Ephesus Prospect Controlled Source Electromagnetic (CSEM) Survey

Environmental Assessment Report

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Abbreviations

µV/m	microvolt per metre
A	ampere
The Accord Acts	*Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act*
BP Canada	BP Canada Energy Group ULC
CBD	Convention on Biological Diversity
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSEM	controlled source electromagnetic
CWS	Canadian Wildlife Service
dB	decibel
DFO	Fisheries and Oceans Canada
EA	environmental assessment
EBSA	Ecologically and Biologically Significant Area
ECCC	Environment and Climate Change Canada
EEZ	Economic Exclusion Zone
EL	Exploration Licence
EMF	electromagnetic field
EMGS	Electromagnetic Services ASA
FFAW-Unifor	Fish, Food and Allied Workers - Unifor
FSC	food, social and ceremonial
HSSE	health, safety, security, and environment
Hz	Hertz
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
km	kilometre
km^2	square kilometre
km/h	kilometre per hour
m	metre
m^2	square metre
mm	millimetre
MARPOL	International Convention for the Prevention of Pollution from Ships
MBCA	*Migratory Birds Convention Act, 1994*

NAFO	Northwest Atlantic Fisheries Organization
NL	Newfoundland and Labrador
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
nT	nanotesla
nV/cm	nanovolt per centimeter
OMS	Operating Management System
The Project	Ephesus Prospect CSEM Survey
ROV	remotely operated vehicle
SARA	*Species at Risk Act*
SBA	Significant Benthic Area
SMMO	seabird and marine mammal observer
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	sound pressure level
V	volt
V/m	volt per metre
VC	Valued Component

1.0 INTRODUCTION

1.1 Project Overview

BP Canada Energy Group ULC (BP Canada) is proposing to conduct a controlled source electromagnetic (CSEM) survey over Exploration Licences (ELs) 1145 and 1146 in the Orphan Basin offshore Newfoundland and Labrador (the Project) (see Figure 1.1). The Project will collect data that will be used to confirm prospectivity for a proposed future exploration drilling program within these ELs.

The Project will require an authorization as a geophysical survey from the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) pursuant to section 138 of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and section 134 of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the Accord Acts).

This document is an environmental assessment (EA) report that has been prepared to fulfill EA requirements of the C-NLOPB as part of the activity authorization process. It has been prepared in accordance with scoping guidelines developed by the C-NLOPB (C-NLOPB 2020) and submitted in accordance with the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019).

1.2 Regulatory Context

Marine CSEM surveys require a Geophysical Program Authorization (Electromagnetic Program Authorization) from the C-NLOPB pursuant to the Accord Acts. The application for this authorization requires, among other things, an EA of the proposed program. Marine CSEM surveys are not included on the *Physical Activities Regulations* listing physical activities that may require environmental assessment under the federal *Impact Assessment Act*. As a result, the EA process conducted as part of the Geophysical Program Authorization is led by the C-NLOPB under the Accord Acts. The Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019) provide information on the application and approval process for a Geophysical Program Authorization.

Other legislation relevant to the environmental aspects of this Project includes:

- *Species at Risk Act* (SARA)
- *Oceans Act*
- *Fisheries Act*
- *Canadian Navigable Waters Act*
- *Canada Shipping Act, 2001*
- *Canadian Environmental Protection Act, 1999*
- *Migratory Birds Convention Act, 1994* (MBCA) and regulations.

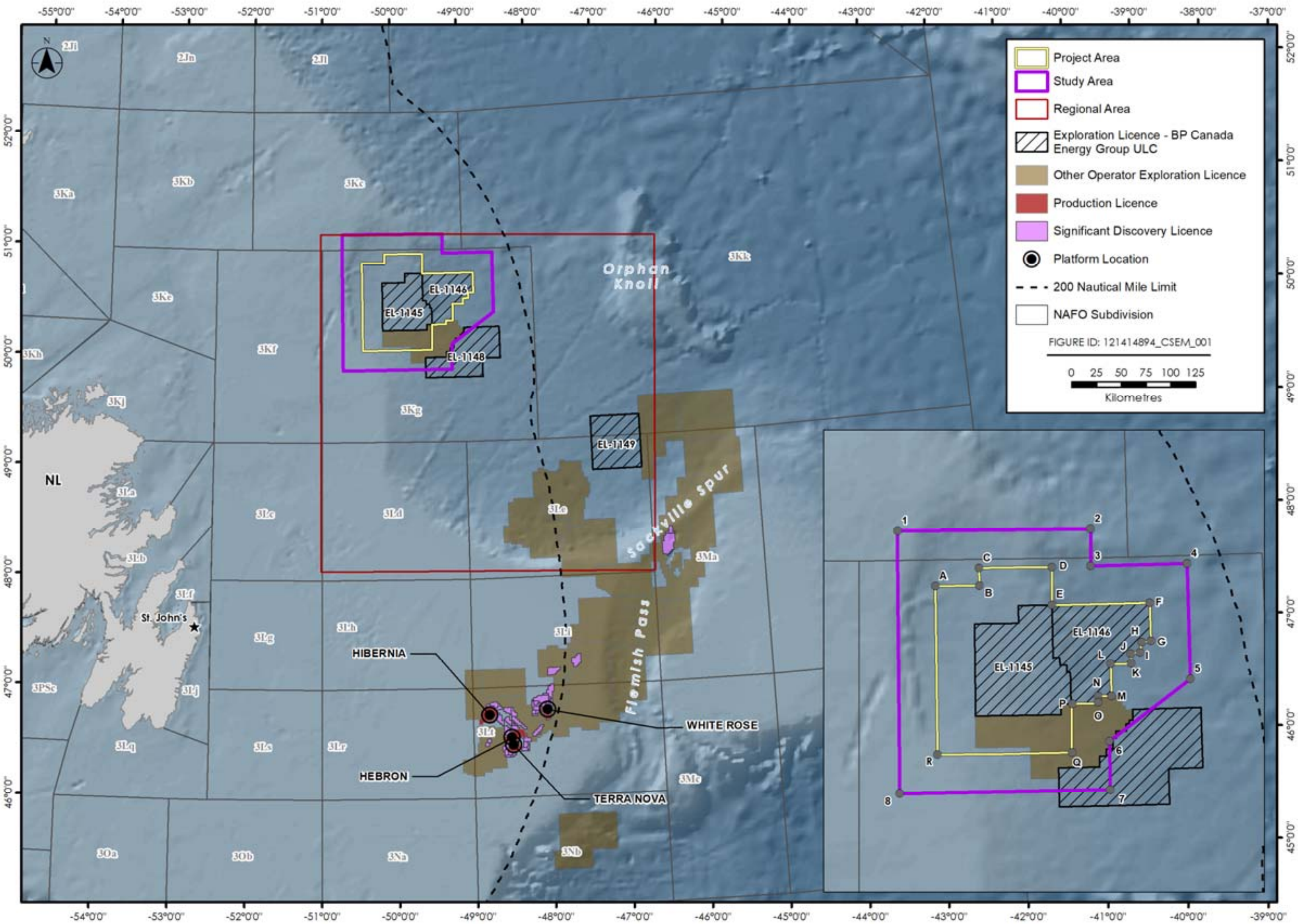


Figure 1.1 Project Location

1.3 Proponent Information

BP is a global energy company, operating in over 70 countries around the world, with well-established operations in Europe, North and South America, Australasia, Asia, and Africa. BP has decades of experience managing the extraction of oil and natural gas in all types of environments around the world, both onshore and offshore. In Canada, BP focuses on developing energy from Canada's oil sands and is also pursuing offshore opportunities in Newfoundland and Labrador (NL) and Nova Scotia.

BP Canada was awarded exploration rights to ELs 1145, 1146, 1148, with its co-venturers Noble Energy Canada ULC and Hess Canada Oil and Gas ULC, and EL 1149 with co-venturer Noble Energy Canada ULC by the C-NLOPB in 2016. BP and its co-venturers have been planning the Newfoundland Orphan Basin Exploration Drilling Program, with a focus on an initial well to be drilled in 2022. An environmental assessment for the drilling program was conducted under the *Canadian Environmental Assessment Act, 2012*. On February 12, 2020, the Minister of Environment released a Decision Statement to allow the drilling program to proceed in accordance with conditions included in the Decision Statement.

To help inform planning and decision making regarding the exploratory drilling program, BP Canada is currently planning to conduct the Project, which will help provide more information on the presence and extent of hydrocarbons below the seabed at prospective wellsite(s) within ELs 1145 and 1146.

1.3.1 How BP Operates

BP is dedicated to maintaining values of Safety, Respect, Excellence, Courage and One Team, upholding these values internally and externally in the areas it operates. BP's health, safety, security, and environment (HSSE) goals are: no accidents; no harm to people; and no damage to the environment. Safety is at the heart of everything BP does as a company, driven by leadership and applied across all operations through BP's Operating Management System (OMS) framework. Everyone who works for BP is responsible for their safety and the safety of colleagues, partners, suppliers, and local communities.

The BP Code of Conduct sets out the standards of behaviour and working in line with BP's values, defines how to work at a group, team and individual level within the company. With clear and concise content setting out the principles and expectations on topics such as equal opportunities, human rights and conflicts of interest, it helps BP's workforce to operate in line with BP's values and maintain the company's commitment to high ethical standards throughout its activities and operations. The BP Code of Conduct applies to all BP employees, officers and members of the Board, and BP expects and encourages all contractors and their employees to act in a way that is consistent with the BP Code of Conduct.

The OMS is a framework that brings together BP's global operating principles. It includes requirements for HSSE management, social responsibility and operational reliability, as well as requirements for other operational aspects, for example, maintenance requirements, contractor relations and organizational learning.

BP's OMS establishes the environmental and social requirements for BP's projects and operations. BP's OMS includes practices that set out requirements and guidance for how BP identifies and manages environmental, social, and human rights risks and impacts. It includes requirements for HSSE management, social responsibility, and operational reliability, as well as requirements for other operational aspects, for example, maintenance requirements, contractor relations, and organizational learning. Effective implementation of the OMS that delivers improved environmental performance is required to support BP's commitment to its long-term goal of "No Damage to the Environment".

The OMS helps BP to manage and reduce risks throughout its activities globally, as well as continuously improve the quality of its operating activities. It sets out consistent principles and processes that are applied across BP. Principles and policies under the OMS are designed to simplify the organization, improve productivity and enable consistent execution and focus throughout BP.

BP's ability to be a safe and responsible operator depends, in part, on the capability and performance of contractors and suppliers. Contractors and suppliers can make up a major part of the workforce throughout the life of a project or operation.

BP's OMS defines requirements and practices for working with contractors. As per BP's OMS, contractors are required to demonstrate conformance with the requirements that have been established, including HSSE standards, performance requirements, environmental commitments (such as environmental protection commitments made in this EA), and regulatory requirements (including, but not limited to compliance with the MBCA). Bridging documents are necessary in some cases to define how BP's safety management systems and those of BP's contractors will co-exist to manage risk on a project. Contractor safety performance is assessed and reviewed by BP using a number of leading and lagging indicators. BP Canada will carry out reviews and assurance activity throughout the duration of the Project. Of particular relevance to this Project is the Shipboard Oil Pollution Emergency Plan (SOPEP) that the contractor will maintain during execution of the Project. The SOPEP will consider the Canadian Standards Association (CSA) publication, Emergency Preparedness and Response, CAN/CSA-Z731-03 as well as Birds and Oil - CWS Response Guidance (ECCC 2017a), and will outline contingency measures to be implemented in the unlikely event of a spill to reduce the risk of adverse effects on the marine environment.

2.0 PROJECT DESCRIPTION

2.1 Purpose of the Project

BP Canada is proposing to conduct the Project over ELs 1145 and 1146 to help inform planning for the proposed Newfoundland Orphan Basin Exploration Drilling Program. CSEM uses electromagnetic remote sensing technology to map electric sensitivity distribution of the subsurface to help indicate the presence and extent of hydrocarbons below the seabed.

Hydrocarbon-bearing rock shows greater resistivity relative to water-bearing rock and thus areas that appear highly resistive may indicate the presence of hydrocarbons (Buchanan et al. 2011). With the presence of a resistive layer, such as a hydrocarbon-bearing rock, the electromagnetic signal can propagate back to the seabed with little attenuation (i.e., higher amplitude) when compared to the case where no such resistive layer is present (EMGS 2015).

Resistivity data provided using CSEM methods is used to assess the presence of geological structures and type of fluids in a reservoir, which, when combined with available seismic data, can provide information on the type and scale of hydrocarbon sources within a reservoir. Data from the proposed Ephesus Prospect CSEM Survey will be interpreted and used to confirm well prospectivity for BP Canada's proposed Newfoundland Orphan Basin Exploration Drilling Program.

2.2 Project Location

The Project Area has been defined to encompass ELs 1145 and 1146 in the Orphan Basin (see Figure 1.1). The "corner" coordinates (Degrees Minutes Seconds, WGS84 projection) of the Project Area are provided in Table 2.1 and illustrated on Figure 1.1. These boundaries have been expanded from those originally published in the Project Description (BP 2020) to account for survey vessel turning movements. Water depth in the Project Area ranges from 409 to 2,275 m; the majority of the Project will be conducted in an approximate water depth of 1,350 m.

