the inner harbour, particularly on the bottom of the navigation channel in the deeper waters. Most of the assessed intertidal shoreline was bedrock or infrastructure constructed along the shoreline at the MAI ferry terminal and public wharves.

In the dredge locations, the substrate is predominantly bedrock, with rock and boulder, and either a thin veneer or isolated patches of fine sediment. The fine sediment is predominantly sand (80 to 100% with small amount of silt (0 to 20%) and the thickness of the fine sediment layer, where it occurs, is generally less than 0.2 m. In the Vardy's Rock dredge location, the substrate is predominantly bedrock with either isolated small patches of sediment or a thin sediment veneer. The South Turning Basin dredge location contains a mix of bedrock and rocky substrates overlain with a thin layer of sediment. The Baldwin Rock dredge location is entirely subtidal bedrock, with small patches of sediment. The fine sediment veneer in the South Turning Basin and on the north and east sides of Vardy's Rock has a greater proportion of silt (up to 80%) than the main dredge locations. The Pikes Island Infill and the Breakwater locations are a mix of bedrock, boulder, and sand. The substrate between Vardy's Rock and Pikes Island is a mix of rock and sand.

Previous sediment sampling programs carried out in the harbour—in 1996, 1998, 2004, 2008, 2009, and 2018 (Figure 6.2; GHD, 2019)—indicated the presence of hydrocarbon, polychlorinated biphenyl (PCB), and heavy metal concentrations in the harbour sediments (GHD, 2019). Marine sediment sampling was conducted by CBCL in July 2020 in the Port aux Basques Harbour to characterize the sediment in the Project Area (Appendix D). Sediment samples were collected in the Pancake area, both inside and outside the dredging location (Figure 6.2); these locations were selected based on sediment characteristics (i.e., a veneer of fine sediment with 30 to 60% silt) observed during the UBHS and the proximity to outfalls from the Town (GHD, 2019).





- Sediment Sample Locations (CBCL July, 2020)
- Historic Sediment Sample Locations (Dessau, 2009)
- Historic Sediment Sample Locations (GHD, 2019)
- Navigation Channel

Project Improvement Components

- Pikes Island Breakwater Repairs
- Pikes Island Infill Area
- Dredge Areas

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Figure 6.2: Sediment Sampling within the Project Area (1996 – 2020)

Drawn by: AO	**Date: 2020-11-02**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:5,000

Notes:

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter
0 70 140 210 280 m

\\HFXDATA4\Data\3\202479.45 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.2 - Sediment Sampling within the Project Area (1996 - 2020).mxd

The reported Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG) for marine sediments were exceeded for PAH parameters. CCME ISQG are considered fairly conservative and apply best to pristine environments that have not been historically subject to anthropogenic influence. CCME probable effects limits for marine organisms are less conservative and applicable to marine sediment in locations affected by human activities. None of the sediment collected in the harbour as part of the 2020 program had concentrations that exceeded the CCME PELs for marine sediments.

6.2.3 Marine Water Quality

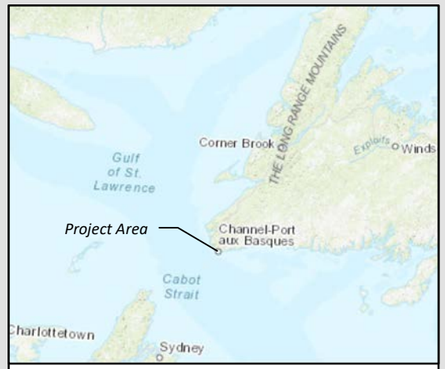
Marine water quality in the outer harbour (i.e., seaward of the Pikes Island Breakwater) of Port aux Basque Harbour is expected to be generally good as it opens directly to the Cabot Strait. The inner harbour is more enclosed than the outer harbour and water quality in the inner harbour is more susceptible to influence from land-based and marine transportation activities. GHD (2019) reported the presence of seven outfalls into Port aux Basques Harbour; these outfalls are located along the shoreline in the inner harbour west of the Project Area in the vicinity of the Town docks. Although not specifically identified by GHD, two sanitary wastewater outfalls discharge directly into the Port aux Basques Harbour (NL ECCC, 2023). Sanitary waste in Channel-Port aux Basques is collected into a communal septic tank for primary treatment and discharged through outfalls into the marine environment (NL ECCC, 2023).

Two water quality sampling events were conducted in Port aux Basques Harbour: the first in 2018 by GHD at six locations in the inner harbour and three reference locations in the outer harbour and Cabot Strait; and a second in 2019 by CBCL at five locations. GHD (2019) found that the water quality of samples from the inner harbour were generally within the range of the reference samples (GHD, 2019). The results from the 2019 water quality sampling also show similar conditions in the inner and outer harbour (Table 6.5) and are within the CCME guidelines for the Protection of Marine Aquatic Life (pH and DO) (CCME, 2026). The sample locations are depicted on Table 6.5.

Table 6.5 Summary of Surface Water Quality Parameters Measured in the Port aux Basques Harbour in December 2019

Sample ID	Latitude	Longitude	Temperature (°C)	Dissolved Oxygen (mg/L)*	pH**	Salinity (ppt)	Conductivity (µs/cm)	ORP (mV)	Depth (m)
PAB-SW-01	47°34.634’	59°07.998’	3.2	11.28	7.27	31.84	29212	790.6	11.2
PAB-SW-02	47°35.752’	59°08.027’	3.2	10.97	7.44	31.85	29232	147.1	7.3
PAB-SW-03	47°34.709’	59°08.275’	3.2	11.09	7.54	31.87	29252	-79.6	20.1
PAB-SW-04	47°34.588’	59°08.225’	3.2	10.92	7.61	31.88	29255	-156.0	27.6
PAB-SW-05	47°34.584’	59°07.706’	3.1	10.93	7.68	31.78	29112	-259.2	19.9

**CCME Marine Aquatic Life Guideline for dissolved oxygen is a minimum of 8.0 mg/L in marine and estuarine environments.*
*** CCME Marine Aquatic Life Guidelines for pH is 7.0 to 8.7*



- Historical Water Sampling Locations (GHD 2019)
- Water Quality Sample Locations (CBCL)
- Navigation Channel

Project Improvement Components

- Pikes Island Breakwater Repairs
- Pikes Island Infill Area
- Dredge Areas

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Port aux Basques, Newfoundland and Labrador

Figure 6.3: Water Quality Sampling Locations in Port aux Basques Harbour

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Approved: LH	**Scale @ 11" x 17" :** 1:16,000

Notes:

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter
0 230 460 690 920 m

W:\FXDATA\Data3\L\202479.05 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.3 - Historical Water Quality Sampling Locations in Port aux Basques Harbour.mxd

6.2.4 Fish and Fish Habitat

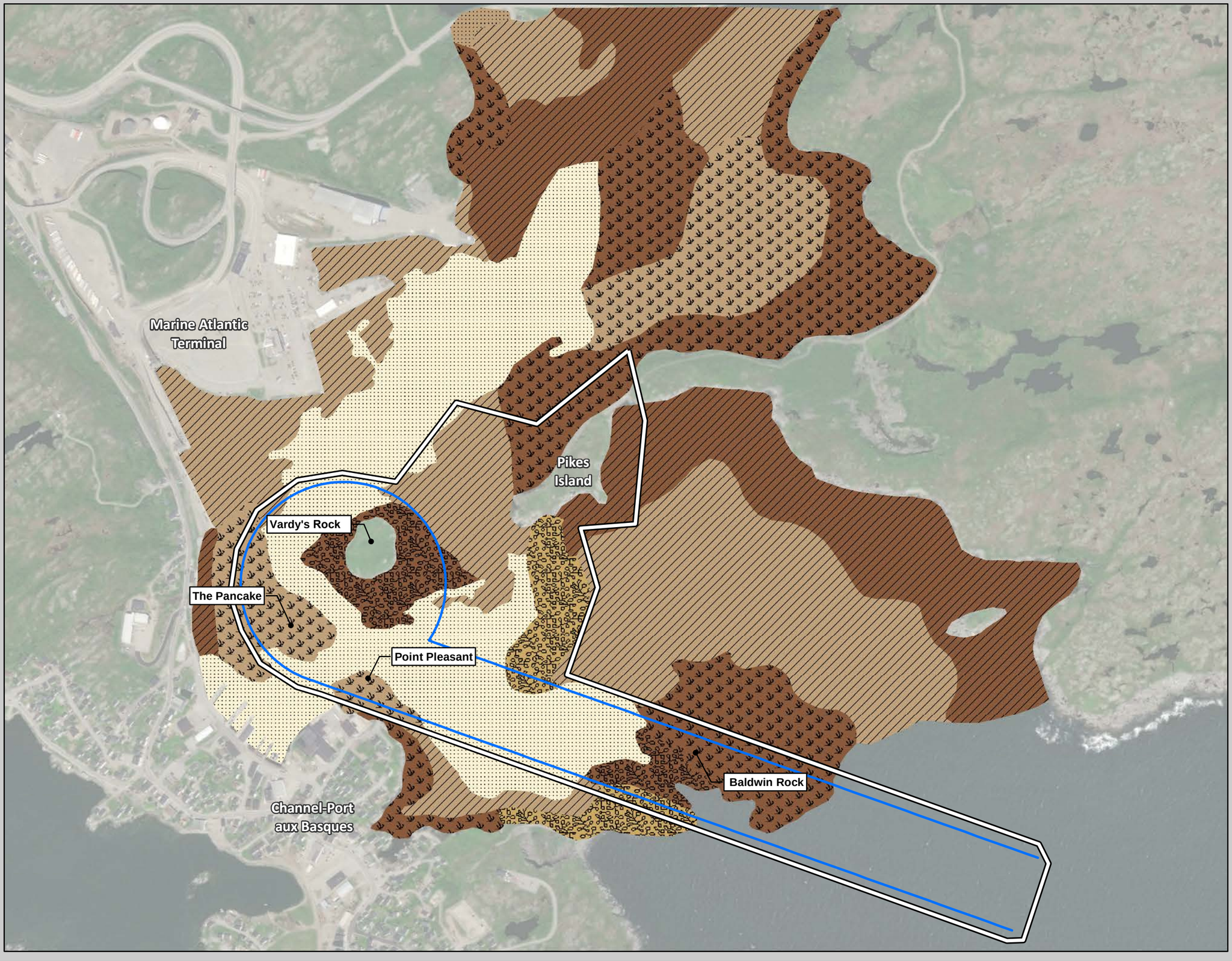
Port aux Basques Harbour is in a granite embayment within the Laurentian Channel / Newfoundland South Coast eco-unit which extends from the coastline to the deep waters of the Laurentian Channel (Park and Mercier, 2014). The coastal environment is strongly influenced by the cold, nutrient rich Arctic waters of the Labrador Current, the warm waters of the Gulf Stream, and the substantial freshwater inputs from the Gulf of St. Lawrence. The mixing of these waters creates highly productive areas on the south coast Newfoundland (Bernier et al., 2018).

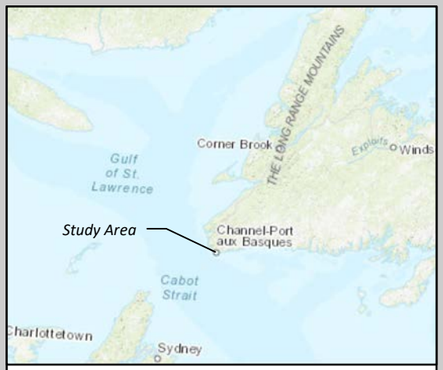
Field investigations were completed in the winter and summer of 2020 to characterize the benthic environment, specifically, the flora, fauna, sediment, and substrate located within the Project Area and Port aux Basques Harbour overall. Substrate in the harbour is described in Section 6.2.2.

Rocky shorelines and rocky habitats are the predominant habitat type in Port aux Basques Harbour. Figure 6.4 shows an overview of the mix of substrates and algal cover in the harbour.

Rocky habitats provide dens and burrows for benthic and demersal species, and offer attachment points for sessile organisms, such as biogenic habitat forming invertebrates and algal species, including kelps. Kelp beds observed in the harbour offer protection and forage and serve as important nursery grounds for juveniles of a variety of marine species, including commercially important and ecologically sensitive fish species (Bernier et al., 2018; Seitz et al., 2013). Extensive beds of brown algae (*Alaria esculenta*, *Agarum clathratum*, *Laminaria digitata*, *Saccharina latissimi*, and *Saccharina longicruris*) and other algal species were observed in the Project Area. Other algae including *Desmarestia* sp., *Chondrus crispus* (Irish moss), *Chordaria flagelliformis*, *Palmaria palmata*, *Polysiphonia* sp., *Phyllophora* sp., and *Ulva lactuca* were observed on rocky substrate in the Project Area, including intertidal and submerged bedrock habitats and submerged rocky habitats beyond the extent of the bedrock habitat. Coralline red algae, which grows as plaques on coarse substrates, was also observed on most rocky substrate in the Project Area. These habitats provided cover and forage for fauna in the harbour, including invertebrates (encrusting and motile) and fish.

The Project Area is habitat that is used by a variety of marine fish and invertebrates based on the species observed during habitat surveys, including commercial and recreational fisheries species (e.g., lobster, Atlantic cod and pollock). Lobsters were observed in the harbour in rocky and mixed rock and fines habitats. Lobsters seek shelter and refuge in crevasses, burrows, and dense algal cover and forage in a variety of habitats, including those observed in the harbour. The abundance and variety of shelters and refuges in the Project Area provides suitable habitat for lobster from post-settlement through to adult lobster. Green sea urchin was observed in rocky habitats in the Project Area, particularly on bedrock substrate with abundant brown algal cover. Green sea urchin forage on brown algae and can completely remove algal cover in areas known as urchin barrens.





Project Area

Navigation Channel

Algal Coverage

- Rare Algal Cover (0-25%)
- Occasional Algal Cover (25-50%)
- Common Algal Cover (50-75%)
- Abundant Algal Cover (75-100%)

Substrate Classification

- Bedrock
- Boulder
- Mixed Rock and Fines
- Fines

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Figure 6.4: Benthic Habitat in the Project Area

Drawn by: MD/ AO	**Date: 2020-11-02**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:7,000

Notes:

Coordinate System: NAD 1983 UTM Zone 21N

Units: Meter

0 0.1 0.2 0.3 0.4 km

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\\HFXDATA\Data3\L\202479.05 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.4 - Summary of Aquatic Habitat Classification.mxd

Pelagic finfish commonly inhabiting shallow coastal waters in Newfoundland, such as Atlantic cod, herring, mackerel, capelin, and smelt, could inhabit the Project Area as juveniles or adults. Cod, mackerel, and pollock were observed in the harbour during the summer habitat survey. The observed habitats provide abundant cover and forage for juveniles, whereas adults may temporarily inhabit the area during foraging and spawning migrations in shallow coastal waters. Other species also find suitable habitat in the Project Area, although their presence is likely temporary. Winter flounders, for example, were observed in the harbour during the summer survey. Flounder temporarily occupy shallower inshore areas during foraging migrations. Encrusting and sessile marine invertebrates were also common on rocky habitats in the harbour.

Marine fish and invertebrates observed in Port aux Basques Harbour during the 2020 habitat surveys are listed in Table 6.6.

Table 6.6 Marine fish and invertebrates observed in Port aux Basques Harbour, 2020

Common Name	Species Name
Fish	
Atlantic cod	*Gadus morhua*
Pollock	*Pollachius virens*
Mackerel	*Scomber scombrus*
Atlantic bluefin tuna	*Thunnus thynnus*
Atlantic wolffish	*Anarhichas lupus*
Ocean pout	*Zoarces americanus*
Winter flounder	*Pseudopleuronectes americanus*
Sculpin	*Myoxocephalus octodecemspinosus; Myoxocephalus scorpius*
Cunner	*Tautogolabrus adspersus*
Rock gunnel	*Pholis gunnellus*
Arctic shanny	*Stichaeus punctatus*
Goosefish	*Lophius americanus*
Skate	Unidentified species
Invertebrates	
American lobster	*Homarus americanus*
Rock crab	*Cancer irroratus*
Toad crab	*Hyas araneus*
Hermit crab	*Pagarus* sp.
Mysid shrimp	*Mysis* sp.
Sand shrimp	*Crangon septemspinosa*
Barnacle	*Balanus* sp.; *Semibalanus* sp.
Green sea urchin	*Strongylocentrotus droebachiensis*
Seastar	*Asterias rubens*
Brittlestar	*Ophiopholis aculeata*
Bloodstar	*Henricia sanguinolenta*

Common Name	Species Name
Sand dollar	*Echinarachnius parma*
Blue mussel	*Mytilus* spp.
Northern horse mussel	*Modiolus*
Sea scallop	*Placopecten magellanicus*
Icelandic scallop	*Chlamys islandica*
Littorines	*Littorina* spp.*; Nucella lapilus*
Northern lacuna	*Lacuna vincta*
Waved whelk	*Buccinum undatum*
Limpets	*Testudinalia testudinalis*
Chitons	*Tonicella marmorea*
Slipper snail	*Crepidula fornicata*
Frilled sea anemone	*Metridium senile*
Northern red anemone	*Urticina felina*
Stalked jellyfish	*Lucernaria quadricornis*
Fan worms	*Myxicola infundibulum*
Breadcrumb sponge	*Halichondria* sp.
Sea peach tunicate	*Halocynthia pyriformis*
Lion's mane jellyfish	*Cyanea capillata*
Moon jellyfish	*Aurelia aurita*
Ctenophores	*Pleurobrachia pileus*

sp.: single species
spp.: multiple species

6.2.5 Marine Mammals and Sea Turtles

Marine mammals occupy the coastal waters of southern Newfoundland, some of them year-round in part due to the largely ice-free waters in the winter. Eleven marine mammal species were reported in the assessment area as part of the desktop review (Appendix F). Marine reptiles also occupy the coastal waters of southern Newfoundland. The approximate occupancy periods for marine mammals and reptiles known to occur in the assessment area are provided in Table 6.7. These are general timeframes and do not indicate fixed periods of occupancy.