Although survey design planning is still in progress, survey lines will be located within these ELs. It is anticipated that the survey lines will be approximately 75 to 80 km long and spacing will be approximately 3 km. Survey vessel operations related to the deployment, testing and operating of survey equipment and turning of vessel will remain inside the Project Area at all times. The only planned activity that will occur outside the Project Area is the transit of the survey vessel between a shorebase (St. John's, NL) and the Project Area at the beginning and end of the survey.

As described in Section 5.1, the spatial boundaries for this assessment also consider a Study Area, which has been delineated as a 20 km buffer around the Project Area to account for potential Project-related environmental effects.

Table 2.1 Project Area and Study Area Coordinates

Vertex	Coordinates - Degrees Minutes Seconds		UTM ZONE 22	
	X	Y	X	Y
Project Area				
A	50° 25' 59.510" W	50° 52' 45.804" N	539875.2128	5636565.761
B	50° 6' 29.476" W	50° 52' 47.238" N	562739.1657	5636835.854
C	50° 6' 31.271" W	50° 57' 46.381" N	562592.4853	5646075.607
D	49° 34' 0.985" W	50° 57' 41.852" N	600638.0019	5646535.152
E	49° 34' 26.109" W	50° 46' 59.718" N	600530.9452	5626691.874
F	48° 50' 56.068" W	50° 46' 59.690" N	651636.3469	5627927.42
G	48° 50' 56.086" W	50° 36' 14.685" N	652214.9554	5608007.066
H	48° 55' 3.591" W	50° 35' 59.671" N	647363.4295	5607404.435
I	48° 55' 48.598" W	50° 32' 59.654" N	646633.9641	5601820.055
J	48° 59' 56.104" W	50° 32' 44.469" N	641776.4039	5601217.422
K	48° 59' 56.111" W	50° 29' 59.470" N	641913.6924	5596121.625
L	49° 8' 56.117" W	50° 29' 59.711" N	631276.3438	5595853.031
M	49° 8' 56.127" W	50° 20' 59.708" N	631691.6047	5579175.647
N	49° 14' 56.130" W	50° 20' 59.480" N	624577.8072	5578996.378
O	49° 14' 56.133" W	50° 19' 14.481" N	624654.0608	5575753.601
P	49° 26' 11.151" W	50° 18' 59.684" N	611316.3509	5574999.404
Q	49° 26' 53.190" W	50° 5' 13.303" N	611016.2536	5549460.346
R	50° 25' 42.613" W	50° 5' 10.857" N	540883.9528	5548387.872
Study Area				
1	50° 42' 47.482" W	51° 8' 24.660" N	520064.6646	5665453.091
2	49° 16' 30.310" W	51° 8' 19.000" N	620671.6561	5666653.747
3	49° 16' 54.670" W	50° 57' 49.017" N	620652.2397	5647184.179
4	48° 33' 51.074" W	50° 57' 45.436" N	671046.6964	5648493.1
5	48° 34' 2.898" W	50° 25' 10.935" N	672800.0926	5588124.982
6	49° 10' 19.602" W	50° 8' 11.670" N	630623.9961	5555415.51
7	49° 10' 32.842" W	49° 54' 29.456" N	630980.8996	5530017.457
8	50° 42' 21.465" W	49° 54' 19.463" N	521114.1062	5528154.878

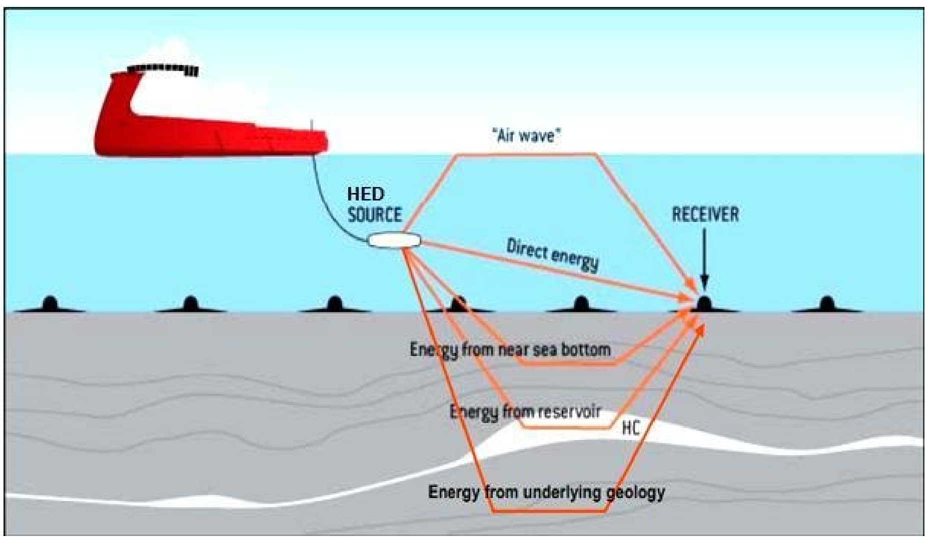
A Regional Area has been defined (see Figure 1.1) to provide a broader geographic context for the effects assessment, particularly the assessment of potential cumulative environmental effects (refer to Section 9).

2.3 Schedule

Originally planned to be conducted in the summer of 2020 as noted in the Project Description (BP 2020), the Project is now planned to be conducted between May and October 2021 pending authorization from the C-NLOPB. It is also possible the Project could be conducted during this same seasonal window between 2022 and 2024. It is estimated that the Project would take less than 30 days to complete including transit to and from the Project Area.

2.4 Project Components and Activities

CSEM surveys are performed by towing an electromagnetic source (a horizontal electric dipole) that emits a low frequency, continuous electromagnetic signal above an array of receivers deployed on the seabed. The electromagnetic signal from the towed source propagates through the subsurface and back to receivers on the seabed (see Figure 2.1). At the end of a survey, the receivers are retrieved and the recordings are interpreted to infer subsurface resistivity. A detailed description of Project components and activities is provided below.



Source: Ganguli 2014

Figure 2.1 CSEM Survey Schematic

2.4.1 Survey Vessel Operation and Logistics

The survey vessel will have suitable systems and procedures in place to meet the operational requirements to safely conduct the work. The vessel will be capable of working in harsh offshore conditions, and will have the necessary equipment, protocols and procedures in place to comply with the *Canada Shipping Act, 2001*, the International Convention for the Prevention of Pollution from Ships (MARPOL) and any other applicable standards. The vessel will be subject to BP's internal marine assurance process, be inspected by Transport Canada, and approved for operation by the C-NLOPB before beginning any Project-related work.

Personnel on the survey vessel will include ship's officers and marine crew as well as technical and scientific personnel. The vessel will also have a fisheries liaison officer (FLO) and seabird and marine mammal observers (SMMOs). The total persons on board would be approximately 50.

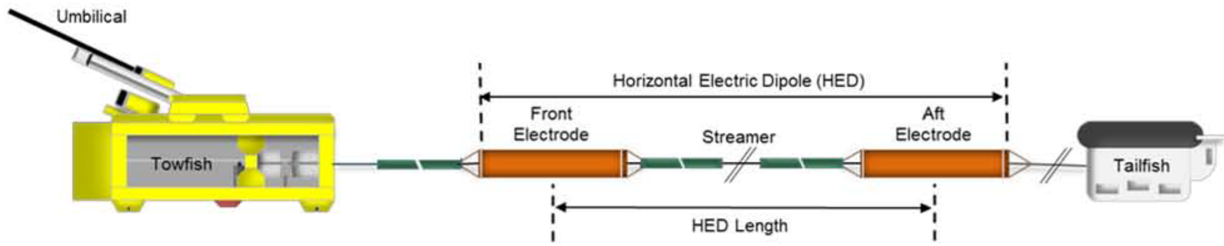
It is anticipated that the vessel would use shore-based facilities in the St. John's region to mobilize for the Project. No new shorebase facilities will be established as part of the Project. Given the length of time to complete the Project (less than 30 days), it is expected to be completed in a single mobilization, absent of inclement weather or mechanical downtime. Offshore resupply and crew changes are not anticipated to be required.

The vessel will travel approximately 22 km/h (12 knots) on average while transiting to and from the Project Area. During the survey, the vessel will travel at an average speed of approximately 4 to 5.5 km/h (2 to 3 knots). The survey vessel will use dynamic positioning to hold on station during the deployment and retrieval of the CSEM receivers. Survey vessel operations related to the deployment and testing of survey equipment and turning of the vessel will not occur outside of the Project Area.

2.4.2 CSEM Source Operation

A CSEM survey uses a frequency-domain electromagnetic approach, in which an oscillating current of constant low frequency (from 0 to 25 Hertz [Hz]) is generated in a transmitter towed approximately 30 m above the seafloor. The oscillating current sets up an oscillating magnetic field at the same frequency (Buchanan et al. 2011). This primary electromagnetic field penetrates the seafloor and creates secondary electric current and magnetic fields via induction. The secondary magnetic field has the same frequency as the primary field, but the signal varies as a result of the properties of the underlying rock. The primary and secondary fields are detected by the receivers (refer to Section 2.4.3), which are then used to develop a resistivity profile of the surveyed area (Buchanan et al. 2011).

The CSEM source technology proposed for use for this Project is more powerful than conventional CSEM sources, and capable of transmitting an electric current of 10,000 amperes (A) with a voltage of 135 volts (V). The CSEM source consists of a power supply and control unit at the topside transmitter mounted on towed subsea-frame (towfish) with a horizontal electric dipole connected to the towfish (Figure 2.2). The topside unit controls the power to generate the predefined electromagnetic signal at the electric dipole. The power is transformed to high voltage / low current and transferred via umbilical to the subsea system. At the subsea system the power is transformed back to low voltage / high current. A trailing electric dipole (antenna) is connected to the subsea signal source. This antenna is fed with a periodic current. The waveform and periodic time can be defined and changed at the topside operator station. A separate power supply feeds the instrumentation on the towfish (LGL 2014).



Source: LGL 2014

Figure 2.2 Schematic of the CSEM Source

Figure 2.2 depicts the general subsea configuration of the CSEM Source. The electrical dipole (antenna) is neutrally balanced for in-line towing operations. A tailfish is designed to stretch the antenna system. Both the towfish and tailfish can carry additional survey and navigational equipment (LGL 2014). The distance between the source and the seabed will be continuously monitored by a Doppler instrument installed on the gear being towed by the vessel (towfish). The position of the source will also be monitored by an ultra-short baseline acoustic positioning system. The position of the towed gear will be indicated at the ocean surface by tail end buoys.

The CSEM towed system includes a single streamer that is comprised of tow and conductor cables and a flotation section. The overall length of the tow package is approximately 1,800 m. The flotation sections of the streamer will be solid (buoyancy provided by thermoplastic rubber), which eliminates the risk of an accidental spill should the streamer break.

2.4.3 CSEM Receiver Deployment and Retrieval

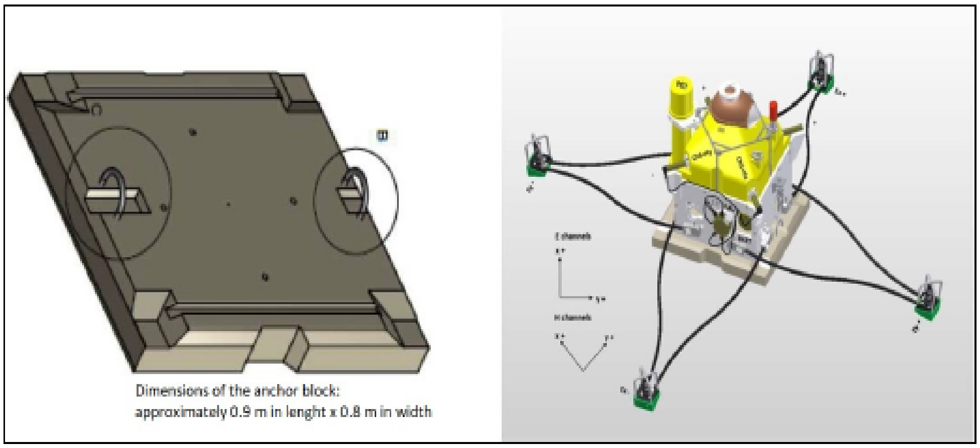
CSEM receivers are comprised of a buoyancy system, data acquisition unit and frame, a battery, electrical and magnetic sensors and a positioning transponder.

It is estimated that up to approximately 100 receivers would be deployed to the seabed in a grid pattern (approximately 3 km apart) for this survey. Receivers are dropped individually from the survey vessel and sink freely down to the seabed. The approximate water depth over most of the proposed survey area is 1,350 m. The positioning transponder on the receiver sends acoustic signals back to the vessel, which allows tracking of the receiver’s location from its descent to the seabed to its ascent back to the surface for retrieval and data download.

Each receiver is attached to a compacted sand anchor to provide negative buoyancy and hold the receiver in position on the seabed (see Figure 2.3). There are no surface buoys or ropes ascending to the surface while the receivers/anchors are on the seabed so there is no risk of entanglement with marine life or fisheries gear.

After the recording period, an acoustic signal from the vessel triggers a release mechanism that causes the receivers to be released from the anchors and float back to the surface. Each receiver has a primary and secondary (back-up) release system. When the acoustic command is sent from the vessel, an electric motor releases the wire attaching the receiver to the anchor. The second release uses a burn wire in case the primary mechanism fails to release. A buoyancy system on the receiver consisting of glass spheres in high quality yellow plastic helps the receiver unit to ascend through the water column to the surface for retrieval by the survey vessel.

The sand anchors remain on the seafloor after release and recovery of the receivers. Each sand anchor is approximately 920 mm (length) x 810 mm (width) x 102 mm (height) and is composed of ingredients found in natural gravel, limestone and/or seawater (no organic admixtures). Each sand anchor will cover an area of the seafloor of approximately 0.75 m². The sand anchors are expected to degrade to natural substances within approximately six to twelve months after their deployment to the seafloor.



Source: Romania Energy Center 2015

Figure 2.3 Anchor Block and CSEM Receiver

2.5 Discharges and Emissions

2.5.1 Waste Discharges

Liquid waste discharges (e.g., grey water, sewage, bilge water, deck drainage) will be managed in accordance with the requirements of MARPOL and the *Canada Shipping Act, 2001*. Solid and domestic waste will be collected onboard the vessel and collected dockside by an approved waste contractor for recycling / disposal at an existing onshore waste management facility in accordance with applicable regulatory requirements.

The effects of marine discharges are expected to be negligible given the regulatory requirements, transitory nature of the vessel, low volume of discharges over a relatively short period, and rapid dilution to the marine environment.

2.5.2 Electromagnetic Emissions

The operation of the CSEM source will generate electromagnetic fields (EMF) in the marine environment. EMF consists of an electric field component (measured in microvolt per metre [µV/m] or nanovolt per centimeter [nV/cm]) and a magnetic field component (measured in nanotesla [nT]), which travel together at the speed of light (Buchanan et al. 2011). The intensity of the electric current generated could reach 10,000 A with a voltage of 135 V. The electromagnetic wave is characterized by a frequency (number of cycles of a wave per unit of time; measured in Hz) and wavelength (distance travelled by the wave in one cycle) (Buchanan et al. 2011).

Electromagnetic fields are generated by anything that carries or produces electricity. The lower end of the electromagnetic spectrum includes radio waves used in AM radio transmissions (750-1,000 kilohertz), with the higher end of the spectrum including x-rays and gamma rays (10^{18} to 10^{20} Hz). High-frequency waves like x-rays and gamma rays contain enough energy to break down molecular bonds and are classified as "ionizing radiation". Extremely low frequency fields are defined as those less than 300 Hz and include common household electrical systems that operation on a 50/60 Hz standard. CSEM surveys emit non-ionizing, extremely low frequencies (0 to 25 Hz).

There are also natural variations in electromagnetic fields from ocean currents and the Earth's magnetic field. The World Health Organization (2006) identifies natural static electric field average value (fair weather, Earth's surface) of 0.13 kilovolts [kV]/m and static magnetic field average value of 35 μT (35,000 nT) at magnetic equator and 70 μT (70,000 nT) at the Earth's magnetic poles.

Based on available scientific information on effects across a wide range of organisms, Buchanan et al. (2011) proposed generic thresholds of effects for magnetic and electric fields generated by electromagnetic surveys of 200 nT and 386 nV/cm, respectively. These generic effects thresholds are based on reported abilities of some of the more sensitive groups of animals (e.g., elasmobranchs) to detect magnetic and electric fields (Buchanan et al. 2011).

Modelling conducted by the electromagnetic survey industry (e.g., Buchanan et al. 2011; Johnsson and Oftedal 2011; LGL 2017) indicates that the distribution of magnetic and electric fields decreases with increasing frequency of the dipole source. Modelling conducted for EMGS's East Canada CSEM Survey, 2014-2018, which was updated to incorporate a more powerful source system, indicated that for the worst case scenario of operating a source output of 10,000 A at a low frequency of 0.25 Hz, the predicted maximum zone of influence radii (based on above effects thresholds) was 800 m and 1,400 m for the magnetic and electric fields, respectively (refer to Tables 2.2 and 2.3 below; see Tables 1 and 2 of LGL 2017 for additional context including reduced radii for higher frequency sources). This modelling is based on magnetic and electric field generation and distance attenuation relationships presented in Johnsson and Oftedal (2011).

Table 2.2 Estimate of Magnetic Fields Generated in Proximity to a Deep-Towed CSEM Transmitter, Assuming a Current of 10,000 A and a Frequency of 0.25 Hz

Vertical Distance from the Dipole Source	Magnetic Field Intensity (nT)				
	Radial Distance from the Dipole Source				
	0 m	300 m	600 m	700 m	800 m
30 m	59061	1876	368	258	188
70 m	27649	583	138	123	105
370 m	2030	965	212	123	70
770 m	382	294	149	112	83
970 m	202	167	101	81	64
Note: Shaded cells indicate distribution above generic effects threshold of 200 nT.					

Table 2.3 Estimate of Electric Fields Generated in Proximity to a Deep-Towed CSEM Transmitter, Assuming a Current of 10,000 A and a Frequency of 0.25 Hz

Vertical Distance from the Dipole Source	Electric Field Intensity (nV/cm)			
	Radial Distance from the Dipole Source			
	0 m	600 m	1,200 m	1,400 m
30 m	401142	9193	711	383
70 m	254636	8695	690	371
370 m	17262	4300	531	294
770 m	2643	1312	299	179
970 m	1351	773	217	135
Note: Shaded cells indicate distribution above generic effects threshold of 386 nV/cm.				

2.5.3 Underwater Sound Emissions

The survey vessel will generate continuous underwater sound primarily attributed to propeller cavitation, propeller singing, and mechanical vibration transferred through the ship's hull. Propellers are used to propel the vessel in transit and also to assist in station keeping. The dynamic positioning system uses bow and stern thrusters as well as the propellers to keep the vessel on station. Sound pressure levels (SPLs) produced by the operating survey vessel are expected to be at a peak frequency of 1 to 500 Hz with SPLs in the range of 170 to 190 dB RMS re 1 μPa @ 1m, depending on vessel speed and use of dynamic positioning.

2.5.4 Light Emissions

Artificial lighting will be used to illuminate the survey vessel at night. There is also limited lighting associated with the tow package and the receivers. The towfish (refer to Figure 2.2) has a white light on it which gets turned on once it is lowered to a safe depth for powering on the towfish Instrumentation (usually between 10 to 50 m depth). This light stays on throughout the towing and is needed for viewing the towfish mounted camera which looks at the towpoint connection on the towfish as it moves through the water. Conversely, the tailfish has a light to assist with detection while it is at the surface. When the tailfish is submerged during the source deployment process, the light goes off once it reaches approximately 20 m in depth.

Each receiver is also equipped with a light which is used to aid in recovery of equipment at night. While sitting on the seafloor, receiver lights are off. However, during retrieval at the end of the survey, a pressure switch is activated to turn on the light when the receiver ascends to within approximately 20 m water depth. This light is used to assist with receiver recovery on the sea surface at night as needed. Lights on the receivers and the tailfish are white strobe lights. Although retrieval time can vary depending on oceanographic conditions at the time, the average length of time a receiver would be on the sea surface before it is recovered on the deck of the vessel is approximately five minutes.

2.5.5 Air Emissions

Air emissions will be generated from fuel combustion in the engine of the survey vessel and will be comparable to offshore supply vessel emissions. Emissions from diesel combustion typically include carbon dioxide, carbon monoxide, sulphur dioxides, nitrogen oxides and particulate matter.

The *Vessel Pollution and Dangerous Chemicals Regulations* under the *Canada Shipping Act, 2001* include regulatory limits for nitrogen oxide emissions from marine vessels as well as for sulphur content in fuel, which are consistent with limits set by the International Maritime Organization of the United Nations. Survey vessel compliance with these requirements will help to reduce greenhouse gas and criteria air contaminant emissions associated with the Project.

3.0 CONSULTATION AND ENGAGEMENT

Since November 2017, BP Canada has been conducting Indigenous and stakeholder engagement with respect to the proposed Newfoundland Orphan Basin Exploration Drilling Program. This has included ongoing engagement with the following fisheries stakeholder groups and Indigenous groups:

Fisheries Stakeholders

- One Ocean
- Fish, Food and Allied Workers – Unifor (FFAW-Unifor)
- Ocean Choice International
- Association of Seafood Producers
- Groundfish Enterprise Allocation Council
- Canadian Association of Prawn Producers

Indigenous Groups

- Labrador Inuit: Nunatsiavut Government, NunatuKavut Community Council
- Labrador Innu: Innu Nation
- Nova Scotia Mi'kmaq First Nations: Acadia, Annapolis Valley, Bear River, Eskasoni, Glooscap, Membertou, Millbrook, Paqtnkek (Afton), Pictou Landing, Potlotek (Chapel Island), Sipekne'katik, Wagmatcook, and We'kmoqma'q (Waycobah)
- New Brunswick Wolastoqiyik (Maliseet) First Nations: Kingsclear, Madawaska Maliseet, Oromocto, St. Mary's, Tobique, and Woodstock
- New Brunswick Mi'gmaq First Nations: Buctouche, Eel River Bar, Fort Folly, Esgenoopetitj, Indian Island, Pabineau, Eel Ground, Metepenagiag, and Elsipogtog
- New Brunswick Peskotomuhkati Nation at Skutik (Passamaquoddy)
- Prince Edward Island Mi'kmaq First Nations: Abegweit and Lennox Island
- Quebec Mi'gmaq: Micmacs of Gespapegiag, Nation Micmac de Gespeg, and Listuguj Mi'gmaq Government
- Quebec Innu: Conseil des Innus de Ekuanitshit and Première Nation des Innus de Nutashkuan

In early February 2020, BP Canada emailed the above fisheries stakeholder and Indigenous groups to provide an update that BP Canada was planning on conducting a CSEM survey in 2020. The email contained a newsletter that described the CSEM survey process. In addition, this newsletter was posted to a webpage dedicated to BP Canada's operations offshore Newfoundland (https://www.bp.com/en_ca/canada/home/who-we-are/offshore/newfoundland-and-labrador.html).

In late February 2020, FFAW-Unifor requested a conference call with BP Canada to obtain more information on the survey. During the call on February 26, 2020, FFAW-Unifor asked questions regarding the CSEM contractor and proposed timing of the survey to facilitate future planning and provision of a FLO. The Association of Seafood Producers also followed up with an email to BP Canada to inquire if any fisheries stakeholders had provided feedback to the introductory email and was informed of BP Canada's communication with FFAW-Unifor. Aside from communicating the requirement for a FLO and the need for advance planning, no concerns were raised to BP by fisheries stakeholders. In March 2020 BP Canada informed fisheries stakeholders of an update to the Project timeline.

No feedback has been received to date from any of the Indigenous groups.

BP Canada will continue to engage Indigenous groups and stakeholders. In advance of the Project, BP Canada will communicate projected timing and location of the survey to fisheries stakeholders and Indigenous groups as well as to other applicable ocean users (e.g., Fisheries and Oceans Canada [DFO], Department of National Defence) who may be conducting activities in the Study Area.

4.0 EXISTING ENVIRONMENT

The description of the existing environment is based on the Eastern Newfoundland and Labrador Offshore Area Strategic Environmental Assessment (AMEC 2014), and supplemented with more up to date and/or site-specific information where available including sources used in the Newfoundland Orphan Basin Exploration Drilling Program Environmental Impact Statement (BP 2018) and the Ephesus Prospect ROV Benthic Survey 2019-2024 Environmental Assessment (BP 2019). Updates on species at risk, sensitive areas, and commercial fisheries that have occurred since these recent environmental assessments have also been incorporated in this assessment.

4.1 Physical Environment

The Project Area is located in the Orphan Basin, which is part of a complex network of connected basins and sub-basins offshore NL. The Orphan Basin is bounded by the Newfoundland Shelf to the west, the Flemish Cap to the south, and the Orphan Knoll to the northeast (Campbell 2005). Water depths in the Project Area range from 409 m to 2,275 m.

4.1.1 Marine Geology and Geomorphology

The Orphan Basin is a wide continental rift (Enachescu 2006), is approximately 160,000 km² in size (Enachescu et al. 2005), and is bound by the Charlie-Gibbs Transfer Fault Zone to the north, the Continent-Ocean Boundary to the east, the Cumberland Belt Transfer Fault Zone to the south, and the Bonavista Fault Zone to the west (Enachescu et al. 2005; Enachescu 2006). The Project Area is located in the West Orphan Basin, on the Northeast Newfoundland Shelf (≤200 m to 2,000 m water depth). The West Orphan Basin contains mostly Cretaceous sedimentary fill. Tertiary cover is thick over the West Orphan Basin (4 km) (Enachescu 2006). Seafloor sediments in the Project Area are expected to grade from glacial tills on the shelf and upper slope, through muddy sands and sandy muds on the lower slope (Tripsanas and Piper 2008).

4.1.2 Atmospheric Environment

The Regional Area experiences weather conditions typical of a marine environment, with surrounding areas having a moderating effect on temperature. Marine climates generally experience cooler summers and milder winters than continental climates and have a smaller annual temperature range. Marine climates also tend to be humid, resulting in reduced visibilities, low cloud heights, and substantial amounts of precipitation.