Table 6.7 Select marine mammals and reptiles known to occupy the Assessment Area with approximate occupancy windows

Common Name	Species Name	Activity	Timing of Occupancy in NAFO 3Pn
Marine Mammals			
Blue whale	*Balaenoptera musculus*	Migration, Feeding, Rearing, Potential Breeding	Year-round
Fin whale	*Balaenoptera physalus*	Migration and Feeding	May 15 – Dec 15

Common Name	Species Name	Activity	Timing of Occupancy in NAFO 3Pn
Grey seal	*Halichoerus grypus*	Whelping, Feeding and Migration	Year-round
Harp seal	*Phoca groenlandica*	Whelping, Feeding and Migration	Sep 1 – Apr 15
Hooded seal	*Cystophora cristata*	Whelping, Feeding and Migration	Feb 15 – Jun 30
Harbour porpoise	*Phocoena phocoena*	Feeding and Migration	May 15 – Dec 15*
Humpback whale	*Megaptera novaeangliae*	Migration and Feeding	May 15 – Dec 15
Killer whale	*Orcinus orca*	Feeding and Migration especially off the coast of Cape Ray	Apr 1 – Dec 15*
North Atlantic right whale	*Eubalaena glacialis*	Migration and Feeding	May 15 – Dec 15
Sei whale	*Balaenoptera borealis*	Possible migration and feeding	Year-round
Sowerby's beaked whale	*Mesoplodon bidens*	Possible migration and feeding in Laurentian Channel	Unknown
Marine Reptiles (Turtles)			
Leatherback sea turtle	*Dermochelys coriacea*	Migration and feeding	Jun 1 – Oct 15
Loggerhead sea turtle	*Caretta caretta*	Migration and feeding	Jun 1 – Oct 15

*Wintering habitats for this species are currently unknown and may occur in the assessment area.

6.2.6 Marine Species at Risk

Species at risk (SAR) include those species that are designated as endangered threatened or special concern and listed in Schedule 1 of the federal *Species at Risk Act* (SARA) or the NL *Endangered Species Act* (ESA). One SAR was observed in the Project Area; Atlantic wolffish was observed during the benthic habitat surveys, in deep water near the base of Vardy's Rock. The Project Area provides habitat that could be used by Atlantic wolffish for spawning and larval rearing. The observed habitats, particularly around Vardy's Rock, provide suitable shelter and habitat such as boulders and cobbles.

One aquatic SAR, banded killifish (*Fundulus diaphanous*), was reported within 5 km of the Project Area by Atlantic Canada Conservation Data Centre (AC CDC) (Appendix G). An additional 10 aquatic SAR that could potentially occur within Port aux Basques Harbour or the Cabot Strait were identified through desktop review (Appendix G and Table 6.8). DFO (2026) aquatic SAR mapping and species at

risk reports consulted indicated that although no critical habitat for aquatic SAR is present in the Port aux Basques Harbour, there are two areas of critical habitat for the Northern wolffish (*Anarhichas denticulatus*) and Spotted wolffish (*Anarhichas minor*) within the larger NAFO 3Pn study area (Appendix F).

Table 6.8 SARA and NL ESA listed SAR identified within the Assessment Area

Common Name	Scientific Name	COSEWIC Population	SARA Status*	NL ESA Status	COSEWIC Status	AC CDC S-rank
Marine, Anadromous, and Coastal Fish						
American eel	*Anguilla rostrata*		No Status	Vulnerable	Threatened	S3N
Atlantic wolffish	*Anarhichas lupus*	Atlantic	Special Concern	-	Special Concern	(not ranked)
Banded killifish	*Fundulus diaphanous*	Newfoundland	Special Concern	Vulnerable	Special Concern	S3
Northern wolffish	*Anarhichas denticulatus*	Atlantic	Threatened	-	Threatened	(not ranked)
Spotted wolffish	*Anarhichas minor*	Atlantic	Threatened	-	Threatened	(not ranked)
White shark	*Carcharodon carcharias*	Atlantic	Endangered	-	Endangered	(not ranked)
Marine Mammals						
Blue whale	*Balaenoptera musculus*	Atlantic	Endangered	-	Endangered	(not ranked)
Fin whale	*Balaenoptera physalus*	Atlantic	Special Concern	-	Special Concern	(not ranked)
North Atlantic right whale	*Eubalaena glacialis*	North Atlantic	Endangered	-	Endangered	(not ranked)
Sowerby's beaked whale	*Mesoplodon bidens*	Atlantic	Special Concern	-	Special Concern	(not ranked)
Marine Reptiles						
Leatherback sea turtle	*Dermochelys coriacea*	Atlantic	Endangered	-	Endangered	(not ranked)
Loggerhead sea turtle	*Caretta caretta*	Atlantic	Endangered	-	Endangered	(not ranked)

*SARA-listed species are designated under Schedule 1 of the Act

6.2.7 Fish Species of Conservation Concern

A total of 15 species of conservation concern (SoCC)—i.e., those that are assessed as endangered, threatened, or special concern by the Committee on the Status of Endangered wildlife in Canada (COSEWIC) but not listed on Schedule 1 of SARA or the NL ESA—were identified as potentially occupying the coastal waters of southwestern Newfoundland (Appendix G) (Table 6.9).

Table 6.9 Aquatic SoCC identified within the Assessment Area

Common Name	Scientific Name	COSEWIC Population	COSEWIC Status
Marine, Anadromous, and Coastal Fish			
Acadian redfish	*Sebastes fasciatus*	Atlantic	Threatened
American plaice	*Hippoglossoides platessoides*	NL	Threatened
Atlantic bluefin tuna	*Thunnus thynnus*	Atlantic	Endangered
Atlantic cod	*Gadus morhua*	Laurentian North Laurentian South	Endangered
Atlantic salmon	*Salmo salar*	South Newfoundland West	Endangered
Basking shark	*Cetorhinus maximus*	Atlantic	Special Concern
Lumpfish	*Cyclopterus lumpus*	Atlantic	Threatened
Porbeagle	*Lamna nasus*	Atlantic	Endangered
Shortfin mako	*Isurus oxyrinchus*	Atlantic	Endangered
Smooth skate	*Malacoraja senta*	Laurentian-Scotian	Special Concern
Spiny dogfish	*Squalus acanthias*	Atlantic	Special Concern
Thorny skate	*Amblyraja radiata*	Atlantic	Special Concern
White hake	*Urophycis tenuis*	Atlantic and Northern Gulf of St. Lawrence	Threatened
		Southern Gulf of St. Lawrence	Endangered
Winter skate	*Leucoraja ocellata*	Eastern Scotian Shelf – Newfoundland; Gulf of St. Lawrence	Endangered
Atlantic sturgeon	*Acipenser oxyrinchus*	Maritimes	Threatened
		St. Lawrence	Threatened

6.2.8 Sensitive Marine Habitat

Sensitive marine habitats were not identified in the Project Area during the habitat surveys completed in 2020 or the desktop literature review completed in 2020 and again in 2026. Two areas of critical habitat identified by DFO are within the NAFO 3Pn area. These include critical habitat for Northern wolfish, approximately 58 km northeast of the Project Area, and Spotted wolffish, approximately 38 km northwest as detailed in Appendix F. Additionally, two sensitive marine habitats were identified in the region: the South Coast Ecologically and Biologically Significant Area (EBSA) and the Laurentian Channel Marine Protected Area (MPA), discussed below.

6.2.8.1.1 Laurentian Channel Marine Protected Area

Prior to its designation as an MPA in 2019, the Laurentian Channel MPA was initially identified as an EBSA (Wells et al., 2019). The Laurentian Channel ESBA is located off the south coast of Newfoundland. The 19,544.53 km^2 ESBA encompasses the Laurentian Channel and recently designated Laurentian Channel MPA, as well as a portion of St. Pierre Bank and Hermitage Channel.

DFO identified this area as an ESBA as it supports Greenland halibut (*Reinhardtius hippoglossoides*) and winter skate (*Leucoraja ocellata*) populations, and a variety of species congregate within the area, including black dogfish (*Centroscyllium fabricii*), spiny dogfish (*Squalus acanthias*), white hake, winter skate (*Leucoraja ocellata*), thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), and sea pens (Wells et al., 2019). SAR that use the ESBA include spotted wolffish (*Anarhichas minor)*, blue whale (*Balaenoptera musculus*), white hake, smooth skate, thorny skate, and winter skate (Wells et al., 2019).

6.2.8.1.2 South Coast ESBA

The Project Area is located within the South Coast EBSA, which spans the southern coast of Newfoundland from Cape Ray (west of Port aux Basques) to just east of the Ramea Islands (Wells et al., 2019). This South Coast EBSA is approximately 6,913 km^2 in size and extends from coastal waters to approximately 35 to 50 km offshore (Wells et al., 2019), encompassing the Rose Blanche Bank and the Northern portion of the Laurentian Channel. Various species occupy the South Coast EBSA, including, but not limited to eelgrass (*Zostera marina*), Atlantic cod, black dogfish, smooth skate, sea pens, Acadian redfish (*Sebastes fasciatus),* deepwater redfish (*Sebastes mentella*)*,* and blue whale (Wells et al., 2019).

6.2.8.1.3 Regulated Salmon Rivers

Three salmon rivers listed under Schedule I of the *Newfoundland and Labrador Fishery Regulations* are in the vicinity of Channel-Port aux Basques. These include the Isle aux Morts River, Grand Bay River, and North West Brook, Grand Bay. There are no direct connections or flow from these rivers into Port aux Basques Harbour; however, salmon and trout may forage in the harbour during summer and fall seasonal foraging migrations in marine waters.

6.3 Terrestrial Environment

6.3.1 Geology

The Geological Map of Newfoundland shows that Channel-Port aux Basques lies within the Gander Zone and is classified as stratified rock from the Cambrian and Ordovician periods (Coldman-Sadd et al., 2000). Additional detail on the geologic setting is provided in Appendix C.

A geotechnical investigation of Vardy's Rock was conducted in July 2020 (Appendix H). Bedrock is exposed at the surface in several areas on Vardy's Rock, though most exposure occurs along the shoreline. The unexposed areas consist of bedrock overlain by a thin layer of vegetation or soil such as till and other sediment. Subsurface materials are composed of peat, cobble/boulder deposits, residual soil, and bedrock.

Laboratory testing was conducted on core samples extracted from Vardy's Rock to confirm compressive strength, bulk specific gravity, splitting tensile, and acid producing potential. Geochemical testing identified one sulphide-bearing sample from borehole BH-3, while the remaining analyzed samples were not classified as sulphide-bearing. These results suggest that

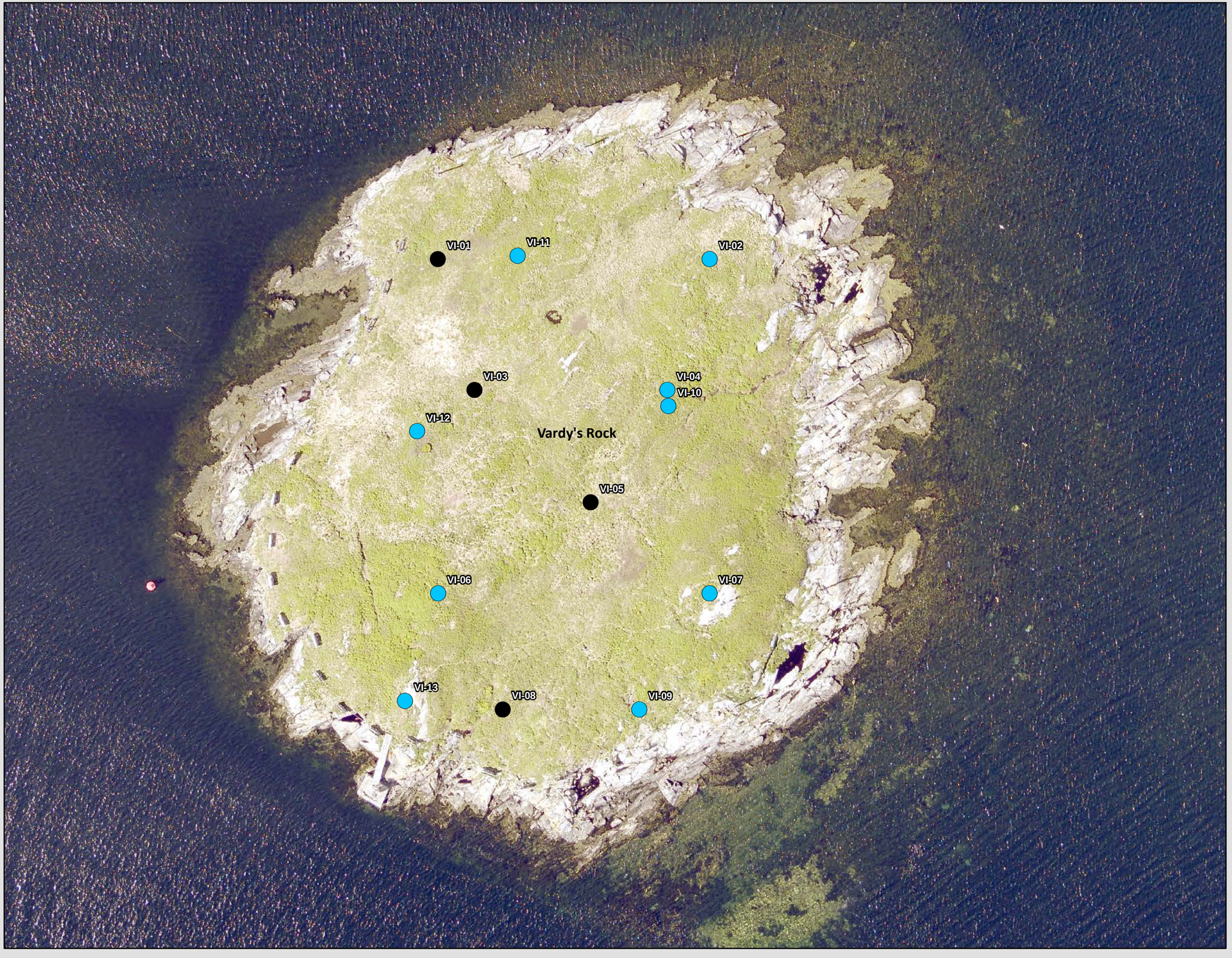
sulphide-bearing bedrock may occur locally within the Project Area; however, the available data indicate a low overall potential for encountering significant volumes of potentially acid-generating material. The criteria used to determine whether bedrock is sulfide bearing, and further information on the analytical results of the bedrock analysis, are provided in Appendix I.

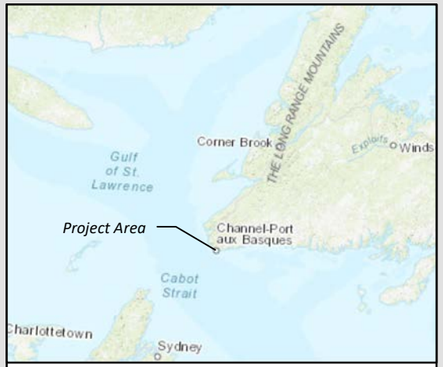
Additional boreholes investigations are currently underway in the area around Vardy's Rock and in the other three potential dredge areas, and samples will be tested for acid producing potential. The analytical results will be used to support design and future permitting.

6.3.2 Surficial Soils

Soils on Vardy's Rock generally consist of dark brown peat and silty sand with organics and roots. The overburden is shallow, extending to a maximum range of approximately 0.76 to 1.00 metres below ground surface (mbgs) (Appendices H and I). No free product and no visual or olfactory evidence of petroleum hydrocarbon (PHC) impacts were observed at any of the locations sampled by CBCL during the soil sampling programs completed in October 2019 and July 2020 (Appendix I). Soil samples were collected at the locations shown on Figure 6.5.

A total of six soil samples were submitted for laboratory analysis of PHCs, metals, polycyclic aromatic hydrocarbons (PAHs), sodium adsorption ratio, electrical conductivity, and total organic carbon during the October 2019 field program. The soils exceeded the CCME Soil Quality Guidelines (SQG) for Agricultural and Residential/Parkland land uses included PHCs (F3 fraction), metals (lead and selenium), and/or PAH parameters at all sample locations with the exception of VI-10 and VI-12. Exceedances of the CCME SQGs for Commercial land use included metals (lead) at one sample location (VI-04) and PAHs at two sample locations (VI-04 and VI-09). Concentrations of polychlorinated biphenyls (PCBs) were non-detect and below applicable guidelines in the four soil samples analysed for this parameter. Further information on the soil sampling program, including sampling locations, analytical results, and the locations of exceedances, is provided in Appendix I.