The Project Area experiences winds predominantly from the southwest to west throughout the year. There is a strong annual cycle in the wind direction; west to northwest winds are prevalent during the winter months and southwest winds are predominant during the summer months. The mean strength of the westerly flow is stronger in the winter months than the summer months.

The mean and maximum wind speeds at MSC50 grid points in the Project Area are shown in Table 4.1. The seasonal and annual percentage frequencies of wind direction at MSC50 grid points in the Project Area are provided in Table 4.2.

Table 4.1 Mean and Maximum Wind Speeds (m/s) in the Project Area

Period	Mean and Maximum Wind Speeds (m/s) [1]	
	Mean	Maximum
Winter	12.17	32.8
Spring	9.29	29.9
Summer	6.70	22.5
Fall	9.72	33.1
Annual	9.46	33.1
Notes: [1]Wind speeds based on the average and maximum speeds of MSC50 Grid Points 16684, 17322, and 17427		

Table 4.2 Seasonal and Annual Percentage Frequency of Wind Direction in the Project Area

Period	Seasonal and Annual Percentage Frequency of Wind Direction [1]							
	NE	E	SE	S	SW	W	NW	N
Winter	4.3	5.3	6.7	10.2	16.6	30.0	19.2	8.6
Spring	8.8	7.0	8.2	13.0	17.2	17.3	16.6	11.7
Summer	5.2	6.3	9.0	19.2	28.2	14.4	11.3	13.8
Fall	5.2	4.5	6.5	13.4	20.5	22.2	19.5	10.3
Annual	5.9	5.8	7.6	14.0	20.6	20.9	16.6	11.1
Notes: [1]Percentage frequency of wind direction based on an average of MSC50 Grid Points 16684, 17322, and 17427								

During the summer, periods of southerly winds with mild conditions are typical with infrequent occurrence of extended storm conditions. The main storm track is through the Gulf of St. Lawrence, or the Island of Newfoundland.

Precipitation may come in three forms: liquid precipitation (including drizzle and rain); freezing precipitation (freezing drizzle and freezing rain); and frozen precipitation (snow, snow pellets, snow grains, ice pellets, hail, and ice crystals). Rain and drizzle may occur at any time of the year but is most likely to occur when there are southerly or southwesterly winds. Snow and rain are possible any time from October through June, and snow is accompanied by winds from any direction. Freezing rain frequently persists for days in the spring along the east coast of Canada and is most common with easterly or northeasterly winds.

Thunderstorms and hail have the potential to occur year-round, although hail is most likely to occur in the winter, and thunderstorms are most likely to occur in the summer. Thunderstorms occur relatively infrequently over the Regional Area, although they may occur in any month of the year. Hail only occurs during severe thunderstorms.

Lightning occurs year-round in offshore Newfoundland. Lightning strikes are stronger during the winter months. Lightning is most commonly produced in thunderstorms and is usually accompanied by thunder. Lightning can pose a safety risk to personnel and can potentially affect electronic systems on the survey vessel.

Visibility in the eastern Newfoundland offshore area is most favorable in the fall and winter and is most frequently restricted in the summer and spring. The eastern Newfoundland offshore area experiences some of the highest occurrences of marine fog in North American (AMEC 2014). Horizontal visibility may be reduced by any of the following phenomena: fog, mist, haze, smoke, liquid precipitation, freezing precipitation, frozen precipitation, and blowing snow.

Obscuration to visibility in the Regional Area is highest during the month of July, most of which is in the form of advection fog, although frontal fog can also contribute to visibility reduction. Reduction in visibility is relatively low during fall and winter and is mainly attributed to the passage of low-pressure systems. In fall, fog is the main cause of reduced visibilities, and in winter, the main cause is snow. The lowest occurrence of reduced visibility occurs in November, when, on average, the air temperature has decreased below the sea surface temperature and it is not yet cold enough for snow.

Storm systems known as weather bombs are known to occur frequently in the Orphan Basin. These are formed by a rapid deepening of an extratropical cyclonic low-pressure area. These storm systems develop in the warm waters off Cape Hatteras, North Carolina, and move northeast across the Grand Banks and Orphan Basin.

The hurricane season in the North Atlantic Basin normally extends from June through November, although tropical storm systems occasionally occur outside this period. The strongest winds typically occur during the winter months and are associated with mid-latitude pressure systems, although storm-force winds may occur at any time of the year because of tropical systems. There has been a substantial increase in the number of hurricanes that have developed within the Atlantic Basin in the last 15 years. Because of the increase in tropical activity in the Atlantic Basin, there has also been an increase in tropical storms or their remnants entering the Canadian Hurricane Centre Response Zone.

4.1.3 Physical Oceanography

The Labrador Current is the dominant current in the Regional Area. It is composed of the West Greenland, Baffin Island, and Irminger Currents. The Labrador Current originates from the Hudson Strait at 60°N and flows southward over the Labrador and Newfoundland Shelf and Slope to the tail end of the Grand Banks at 43°N (Lazier and Wright 1993).

The Labrador Current becomes two branches on the southern Labrador Shelf; an inshore branch with approximately 15% of the transport, and an offshore branch with approximately 85% of the transport (Lazier and Wright 1993). The main branch of the offshore Labrador Current typically flows along the Continental

Slope between 300 and 1,500 m (Lazier and Wright 1993). The inshore branch generally has a weaker flow and is not well defined (Lazier and Wright 1993). The offshore branch has mean surface water velocities that typically range from 25 to 50 cm/s, while those of the inshore branch are weaker and range from 5 to 20 cm/s (Fissel and Lemon 1991; Lazier and Wright 1993; Colbourne 2000).

The currents on the Newfoundland Slope are highly variable, which results in seasonal and interannual variations in velocity and transport in the Labrador Current. The upper waters of the Labrador Current are typically stronger in the fall and winter and weaker in spring (Lazier and Wright 1993; Han and Tang 1999; Han and Li 2004). Lazier and Wright (1993) found seasonal variations in circulation in the upper 400 m, but no substantial variations were found deeper than the 1,000 m level.

Moored current measurements in the Orphan Basin have been carried out by the Bedford Institute of Oceanography with two moorings (WOB_1 and WOB_2) measuring currents between May 1991 and May 1992. Both mooring sites are close to EL 1148 in the Study Area. Mean and maximum current speeds at these two locations are provided in Table 4.3.

Table 4.3 Mean and Maximum Current Speeds at Two Moorings in the Orphan Basin

Mooring	Latitude	Longitude	Period	Depth (m)	Mean Current Speed (cm/s)	Maximum Current Speed (cm/s)	Month of Maximum Current Speed	Predominant Current Direction
WOB_1	49.7485N	49.7465W	May 1991 to Nov 1991	200	11.7	30.7	October	S-SE
WOB_1	49.7485N	49.7465W	May 1991 to Nov 1991	400	9.1	22.0	September	S-SE
WOB_1	49.7485N	49.7465W	May 1991 to Nov 1991	900	8.2	19.7	May	S-SE
WOB_2	49.7467N	49.7388W	Nov 1991 to May 1992	400	7.6	23.2	December	S-SE
WOB_2	49.7467N	49.7388W	Nov 1991 to May 1992	900	7.4	23.1	April	S-SE

Within the Regional Area and surrounding areas, the largest seas are typically found the furthest offshore, usually during the winter season. Extra-tropical storms dominate the wave climate of the Regional Area, primarily from October through March, although severe storms may occur outside of these months. Storms of tropical origin may occur during the early summer and early winter, but most often occur from late August through October. Hurricanes are usually reduced to tropical storm strength or evolve into extra-tropical storms by the time they reach the Regional Area, but they are still capable of producing storm force winds and high waves.

Wind and wave climate statistics for the Project Area were extracted from the MSC50 North Atlantic wind and wave climatology database. The descriptions below are based on a subset of MSC50 data from 1985 to 2015 for grid points 16684, 17322, and 17427 in the Project Area. The dominant direction of the combined significant wave height is from the west during fall and winter. During the months of March and April, the wind wave remains predominantly westerly while the swell begins to come from a southerly direction, which results in the vector mean direction of the combined significant wave heights being southwesterly. There is a mean southwesterly direction for the combined significant wave heights during the summer months. During the months of September and October, the wind wave will veer to the west and become a dominant component of the combined significant wave height.

Significant wave heights in the Project Area peak during the winter months and have a mean monthly significant wave height in January ranging from 4.4 to 4.6 m. The lowest significant wave heights occur in the summer, with July having a mean monthly significant wave height of 1.7 m.

Combined significant wave heights of 10 m or more occurred in each month between September and April, with the highest waves occurring during the months of December and January. The maximum significant wave heights tend to peak during the winter months, although a tropical system could pass through the area and produce high wave heights during any month of the year. Seasonal and annual maximum combined significant wave heights are shown below in Table 4.4.

Table 4.4 Maximum Combined Significant Wave Heights (m) in the Project Area

Period	Maximum Combined Significant Wave Heights (m) [1]
Winter	15.1
Spring	11.7
Summer	7.2
Fall	12.8
Annual	15.1
Notes: 1 Maximum combined significant wave height based on maximum of MSC50 Grid Points 16684, 17322, and 17427	

4.1.4 Ice Conditions

The Study Area, like other parts of the eastern Newfoundland offshore area, are subject to seasonal intrusions of sea ice and icebergs. Statistics from the Canadian Ice Service (1981 to 2010) indicate the Study Area is primarily affected by sea ice from early January through the beginning of July, with the highest frequency of sea ice observed in March (Environment Canada 2011). Icebergs can be present in the Study Area any month of the year, with peak sightings between the months of March and May (National Snow and Ice Data Centre 2015).

4.2 Marine Fish and Shellfish

The eastern Newfoundland offshore area is a highly productive ecosystem, and many marine fish species are known to occur in NL waters (Templeman 2010; AMEC 2014). The occurrence of these species is based on their physiological and life history requirements; their presence may vary according to habitat, environmental conditions, and life history stage (AMEC 2014). Within the Study Area, habitats transition from Newfoundland slope to abyssal. These Newfoundland slope areas support regionally important areas of biodiversity and marine productivity and are used by fish and invertebrate species of commercial, cultural, and/or ecological value. The abundance and distribution of these fish and invertebrate species depend on their linkages with other species across fish habitats and interactions with the physical parameters of the marine environment.

At least 60 species of phytoplankton, 160 species of zooplankton, and 30 species of ichthyoplankton may occur in the Orphan Basin based on historical studies (Movchan 1963; Buchanan and Foy 1980a, 1980b; Buchanan and Browne 1981; Tremblay and Anderson 1984, in LGL 2003). Phytoplankton in the Orphan Basin is likely dominated by microflagellates and diatoms, at least during the summer months (LGL 2003). The distribution of macroalgae and marine plants is predominantly limited to areas reached by sunlight, as they are reliant on photosynthesis to produce energy; however, some types of marine algae (e.g., coralline algae) occur at greater depths (AMEC 2014).

There is a high abundance and diversity of structure-forming benthic invertebrate species that occur in the Orphan Basin and in surrounding areas, including corals, sponges, and sea pens (AMEC 2014). Within the Regional Area, corals and sponges are present on the Northeast Newfoundland Shelf and Slope and are also found in the Flemish Pass and Flemish Cap adjacent to the Regional Area. The Orphan Knoll, partially located within the Regional Area and approximately 125 km to the northeast of the Project Area, is a biologically rich and complex area, with corals (including stony corals [*Scleractinia* spp.]) and sponges observed on the flanks of the knoll and surrounding seamounts using a remotely operated vehicle (ROV) (Northwest Atlantic Fisheries Organization [NAFO] 2017).

DFO has defined a large Significant Benthic Area (SBA) for sea pens that encompasses the edge of the Northeast Newfoundland Shelf, including the far western portion of the Project Area and EL 1145, and a small portion of EL 1146. There are additional SBAs for small and large gorgonian corals surrounding the Project Area along the Northeast Newfoundland Slope. The Northeast Newfoundland Slope Closure is a marine refuge designated by DFO which is closed to bottom contact fishing to protect corals and sponges in this area and encompasses all of ELs 1145 and 1146. Figure 4.1 provides existing DFO research data for corals and sponges in the Regional Area. It is acknowledged that data on corals and sponges is primarily related to survey transects on the shelf and data are lacking particularly in EL 1146.

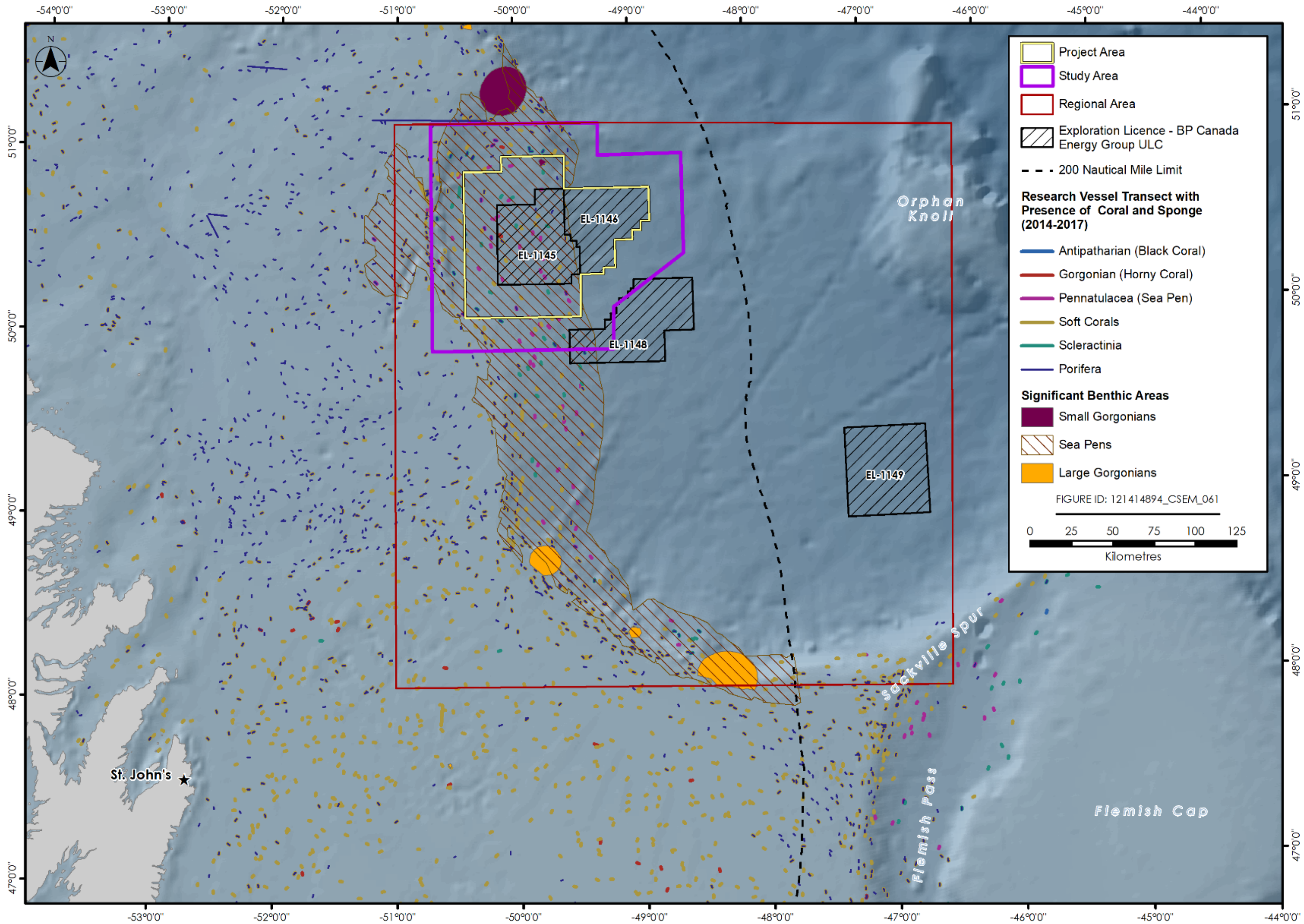


Figure 4.1 Corals and Sponges

The benthic or demersal species that inhabit the continental slope and abyssal habitats in the Study Area are not yet well studied. Emerging continental slope fisheries for grenadiers, Greenland halibut (*Reinhardtius hippoglossoides*), and redfish (*Sebastes* spp.) are resulting in additional pressures for other continental slope species found within the Study Area such as blue hake (*Macruronus novaezelandiae*), roughhead grenadier (*Macrourus berglax*), roundnose grenadier (*Coryphaenoides rupestris*), skate species and synaphobranchid eels (Devine et al. 2006). Pelagic species include resident (capelin [*Mallotus villosus*] and lanternfish) and migratory (tunas, swordfish, and several shark species) species. The most abundant fish species found in the Study Area (based on 2015-2016 DFO research vessel survey data) include redfish, Greenland halibut, roughhead grenadier, roundnose grenadier, witch flounder (*Glyptocephalus cynoglossus*), and northern wolffish (*Anarhichas denticulatus*). These species would be expected to be present in the Study Area year-round.

A summary of spawning seasons and known spawning areas for fish species with a high potential to be found in the Study Area is provided in Table 4.5.

Table 4.5 Spawning Periods and Locations for Marine Fish with High Potential to be Found in the Study Area

Common Name	Scientific Name	Spawning Time												Known Spawning Locations
		J	F	M	A	M	J	J	A	S	O	N	D	
Deepwater redfish	*Sebastes mentella*			■	■	■								April-May southern Labrador shelf, Newfoundland shelf and Grand Banks, March-April Flemish Cap[1]
Greenland Halibut	*Reinhardtius hippoglossoides*			■	■	■								Spawning thought to occur in the deep waters (650-10,00 m) of the Davis Strait[2,3]
Northern wolffish	*Anarhichas denticulatus*									■	■	■		Spawns in deep water on the continental slope, subsequently returning to the shelf [4]
Roundnose grenadier	*Coryphaenoides rupestris*	■	■	■	■	■	■	■	■	■	■	■	■	Spawning occurs throughout the year throughout the species range[5]
Roughhead grenadier	*Macrourus berglax*	■	■	■	■									Southern and southeastern slopes of the Grand Bank[6]
Witch Flounder	*Glyptochepalus cynoglossus*				■	■	■	■	■	■				Labrador shelf, and northwestern Newfoundland shelf[7]

Note: Shading indicates spawning periods.
Sources: [1] Vaskov 2005, [2] DFO 1993, [3] Bowering & Nedreaas, 2000, [4] Shelvelev and Kuz'michev 1990 in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2001; [5] COSWEIC 2008; [6] COSEWIC 2007; [7] Bowering 1989.

There are several fish species at risk that may occur in the Study Area (refer to Section 4.5). The Northern Grand Banks encompasses an area designated as critical habitat for northern and spotted wolffish (*Anarhichas minor*) (DFO 2020); both species are listed under SARA Schedule 1 as threatened (refer to Section 4.5).

Within the waters offshore NL, including waters within the Regional Area, commercial fishing occurs for several different species, including species that Indigenous groups may hold commercial communal licenses to harvest. Species harvested for commercial communal purposes offshore eastern Newfoundland include capelin, groundfish, herring (*Clupea harengus*), mackerel (*Scomber scombrus*), seal, shrimp, snow crab (*Chionoecetes opilio*), tuna, and whelk. Species harvested by Indigenous groups for food, social, and ceremonial (FSC) purposes include, but are not limited to, gaspereau / alewife (*Alosa pseudoharengus*), trout, Atlantic salmon (*Salmo salar*), bass, mackerel, eel (*Anguilla rostrata*), shad (*Alosa sapidissima*), groundfish (e.g., flounder, halibut [*Hippoglossus hippoglossus*], pollock), Arctic char (*Salvelinus alpinus*), smelt, blue shark (*Prionace glauca*), herring, mussel, clams, periwinkle (*Littorina* spp.), soft-shell clams (*Mya arenaria*), squid, tomcod (*Microgadus tomcod*), quahaug (*Mercenaria mercenaria*), razor clams (*Siliqua patula*), lobster (*Homarus americanus*), crab, and scallops. Many FSC species are harvested in the inshore and/or freshwater systems. However, some species are anadromous and can potentially migrate through the Regional Area and/or Project Area. Two migratory fish species in particular have been highlighted during previous Indigenous engagement as being of concern due to potential interaction with oil and gas exploration activities: American eel; and Atlantic salmon. The American eel has been identified as important to Aboriginal rights-based, Treaty rights-based, and commercial fisheries, particularly to the Mi’kmaq peoples (Denny and Kavanagh 2018). Atlantic salmon have traditionally been a staple food for Indigenous peoples, although today, due to a lack of abundance and concern for local populations, it is often reserved for special occasions (Denny and Fanning 2016).

4.3 Marine Mammals and Sea Turtles

Twenty-four marine mammal species are known to occur within or near the Study Area, including nineteen species of cetaceans (whales, dolphins, and porpoises) and five species of pinnipeds (seals) (Table 4.6). Most marine mammals use the area seasonally. The region likely represents important foraging habitat for many marine mammals. Three species of sea turtles may also potentially occur within or near the Study Area, although their presence would be rare.

Figures 4.2 and 4.3 present marine mammal observations in the Regional Area compiled from the DFO sightings database (1947 to 2015) for baleen whales and toothed whales, respectively. While marine mammal sightings occur year-round in the Regional Area, they are more common in the Study Area during the months of June to September. However, the appearance of concentrations in certain areas and during certain times may be a monitoring bias artifact of the survey effort in these areas compared to elsewhere. Conversely, low sighting numbers in other areas and during other times may, at least in part, be attributable to a lack or absence of survey effort. Overall, the summer is an important period for cetaceans and sea turtles in waters offshore Newfoundland, where many migratory species come to feed before returning to more southern latitudes for the winter. Pinnipeds may be more common during winter and spring. As shown by the observations depicted in Figure 4.4, sea turtle presence in the Regional Area is considered a rare occurrence.

Table 4.6 Marine Mammals and Sea Turtles with Reasonable Likelihood of Occurrence in the Study Area

Species	Scientific Name	Study Area		Habitat
		Occurrence	Season	
North Atlantic Right Whale	*Eubalaena glacialis*	Rare	Summer	Coastal, shelf and pelagic
Humpback Whale	*Megaptera novaeangliae*	Common	Year-round, but mostly May-Sep	Coastal and banks
Minke Whale	*Balaenoptera acutorostrata*	Common	Year-round, but mostly May-Oct	Coastal, shelf, and banks
Sei Whale	*Balaenoptera borealis*	Uncommon	May–Nov	Pelagic
Fin Whale	*Balaenoptera physalus*	Common	Year-round, but mostly summer	Shelf breaks, banks & pelagic
Blue Whale	*Balaenoptera musculus*	Uncommon	Year-round	Coastal and pelagic
Sperm Whale	*Physeter macrocephalus*	Common	Year-round, but mostly summer	Slope, canyons and pelagic
Northern Bottlenose Whale	*Hyperoodon ampullatus*	Uncommon	Year-round	Slope, canyons and pelagic
Sowerby's Beaked Whale	*Mesoplodon bidens*	Rare	Year-round	Slope, canyons and pelagic
Striped Dolphin	*Stenella coeruleoalba*	Rare	Summer	Shelf and pelagic
Atlantic Spotted Dolphin	*Stenella frontalis*	Rare	Summer	Shelf, slope and pelagic
Short-beaked Common Dolphin	*Delphinus delphis*	Common	Summer	Shelf an pelagic
White-beaked Dolphin	*Lagenorhynchus albirostris*	Common	Year-round, but mostly Jun-Sep	Shelf and pelagic
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	Common	Year-round, but mostly summer-fall	Coastal and shelf
Common Bottlenose Dolphin	*Tursiops truncatus*	Rare	Summer	Coastal and pelagic
Risso's Dolphin	*Grampus griseus*	Rare	Year-round	Continental slope
Killer Whale	*Orcinus orca*	Uncommon	Year-round	Coastal and pelagic
Long-finned Pilot Whale	*Globicephala melas*	Common	Year-round, but mostly spring-fall	Shelf break, pelagic and slope
Harbour Porpoise	*Phocoena phocoena*	Uncommon	Year-round, but mostly spring-fall	Coastal, shelf and pelagic
Harp Seal	*Pagophilus groenlandicus*	Common	Year-round, but mostly winter-spring	Pack ice and pelagic
Hooded Seal	*Cystophora cristata*	Common	Year-round, but mostly winter-spring	Pack ice and pelagic
Grey Seal	*Halichoerus grypus*	Uncommon	Year-round, but mostly summer	Coastal and shelf
Ringed Seal	*Pusa hispida*	Uncommon	Winter-spring	Landfast ice with snow cover

Table 4.6 Marine Mammals and Sea Turtles with Reasonable Likelihood of Occurrence in the Study Area

Species	Scientific Name	Study Area		Habitat
		Occurrence	Season	
Bearded Seal	*Erignathus barbatus*	Uncommon	Year-round	Coastal, shallow and ice edge
Leatherback Sea Turtle	*Dermochelys coriacea*	Rare	Apr to Dec	Shelf and pelagic
Loggerhead Sea Turtle	*Caretta caretta*	Rare	Summer and fall	Pelagic
Green Sea Turtle	*Chelonia mydas*	Rare	Summer	Pelagic
Note: Bolded species have conservation designations (see Section 4.5).				