Soil Sample Locations

- Soil Sample Not Submitted for Analysis
- Soil Sample Submitted for Analysis

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Figure 6.5: Soil Sample Locations within the Project Area

Drawn by: RM/ AO	**Date: 2020-11-02**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:650

Notes:

F3 = >C16-C34 HYDRPCARBONS
Pb = LEAD
Se = SELENIUM
PAHs = POLYCYCLIC AROMATIC HYDROCARBONS

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter

0 9 18 27 36 m

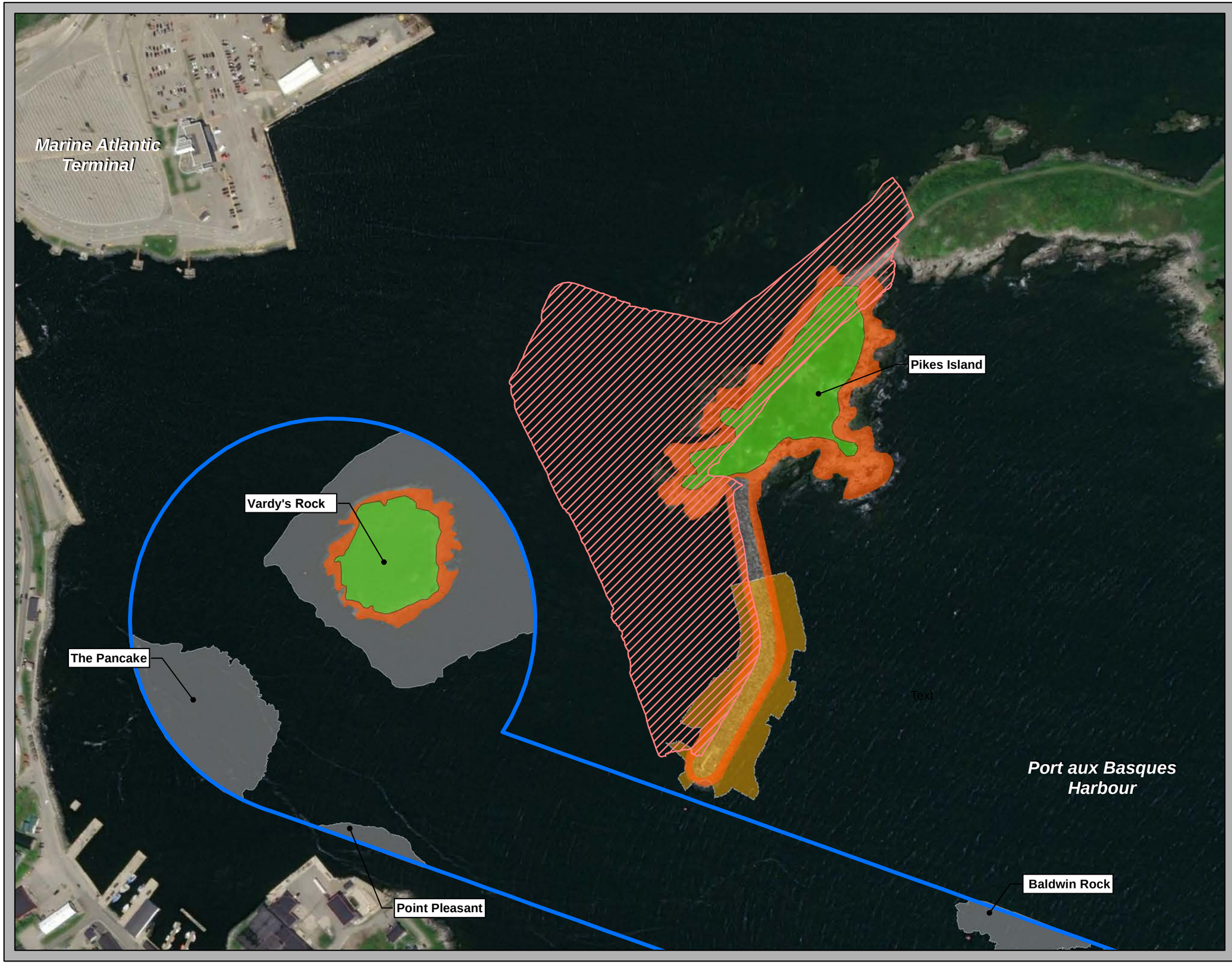
\\HFXDATA4\Data\3\202479.45 VARDY'S ISLAND ENVIRONMENTAL\MAE and TC-Joint EA Document - Maps\202479.05 Figure 6.5 - Soil Sample Locations within the Project Area.mxd

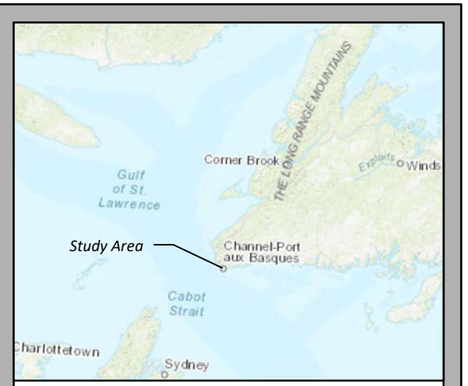
6.3.3 Vegetation

Port aux Basques is located within the South Coast Barrens subregion of the Maritime Barrens Ecoregion. This subregion is characterized by higher elevations (up to 300 m) and shallow snow cover. Forest stands are scarce within this subregion and where they occur consist mainly of balsam fir (*Abies balsamea*) with scattered yellow birch (*Betula alleghaniensis*) (Protected Areas Association of NL, 2008). Ground vegetation in this subregion is characterized by arctic-alpine plants (Government of NL, 2020). No forest stands are present on Vardy's Rock or Pikes Island, and the terrestrial habitat for both is characterized by three main habitat types: herbaceous, shrub, and rocky shore habitats. The full inventory of species detected by CBCL in 2019 and 2020 is provided in Appendix J.

Herbaceous habitat is the dominant vegetation community present on Vardy's Rock. This habitat type consists of herbaceous species of varying heights, ranging from less than 0.5 m to 1.5 m, and is largely dominated by fireweed (*Chamerion angustifolium*), rough goldenrod *(Solidago rugosa*), and grasses such as Canada bluegrass (*Poa compressa*). Smaller amounts of shrub habitat also occur on Vardy's Rock, consisting primarily of somewhat stunted red raspberry (*Rubus idaeus*) interspersed with patches of low-growing shrub species in rockier areas, especially around the shoreline. The rocky shoreline around the perimeter of Vardy's Rock consists mostly of bedrock with some boulders and loose rock extending to the intertidal zone. There is little terrestrial vegetation in this habitat, though lichens are common. Salt tolerant plants occur in areas with thin soil. A total of 68 species of vascular flora and five species of lichens were identified on Vardy's Rock.

The dominant habitat type on Pikes Island is shrub habitat, as a large portion of Pikes Island is covered in low shrub habitat. Shrubs tend to be much lower in height and more stunted than those on Vardy's Rock. Predominant species include ericaceous shrubs, such as late lowbush blueberry (*Vaccinium angustifolium)* and bog blueberry (*Vaccinium uliginosum*). Slightly taller shrub species, including low stunted specimens of speckled alder (*Alnus incana*) and white spruce (*Picea glauca*), are also present. Herbaceous habitat occurs in patches on Pikes Island. Vegetation communities within the rocky shore habitat along the perimeter of Pikes Island, particularly on the more sheltered western shore, are more developed than those on the rocky shore habitat of Vardy's Rock. In total, 84 species of vascular flora and 12 species of lichens were observed on Pikes Island.





- Navigation Channel
- Shrub/Herbaceous Habitat
- Rocky Shoreline Habitat

Project Improvement Components

- Pikes Island Breakwater Repairs
- Pikes Island Infill Area
- Dredge Areas

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Figure 6.6: Vegetation Communities in the Project Area

Drawn by: NH/ AO	**Date: 2020-11-02**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:3,500

Notes:

Different habitat types on Vardys and Pikes Island.

Coordinate System: NAD 1983 UTM Zone 21N
Units: Meter

0 0.05 0.1 0.15 0.2 km

\\HFXDATA\Data\31924795 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.6 - Summary of Terrestrial Habitat Types within Project Area.mxd

6.3.4 Wildlife

Wildlife observed within the Project Area during field surveys completed between fall 2019 and fall 2020, are discussed in the following subsections. Further information on survey methodology and results of these surveys is provided in Appendix K.

A total of 52 species of birds were detected within Port aux Basques Harbour over the fall, winter, spring, and summer surveys. Of the 52 species of birds detected, 33 of these species are considered land birds. The remaining 19 species are considered marine or coastal birds. Two species of coastal birds were confirmed breeding on Vardy's Rock during the survey: Great Black-backed Gull and Herring Gull. Two species of land birds were identified as probably breeding on Pikes Island: American Robin and Savanah Sparrow. A complete inventory of bird species detected during the 2019 and 2020 field surveys is provided in Appendix K.

One Important Bird Area (IBA), the Grand Bay West to Cheeseman Provincial Park IBA, is 40.33 km^2 in size and is located west of Port aux Basques (AC CDC, 2026; Appendix G). The IBA encompasses coastal and upland habitat, including sedge and grass meadows, tidal rivers and estuaries, mud or sand flats, and ocean. The eastern most boundary is approximately 2.5 km west of the Project Area at Grand Bay East and extends further west to Cape Ray. The Grand Bay West beaches, which do not bear protective status, are in the eastern and central portions of the IBA. The beaches from Grand Bay West to Cape Ray comprise an eight-kilometre-long beach system that provides nesting habitat for the federally and provincially endangered Piping Plover (*Charadrius melodus melodus*).

Other terrestrial wildlife observed in the Project Area are small mammals, including American mink (*Neovison vison*), Norway rat (*Rattus norvegicus*), and small rodents such as voles. There is no forest cover or habitat suitable for medium or large terrestrial mammals on Vardy's Rock. No reptile or amphibian species are likely to occur on Vardy's Rock due to its small size and lack of suitable freshwater wetlands or waterbodies for amphibian reproduction. Vardy's Rock has a local reputation as containing a rat population (MAI employee, *pers. comm*., 2019).

6.3.5 Species at Risk and Species of Conservation Concern

No federally or provincially protected SAR were detected on Vardy's Rock or Pikes Island during the 2019 and 2020 field programs completed by CBCL. Several flora and fauna SoCC were, however, detected.

Six flora SoCC were detected on Vardy's Rock during the 2019 and 2020 vegetation surveys conducted by CBCL, including four species of vascular plants and two species of lichens. Eight flora SoCC (four vascular plants and four lichens) were observed growing on Pikes Island. The full inventory of the vascular plant and lichen SoCC detected during the 2019 and 2020 vegetation surveys is provided in Appendix J.

A review of AC CDC (2026) rare species data indicated that no terrestrial mammals of conservation concern have been reported within 5 km of Port aux Basques Harbour. Two avian SAR, however,

have been reported to occur within 5 km of the Project Area (AC CDC, 2026; Appendix G). These species are Lesser Yellowlegs (*Tringa flavipes*) and Piping Plover. Lesser Yellowlegs is listed under the NL ESA as threatened and assessed by COSEWIC as threatened and under consideration for addition to Schedule 1 of SARA. Piping Plover is listed under the NL ESA and SARA as endangered.

ECCC-Canadian Wildlife Service (CWS) identified the Project Area as potential overwintering habitat for Purple Sandpiper (*Calidris maritima*), a SoCC listed as S3N in NL (ECCC-CWS, personal communication, 2020). Purple Sandpipers overwinter in rocky coastal habitat around the island of Newfoundland. Data provided by CWS show that 24 Purple Sandpipers were observed in the vicinity of Channel-Port aux Basques at Southwest Point, approximately 1 km from the Project Area. Purple Sandpipers were not observed in Port aux Basques Harbour during the bird surveys conducted by CBCL in 2019 and 2020.

ECCC-CWS advised that the following SAR/SoCC may also occur in the Project Area (ECCC-CWS, personal communication, 2026):

- Bank Swallow (*Riparia riparia*) – SARA and NL ESA – Threatened
- Barn Swallow (*Hirundo rustica*) – SARA- Threatened, NL ESA – Vulnerable
- Bobolink (*Dolichonyx oryzivorus*) – SARA – Threatened, NL ESA – Vulnerable
- Olive-sided Flycatcher (*Contopus cooperi*) – SARA – Endangered, NL ESA – Vulnerable
- Red Crossbill (*Loxia curvirostra*) – SARA and NL ESA – Threatened
- Rusty Blackbird (*Euphagus carolinus*) – SARA – Special Concern, NL ESA – Vulnerable
- Short-eared Owl (*Asio flammeus*) – SARA – Special Concern, NL ESA – Threatened
- Little Brown Myotis (*Myotis lucifugus*) – SARA and NL ESA – Endangered
- Northern Myotis (*Myotis septentrionalis*) – SARA and NL ESA – Endangered
- Hoary Bat (*Lasiurus cinereus*) – NL ESA – Endangered
- Eastern Red Bat (*Lasiurus borealis*) – NL ESA – Endangered
- Silver-haired Bat (*Lasionycteris noctivagans*) – NL ESA – Endangered
- Yellow-banded Bumblebee (*Bombus terricola*) – SARA – Special Concern, NL ESA – Vulnerable

Although there is no direct overlap, Piping Plover critical habitat is located near the Project Area (from Grand West Bay to Cape Bay). Suitable breeding and foraging habitat for Piping Plover is not present within the Project Area. Suitable breeding, nesting, and foraging habitat for most of the SAR listed above is limited or absent on Vardy's Rock and Pikes Island, with the exception of the Short-eared Owl. As shown on Figure 3.3 in Appendix K, the islands are characterized primarily by herbaceous and shrub habitat surrounded by rocky shoreline.

Lesser Yellowlegs use a variety of habitats during migration, including freshwater and brackish wetlands, mudflats, agricultural fields, as well as lake and pond edges. None of these habitats are present on Vardy's Rock or Pikes Island.

The likelihood that the Yellow-banded Bumblebee forages in the Project Area is considered low due to the limited number of nectar producing plants on Vardy's Rock and Pikes Island.

CBCL conducted wildlife and bird surveys on Vardy's Rock, Pikes Island, and within the surrounding area in 2019 and 2020. None of the SAR or SoCC identified by ECCC-CWS were observed during these surveys. A total of nine bird SoCC was identified during the surveys. A full inventory of SoCC detected in Port aux Basques Harbour is provided in Appendix K.

6.4 Socio-Economic Environment

6.4.1 Population

The Municipality of Channel-Port aux Basques is a community of approximately 3,547 individuals, as documented in the 2021 Census. Census results indicate that the population of Channel-Port aux Basques decreased by 12.8%, from 4,067 to 3,547 individuals (Statistics Canada, 2023).
The Municipality of Channel-Port aux Basques is in Statistics Canada's Census Division No. 3, which encompasses the southcentral and southwest portion of NL, extending from Chapel Island west to Cape Ray. This Census Division demonstrated a similar trend. The population declined by 10.5% between 2016 and 2021, from 15, 560 to 13, 920 individuals, respectively (Statistics Canada, 2023).

Population estimates for the Municipality Channel-Port aux Basques provide a projected estimate of population numbers today (approximately 3,300) and show a continuous downward trend in population numbers (World Population Review, 2026).

6.4.2 Economy, Employment, and Business

For 120 years, MAI has been a major economic driver for the community of Port aux Basques. Following the closure of the fish plant, MAI and its ferry services became the mainstay of the local economy (Town of Channel-Port aux Basques, 2009). The Town of Channel-Port aux Basques estimates that 90% of perishable goods reach Newfoundland through this port on an annual basis (Town of Channel-Port aux Basques, 2009). MAI provides twice daily, year-round services, transporting passengers and resources (e.g., perishable foods, medical supplies) to and from the island. MAI contributes to supporting local businesses by maintaining their supply chain and plays an important role in the tourism industry (MAI, 2025).

The Town established a Strategic Economic Development Plan (SEDP) with the goal of diversifying the work force and promoting future economic growth (Town of Channel Port aux Basques (TCPAB), 2009). The SEDP identified numerous initiatives for economic development, including those related to the following:

- Harbour development
- Marine development (e.g., marina)
- Fish plant revitalization
- Tourism
- Social services development

- Business development
- Oil and gas servicing
- Mineral exploration and development

Since development of the SDEP, the Town has diversified its economy by implementing several of these initiatives. In recent years, the Town has been focused on the rejuvenation of downtown Port aux Basques and has been implementing upgrades using a phased approach (CBCL, 2012). The Town has also followed through on their initiative to develop a marina to enhance local business opportunities and contribute to revitalizing the downtown, renovating the fish plant infrastructure for industrial use and business opportunities, implementing tourism initiatives by establishing the Grand Bay West Beach Trailway, and promoting social services through renovations to the sports centre (Government of NL Department of Innovation, Trade and Rural Development, 2010; TCII, 2017; TCPAB, 2020,b).

6.4.2.1 EMPLOYMENT

The most recent census data for Channel-Port aux Basques was published in the 2021 Census Profile (Statistics Canada, 2023). Statistics Canada reported that the 2021 employment rate in Channel-Port aux Basques was 40.1% across all age cohorts. The employment rate in Channel-Port aux Basques in 2021 was 17.1%.

Estimates of labour force characteristics for sub-provincial areas have been published by Statistics Canada up to December 2024 (Statistics Canada, 2025b). The average estimated employment rate for Channel-Port aux Basques in 2024 was 38.7%, and the average estimated unemployment rate in 2024 was 19.3% (Statistics Canada, 2025b).

The sales and trades industries employed the highest proportion of individuals as of the 2021 census; however, there has been an increase in health-related positions since previous censuses were completed in 2011 and 2016 (Statistics Canada, 2023). All labour force sectors except health, trades, transport, and equipment operators have shown decreases or remained unchanged (Table 6.10).

Table 6.10 Labour force in Channel-Port aux Basques by occupation

Statistics Canada Census Year	2011[2]	2016[3]	2021[3]
Legislative and senior management	80	110	0
Business, finance, & administration	20	145	145
Natural, applied sciences & related	50	90	45
Health	35	90	130
Education, law and social, community and government services	25	255	215
Art, culture, recreation, sport	0	20	20
Sales and service	180	530	400
Trades, transport, equipment operators & related	540	400	405
Natural resources, agriculture & related	65	50	50

Statistics Canada Census Year	2011[2]	2016[3]	2021[3]
Manufacturing & utilities	55	50	45

[1] 2011 data obtained from archived Statistics Canada, 2016
[2] 2016 results reported by Statistics Canada are based on 25% of sample data
[3]2021 results reported by Statistics Canada are based on 25% of sample data

6.4.3 Community Services and Infrastructure

The Town of Channel-Port aux Basques is considered the hub of Southwestern Newfoundland and the main point of entry connecting the province to the Canadian Maritimes from sea. It provides modernized facilities, commercial, education, emergency, and recreational services to the area.

Within the townsite, and directly adjacent to the Project Area along the southwest side of the navigation channel, is a small coastal wharf identified as the small craft harbour (SCH). The SCH is a core fishing harbour operated by the Harbour Authority of Port aux Basques and used by commercial and recreational vessels for docking, loading/offloading, boat maintenance, and refueling (GHD, 2019).

Key emergency services include the hospital, Dr. Charles L. Legrow Health Centre, and the RCMP station, which are located approximately 2 km and 4 km northwest of the MAI ferry terminal, respectively. The fire station, Fire Dept. Port aux Basques, is situated directly south of the SCH.

The two nearest schools are located approximately 2 km from Port aux Basques Harbour. Mountain Hope personal care home is approximately 4 km northwest of the Project Area. Other infrastructure of interest includes the main community center, and CCG, each within 500 m of the Project Area.

6.4.4 Historic Resources

A Historic Resources Overview Assessment (HROA) and Historic Resources Impact Assessment (HRIA) for the Project were conducted by Davis MacIntyre & Associates Ltd in 2019 and 2020.

The HROA found no known archaeological resources in Project Area; the nearest archaeological resources have been identified at Isle aux Morts, located to the east of Port aux Basques, and Cape Ray to the west. Most archaeological resources related to the earliest human occupation of the island (the Maritime Archaic Indian period, c. 5500 to 4000 BP) are likely located below current sea levels. Later use and occupation sites related to First Nations occupation may exist in coastal regions and on Vardy's Rock. Bathymetric data revealed that no significant submerged historic features were evident in the assessment area. Bathymetry did indicate that there may be small remnant terraces at the deeper reaches of the navigational channel. However, previous dredging of the harbour and navigational channel in the 1950s would have resulted in substantial impact, lowering the potential for encountering intact Maritime Archaic sites. Bathymetry data and historic research did not reveal any evidence of shipwrecks in the navigational channel.

The HRIA involved a site reconnaissance of Vardy's Rock, Pikes Island, and a portion of the shorelines to the east of Pikes Island. It also included a review of the videos which were part of the

UBHS to investigate potential evidence of shipwrecks, artifacts, past disturbances, and submerged terraces. The site reconnaissance did not reveal any indications of significant archaeological resources on Vardy's Rock or along the shoreline at Pikes Island. Although it is likely that some sort of structure and/or outbuildings related to the operation of Vardy's Rock light existed in the late 19th to early 20th century, no evidence of such features was observed and there was no evidence of potential buried archaeological resources or burial sites.

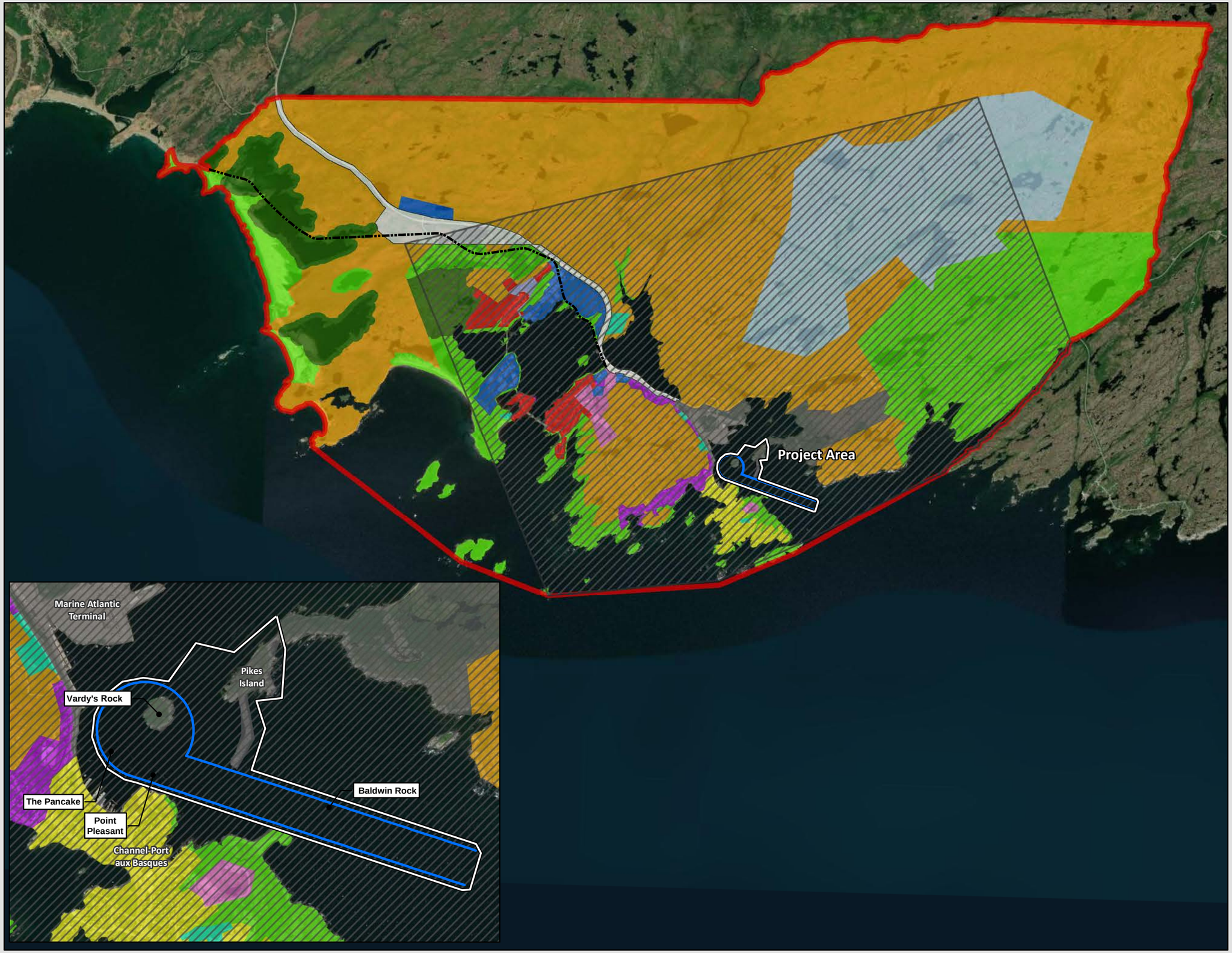
6.4.5 Land Use

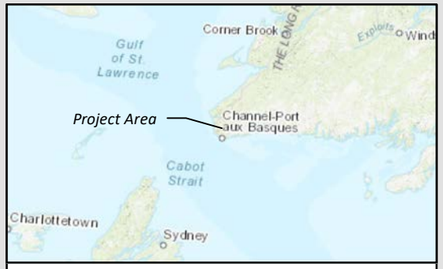
The summary of land use was derived from the Government of NL Department of Fisheries and Land Resources Provincial Land Use Atlas (LUA), the *Town of Channel-Port aux Basques Municipal Plan 2019-2029*, and the *Town of Channel-Port aux Basques Development Regulations 2019-2029* (Government of NL FAL, 2026; Boundridge Planning and Development Services Inc., 2019 a,b). Municipal boundary and municipal planning area boundaries for the Town are depicted in Figure 6.7.

The main town centre is immediately south of the Project Area. The Project is in an area that is zoned industrial. Land directly west of the navigation channel is zoned for environmental protection; conservation and recreational open space activities are permitted, while discretionary uses may include transportation, utilities, mineral exploration, and mineral working (Government of NL FAL 2026; Boundridge Planning and Development Services Inc., 2019 a,b). Lands north of the Project Area are the Gull Pond and Wilcox Pond water supply for Channel-Port aux Basques and are protected lands (Government of NL FAL 2026). Lands to the immediate east of the Project Area are zoned for industrial use, and further lands are zoned for rural use (Boundridge Planning and Development Services Inc., 2019 a,b). Land use within and immediately surrounding the Project Area are shown in Figure 6.7.

Vardy's Rock is in a zone restricted to industrial land uses, and island activity is restricted to use by MAI who maintain navigation lighting and a weather station on the island. Permitted land uses include antennas, communications, conservation, general industry, general service, light industry, office, passenger assembly, service station, and transportation. Discretionary land uses include hazardous industry, mineral exploration, mineral working, scrapyard, and utilities (Boundridge Planning and Development Services Inc., 2019 a,b).

Within the harbour, there are various recreational uses including use of watercraft and fishing. The harbour supports recreational fisheries—such as cod, squid, mackerel, herring, pollock, and trout—from the SCH wharfs (GHD, 2019). Mussel harvesting has been reported to occur in the Northwest and Southeast Arm of the Harbour, north of the Project Area and around Vardy's Rock (GHD, 2019). The frequency of harvesting within these areas have reportedly decreased over the years due to concerns regarding potential environmental impacts adjacent to the waters. Harvesting for mussels typically occurs from June to July. Commercial fishing also occurs in the harbour and lobster pots are set within the harbour, including the inner harbour around Vardy's Rock, and the outer harbour on the ocean side of the Pikes Island breakwater. Further description of the local fisheries is provided in Section 6.4.7.





- Project Area
- Navigation Channel
- Trailway
- Municipal Boundary
- Municipal Planning Boundary

Landuse Zones

- Public
- Open Space
- Environmental Protection
- Town
- Rural
- Mixed Development
- Commercial
- Industrial
- Residential
- Environmental Protection Management Unit
- Protected Public Water Supply
- Highway
- Residential (Medium Density)

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Figure 6.7: Land Use Within and Immediately Surrounding the Project Area

Drawn by: MD/ AO	**Date: 2020-10-28**
Checked: MD	**CBCL Project #: 202479.05**
Approved: LH	**Scale @ 11" x 17" :** 1:56,578

CBCL

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Units: Meter
0 775 1,550 2,325 3,100 m

\\HFXDATA\Data\202479.45 VARDYS ISLAND ENVIRONMENTAL\MAE and TC Joint EA Document - Maps\202479.05 Figure 6.7 - Land Use within and Immediately Surrounding the Project Area.mxd

6.4.6 Shipping and Navigation

The Port aux Basques Harbour and navigation channel have been used for the transportation of people and goods from NS to NL since 1898. MAI is a primary user providing daily ferry transportation between North Sydney, NS and Port aux Basques, NL. Additional users include local fishers, the CCG, oil companies providing fuel deliveries, cruise lines, and other shipping companies (TCPAB, 2020). Use of the Port aux Basques Harbour for shipping and transportation occurs year-round.

6.4.7 Fisheries

Twenty-six marine species were identified as part of commercial or recreational fisheries in the region and seven species are harvested inside of Port aux Basques Harbour. Commercial and recreational fisheries in the assessment area were determined through consultation with DFO resource managers and fisheries officers in Newfoundland (Barter, *pers. comm*., 2020; Riggs-Power, *pers. comm*., 2019), as well as through input provided by commercial fishers from the Port aux Basques area. The fishing season spans the year for commercial and recreational fisheries with varying opening times from year to year and among fishing area zones. The opening and closing dates for fisheries in the region are summarized in Table 6.11. The key commercial fishery activity (i.e., lobster fishing) occurs from April to July.

Limited information is available for landings or catch per unit effort (CPUE) data from Port aux Basques Harbour and Northwest Atlantic Fisheries Organization (NAFO) 3PN. The lack of data available from DFO for this area is based on the small number of commercial fishers and privacy implications for access to such data. The data that was provided shows that landings at Port aux Basques Harbour varied each year from 2010 to 2020, with 3,589 metric tonnes (MT) landed over 456 trips in 2010 and 648 MT in 2020 (unknown number of trips). The lowest landings from the data available during that period occurred in 2012, with 363 MT over 204 trips.

Table 6.11 Opening and closing dates for fisheries in the Assessment Area

Common Name	Fishery Status	Opening and Closing Dates (Anticipated 2020)	Fishing Area
American lobster	Commercial	April 21 – June 30	LFA 12, inclusive of Port aux Basques Harbour
		April 1 - July 2	LFA 13A
Atlantic cod	Commercial	Summer: July 01 – Aug 01	NAFO 3Pn
		Fall 1: September – 2 weeks, Fall 2: October – 1 week	NAFO 3Pn
		July 1 – Feb 28	NAFO 3Pn
	Recreational	Summer: June 30 – September 3	All NL
		Fall: Sept. 22 – 30	All NL
		Open weekends June 29 – September 2 and September 2-29	Port aux Basques Harbour
Atlantic halibut	Commercial	April 30 - May 5	NAFO 3Pn
Atlantic herring	Commercial Bait	January 1 - December 31	Port aux Basques Harbour
Atlantic mackerel	Commercial	August 1 – no set close	Port aux Basques Harbour

Common Name	Fishery Status	Opening and Closing Dates (Anticipated 2020)	Fishing Area
	Commercial Bait	January 1 - December 31	Port aux Basques Harbour
Atlantic mackerel	Recreational	No season	Port aux Basques Harbour
Atlantic salmon	Recreational	June 04 until quota reached	Insular Newfoundland
Capelin	Commercial	June 15 until quota reached	NAFO 3Pn
Eel	Recreational	June 01 until quota reached	Coastal Newfoundland
Northern Shrimp	Commercial	April 01 until quota reached	Gulf of St. Lawrence
Redfish	Commercial	July 14 – March 31 (Spawning closure April 1- June 30)	NAFO 3Pn
Seal	Commercial/ Personal	When ice conditions are suitable	Port aux Basques Harbour
	Recreational	April 09 until quota reached	Sealing Areas 4-23, 25-27
Sea-run Trout	Recreational	Year-round in coastal waters. No closed season	Coastal Newfoundland
Trout	Recreational	Winter: February 1 - April 15	Insular Newfoundland
Skate	Commercial	April 1 to March 31	NAFO 3Pn
Snow crab	Commercial	April 9 to ~ June 22	NAFO 3Pn
Squid	Recreational	No season (mostly present in August and September)	Port aux Basques Harbour
Toad crab / Lyre crab	Recreational	May 08 until quota reached	NAFO 3Pn
		Summer May 15 – September 7	
Whelk	Commercial	May 28 until quota reached	NAFO 4R3Pn
Winter flounder	Commercial Bait	January 1st - December 31st	Port aux Basques Harbour
Witch flounder / Greysole	Commercial	April 1 - March 31	NAFO 3Pn

Chapter 7 Environmental Effects Analysis

This chapter presents the evaluation of potential environmental effects of the Project. The environmental effects analysis follows the methods outlined in Chapter 5. Section 7.1 presents the initial screening to identify potential interactions between Project components and activities, as described in Chapter 3, and the existing environment, which is described in Chapter 6. The subsections that follow Section 7.1 provide a description of the potential environmental effects and outline mitigation measures to avoid or reduce potential adverse environmental effects.

7.1 Interaction of Project Components with the Environment

The potential interactions between the Project and the existing environment, organized as VCs, are presented in Table 7.1. Interactions are identified in Table 7.1 as positive (P) or negative (N). In some cases, the interaction may include both positive and negative aspects. Potential interactions that could lead to measurable positive and/or adverse environmental effects are identified for the following VC sub-components, which are further evaluated in this Chapter:

- Air quality
- Acoustic environment
- Marine sediment
- Marine water quality
- Fish and fish habitat
- Marine mammals and turtles
- Geology and soils
- Vegetation, including SAR
- Wildlife, including migratory birds and SAR
- Economic conditions
- Infrastructure and services
- Navigation
- Fisheries
- Human health

No interactions that could lead to measurable positive and/or adverse environmental effects are identified for the following VC sub-components; therefore, potential environmental effects are considered not significant for these, and they are not further evaluated in this EARD/EEE:

- Climate
- Environmentally sensitive areas
- Land use
- Archaeological and heritage resources
- Traditional use of lands

Table 7.1 Potential interactions between Project Activities and the Environment

Project Components and Activities	Valued Components																		
	Atmospheric			Marine					Terrestrial			Socio-economic & Cultural							
	Climate	Air Quality	Acoustic Environment	Marine Sediment	Marine Water Quality	Fish & Fish Habitat	Marine Mammals and Turtles	Environmentally Sensitive Areas	Geology & Soils	Vegetation, including SAR	Wildlife, including Migratory Birds & SAR	Economic Conditions	Infrastructure and Services	Land Use	Navigation	Fisheries	Human Health	Archaeological & Heritage Resources	Traditional Use of Lands
Site Preparation																			
Access Road Upgrades and Staging/Laydown Area		N							N	N	N	P	P						
Decommissioning of Island Infrastructure		N							N		N	P	N				N		
Overburden Stripping and Removal		N	N	N					N	N	N	P					N		
Marine Construction																			
Drilling and Blasting		N	N	N	N	N	N				N	P/N	P/N	N	N	N	N		
Dredging		N	N	N	N	N					N	P/N	P/N	N	N	N	N		
Transportation of Dredged Material		N		N		N					N	P/N	P/N		N		N		
Breakwater Repairs		N	N	N	N	N			N	N/P	N	P/N	P	P	N	N	N		
Construction of Pikes Island Infill		N	N	N	N	N			N	N/P	N	P/N	P/N	N	N	N	N		
Temporary Haul Road Construction and Removal (optional)		N	N	N	N	N			N		N	P/N	P/N	N	N	N	N		
Installation of Temporary Aids to Navigation					N						N	P/N	P/N	N					
Restoration of Temporary Work Areas		N							N	N/P	N	P/N	P/N						
Post-construction																			
Absence of Vardy's Rock						P			N		N	P	N		P/N	P			
Presence of Pikes Island Infill						N			P			P	P		P/N				
Upgraded Pikes Island Breakwater						P/N			P			P	P	P	P	P			

Legend: [*Blank*] = No Effect; [P] = Potential Positive Environmental Effect; [N] = Potential Negative (Adverse) Environmental Effect

7.2 Atmospheric Environment

The Atmospheric Environment VC includes air quality and the acoustic environment. The Atmospheric Environment was selected as a VC because Project activities can alter existing air quality and lead to changes to the acoustic environment.

Impacts to the Atmospheric Environment as a result of Project Activities can lead to effects on Socioeconomic, Marine, and Terrestrial VCs. Potential impacts to the Socioeconomic, Marine, and Terrestrial VCs are discussed in more detail in Sections 7.3, 7.4, and 7.5.

7.2.1 Pathways of Potential Environmental Effects

Potential interactions between the Project and the Atmospheric Environment VC identified in Table 7-1 are further described in the following sections.