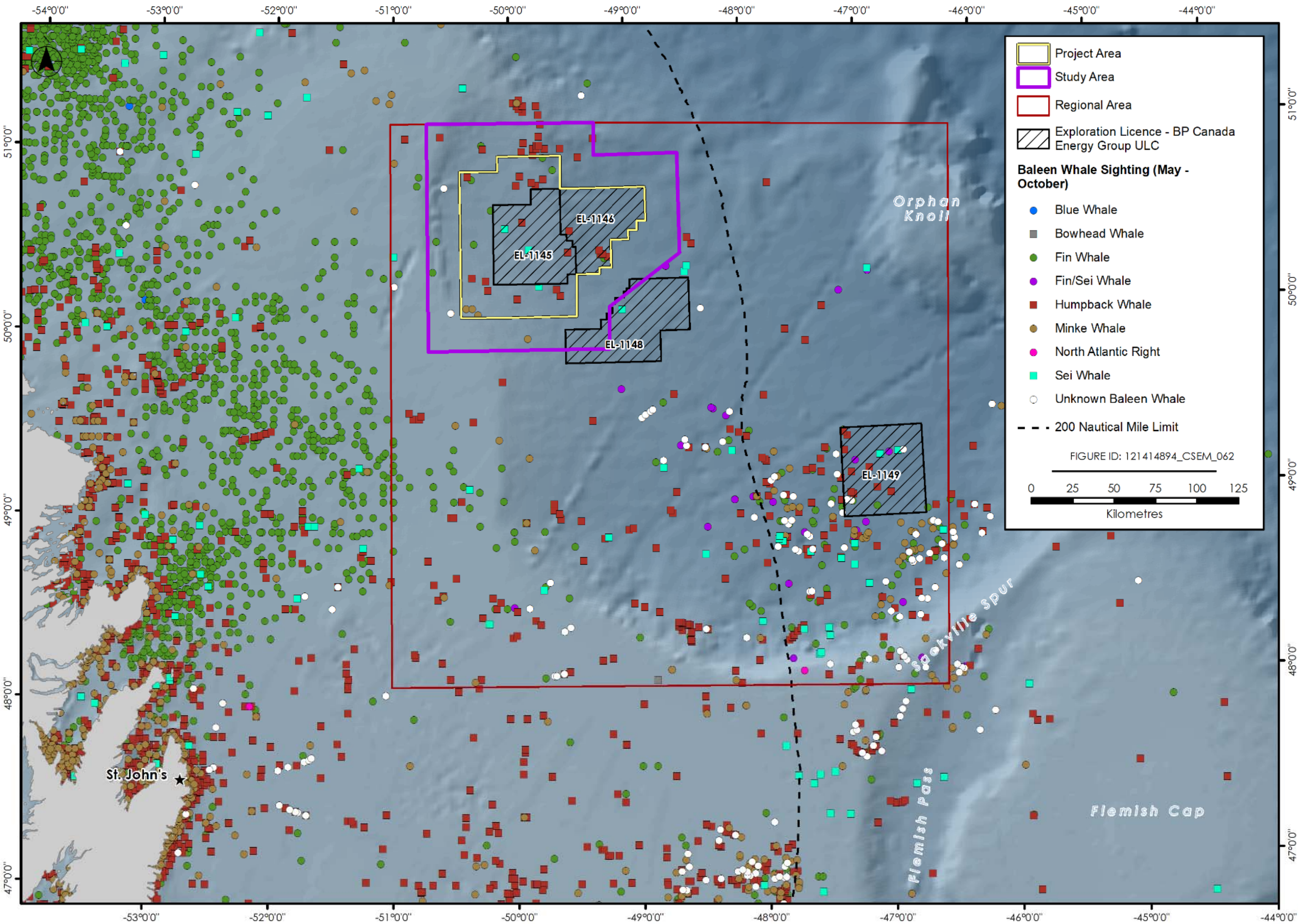


Figure 4.2 Baleen Whale Sightings (May to October) (Compiled from DFO Sightings Database 1947 to 2015)

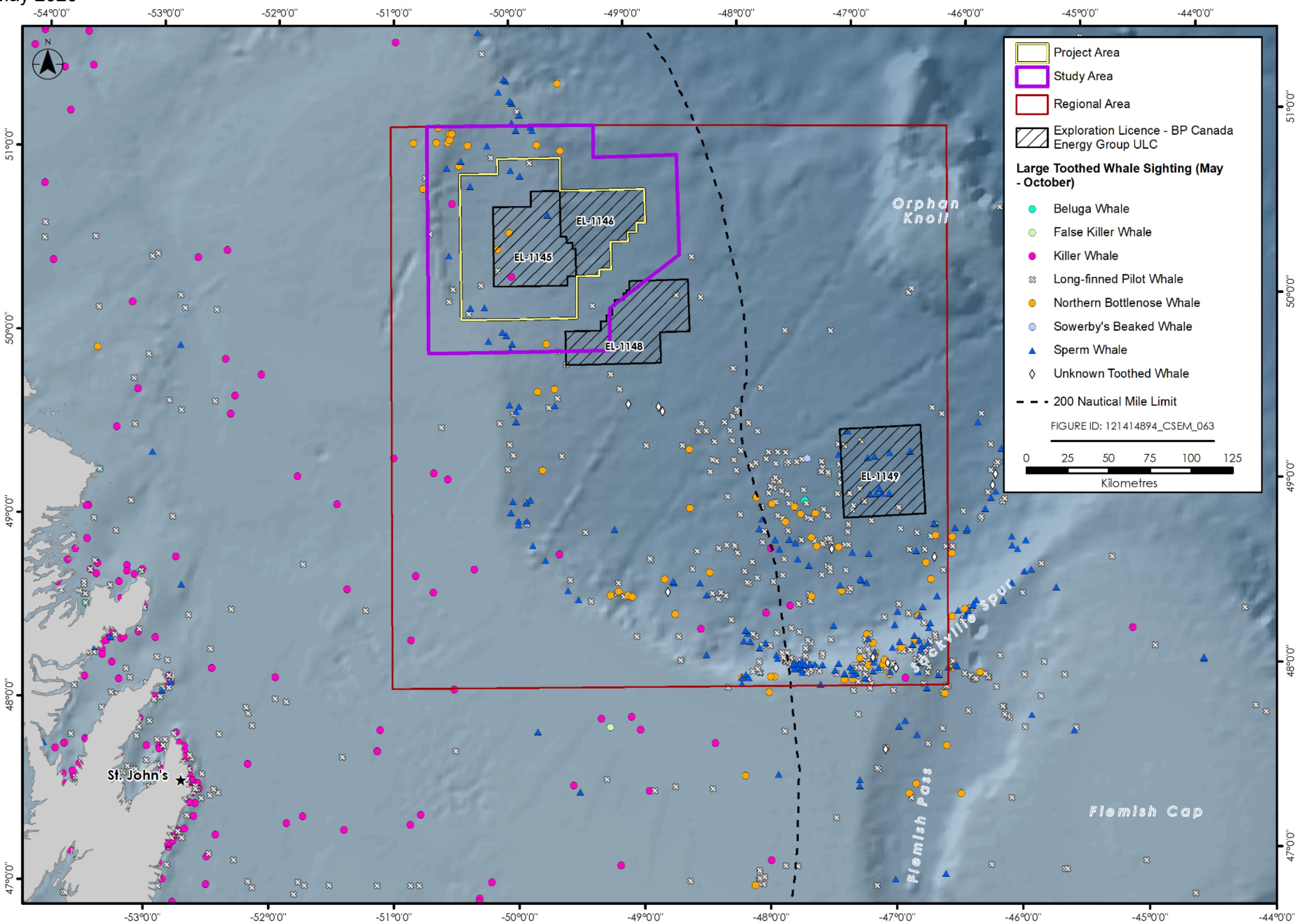


Figure 4.3 Toothed Whale Sightings (May to October) (Compiled from DFO Sightings Database 1947 to 2015)

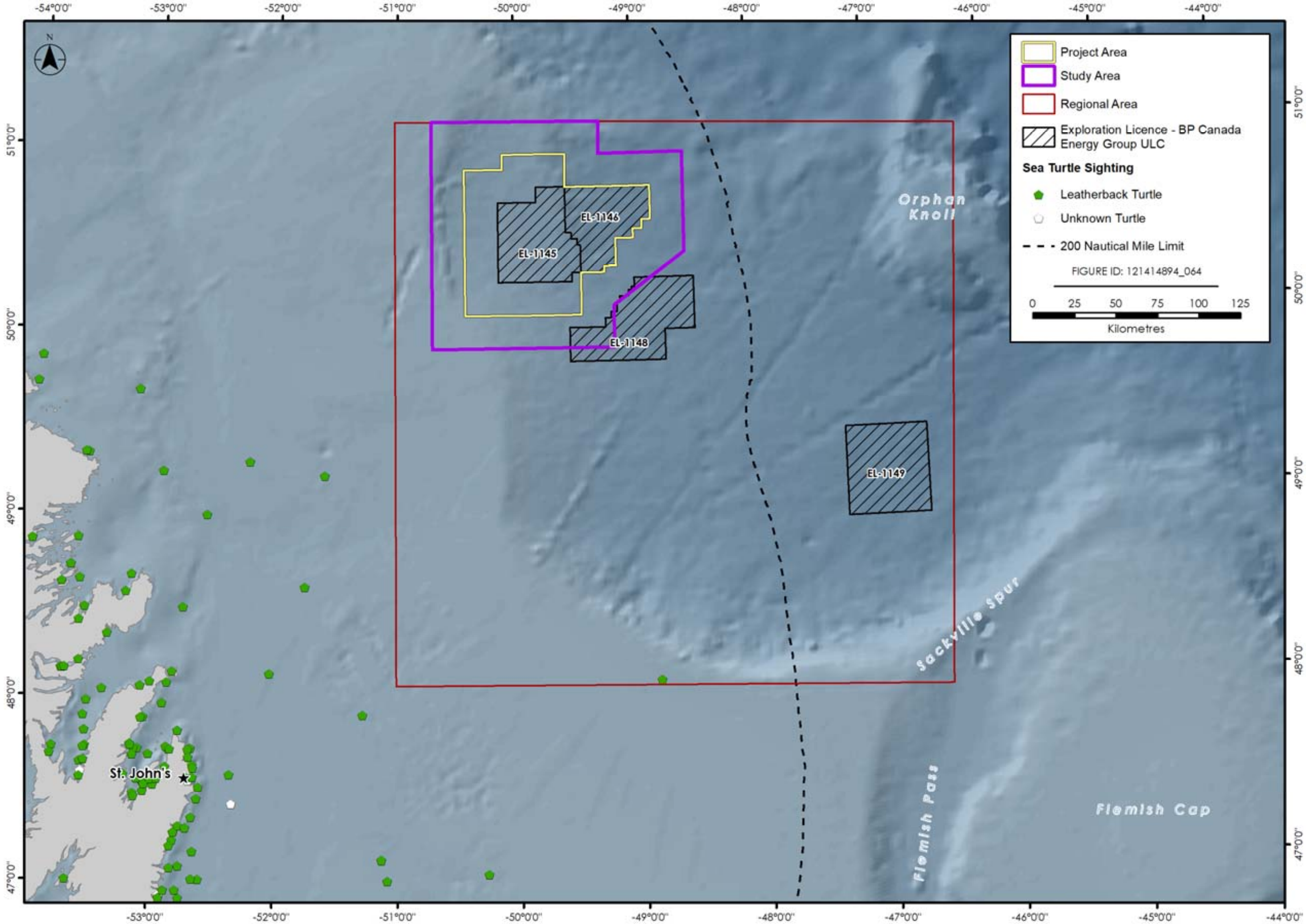


Figure 4.4 Sea Turtle Sightings (May to October) (Compiled from DFO Sightings Database 1947 to 2015)

4.4 Marine and/or Migratory Birds

The highly productive Grand Banks and adjacent waters are known to support large numbers of seabirds in all seasons (Lock et al. 1994; Fifield et al. 2009). Several million seabirds nest along the coasts of the eastern and northeastern Newfoundland and forage on the Grand Banks and adjacent areas during and following the nesting season. There are also many non-breeding seabirds that could be in the Regional Area during the summer months. During this time most of the world's population of great shearwater (*Puffinus gravis*) and large numbers of sooty shearwater (*Ardenna grisea*) nesting in the South Atlantic are thought to migrate to Newfoundland waters. Leach's storm-petrels (*Oceanodroma leucorhoa*) traverse the continental shelf to forage for nestlings in deep waters off the shelf in areas such as the Orphan Basin, which is the nearest deep-water area to Baccalieu Island, the largest nesting colony in the world of this species. During the winter months, seabirds from the Arctic and subarctic of eastern Canada, and from Greenland, gather in the waters off eastern Newfoundland. Of those seabirds, the non-breeding, sub-adults, especially northern fulmar (*Fulmarus glacialis*) and black-legged kittiwake (*Rissa tridactyla*), could be present in the Regional Area year-round. Waterfowl nest in coastal Newfoundland in relatively small numbers but winter in coastal waters in large numbers (Lock et al. 1994). However, they occur away from the coast generally only as vagrants in small numbers. Some species of Arctic-nesting shorebirds (plovers and sandpipers) undertake trans-oceanic flights during fall migration from eastern North America to South America (Williams and Williams 1978; Richardson 1979), so some passage offshore through the Regional Area may be expected. During summer, the Grand Banks also host species that migrate from nesting areas in the South Atlantic, including globally important numbers of great shearwater, large numbers of sooty shearwater, and smaller numbers of Wilson's storm-petrel (*Oceanites oceanicus*), and south polar skua (*Stercorarius maccormicki*).

Figures 4.5 to 4.8 and Table 4.7 provide the presence and relative abundance of marine and/or migratory birds in the Regional Area based on data from the Atlas of Seabirds at Sea in Eastern Canada 2006-2016 (Environment and Climate Change Canada [ECCC] 2017b).

Several coastal areas have been designated as Important Bird Areas (IBAs), which have been designated internationally to recognize sites of national and international importance to birds and generally include areas where large concentrations of seabirds nest, stage, or overwinter. There are 21 IBAs in eastern Newfoundland. Some of these IBAs are also designated federal Migratory Bird Sanctuaries or provincial Seabird Ecological Reserves. Project activities are not predicted to interact with any IBAs.