7.2.1.1 Air Quality

Adverse effects to air quality are anticipated to occur as a result of air emissions associated with land-based and marine-based activities during construction of the Project. Both land-based and marine-based activities can affect air quality by increasing emissions of critical air contaminants (CAC), such as CO, SO_2, NO_2, NO, NO_x, and $PM_{2.5}$, and dust (particulates). Construction activities that could result in changes to air quality are identified in Table 7.1. These activities will require the use of fuel-based equipment (e.g., excavators, haul trucks, vessels), which will result in CAC emissions. These activities will also contribute to the generation of dust emissions, particularly during blasting above the water line on Vardy's Rock.

Stockpiling of soil during overburden removal from Vardy's Rock can lead to dust generation, including PHC-, PAH-, or metal-impacted soil particles. The transportation of uncovered loads at high speeds can result in the loss of load materials from the truck and the generation of dust. Travel of vehicles on unpaved roads can also result in dust generation.

The zone of influence of the Project on air quality has been established based on the distance that fugitive dust emissions from construction can travel, which can vary depending on the size and density of the particulate and wind speed. For example, at lower wind speeds, particulate fallout occurs in closer proximity to the source of generation (English and Luo, 2013). A study examining fugitive dusts (e.g., respirable and non-respirable) and fumes (NO_2, NO, CO, and ammonia (NH_3)) for several blasting sites (English and Luo, 2013) determined that dust generally settles within approximately 300 m of a blast site, and dust and fume emissions within 300 m of the blast site are typically below adverse levels. Adverse levels within 300 m of the blast site occurred only infrequently and for short durations. When fumes or dust emissions approached 600 m, measured levels were extremely low. An assessment area of 600 m from Vardy's Rock has, therefore, been established for this Project. Changes in air quality as a result of blasting and construction activities are not anticipated to extend beyond the assessment area. The proximity to sensitive receptors is discussed in Section 7.4.1 for wildlife receptors and 7.5.1 for human receptors.

7.2.1.2 ACOUSTIC ENVIRONMENT

Changes to the acoustic environment are anticipated to occur during construction as a result of noise and vibration emissions associated with the use land-based and marine-based activities during construction of the Project. Construction activities that could result in changes to the acoustic environment are identified in Table 7.1.

Noise and vibration emissions generated during construction will vary based on the activity being performed. For example, drilling and blasting will produce higher emissions than soil excavation and dredging. Sound produced during drilling will mainly emanate close to the seafloor, although some sound may be emitted through the air from the drill shaft and hull of the vessel holding the equipment (JASCO, 2021; Appendix L).

Blasting is anticipated to result in the greatest increase in baseline noise and vibration levels, particularly above-water blasting at Vardy's Rock. JASCO (2021) used an Impulse Noise Propagation Model (INPM) to estimate the distances that sound emissions will travel in air. In-air modelling was based on the atmospheric conditions (i.e., pressure, temperature, relative humidity, and wind as a function of elevation) in April, which lead to the longest in-air propagation of sound (JASCO, 2021; Appendix L) and therefore represent the worst-case for noise. Results of the acoustic modelling indicate that peak pressure levels will be greatest at Vardy's Rock and will decline to 109 dB at 1,130 m from the blasting site (based on the detonation of 48 kg of TNT). Peak levels in the Town, at 480 m from the blast, could reach 115 dB. Noise from blasting above-ground at Vardy's Rock is expected to extend further than 1 km, and an assessment area of 5 km was, therefore, established for the acoustic environment. Acoustic modelling indicates that most of the harbour and the Town Centre will experience noise levels in the range of 60 to 90 dBA during blasting on Vardy's Rock (JASCO, 2021; Appendix L). Although construction is expected to take 12 months, in-air blasting at Vardy's Rock represents only a fraction of the construction period, these peak noise levels are expected only if in-air blasting occurs in April, and noise levels are expected to be lower during the remaining months of the construction period.

Sound intensity from construction equipment can range upwards of 90 dBA within approximately 15 m of the source, which is comparable to sound levels associated within an urban, commercial, or industrial environment (U.S. Department of Transportation Federal Transit Administration, 2006; U.S. Department of Transportation Federal Highway Administration, 2017). Research conducted by Defence Research and Development Canada (2010) suggests that sound propagation over water from a 115-dB re 20 µPa source, in winds of 10 km/h, will be audible up to 600 m upwind and 1,800 m downwind from the source, but will decline in intensity and noise levels are substantially reduced within 400 m of the source. Most of the construction activities will occur around Vardy's Rock and Pikes Island which are at least 400 m from the Town Centre, and wind speeds in Port aux Basques Harbour are generally expected to be greater than 10 km/h. These factors will reduce the amount of time that noise levels will substantially exceed baseline levels in Channel-Port aux Basques; however, noise from drilling and excavation could occasionally reach levels up to 90 dBA.

7.2.2 Mitigation of Project Environmental Effects

Mitigation measures proposed to reduce effects to the Atmospheric Environment VC, specifically for each air quality and noise/vibration, are discussed in the following subsections.

7.2.2.1 Air Quality Mitigation Measures

The following measures are proposed to mitigate changes in air quality that are anticipated to occur as a result of Project activities:

- Apply water for dust suppression, as needed, during dust-generating construction activities.
- Stabilize exposed surfaces and cover stockpiles to reduce erosion.
- Construct haul road using coarse aggregate with low silt content.
- Cover and secure loads on vehicles transporting materials to and from the site.
- Use appropriately-sized haul trucks in order to minimize the frequency and number of trips needed to transport excavated materials off site.
- Vehicle operation will comply with the *Newfoundland and Labrador Air Pollution Control Regulations*.
- Encourage anti-idling of heavy machinery and vehicles, whenever possible.
- Regularly inspect and maintain heavy machinery and vehicles to manage emission levels.
- No burning will be permitted on-site.

7.2.2.2 Noise and Vibration Mitigation Measures

The following measures are proposed to reduce noise and vibration levels generated as a result of Project activities:

- Limit blasting activities to daytime hours to reduce impacts to sensitive receptors.
- Heavy machinery and vehicles should be properly muffled to manage noise emissions.
- Develop and implement an Environmental Protection Plan that includes a Blasting Plan and Monitoring Plan to manage noise and vibration, as well as a Complaints Response Plan for recording, addressing, and resolving complaints related to Project activities.

7.2.3 Characterization of Residual Environmental Effects

Adverse residual environmental effects associated with the Project, after implementation of the mitigation measures listed in Section 7.2.2, are anticipated with respect to air quality and the acoustic environment. These effects are expected to be small in magnitude for air quality and moderate to large in magnitude for acoustic environment, surpassing baseline levels. Changes to air quality and the acoustic environment are anticipated to extend beyond the Project Area. The dredging activities are anticipated to occur over a 12-month period; however, the period where the greatest noise levels will occur (i.e., in-air blasting) represents only a fraction of this construction period. Timing sensitivity for air quality is expected to be low. The duration of the effects to air quality is short-term, as they will occur for short periods during construction, and the frequency of the effects will be intermittent. Effects on noise/vibration levels will be medium-term, and the frequency of the effect will be continuous for most activities but intermittent with respect to drilling and blasting. Effects to air quality and noise/vibration levels will be reversible, as they are expected to return to baseline levels following the completion of construction.

7.3 Marine Environment

The marine environment VC includes marine sediment and water quality, marine fish and fish habitat, marine mammals and turtles, and sensitive marine habitats. The marine environment was selected as a VC because the Project involves in-water works and activities adjacent to shore that interact with the marine environment.

The marine environment VC is directly linked to other VCs including the terrestrial wildlife VC for birds, and socio-economic and cultural VCs for fisheries in Port aux Basques Harbour. Marine birds (seabirds and shorebirds) can be affected by changes in marine water quality and effects on foraging habitat, which could include fish. Fish and fish habitat are intrinsic to the fisheries VC and effects to fish and fish habitat are likely to have corresponding effects to fisheries. Potential environmental effects to marine birds are described in Section 7.4. Effects to fisheries are described in Section 7.5.

7.3.1 Pathways of Potential Environmental Effects

Potential interactions between the Project and the marine environment VC are identified in Table 7.1 and are further described in the following sections. The methods used to evaluate the potential environmental interactions and POEs are provided in Section 5.3. Direct Project-related interactions include the alteration of the existing fish habitat in the dredge and infill locations and the creation of new fish habitat in the Vardy's Rock dredge area and subtidal portions of the infill area. Temporary effects to the marine environment are anticipated to occur in the harbour and coastal waters. Potential adverse effects of the Project are primarily associated with the drilling, blasting, and dredging of rock and the resulting noise and vibrations produced by these activities. The marine environment outside of Port aux Basques Harbour is included in the VC as the noise and vibration from drilling, blasting, and dredging of rock have the potential to extend out of the harbour into the deeper offshore waters of the Cabot Strait and Laurentian Channel.

7.3.1.1 Marine Sediment and Water Quality

Effects of the Project on marine sediment are primarily associated with resuspension and redistribution of fine sediment in the harbour. The drilling, blasting, dredging, and placement of excavated material has the potential to temporarily resuspend sediment into the water column. Most of these areas for dredging and infilling are predominantly bedrock, and sediment resuspension is limited to small pockets or thin layers of fine sediment (sand and silt) that accumulate on the bedrock or in crevices. Fine material constitutes a very small proportion (approximately 1.4%) of the overall volume of dredge material and the fine material is predominantly sand, which is not likely to be transported out of the Project Area. However, portions of the Vardy's Rock and South Turning Basin dredge areas contain a surficial layer of sediment that has higher proportions of silt and may be resuspended during the dredging process. Suspended sediment could include PAH-contaminated material; however, none of the sediment collected in the harbour as part of the 2020 program had concentrations that exceeded the CCME PELs for marine sediments. The fragmentation of rock during blasting will produce a wide range of particle sizes from small to boulder sized. Fine-grained particles may become suspended in the water column after blasting and during dredging. Blasting may also release organic and inorganic materials into the

water column which can be temporarily transported in the water column before settling to bottom. Water and sediment quality are unlikely to exceed established guidelines for the protection of aquatic life (CCME, 2026) as a result of suspension and redistribution of sediment.

Metal- or PAH-contaminated soil has the potential to enter the marine environment at the Vardy's Rock dredge area during removal of the overburden. Runoff from exposed soils on the island has the potential to introduce contaminated soils to the marine environment. Accidental releases during the transportation of materials could also temporarily affect water quality in the harbour.
The use of explosives can create nutrient by-products depending on the selected explosives. Nutrient by-products include those released from rock into the water column during blasting and as by-products of the nitrates used in the explosives (Wright and Hopky, 1998). Overabundance of nutrients, including nitrogen, phosphorous, and mineral compounds containing these elements can lead to changes in water quality in the harbour; however, water quality changes related to nutrient increases are unlikely due to the relatively small quantity of the potential nutrients released when compared to the size of the harbour. The Project is also not expected to affect other sources of nutrient input in the harbour, such as the existing wastewater outfalls.

7.3.1.2 Fish and Fish Habitat

Project-related effects to fish and fish habitat are associated with the proposed drilling, blasting, and dredging activities, and the placement of materials in water and are categorized as follows:

- Change in fish habitat
- Change in mortality risk
- Change in behaviour

Fish habitat in the Project Area will undergo changes including habitat creation in the Vardy's Rock dredge area, habitat loss in the Pikes Island Infill area, and habitat alteration in the Vardy's Rock, South Turning Basin, and Baldwin Rock dredge areas, and at the Pikes Island Breakwater.

Overall, blasting and dredging will alter 60,000 m^2 of existing fish habitat in the Project Area. The altered substrates will provide a mix of rock substrates with interstitial space that can be utilized by lobster and other fish. In the Baldwin Rock dredge area approximately 17,000 m^2 of continuous bedrock substrate will be altered to a mixture of rock substrate containing boulder, cobble, and gravel sized materials. Similar habitat alteration will occur at the Vardy's Rock dredge area. Existing fish habitat in the subtidal portion of the Vardy's Rock dredge area varies; generally, fish habitat on the south side of the island consists of bedrock and boulder to harbour bottom whereas habitat on the north side of the island features a mixture of more shallow rock habitats and surficial fines. Dredging in these areas results in the alteration of approximately 27,400 m^2 to a mixture of rocky substrates. The South Turning Basin dredge area contains approximately 15,600 m^2 of mixed rock and surficial fines habitats; the habitat alteration in this dredge area will create an equivalent area of mixed rock substrates. The north side of Vardy's Rock and the South Turning Basin currently contain mixed rock and fine substrates with a relatively flat overall topography. Fish habitat in these areas may be improved through the creation of boulder dominated habitat with interstitial spacing. A

small proportion of the existing fines habitats in these areas will be altered to rocky substrate and could reduce forage for bottom feeding fish and invertebrates; this reduction is expected to be small in comparison to the available fines habitat in the deeper areas of the harbour and navigation channel.

The Project creates new fish habitat in the Vardy's Rock dredge area. The complete removal of the island will create approximately 14,300 m^2 of subtidal rocky habitat that previously did not exist in the harbour. The new fish habitat will provide a mix of rocky substrates (bedrock, boulder, cobble, and gravel) previously unavailable in this portion of the dredge area. The creation of the Pikes Island Infill will result in the loss of approximately 72,000 m^2 of intertidal bedrock, and mixed rock and fines subtidal habitats. Habitat alteration also occurs on the Pikes Island Breakwater. Repairs to the breakwater occur over approximately 12,500 m^2 of the subtidal portion of the breakwater, including the expanded breakwater footprint. Rock habitat on the slope of the existing breakwater consists primarily of large armour stone boulders, whereas fish habitat in the expanded footprint consist of fines on the harbour bottom. The placement of additional armour stone to repair the Pikes Island Breakwater may benefit fish by increasing refuge areas in the interstitial spaces created following the completion of the Project.

Fish habitat between Vardy's and Pikes Island may also be temporarily altered by the construction of a temporary haul road. Construction of a temporary haul road will depend on the chosen means and methods of the dredge contractor. If used, the construction of the road will temporarily remove fish habitat during the completion of the dredging and disposal activities. After dredging in the Vardy's Rock location is completed, the temporary haul road will be removed up to the infill and that area will be reinstated to pre-dredge elevations. If used, the road is expected to occupy approximately 2,000 m^2 of existing mixed rock and fines habitats between Vardy's Rock dredge area and the Pikes Island Infill.

The installation of temporary of navigation aids may alter a small area of fish habitat in the harbour due to the placement of anchor blocks on bottom. The anchor blocks are likely to be constructed of a large concrete block attached to the floating navigation aid by a length of chain. The area of each block is expected to be only a few square metres.

The underwater noise and instantaneous pressure changes that occur during drilling, blasting, and to a lesser degree dredging, can increase the risk of mortality, injury, and behavioural changes in fish. Behavioural changes include area avoidance, reduced foraging and reproductive success, altered predator-prey interactions, increased concentrations of stress hormones, and decreased growth rates. Instantaneous overpressure of 100 kilopascal (kPa) or greater can lead to injury or death of fish (Wright and Hopky, 1998).

Underwater pressure changes and noise produced during drilling, blasting and excavation at Vardy's Rock and Baldwin Rock were modelled by JASCO (2021) to estimate areas within which the risk of mortality or injury of fish is increased as a result of Project activities (Appendix L). JASCO (2021) used

a combination of models to estimate the distances that sound emissions will travel in water to account for the continuous noise generated by drilling and dredging and impulse noise generated by blasting. Underwater noise propagation modelling was based on the sea state conditions (i.e., salinity, temperature, and sound speed) in February, which represent the longest in-water propagation of sound (JASCO, 2021; Appendix L) and therefore represent the worst-case for underwater noise. Water depth, substrate composition, and the roughness of the water surface (from waves) are factors that influence the distance noise will travel underwater. In addition to the use of February sea state conditions, JASCO assumed the substrate is bedrock and used high resolution site-specific bathymetry for the harbour as well as chart data and bathymetric data from the National Oceanic and Atmospheric Administration (NOAA) to model underwater noise propagation (JASCO, 2021).

Several primary assumptions lead to JASCO's 2021 model to be highly conservative, resulting in modelled noise levels extending farther than is likely to be typically observed during the Project construction; these conservative assumptions are the sea state conditions in February with wind speed of 10 knots and the pressure levels generated by the modelled blast source (Dr. J. Miller, University of Rhode Island, Dept. of Ocean Engineering, *pers. comm*.,2021). As described in Section 6.1.1, February wind speeds average 16.7 knots (i.e., 31 km/hr) and average wind speeds are greater than 10 knots for most months in Port aux Basques; only the summer months of June to September have average wind speeds similar to the modelled speed (i.e., 9.2 knots in August to 11.1 knots in June). Further, the source model may overestimate the sound levels produced by approximately 2 dB (Dr. J. Miller, University of Rhode Island, Dept. of Ocean Engineering, *pers. comm*., 2021); an overestimate of the sound produced at the source would result in predicted sound levels extending farther from the blast site than what will be observed. Combined, these assumptions lead to a very conservative estimate of how far the sound will travel underwater. For this assessment, the conservative estimates of the maximum distances are discussed and represent the maximum potential zone of influence.

Table 7.2 provides a summary of the modelling results. The distance over which the risk of mortality or injury is increased will be greater during blasting at Baldwin Rock in the outer harbour; this distance will depend on the blast plan that will be developed by the contractor. Based on the modelled blast scenarios, the risk of mortality to fish and crustaceans is increased for a maximum distance of up to 280 m from the detonation point in the outer harbour and up to 252 m from the detonation point in the inner harbour; the risk to eggs and larvae increases within 105 m in both areas of the harbour (113 m in the outer harbour). The risk of injury to crustaceans is increased for a maximum distance of up to 1,524 m from the detonation point in the outer harbour and up to 771 m from the detonation point in the inner harbour. The increased risk of injury or mortality from drilling is less than for blasting; however, drilling may result in a temporary threshold shift (TTS) for some species of fish (i.e., those that have a swim bladder involved in hearing). The increased risk of non-lethal injury to fish from dredging is negligible in both the inner harbour and outer harbour; in both cases, the risk of injury to fish is increased for a maximum distance of less than 10 m from the dredging activity.

Table 7.2 Modelled distances for increased risk for fish and crustaceans (JASCO, 2021)

Activity Location	Potential Effect	Organism Group	Maximum Distance from Activity Risk is Increased (m)		
			Drilling	Blasting	Dredging
Inner Harbour	Mortality or mortal injury	Fish	-	253	-
		Crustaceans	-	253	-
		Eggs and larvae	-	105	-
	Non-lethal injury	Fish	91	-	<10
		Crustaceans	-	771	-
	TTS*	Fish	530	-	19
Outer Harbour	Mortality or mortal injury	Fish	-	280	-
		Crustaceans	-	280	-
		Eggs and larvae	-	113	-
	Non-lethal injury	Fish	64	-	<10
		Crustaceans	-	1,524	-
	TTS*	Fish	590	-	15

Notes:

"-" indicates thresholds for effect are not available; therefore, distance was not modelled.

*TTS for fish with swim bladder involved in hearing.

Underwater noise as a result of vessel use, drilling, and dredging is expected to cause some fish to avoid the area, which would reduce potential mortality during blasting and rock placement. Fish actively avoid anthropogenic sound sources and seek refuge in habitats with lower sound levels (Slotte et al., 2004; Nedwell and Mason, 2012). Other behavioural responses are not anticipated as the noise generated by the Project is expected to drive fish temporarily out of the area.

Temporary increases in total suspended solids (TSS) will occur in conjunction with the blasting, drilling, and dredging in the immediate Project Area where fish are likely to avoid. Placement of rock in the infill area and breakwater increases the risk of mortality to fish and invertebrates occupying the area. This is a greater risk for sedentary species that could be buried or crushed due to the placement of materials on bottom. Motile species are expected to avoid the materials as they are deposited and are likely to avoid the area as a result of construction noise.

7.3.1.3 Marine Mammals and Turtles

Marine mammals and turtles are not known to occupy Port aux Basques Harbour, however underwater noise emissions during drilling, blasting, and dredging are expected to extend into the Cabot Strait where these animals are known to be present. Noise emissions can elicit behavioural disturbance and may cause temporary hearing threshold shifts (TTS) or permanent hearing

threshold shifts (PTS). Marine mammals are grouped into categories based on functional hearing range and their response or how they are affected by underwater noise.

Four of the six modelled categories of marine mammals are known to be present in the Cabot Strait (Table 7.3). The increased risk of PTS and TTS to marine mammals as a result of the Project extends the furthest for the six LF cetaceans, three of which are SAR: blue whale, fin whale, and North Atlantic right whale.

Table 7.3 Functional hearing groups of marine mammals known to occupy waters on the south coast of Newfoundland

Functional Hearing Group*	Species	Potential Occupancy Window in Cabot Strait
LF Cetaceans	Blue whale	Potentially year-round
	Fin whale	May to December
	Humpback whale	May to December
	Minke whale	April to November
	North Atlantic right whale	May to December
	Sei whale	Potentially year-round
HF Cetaceans	Atlantic white-sided dolphin, bottle-nosed dolphin, common dolphin, killer whale, long-finned pilot whale, short-beaked common dolphin, sperm whale, white beaked dolphin	Generally, April to December (some dolphins may overwinter in Cabot Strait)
	Sowerby's beaked whale	Unknown
VHF Cetaceans	Harbour porpoise	May to December (some individuals may overwinter in Cabot Strait)
Phocids	Gray seal, harbour seal, harp seal, hooded seal	Potentially year-round

* Based on Southall et al., 2019

Thresholds for permanent and temporary shifts and behavioural disturbance are not established for sea turtles however their hearing is less sensitive than marine mammals, therefore guidelines established for marine mammals are conservatively considered applicable to turtles.

Underwater noise produced during drilling, blasting, and dredging at Vardy's Rock and Baldwin Rock were modelled by JASCO (2021) to estimate areas within which the risk of TTS or PTS is increased as a result of Project activities (Appendix L). Table 7.4 provides a summary of the modelling results.

Table 7.4 Modelled Distances for Increased Risk for Marine Mammals (JASCO, 2021)

Activity Location	Potential Effect	Organism Group	Maximum Distance from Activity Risk is Increased (m)*		
			Drilling	Blasting	Dredging
Inner Harbour	PTS	LF cetaceans	602	2,500	46
		HF cetaceans	15	66	<10
		VHF cetaceans	375	921	<10
		Phocid in water	103	620	<10
	TTS	LF cetaceans	3,049	6,160	781
		HF cetaceans	375	169	<10
		VHF cetaceans	2,918	2,180	131
		Phocid in water	1,155	2,470	160
	Behavioural	Marine mammals	21,700	6,300	2,493
Outer Harbour	PTS	LF cetaceans	630	3,542	51
		HF cetaceans	15	64	<10
		VHF cetaceans	430	1,693	<10
		Phocid in water	94	572	<10
	TTS	LF cetaceans	8,400	>50,000	945
		HF cetaceans	433	155	<10
		VHF cetaceans	3,250	3,020	121
		Phocid in water	1,680	2,700	158
	Behavioural	Marine mammals	>50,000	>50,000	3,700

Notes:

*Where the modelled results differ for distance to SEL or peak threshold, the greater distance is reported here. See Appendix L for details.

As discussed in Section 7.3.1.2, the modelling provides a conservative or worst-case estimate of noise impacts. The greater wind speeds in the winter months and warmer water temperatures in the summer months compared to the model would reduce the underwater noise propagation, particularly at distances greater than 10 km from the source, and the distance for risk of TTS in LF cetaceans is likely at least half what is modelled (Dr. J. Miller, University of Rhode Island, Dept. of Ocean Engineering, *pers. comm*., 2021). The source levels will likely be at least 2 dB less than what is modelled, which would reduce the risk distance by another 26% (Dr. J. Miller, University of Rhode Island, Dept. of Ocean Engineering, *pers. comm.*, 2021). For this assessment, the conservative estimates of the maximum distances are discussed and represent the maximum potential zone of influence.

The distance over which the risk of PTS for marine mammals is increased will be greater during drilling and blasting in the outer harbour; this distance will depend on the blast plan that will be developed by the contractor. Based on the modelled blast scenarios, without any mitigation to reduce the risks, the risk of PTS and TTS extends the furthest for low frequency (LF) cetaceans: risk of PTS up to 3.5 km from the detonation point and risk of TTS greater than 50 km from the detonation point in the outer harbour.

The risk of PTS and TTS for marine mammals during drilling and blasting is lower when these activities are carried out in the inner harbour. The existing breakwater and bathymetry reduce the distance that noise will extend from the source. Based on the modelled blast scenarios, without any mitigation to reduce the risks, the risk of PTS and TTS extends the furthest for LF cetaceans: risk of PTS up to 2.5 km from the detonation point and risk of TTS greater than 6.2 km from the detonation point in the inner harbour.

The modelling suggests the risk of behavioural changes induced by Project construction noise during drilling and blasting could extend to 21.7 km from the work area in the inner harbour, and greater than 50 km from the work area in the outer harbour. As previously discussed, these are conservative estimates and the distance from the source where these risks are high may be at least 75% less than the modelling predicts.

The primary potential environmental effect to marine mammals is the increased of risk PTS, TTS, and behavioural changes during blasting in the outer harbour. Blasting in the outer harbour is required for only a small proportion (approximately 8%) of the total volume of material to be dredged and will occur over a short period in the overall construction, which reduces the likelihood that the increased risk will result in a PTS or TTS in an individual marine mammal SAR. The likelihood of PTS can be further reduced by timing the outer harbour blasting to occur in the winter when fewer marine mammals, including SAR, are likely to pass through the zone of influence.

Vessel collisions with marine mammals as a result of increased vessel traffic during construction are possible but unlikely. Vessel strikes at speeds lower than 15 knots substantially decrease the likelihood of mortality (Vanderlann and Taggart, 2007). Vessels used for the Project are not anticipated to require sustained speeds in excess of 15 knots and marine mammals are likely to avoid the Project Area during construction.

7.3.2 Mitigation of Project Environmental Effects

A number of mitigation measures can be applied to lessen the potential environmental effects of the Project on the Marine Environment VC. The measures and standards are intended to avoid the death of fish, including mitigations that support the avoidance or mitigate the harmful alteration, disruption or destruction of fish habitat. Standard and effective mitigation measures applicable to the Project include the following:

- Compliance with Project-specific conditions as outlined in federal and provincial permits and authorizations

- Project-specific Environmental Management Plan
- Compliance with DFO's (1998) *Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters*—where the guideline values cannot be met, consult with DFO and obtain Authorization under the *Fisheries Act*
- Timing of Project components to avoid sensitive periods for fish and marine mammals. Drilling, blasting, and dredging will be avoided at Baldwin Rock in the outer harbour during periods when most LF cetaceans may be present
- Develop ramp-up procedures to deter fish and marine mammals from the area prior to drilling or blasting
- Visual and acoustic monitoring, or other acceptable method, for marine mammals and establishment of a shut-down zone in consultation with DFO
- If a marine mammal is observed within the shut-down zone, drilling, or blasting activities will cease until the animal has left the zone
- Turbidity monitoring in the harbour
- Fish habitat offsetting for loss of marine habitat in the harbour to be developed in consultation with local stakeholders and DFO
- Reuse of dredged material for infilling, habitat creation and offsetting
- Erosion and sediment control during on-land activities including site preparation on Vardy's Rock and grading on Pikes Island Infill
- Compliance with best practices for preventing the harmful spread of aquatic invasive species (AIS), including taking precautions with respect to vessel traffic and gear movement between affected and unaffected areas; clean, drain, and dry gear and ropes before moving between areas, routine vessel maintenance, and reporting any AIS to DFO

Alternative methods were considered to minimize sediment resuspension and the migration of suspended sediments during in-water construction activities. The assessment considered the nature of the proposed work, including drilling, controlled blasting, dredging, barge-based material handling, and placement of dredged rock for beneficial reuse within the Project Area. Methods evaluated included source-control measures, physical containment systems, operational controls, and monitoring-based management approaches.

Physical containment measures, such as full work-area isolation and large-scale turbidity curtains, were considered but are not proposed as the primary mitigation approach because of the active harbour setting, water depths, wave and current conditions, navigation requirements, and the logistical constraints associated with dredging and marine construction activities. While localized turbidity curtains may be used where site conditions are suitable and their effectiveness can be demonstrated, these measures are not expected to provide additional environmental benefit commensurate with the increased cost and operational complexity of full-area containment.

The preferred approach is a layered sediment management strategy that emphasizes minimizing sediment generation at the source, implementing operational controls to reduce sediment disturbance, and verifying effectiveness through monitoring and adaptive management. This

approach is considered the most technically and economically feasible for the Project and is consistent with the anticipated distribution of fine sediments, which are expected to occur primarily within localized depositional areas and thin surficial sediment layers overlying bedrock.

Mitigation measures will be refined during detailed design and construction planning based on updated bathymetric surveys, seabed characterization, and sediment sampling. If monitoring indicates that suspended sediment concentrations exceed established action thresholds or that sediment plumes are extending beyond the predicted zone of influence, additional mitigation measures will be implemented, including modification of work methods, reduced production rates, deployment of localized containment measures, or temporary suspension of sediment-generating activities until conditions improve.

Sediment characterization data indicate that fine sediments comprise a small proportion of the overall dredge volume; however, because portions of these sediments contain elevated concentrations of PAHs, metals, and PCBs, mitigation measures have been specifically designed to minimize the resuspension, transport, and redeposition of fine-grained materials during excavation and placement activities.

To minimize the potential resuspension, transport, and redeposition of fine sediments, the following measures will be implemented during blasting, dredging, material handling, and infill placement activities:

- Controlled drilling and blasting methods to minimize disturbance and resuspension of fine sediments
- Employ dredging methods and operating procedures that minimize sediment disturbance, turbidity, and loss of fine materials during excavation and handling
- Transport and place excavated materials in a controlled manner to minimize the release and dispersion of suspended sediments
- Complete placement of material at the Pikes Island infill area in a staged and controlled manner to reduce turbidity and mobilization of entrained fine sediments
- Water quality monitoring, including turbidity and total suspended solids (TSS), during blasting, dredging, and material placement activities to verify the effectiveness of mitigation measures
- Project-specific turbidity action thresholds and adaptive management procedures, including modification or temporary suspension of construction activities if monitoring indicates exceedances of established thresholds
- Regular visual monitoring of sediment turbidity plumes to confirm that suspended sediments remain localized
- Stabilize completed infill areas to minimize erosion and the potential remobilization of fine sediments following construction

Other mitigation measures proposed for the Project include:

- Fish Rescue and Relocation Program – Potential relocation program to be developed in consultation with local stakeholders and DFO
- Reduce the sound pressure at the source by stemming the charges to the extent possible
- Deterrents using underwater sound to drive fish, invertebrates, marine mammals, and turtles out of the harbour prior to blasting
- Alterations to existing fish habitat and newly created fish habitat will be designed to provide additional areas of interstitial spacing and shelter which could increase survivability of juvenile lobsters and support a larger local lobster population

7.3.3 Characterization of Residual Environmental Effects

Positive environmental effects of the Project are primarily associated with the creation of fish habitat in the Vardy's Rock dredge area. The removal of the island will create new fish habitat that had previously been unavailable due to the presence of the island at the centre of the turning basin. Fish habitat will also be created in the South Turning Basin and Baldwin Rock dredge areas. These habitats are anticipated to function as similar or improved fish habitat based on the proposed method of leaving boulder sized materials in these areas following dredging. Areas in the harbour with boulder sized materials were identified as favourable habitats for important fisheries species and SAR in the harbour, including lobster and wolffish. Positive environmental effects associated with the Project include:

- Creation of new habitat for fish, marine mammals, and turtles in the Vardy's Rock dredge area due to the removal of Vardy's Rock
- Creation of new rock habitat in the new footprint of the Pikes Island Breakwater
- Alteration of habitat in the South Turning Basin and Baldwin Rock dredge areas may provide increased habitat function in these areas over time

Adverse residual environmental effects associated with the Project, after implementation of the mitigation measures listed in Section 7.3.2, are described in the following subsections.

7.3.3.1 Marine Water and Sediment Quality

Temporary adverse effects are anticipated to occur to marine water and sediment as a result of the Project following the implementation of mitigation measures. The environmental effects are anticipated to be small in magnitude and restricted to the immediate Project Area. The environmental effects will occur intermittently during the construction phase (medium-term) and the effects of the disturbance are reversible as fine sediments are anticipated to settle to bottom relatively quickly (i.e., a period of days) following disturbance.

7.3.3.2 Fish and Fish Habitat

Altered fish habitats are anticipated to fully recover over a period of years; however, based on studies of artificial reef habitats, lobsters and other fish species can be expected to return to the Project Area and move into the altered and created habitat within a few weeks or months (Briggs and Zawacki, 1974; Scarratt, 1968; Sheehy, 1976; Bailey-Brock, 1989). Marine fish and fish habitat in

the dredge areas are common in the harbour and the new rock habitats are anticipated to return to function following a few years of recruitment and colonization. Habitat offsetting reduces the magnitude of this effect to small or moderate. The geographic extent of the effect will be limited to the immediate footprint of the Project Area. The effect will occur over the construction period and, during both low and high sensitivity time periods; therefore, timing is considered moderate and duration will be medium- to long-term. Frequency of effects on fish habitat is once, as the effects will occur once in each area, and the effects are reversible; a temporary reduction in fish habitat productivity will be mitigated and offset by an overall net gain after the altered and newly created habitats reach productive capacity.

Underwater noise emissions are anticipated to adversely effect fish even with the implementation of mitigation measures. Blasting required to remove rock from the dredge areas will increase the risk of mortal or potentially mortal injuries to fish and invertebrates in the Project Area. The magnitude of the effects of noise emissions is large, and the geographic extent is local. The effect will occur during both low and high sensitivity time periods. With mitigation, the effect will occur intermittently during the construction period and duration is medium-term. Any fish mortality will be irreversible; however, the conditions that cause the effects are reversible as noise emissions return to baseline conditions following the completion of Project components that generate emissions.

7.3.3.3 Marine Mammals and Turtles

Effects of underwater sound on marine mammals known to occupy the region differ by group. Drilling adversely effects VHF cetaceans at the greatest distance from the noise source. Harbour porpoise are known to occupy the region from May to December and may be present in ice-free portions of the Cabot Strait during the winter months (JASCO, 2018). LF cetaceans are impacted at the greatest distance from the sound source by blasting and dredging. These organisms detect sound at lower frequencies than HF and VHF cetaceans and phocids.

Mitigation measures reduce the magnitude of the residual effects. Noise generated in the inner harbour is not likely to affect many individuals in the Cabot Strait as TTS and PTS occur over a narrow area and TTS does not extend far beyond the harbour; behavioural responses extend into the strait over a wider area, but the anticipated levels of noise won't exclude marine mammals or turtles from occupying the strait. The magnitude of effects to marine mammals and turtles from activities in the inner harbour is considered small to moderate and the geographic extent is local to regional. The volume of material to be removed through drilling, blasting, and dredging requires these activities to be undertaken year-round; therefore, the effects in the inner harbour are considered moderate to high sensitivity with respect to timing. With mitigation, the effect will occur intermittently during the construction period and duration is medium-term. The effects include reversible (i.e., TTS, behavioural effects) and irreversible (i.e., PTS) effects.

The magnitude of the effects to marine mammals from drilling, blasting, and dredging in the outer harbour is moderate. The geographic extent of the noise effects is regional in scale. Timing of the

drilling and blasting in the outer harbour to occur outside of when most marine mammal species may be present reduces the timing sensitivity to low. The duration of the noise effects from construction in the outer harbour is short-term as they occur only during a portion of the construction period, and the frequency of the effect is intermittent. The effect of noise is reversible as the marine environment will return to baseline conditions following the completion of construction.