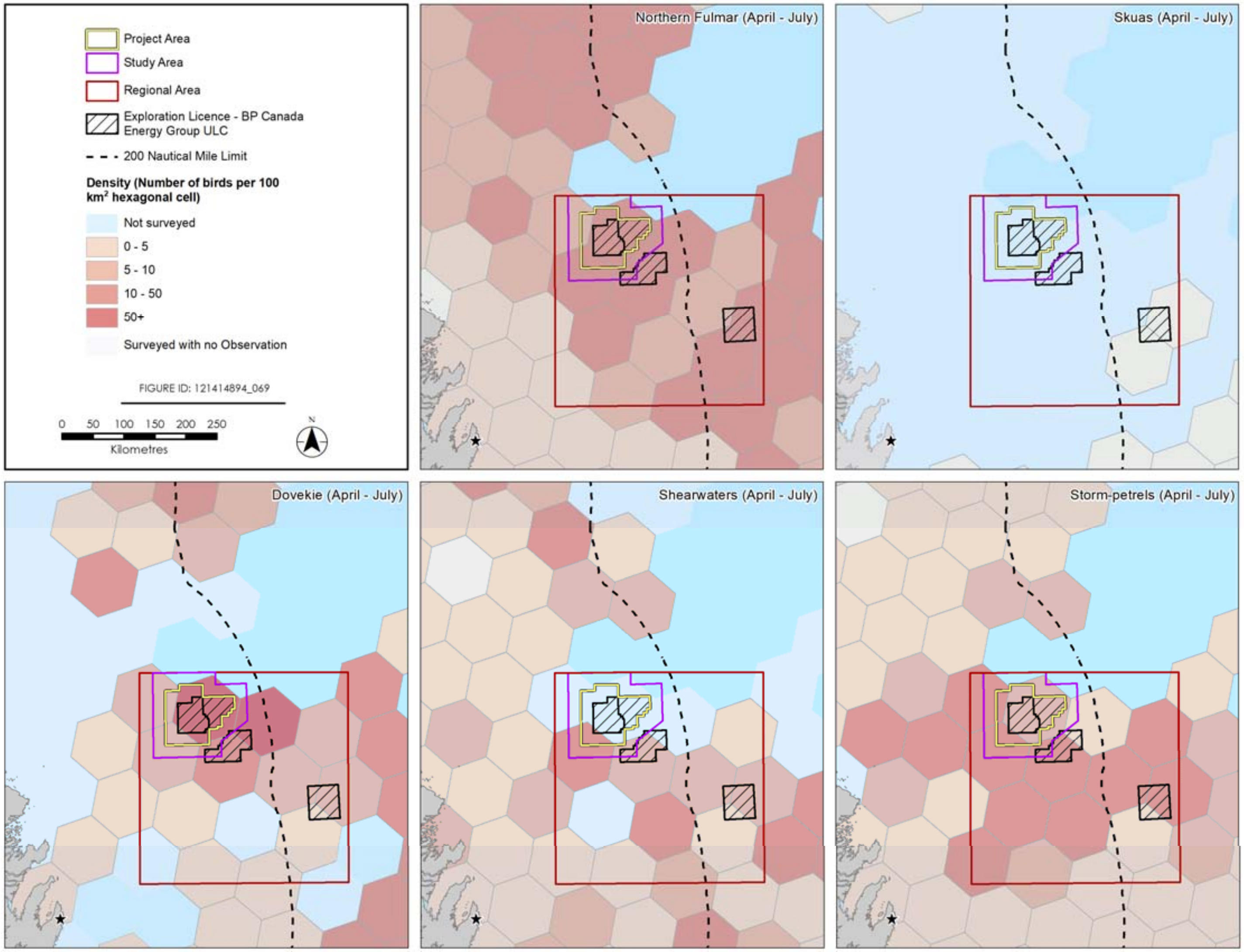


Figure 4.5 Seasonal Distribution of Northern Fulmar, Skuas, Dovekie, Shearwaters, and Storm-petrels in the Regional Area – April to July

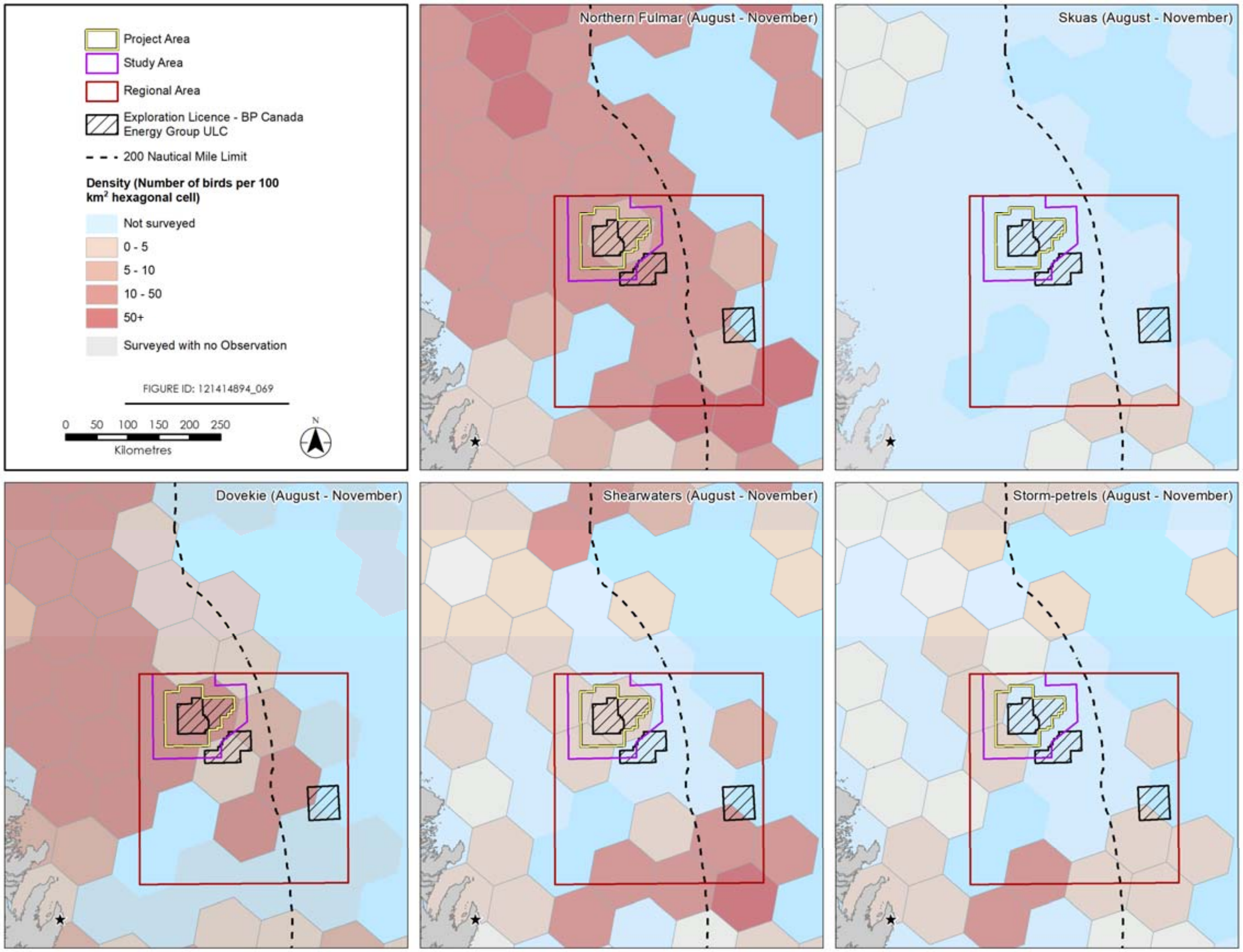


Figure 4.6 Seasonal Distribution of Northern Fulmar, Skuas, Dovekie, Shearwaters, and Storm-petrels in the Regional Area – August to November

Figure 4.7 Seasonal Distribution of Northern Gannet, Jaegers, Gulls, Murres, and Black-legged Kittiwake in the Regional Area – April to July

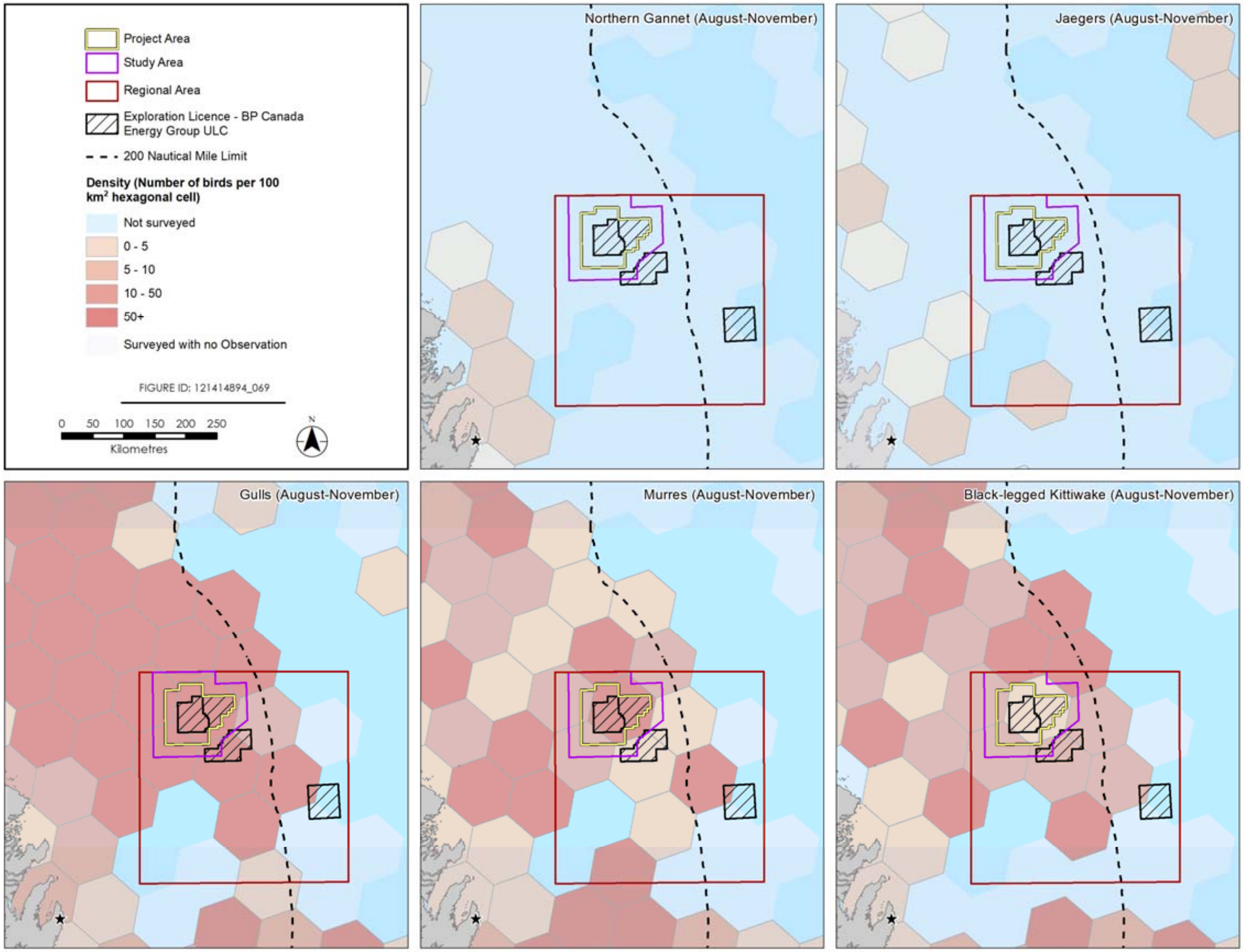


Figure 4.8 Seasonal Distribution of Northern Gannet, Jaegers, Gulls, Murres, and Black-legged Kittiwake in the Regional Area – August to November

Table 4.7 Summary of Seasonal Presence of Marine-associated Birds in the Study Area

Common Name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Ducks, Geese, and Swans												
Waterfowl (passage migrants)			VS	VS					VS	VS		
Plovers and Sandpipers												
Shorebirds (passage migrants)							S	S	S	S		
Phalaropes												
Red-necked phalarope (*Phalaropus lobatus*)					S	S	S	S	S			
Red phalarope (*Phalaropus fulicarius*)					S	S	S	S	S	S		
Gulls and Terns												
Black-legged kittiwake (*Rissa tridactyla*)	C	C	C	C	C	C	C	C	C	C	C	C
Ivory gull (*Pagophila eburnea*)	VS	VS	VS	VS								
Sabine's gull (*Xema sabini*)					VS	VS		VS	VS			
Ross's gull (*Rhodostethia rosea*)	VS	VS	VS	VS	VS					VS	VS	VS
Herring gull (*Larus argentatus*)	U	U	U	U	U	S	S	S	S	S	S	S
Iceland Gull (*Larus glaucoides*)	S	S	S	S						S	S	S
Lesser black-backed gull (*Larus fuscus*)					VS	VS	VS	VS	VS	VS	VS	VS
Glaucous gull (*Larus hyperboreus*)	S	S	S	S						S	S	S
Great black-backed gull (*Larus marinus*)	U	U	U	U	U	S	S	U	C	C	U	U
Arctic tern (*Sterna paradisaea*)					S	S	S	S	S			
Skuas and Jaegers												
Great skua (*Stercorarius skua*)					S	S	S	S	S	S		
South polar skua (*Stercorarius maccormicki*)					S	S	S	S	S	S		
Pomarine jaeger (*Stercorarius pomarinus*)				S	S	S	S	S	S	S		
Parasitic jaeger (*Stercorarius parasiticus*)					S	S	S	S	S	S		