7.4 Terrestrial Environment

The Terrestrial Environment was selected as a VC because the Project will involve land-based activities on Vardy's Rock and Pikes Island and marine-based activities that could affect birds. These activities have the potential to affect wildlife, primarily migratory birds. Project activities proposed to occur during site preparation (e.g., removal of soil overburden) and construction (e.g., blasting, excavation, transportation of excavated materials, etc.) are anticipated to affect one or more of the subcomponents comprising the Terrestrial Environment VC. These subcomponents include the following:

- Soils and geology
- Vegetation
- Wildlife

Potential effects that the Project may have on these terrestrial subcomponents are described in Section 7.4.1. The temporal and spatial boundaries for the Terrestrial Environment have been defined for each individual subcomponent, as these boundaries vary based on Project timing and the zone of influence. No SAR have been identified in the Project Area, and there is little or no potential for interaction with terrestrial SAR.

Several potential environmental effects to the Atmospheric Environment and Marine Environment VCs are pathways for effects to the Terrestrial Environment VC.

7.4.1 Pathways of Potential Environmental Effects

7.4.1.1 Soils and Geology

Site preparation and construction activities on Pikes Island will result in soil disturbance and potential changes to soil quality, and removal of Vardy's Rock will result in changes to soil quantity within the Project Area. Exposed soils, if not properly mitigated, can be subject to wind erosion and contamination from accidental equipment leaks, both of which can lead to reduced soil quality. It is anticipated that approximately 17,250 m^3 of overburden will be removed from Vardy's Rock and transported offsite to be disposed of at an approved facility. There is potential for soils to be dispersed to other areas during removal, resulting in the potential increase of contaminant levels where particulates are deposited.

After the overburden removal on Vardy's Rock is complete, construction activities will take place primarily in the marine environment and will not interact with soils or geology. Much of Pikes Island

may be used for construction staging, which could lead to soil disturbances and changes in soil quality from accidental leaks or spills.

7.4.1.2 Vegetation Communities and Habitat Types

The main impact of the Project on vegetation communities and habitats will occur as a result of direct habitat loss and alteration, which will occur during the site preparation phase of the Project. Prior to construction, vegetation on Vardy's Rock will be removed along with the overburden and it is expected that some vegetation removal will be required on Pikes Island to establish staging areas for construction, resulting in the loss of vascular plants and vegetation communities in the Project area. Disturbance to, and alteration of, vegetative communities is assumed to potentially include all of Pikes Island.

Project construction activities on Vardy's Rock and Pikes Island will result in the removal of herbaceous and shrub habitat types, leading to the loss of terrestrial habitat in the Project Area. Most of the vegetation identified on Vardy's Rock is common in the region. Overburden stripping on Vardy's Rock will lead to the removal of rocky shoreline habitat and associated vegetation, including lichens. Although rocky shore habitat will be lost on Vardy's Rock, it is anticipated that new rocky shore habitat will be created on Pikes Island from the use of dredged rock to construct the infill and breakwater.

The composition of vegetation communities on Pikes Island could be altered during site preparation and construction activities should invasive plant species become unintentionally introduced via seed transport on machinery and heavy equipment. Construction activities, such as excavation, blasting, upgrading of existing access road (addition of gravel and grading), will generate dust.

Adverse effects to lichens (i.e., loss of abundance and diversity) are anticipated to be negligible on Pikes Island. Many lichen species are epiphytic and are most abundant in forested areas. Lichen diversity is also known to be higher in mature and old growth forests, with many species only occurring in these habitats (Lesica et al., 1991; McMullin et al., 2008). Pikes Island does not have forested habitat and the three species of lichens identified on Pikes Island (Maritime sunburst lichen, Peppered rocktripe lichen, and pincushion sunburst lichen) were observed growing on rocks within the rocky shoreline habitat. The additional placement of dredged rock along the breakwater and within the infill area of Pikes Island could create new habitat for lichens to colonize, potentially resulting in positive effects (i.e., increased abundance and diversity) to lichens on Pikes Island.

7.4.1.3 Wildlife

Medium and large sized terrestrial mammals have not been observed on Vardy's Rock. Terrestrial mammals present on Vardy's Rock are limited to smaller rodents and mink. Site preparation activities may lead to abandonment of habitat on Vardy's Rock and the spread of these mammals into surrounding habitat. Terrestrial wildlife that will experience the greatest adverse impacts from the Project will be those that regularly use the habitat on each island. Since birds utilize habitat on Vardy's Rock and Pikes Island, and the marine environment in the harbour, birds (and bird habitat)

will be adversely affected by the Project. Potential environmental effects on birds and their habitat may occur during all Project phases and are anticipated to include the following:

- Change in habitat (loss and/or alteration)
- Change in mortality risk
  - Nest destruction, disturbance, or abandonment
  - Injury and accidental mortality
- Change in behaviour from sensory disturbance (e.g., noise)

Habitat Loss and Alteration

Habitat loss, alteration, and disturbance will occur during site and construction activities previously discussed in Section 7.4.1.2. The removal of Vardy's Rock will result in the permanent loss of nesting habitat for two marine species that have been confirmed to nest on the island: Great Black-backed Gulls and Herring Gulls. While the loss of this habitat is a recognized Project effect, the alternatives assessment concluded that retaining Vardy's Rock would not achieve the Project's navigation objectives. As a result, avoidance of this effect through retention of the feature was not considered feasible within a design capable of providing the required navigation improvements. The Project therefore incorporates mitigation measures to reduce effects on migratory birds where practicable, while achieving the navigation safety objectives that underpin the Project.

Shorebirds and waterbirds that forage within the intertidal zone and may be affected by the loss of rocky shoreline habitat on Vardy's Rock include Great Black-backed Gulls, Herring Gulls, Purple Sandpiper, and Greater Yellowlegs. Greater Yellowlegs were confirmed using the rocky shore habitat on Vardy's and Pikes Islands for foraging during the September 2020 migration surveys. In addition to the loss of potential foraging habitat, construction activities may result in the loss of overwintering habitat for Purple Sandpipers. While no Purple Sandpipers were reported within the assessment area during surveys completed for this Project, Canadian Wildlife Service (CWS) has reported Purple Sandpiper overwintering habitat within 2 km of the Project Area. As the coastal habitat in Port aux Basques Harbour is very similar to that of the surrounding area, it is possible that Purple Sandpipers may lose access to overwintering habitat in Port aux Basques Harbour as a result of construction activities.

While the loss of habitat on Vardy's Rock will be permanent, the loss or alteration of habitat on Pikes Island is anticipated to be temporary. Habitat loss and alteration will primarily occur within the Project Area boundaries, with the exception of laydown areas, which may occur outside the Project footprint.

Injury and Accidental Mortality

Site preparation and construction activities on Vardy's and Pikes Islands during the breeding season can result in adverse impacts to breeding birds, as well as their nests and eggs. Removal of overburden could result in the destruction of nests and disturbance to nesting migratory birds if mitigation measures are not implemented prior to the commencement of site preparation activities. The use of heavy machinery and the presence of workers and associated noise within the Project

Area could also disturb land and marine birds that are already nesting in the area and lead to the abandonment of breeding habitat and nests. Injury or accidental mortality may also occur in the event of accidental spills or leaks.

Sensory Disturbance and Behavioural Changes

Noise emissions will be produced as a result of site preparation and construction activities. Noise emissions could result in sensory disturbance to birds and adversely impact birds as follows (Ortega, 2012):

- Stress responses
- Fright-flight responses
- Avoidance response
- Behavioural changes
- Changes in reproductive success

Noise modelling for the Project used the frequency weighted sound exposure level accumulated over 24 hours (h) ($SEL_{w,24h}$) to determine the zone of influence where noise from blasting could result in PTS in birds. Modelling indicated that the PTS was not reached at distances greater than 10 m from the blast. The zone of influence in which birds may be affected by noise emissions associated with blasting likely extends in the range of 2 to 3 km beyond the Project Area at a dBA which may result in behavioural changes in birds but not PTS. It is likely that birds will avoid the Project Area, and potentially the assessment area, during blasting activities and PTS in birds is not expected to occur as a result of the Project.

Effects to birds in the Grand Bay West to Cheeseman Park IBA are expected to be minimal. Direct impacts to breeding birds, nests, and eggs are not anticipated since the IBA is outside the Project footprint. There is potential that noise from blasting could result in behavioural changes in birds using the IBA, which is located approximately 2.5 km west of the Project Area; however, any changes are expected to be temporary and intermittent.

Lighting may be used on site on or near trailers and for safety at the staging areas. Additional sources of light include lights on barges and vessels operating within the Project Area. Light is known to attract migrating birds, and this attraction may increase the risk of bird collisions with structures and machinery on site (van de Laar, 2007). Certain species may also be attracted to cleared or stockpiled materials.

No Project activities will occur within Piping Plover critical habitat. Activities are not expected to affect Piping Plover habitat; however, marine vessel activities and worksite access will avoid beaches containing designated critical habitat.

7.4.2 Mitigation of Project Environmental Effects

Mitigation measures to avoid or reduce the potential adverse environmental effects identified for the subcomponents comprising the Terrestrial Environment VC are outlined in Sections 7.4.2.1 to 7.4.2.4.

7.4.2.1 Soils and Geology

- Excavated/dredged rock will be reused within the Project Area, where possible.
- Soils impacted via spills and releases will be handled and disposed of in accordance with applicable environmental regulations and legislation.
- Waste materials will be disposed of in an environmentally acceptable manner, and in compliance with all local and provincial laws and regulations.
- Any new material used for the proposed of construction will be clean and devoid of contamination.
- Material will be handled and stored in a manner applicable to relevant regulatory requirements.
- Equipment and vehicles will be inspected for spills or leaks regularly.
- Refer to Section 7.4.2.1 for additional mitigation measures pertaining to soils.

7.4.2.2 Vegetation Communities and Habitat

The loss of, or alteration to, vegetation communities as a result of Project activities cannot be completely avoided. However, these effects can be reduced through implementation of best management practices and the following mitigation measures:

- To avoid the unintentional introduction or spread of invasive or exotic vascular plants, all equipment used on site should be cleaned to remove invasive species prior to arriving at the Project Area.

7.4.2.3 Wildlife

Direct impacts to wildlife, including birds and terrestrial mammals, can be mitigated through implementation of the following measures.

- A Wildlife Management Plan (WMP) will be developed prior to the commencement of construction, and the plan will include a contingency plan that identifies mitigation measures for migratory birds and SAR, a monitoring plan (including post-construction monitoring), details on bird deterrence measures that will be employed during construction, and emergency response procedures.
- Existing access roads will be used to reduce unnecessary disturbance.
- Avoid vegetation clearing, overburden removal and placement, and establishment of staging/laydown areas during the regional nesting period for migratory birds, which spans from mid-April to mid-August.
- If clearing and overburden removal during the regional nesting period for migratory birds cannot be avoided, the use of bird deterrents, active monitoring, and regulatory consultation will be implemented.

- Should clearing occur during the breeding season, an area search is recommended prior to the commencement of cutting/grubbing to mitigate disturbance to nesting habitat.
- If a nest is identified on site during the area search, site preparation, or construction, a species-specific buffer will be established around the nest, site preparation or construction activities within the buffer area will cease, and CWS will be contacted for further advice. Nests should not be marked with flagging tape or other similar material in order to avoid nest predation.
- High disturbance activities (e.g., in-air drilling and blasting) required for the removal of the portion of Vardy's Rock above water will occur prior to the start of regional nesting period for migratory birds, if feasible. All other drilling and blasting will occur under water and is not expected to be a high disturbance activity for breeding birds.
- If activities during the breeding season cannot be avoided, the following buffers are generally recommended by ECCC for breeding landbird SAR and nests:
  - Low disturbance activities – 50 m (e.g., site monitoring)
  - Medium disturbance activities – 150 m (e.g., sensory disturbance)
  - High disturbance activities – 300 m (e.g., vegetation clearing, construction activities involving heavy equipment)
- Cover stockpiles to deter species of migratory birds that may nest in large piles of soil.
- Develop a plan for bird deterrence that will be implemented prior to blasting. Deterrence measures will be incorporated into the WMP and will include a combination of visual deterrents (e.g., flags, predator silhouettes, reflective devices) and acoustic deterrents (e.g., distress calls, horns) that are rotated regularly to reduce habituation.
  - Increased human presence associated with surveying, site preparation, equipment mobilization, and construction activities will naturally discourage birds from establishing nests within active work areas.
  - Routine movement of personnel, equipment, vessels, and construction machinery is expected to reduce the attractiveness of the site for nesting and loafing birds.
  - Work areas will be maintained in an active condition to discourage re-colonization by birds.
- Nighttime activities and use of artificial light at night between April and mid-November will be avoided, if feasible. If nighttime activities during this period are necessary, a site monitoring plan will be developed and implemented when artificial lighting is being used during night hours and will include monitoring for the presence of migratory birds.
- Where site lighting is required, it will be designed to reduce light disturbance to wildlife (particularly migratory birds). Securely contain food waste, refuse, and other wildlife attractants.
- Staff and contractors should not approach concentrations of seabirds, waterfowl, or shorebirds.
- Careful planning of access routes and reducing vessel speed when in the vicinity of a flock of birds is important to avoid disturbance.
- Vessels and equipment should be appropriately muffled to reduce noise disturbance. The Proponent should adhere to ECCC guidance on stranded migratory birds (ECCC, 2016, 2021).

If a migratory bird is found stranded on site, the Proponent will immediately contact ECCC for further advice at SCFATLEvaluationImpact-CWSATLImpactAssessment@ec.gc.ca.

- A handling permit will be obtained prior to handling any stranded birds.
- An EPP will be implemented and will include measures to prevent the deposit of oil, oil wastes, or any substance harmful to migratory birds, as well as a spill response and contingency plan.

7.4.3 Characterization of Residual Environmental Effects

Adverse residual environmental effects associated with the Project, after implementation of the mitigation measures listed in Section 7.4.2, are described in the following subsections.

7.4.3.1 Soils and Geology

The Project is anticipated to interact with soils quality and quantity during site preparation and construction activities. Although the Project will entail the removal of rock from Vardy's Rock and additional areas within the Project footprint, it is intended that the materials will be beneficially re-used, resulting in small to moderate changes relative to baseline conditions for soil quality and quantity, respectively. Impacts to soil and geology will be limited to the Project Area. The timing of effects to soils is low, and the duration short-term for soil quantity, as the effect will occur only during removal of overburden at Vardy's Rock, to medium-term for soil quality, which could occur at any time during construction. Effects to soil quality will be intermittent, potentially occurring more than once, while effects to soil quantity will occur once. Effects on soil quality are reversible, while effects on soil quantity are irreversible, as Vardy's Rock will be permanently removed.

7.4.3.2 Vegetation Communities and Habitat

The main impacts to vegetation and habitat will occur during overburden removal on Vardy's Rock and staging/laydown establishment on Pikes Island, if required for construction staging areas. The amount of change these activities will have on vegetation over the broader assessment area will be small and will be limited to the Project footprint. The timing of the effects will be low, the duration short-term, and will occur once during the site preparation stage of the Project. The effect with this is irreversible.

7.4.3.3 Wildlife

Impacts to birds and wildlife will occur throughout site preparation and construction. Change in habitat has the same characteristics as change in vegetation. The magnitude of change in mortality risk and behaviour is anticipated to be moderate and local. Activities that will affect wildlife, including migratory birds, will occur during the winter outside of the breeding bird season; therefore, the sensitivity of timing for change in mortality risk is low. Project activities that can result in behaviour changes will occur during low, moderate, and high sensitivity periods. The duration of change in mortality is short-term, as it will occur primarily during site preparation. The duration of change in behaviour is medium-term, as it will occur throughout construction but is not anticipated to persist beyond the construction phase of the Project. Change in mortality risk will occur once, during site preparation. Change in behaviour will occur intermittently, particularly during periods of

blasting. Adverse effects of the Project on birds and wildlife are generally anticipated to be reversible.

7.5 Socio-Economic Environment

The Socio-economic Environment VC considers potential impacts of the Project to the health and livelihood of the local community. This VC includes the following subcomponents that could be affected by changes to the environment as a result of site preparation, construction, and operation:

- Economic conditions
- Infrastructure and services
- Navigation
- Fishing
- Human health

The Project will be carried out primarily in the marine environment and the Project Area is adjacent to the Town; therefore, the atmospheric VCs is a key pathway when considering how the Project components will affect human health. Additionally, impacts to the marine VC that affect fish and fish habitat are pathways to affect fisheries.

7.5.1 Pathways of Potential Environmental Effects

7.5.1.1 Economic Conditions

Overall, the town has responded favourably to the proposed improvements as there are many benefits associated with its implementation. During construction, the Project will result in a positive change in local economic conditions through employment and expenditure activities in the Town. Benefits will include increased employment rates and income paid to workers through direct and indirect employment. Direct employment refers to employees working at the Project site during construction, while indirect employment refers to employees working for Project supplier companies and additional employment resulting from Project-related increases in consumer expenditures. Construction activities will provide an opportunity for employment of local residents through the procurement of local services, including site preparation, equipment servicing, and other construction support services. During construction, workers may temporarily relocate to Channel-Port aux Basques, contributing to the local economy.

After construction, the deep-water port with reduced navigational obstructions will reduce the risk of cancellations due to limited maneuverability and weather conditions within the harbour and may encourage more marine shipping, transportation, and tourism in Channel-Port aux Basques.

7.5.1.2 Infrastructure and Services

Hydrodynamic modelling (Appendix C) shows that the Pikes Island Infill and the repaired and upgraded breakwater will directly improve existing infrastructure as it is critical infrastructure for the protection of the inner harbour. Currently, Vardy's Rock, combined with the existing breakwater, provides shelter to the inner harbour from wind and wave action; the Pikes Island Infill

and upgraded breakwater will offset the loss of Vardy's Rock. Further, the Pikes Island Infill will provide a base for future development of coastal infrastructure, such as a marina, providing economic development benefits to the Town and the region.

A possible increase of temporary workers during the construction period will require accommodations and rely on community infrastructure and services during construction of the Project; however, the population of Channel-Port aux Basques and the Town infrastructure will be capable of supporting the increase. There will be increased traffic on the highway due to equipment mobilization during site preparation and marine construction, transportation of residual wastes (soils and rock) and later demobilization of equipment, though these increases will be temporary and will subside once the activities have concluded.

Vibrations will be caused during construction by drilling and blasting and to a lesser extent, excavation. Vibrations in the ground, when they reach certain peak particle velocities (PPV), can result in damage to buildings and other infrastructure. The potential for structural damage as a result of blasting or drilling is related to a variety of factors, including blasting size and pattern and the substrate conditions that contribute to the PPV. Typical PPV limits are generally protective of structures with foundations on rock (Norén-Cosgriff et al., 2020).

7.5.1.3 NAVIGATION

The Project will improve navigation conditions for the MAI ferry operations by eliminating a narrow and shallow area at Baldwin Rock and removing the significant obstruction caused by Vardy's Rock. These navigation improvements will provide room for vessel maneuverability, enhance marine operations and efficiencies, and improve navigational safety.

There may be an increased risk of collisions for vessels due to increased activity in the harbour during the construction phase. After the channel improvements are completed, some of the existing impediments to navigation in the harbour (Vardy's Rock, shallow areas) will be removed which will be a positive change.

Navigation within the harbour may be restricted and navigation routes of fisheries and recreational boaters may be altered during construction. While the removal of Vardy's Rock may modify wave conditions in the harbour, which could reduce boating activities, modelling shows that the Pikes Island Infill and upgrades to Pikes Island Breakwater will mitigate this change such that wave conditions will be similar to existing conditions.

7.5.1.4 FISHERIES

Construction activities can displace recreational and commercial fisheries within the harbour through loss of access. Lobster are the primary species known to be commercially targeted inside the harbour and were identified in the harbour during the habitat survey. Local fishers also stated that mackerel and herring are fished in the harbour. Recreationally targeted finfish, including Atlantic cod, pollock, and mackerel, were also observed in the harbour. Existing fisheries in the inner

harbour will be curtailed during construction, which are anticipated to take 12 months to complete and will therefore extend over two seasons of peak fishery activities. During this period, fishing can continue to occur outside Port aux Basques Harbour, which will increase the time and travel distance required for fishers that would normally fish inside the harbour. Drilling and blasting activities in the outer harbour will be scheduled to occur during the winter months and are not expected to result in a change to the fishery of Port aux Basques Harbour.

Adverse environmental effects to fish habitat described in Section 7.3.1 and 7.3.3 have the potential to affect fisheries in the Project Area and in the harbour. These adverse effects are expected to subside after construction is completed and the altered habitat is expected to increase productivity of some species, such as lobster, which could potentially result in increased catches over time. The new fish habitat will be constructed to provide habitat that increases refuge for juvenile lobsters, increasing the survival rate to the minimum size that can be commercially harvested. Juvenile and adult lobsters are expected to return to repopulate the dredged areas within a few months of completion of construction; however, an increase in the production of adults available for commercial fishery will not be realized for at least 8 to 10 years, the time required for juveniles to reach legal size for commercial harvest (DFO, 2016).

After completion of construction, fishers will be able to resume fishing activities in the Port aux Basques Harbour; however, the exclusion zone for fishing will increase to cover the new turning basin and wider navigation channel. Good lobster habitat is available throughout the harbour, and fishing can resume in areas outside this exclusion zone.

7.5.1.5 HUMAN HEALTH

Impacts to human health are related to changes to the atmospheric environment (air quality and noise). Atmospheric emissions, while they will occur, will not result in substantial changes to air quality that will affect human health.

Acoustic modelling predicted that most of the Town Centre will experience noise levels in the range of 60 to 90 dBA during blasting on Vardy's Rock (JASCO, 2021; Appendix L). These noise levels follow Health Canada's (2023) guideline of 125 dB for blasting. Project noise generation will not be at a level that presents a risk to hearing loss of residents of the Town Centre, since noise levels associated with hearing loss (> 140 dBZ for adults and 120 dBZ for children) recommended by the world Health Organization and followed by Health Canada (2023) are not predicted to occur outside the Project Area (JASCO, 2021; Appendix L). Noise levels during other construction activities could reach annoyance levels in the Town. Residential areas are the most sensitive receptors for noise impacts, as these areas tend to include sensitive receptor locations (e.g., daycare centres, hospitals, and seniors' residences) and highly sensitive receptors (e.g., children, sick people, and the elderly) (Heath Canada, 2023). The nearest hotel is approximately 400 m from Vardy's Rock and noise modelling indicates that sound levels at the hotel could reach peaks of 115 dB during blasting. The nearest school and hospital are located approximately 2 km northeast of the Project Area. Health Canada (2023) notes that widespread complaints within a community may occur when Project noise

reaches 62 dBA, and complaints can be expected to reach strong appeals in exceedance of 75 dBA. Should construction occur at night, sound levels within this range would also lead to sleep disturbance.

7.5.2 Mitigation of Project Environmental Effects

In addition to mitigation measures to avoid or reduce potential environmental effects on atmospheric, marine and terrestrial VCs, the following measures and standards will serve to mitigate the potential adverse effects associated with the Socio-economic Environment VC:

- Notification of activities to mariners.
- Model the peak particle velocities (PPV) and identify infrastructure that may be affected by vibration, conduct pre-blast surveys of such infrastructure, monitor vibration levels in the zone of influence and at sensitive receptors, and develop and implement a noise and vibration management and monitoring plan as part of the Environmental Protection Plan for the Project.
- Implement an environmental protection plan, waste management plan, health and safety plan, and emergency response plan to abate pollutant release and to protect workers and the public.
- Establish safety perimeter within the Project construction zones.

Other mitigation measures that may be applied include:

- Engagement and communication with local fishers
- Engagement and communication with the community and general public
- Engagement with Transport Canada with respect to relocation of navigation aids
- Hiring of qualified local workers and providing applicable on-the-job training
- Employment of local fishers for fish rescue and relocation program

7.5.3 Characterization of Residual Environmental Effects

The Project will eliminate a significant obstruction to navigation in Port aux Basques Harbour. The Pikes Island Infill and breakwater repairs and upgrade will offer protection to the harbour and provide a base for future economic development. New fish habitat will be created and fish habitat that is altered will be designed to support important fisheries species in the harbour, primarily lobster. Positive environmental effects associated with the Project include:

- Improved navigation with entrance channel designed to international accepted guidelines
- Increased employment and future economic development opportunity
- Increase survival rate of juvenile lobsters, leading to increase in adult lobster catch per unit effort over time

Adverse residual environmental effects associated with the Project, after implementation of the mitigation measures listed in Section 7.5.2, are described in the following subsections.

7.5.3.1 INFRASTRUCTURE AND SERVICES/NAVIGATION

Adverse effects to infrastructure and services and to navigation can be avoided through the implementation of the mitigation measures listed in section 7.5.2 and therefore the residual environmental effects are positive. Any adverse environmental effects are expected to be small in magnitude, restricted to the local area, short-term, occurring once or intermittently, and reversible. The positive effects are considered long-term, continuous, and irreversible.

7.5.3.2 FISHERIES

The overall long-term residual environmental effects will be positive as the removal of Vardy's Rock will result in new fish habitat that will potentially increase yields in the Project Area and habitat offsetting will potentially increase yields in the region. However, adverse effects are anticipated as a result of marine construction activities. These activities will affect a relatively small proportion of active fishers and fishing is available outside of the harbour. The environmental effects are small to moderate in magnitude and local in geographic extent. The timing occurs over at least one year of fishing, so the timing sensitivity is high and the duration is medium- to long-term, as the fishery in the harbour can resume after construction is completed, but the turning basin and navigation channel will be permanent exclusion zones for fishing and productivity in the harbour will be reduced until the habitat reaches a productive capacity that is the same as the baseline. Project environmental effects will be continuous during construction but are reversible.

7.5.3.3 HUMAN HEALTH

Drilling and blasting will be managed in accordance with Health Canada guidelines such that annoyance levels are avoided where possible, however the noise impacts of the construction activities will be difficult to fully mitigate. Feasible noise attenuation to reduce annoyance levels may not be possible. The magnitude of the residual adverse effects will be moderate and local. The sensitivity to the timing is low to moderate, duration is medium-term, and frequency is intermittent to continuous. Project effects on human health as a result on construction noise are considered reversable.

Chapter 8 Summary

This EARD/EEE documents the environmental effects assessment of the Port aux Basques Navigation Improvement Project. The Project components and activities are described, and the potential environmental effects of the Project are assessed in accordance with the requirements of the NL EPA and Section 82 of the federal IAA.

Valued components (VCs) are identified and the potential for the Project to interact with the VCs are assessed. The assessment used qualitative and, where possible, quantitative analysis to estimate the magnitude and extent of the potential environmental effects. Mitigation measures are identified to avoid or reduce adverse environmental effects. Some of the mitigation measures are incorporated into the Project design; others will be incorporated into Project construction specifications.

Residual environmental effects that are predicted to occur following the application of mitigation measures include both positive and adverse environmental effects. The residual environmental effects are characterized based on criteria defined in Chapter 5. The characteristics and an evaluation of the significance of the residual environmental effects are summarized in Table 8.1.

Table 8.1 Summary of residual environmental effects characteristics and significance

Valued Component (VC)	Residual Environmental Effect	Characteristics							Significance of Residual Environmental Effect[8]
		Direction[1]	Magnitude[2]	Geographic Extent[3]	Timing[4]	Duration[5]	Frequency[6]	Reversibility[7]	
Atmospheric Environment	Change in air quality	N	S	L	L	S	I	R	NS
	Change in acoustic environment	N	M/L	L	L/M	M	I/C	R	NS
Marine Environment	Change in marine water and sediment quality	N	S	I	L	M	I	R	NS
	Change in fish habitat	P	S/M	I	M	M/L	O	I	NS
	Change in mortality risk	N	S/L	L	L/H	M	I	R/I	NS
	Change in behaviour	N	S/L	L/R	L/H	M	I	R	NS
Terrestrial Environment	Change in soil quality	N	S	I	L	M	I	R	NS
	Change in soil quantity	N	M	I	L	S	O	I	NS
	Change in vegetation	N	S	I	L	S	O	I	NS
	Change in habitat	N	S	I	L	S	O	I	NS
	Change in mortality risk	N	M	I	L	S	O	R	NS
	Change in behaviour	N	M	L	L/H	M	I	R	NS

Valued Component (VC)	Residual Environmental Effect	Characteristics							Significance of Residual Environmental Effect[8]
		Direction[1]	Magnitude[2]	Geographic Extent[3]	Timing[4]	Duration[5]	Frequency[6]	Reversibility[7]	
Socio-economic Environment	Change in economic conditions	P	S	L	M	M	C	R	NS
	Change in infrastructure and services	P	S	L	L	L	C	I	NS
	Change in navigation	P	S	I	L	L	C	I	NS
	Change in fisheries	N/P	M	L	H	L	C	R	NS
	Change in human health	N	M	L	L/H	S	I	R	NS

Notes:

1. **P = Positive:** beneficial for the VC
   N = Negative: adverse for the VC
2. **S = Small:** at, or nominally above, baseline conditions
   M = Moderate: exceeds baseline conditions but does not exceed established regulatory criteria or published guidelines
   L = Large: exceeds established regulatory criteria or published guidelines
3. **I = Immediate:** limited to the Project Area
   L = Local: extends beyond the Project Area boundary but is within the municipal boundary
   R = Regional: will occur on a regional scale
4. **L = Low:** occurs during low or non-sensitive periods
   M = Moderate: occurs during moderately sensitive periods
   H = High: occurs during highly sensitive periods
5. **S = Short-term:** occurs only during the site preparation or a portion of the construction phase
   M = Medium-term: occurs throughout construction
   L = Long-term: will persist beyond the construction phase
6. **O = Once:** the conditions or activities causing the effect to occur once
   I = Intermittent: the conditions or activities causing the effect to occur intermittently
   C = Continuous: the conditions or activities causing the effect to occur continuously throughout the Project phases
7. **R = Reversible:** readily reversible
   I = Irreversible: permanent
8. **S = Significant:** potentially significant
   NS = Not significant: not significant

The key positive environmental effect of the Project is the improvement to navigation. The Project will eliminate the primary obstruction caused by Vardy's Rock, which will significantly enhance navigation conditions by providing room for vessel maneuverability, enhance marine operations and efficiencies, and improve navigational safety. The inclusion of secondary improvement measures that widen and deepen the navigation channel at Baldwin Rock and deepen the inner harbour turning basin will further improve the navigation conditions as part of this Project.

Other positive effects of the Project include economic benefits through employment during construction and potential future development that would benefit the local economy of Channel-Port aux Basques. The Project also improves the existing breakwater to provide protection of the harbour infrastructure from wind and wave action. Further, the creation of new fish habitat combined with the off-site creation of lobster habitat in the region will increase available habitat for juvenile lobster, which, in the long-term, will increase lobster productivity and benefit the local lobster fishery.

The primary adverse environmental effects are associated with noise, both above and below water, that will occur during construction. The environmental effects on the fish and fish habitat, as well as safety zones required during construction, will adversely affect the local fishery over the medium term; however, as noted previously, with mitigation measures the adverse effects will be offset over the long term. If any or all of the secondary objectives are not completed, the residual environmental effects of the Project are expected to be reduced in geographic extent and duration. Overall, based on the results of the environmental effects assessment, the residual adverse environmental effects of the Project will not be significant.

A monitoring program will be developed to verify the effectiveness of mitigation measures and measure compliance with regulatory requirements. Programs implemented during construction will include monitoring the turbidity of marine water, monitoring noise and vibration, as well as monitoring the success of the mitigation measures for fish and fish habitat. Post-construction monitoring will include monitoring the success of offsetting measures for fish habitat.

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APPENDIX A

Preliminary Design Drawings

APPENDIX B

Hydrodynamic Modelling Reports

APPENDIX C

Bathymetry & Sub-bottom Profile Data

APPENDIX D

Sediment Report

APPENDIX E

UBHS Data (Dredge and Rock Placement Locations)

APPENDIX F

Fish and Fish Habitat Reports

APPENDIX G

Atlantic Canada Conservation Data Centre Data Report

APPENDIX H

Geotechnical Reports

APPENDIX I

Soil Sampling Program Report

APPENDIX J

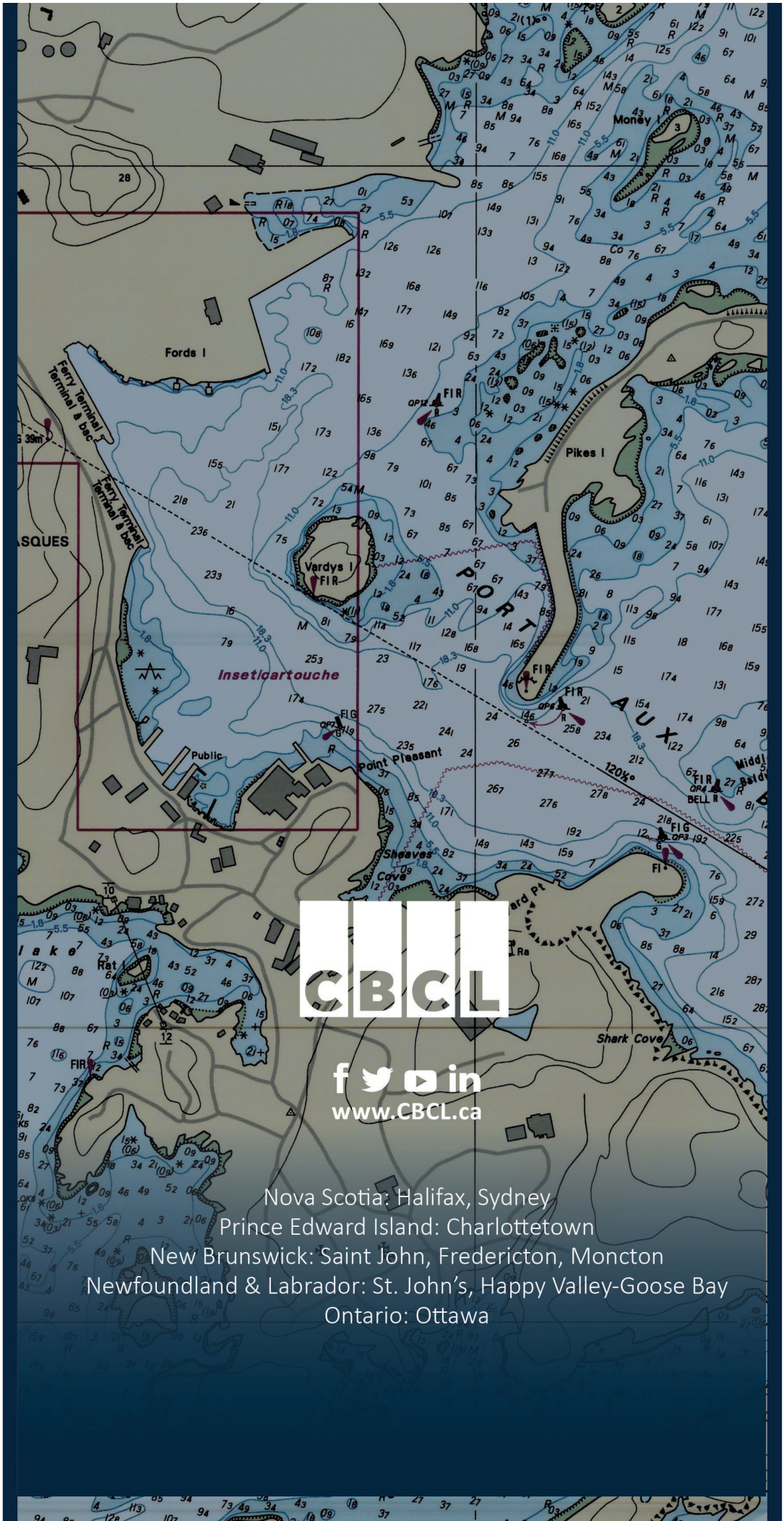
Plant and Lichen Report

APPENDIX K

Wildlife Report

APPENDIX L

Marine Acoustic Assessment



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