Table 4.7 Summary of Seasonal Presence of Marine-associated Birds in the Study Area

Common Name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Long-tailed jaeger (*Stercorarius longicaudus*)					S	S	S	S	S			
Auks, Murres, Puffins, and Guillemots												
Dovekie (*Alle alle*)	C	C	C	C	U	VS	VS	VS	S	C	C	C
Common murre (*Uria aalge*)	S-U	S-U	S-U	C	C	C	C	C	C	C	C	C
Thick-billed murre (*Uria lomvia*)	C	C	C	C	C	S-U	S-U	S-U	U-C	C	C	C
Razorbill (*Alca torda*)				S	S	S	S	S	S	S	S	
Atlantic puffin (*Fratercula arctica*)				S	S	S	S	S	U	U	U	U
Fulmarine Petrels, Shearwaters, and Gadfly Petrels												
Northern fulmar (*Fulmarus glacialis*)	C	C	C	C	C	C	C	C	C	C	C	C
Great shearwater (*Puffinus gravis*)					U	C	C	C	C	C	S	
Sooty shearwater (*Ardenna grisea*)					S	S-U	S-U	S-U	S-U	S-U	S	
Manx shearwater (*Puffinus puffinus*)					S	S	S	S	S	S		
Cory's shearwater (*Calonectris borealis*)							VS	VS	VS			
Bermuda petrel (*Pterodroma cahow*)		VS	VS	VS	VS							
Zino's petrel (*Pterodroma madeira*)				VS	VS	VS	VS	VS	VS	VS		
Desertas petrel (*Pterodroma deserta*)	VS	VS	VS								VS	VS
Storm-Petrels												
Leach's storm-petrel (*Oceanodroma leucorhoa*)					U-C	C	C	C	C	C	S	
Band-rumped storm-petrel (*Oceanodroma castro*)					VS	VS	VS	VS				
Wilson's storm-petrel (*Oceanites oceanicus*)							S	S	S	S		
Gannets												
Northern gannet (*Morus bassanus*)				S	S	S	S	S	S	S		

Table 4.7 Summary of Seasonal Presence of Marine-associated Birds in the Study Area

Common Name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Cormorants												
Great (*Phalacrocorax carbo*) and double-crested (*Phalacrocorax auritus*) cormorants				VS	VS				VS	VS		
Landbirds												
Landbirds (vagrant migrants)				VS	VS			VS	VS	VS		
Notes: Bolded species have conservation designation (see Section 4.5). C = Common, present daily in moderate to high numbers; U = Uncommon, present daily in small numbers; S = Scarce, present, regular in very small numbers; VS = Very Scarce, very few individuals or absent. Blank spaces indicate not expected to occur in that month.												

4.5 Species at Risk

For the purpose of this report, species at risk are defined as those listed as endangered, threatened or of special concern under Schedule 1 of SARA, or by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC). Only species listed under Schedule 1 of SARA are legally protected. There are several fish, bird, mammal, and sea turtle species designated at risk that have the potential to occur in the Regional Area or Study Area (Table 4.8) although for most, occurrence in the Study Area and/or Project Area would be uncommon.

Table 4.8 Species at Risk listed under SARA and/or under Consideration by COSEWIC with Potential to Occur within the Study Area

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation
Marine Fish			
Acadian redfish	*Sebastes fasciatus*	Not Listed	Threatened
American eel	*Anguilla rostrata*	Not Listed	Threatened
American plaice (NL population)	*Hippoglossoides platessoides*	Not Listed	Threatened
Atlantic bluefin tuna (Western Atlantic population)	*Thunnus thynnus*	Not Listed	Endangered
Atlantic cod (NL population)	*Gadus morhua*	Not Listed	Endangered
Atlantic salmon (Outer Bay of Fundy)	*Salmo salar*	Not Listed	Endangered
Atlantic salmon (South Newfoundland population)	*Salmo salar*	Not Listed	Threatened
Atlantic salmon (Nova Scotia Southern Upland)	*Salmo salar*	Not Listed	Endangered
Atlantic salmon (Eastern Cape Breton)	*Salmo salar*	Not Listed	Endangered
Atlantic salmon (Gaspe-Southern Gulf of St. Lawrence)	*Salmo salar*	Not Listed	Special Concern
Atlantic salmon (Quebec Eastern North Shore population)	*Salmo salar*	Not Listed	Special Concern
Atlantic salmon (Quebec Western North Shore population)	*Salmo salar*	Not Listed	Special Concern
Atlantic salmon (Inner St. Lawrence population)	*Salmo salar*	Not Listed	Special Concern
Atlantic salmon (Anticosti Island population)	*Salmo salar*	Not Listed	Endangered
Atlantic wolffish	*Anarhichas lupus*	Special Concern	Special Concern
Basking shark (Northeast Atlantic population)	*Cetorhinus maximus*	Not Listed	Special Concern
Common lumpfish	*Cyclopterus lumpus*	Not Listed	Threatened

Table 4.8 Species at Risk listed under SARA and/or under Consideration by COSEWIC with Potential to Occur within the Study Area

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation
Cusk	*Brosme brosme*	Not Listed	Endangered
Deepwater redfish (Northern population)	*Sebastes mentella*	Not Listed	Threatened
Northern wolffish	*Anarhichas denticulatus*	Threatened	Threatened
Porbeagle shark	*Lamna nasus*	Not Listed	Endangered
Roundnose grenadier	*Coryphaenoides rupestris*	Not Listed	Endangered
Shortfin mako shark (Atlantic population)	*Isurus oxyrinchus*	Not Listed	Endangered
Smooth skate (Funk Island Deep Population)	*Malacoraja senta*	Not Listed	Endangered
Spotted wolffish	*Anarhichas minor*	Threatened	Threatened
Thorny skate	*Amblyraja radiata*	Not Listed	Special Concern
White hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*	Not Listed	Threatened
White shark (Atlantic population)	*Carcharodon carcharias*	Endangered	Endangered
Winter skate (Eastern Scotian Shelf – Newfoundland population)	*Leucoraja oscellata*	Not Listed	Endangered
Marine Mammals			
Blue whale	*Balaenoptera musculus*	Endangered	Endangered
Fin whale (Atlantic population)	*Balaenoptera physalus*	Special Concern	Special Concern
Harbour porpoise (Northwest Atlantic population)	*Phocoena phocoena*	Not Listed	Special Concern
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	Not Listed	Special Concern
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Endangered
Northern bottlenose whale (Scotian Shelf population)	*Hyperoodon ampullatus*	Endangered	Endangered
Northern bottlenose whale (Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*	Not Listed	Special Concern
Sei whale (Atlantic population)	*Balaenoptera borealis*	Not Listed	Endangered
Sowerby's beaked whale	*Mesoplodon bidens*	Special Concern	Special Concern
Sea Turtles			
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Endangered
Loggerhead sea turtle	*Caretta caretta*	Endangered	Endangered

Table 4.8 Species at Risk listed under SARA and/or under Consideration by COSEWIC with Potential to Occur within the Study Area

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation
Marine Birds			
Ivory gull	*Pagophila eburnea*	Endangered	Endangered
Red-necked phalarope	*Phalaropus lobatus*	Special Concern	Special Concern
Ross's gull	*Rhodostethia rosea*	Threatened	Threatened

A summary describing the distribution, habitat and ecology of species at risk as listed on SARA Schedule 1 which could potentially occur in the Study Area is provided in Table 4.9.

Table 4.9 Distribution / Habitat / Ecology of SARA Schedule 1 Species at Risk that Could Potentially Occur in the Study Area

Species	Distribution / Habitat / Ecology
Marine Fish	
Atlantic wolffish (Special Concern)	The Atlantic wolffish is widely distributed across the North Atlantic, with the centre of its western Atlantic distribution off the coast of northeast Newfoundland. Offshore Newfoundland, it is found in nearshore waters up to 918 m and is most frequently found in water depths of 150 to 350 m (DFO 2020). Unlike northern and spotted wolffish, it has been found in shallower waters on the southern Grand Banks (DFO 2020). Although larvae are pelagic, adult Atlantic wolffish are relatively sedentary. However, the species can conduct short (few km) seasonal migrations between offshore waters and shallow waters (<120 m deep) for spawning (which occurs in September) (COSEWIC 2012a; DFO 2020). A Management Plan has been finalized for the Atlantic wolffish (DFO 2020).
Northern wolffish (Threatened)	The northern wolffish inhabits boreal and subarctic waters on both sides of the North Atlantic and in the Arctic. It is most abundant on the shelf off northeastern Newfoundland and in the Labrador Sea, with highest densities at temperatures between 2°C and 5°C. While northern wolffish has been found in water depths ranging from 38 to 1,504 m, it is found mainly between 500 and 1,000 m water depth (COSEWIC 2012b). Critical habitat is thought to be at depths from 118 m to 636 m (DFO 2020). Spawning is thought to occur late in the year (COSEWIC 2012b). A Recovery Strategy has been finalized for the northern wolffish that includes designated critical habitat (DFO 2020). This critical habitat for northern wolffish overlaps with the Project Area and Study Area. This species is considered "data poor" in that basic life history information is only partially understood. For example, in the offshore, there is limited knowledge on what functional role specific habitat features play in supporting/maintaining the life cycle processes of northern wolffish (DFO 2020).
Spotted wolffish (Threatened)	Spotted wolffish are found on both sides of the North Atlantic and in the Arctic Ocean. They typically occupy water depths between 200 and 750 m on the continental shelf or in deep trenches. Mating likely occurs in the summer and fertilization is internal. Eggs are deposited on the bottom. Larvae are pelagic; juveniles and adults occupy bottom water (COSEWIC 2012c). A Recovery Strategy has been finalized for the spotted wolffish that includes designated critical habitat (DFO 2020). This critical habitat for spotted wolffish occurs within the Regional Area. Like northern wolfish, this species is considered "data poor" in that basic life history information is only partially understood (DFO 2020).

Table 4.9 Distribution / Habitat / Ecology of SARA Schedule 1 Species at Risk that Could Potentially Occur in the Study Area

Species	Distribution / Habitat / Ecology
White shark (Endangered)	The white shark is found in sub-polar to tropical seas of both hemispheres. In Atlantic Canada, it has been recorded from the Northeast Newfoundland Shelf to the Bay of Fundy. Canadian waters represent the northern fringe of the white shark's range. In the water column it can be found from just below the surface to just above the bottom, down to depths of least 1,200 m. Possible white shark pupping areas in the Atlantic Ocean have been identified in the Mid-Atlantic Bight (COSEWIC 2006a). Ocearch (2019) has tagged several white sharks with satellite tags; while individual sharks travel to the Grand Banks and the Flemish Cap, they do not typically travel further north into the Orphan Basin.
Marine Mammals	
Blue whale (Endangered)	The blue whale is the largest animal on the planet and is found in all oceans of the world. Blue whales became severely depleted during industrial whaling and still occur at relatively low densities in the North Atlantic. It has been estimated that 400 to 600 whales may be found in the western North Atlantic (Waring et al. 2011). There are no sightings of blue whales in the Study Area based on the DFO sightings database (1947 to 2015). The latest proposed Action Plan for the Northwest Atlantic population of the blue whale (DFO 2018) recommends recovery objectives intended to increase knowledge of the population, its habitat and threats, and implement measures to mitigate threats (e.g., underwater sound, vessel collisions, spills). No critical habitat has yet been defined for the Northwest Atlantic blue whale.
North Atlantic right whale (Endangered)	In the western North Atlantic, the right whale can be found from Florida to Newfoundland and the Gulf of St. Lawrence. Two-thirds of the North Atlantic population can be found on the Scotian Shelf and Bay of Fundy in summer and fall, with smaller numbers reported in the Gulf of St. Lawrence (COSEWIC 2013). In spite of being the first whale to receive total international protection from hunting in 1937, the population size of North Atlantic right whales remains low. The current best estimate is 451 animals and this number has been declining since 2010 (Pace et al. 2017; Pettis et al. 2017). Between June and September 2017, 12 dead North Atlantic right whales were reported in the Gulf of St. Lawrence. Necropsies were performed on seven of the whales and it was determined that the cause of death was blunt trauma in four instances and drowning as a result of entanglement in two instances. The cause of death could not be determined in the case of one whale for which post-mortem decomposition was very advanced (Daoust et al. 2017). In addition to these mortalities, additional entanglements were reported within the same timeframe (Daoust et al. 2017). The North Atlantic right whale would be considered a rare visitor to the Regional Area, with one recorded sighting of two individual right whales south of the Regional Area in the DFO sightings database near the Flemish Cap. A Recovery Strategy (DFO 2014) and proposed Action Plan (DFO 2016a) to achieve objectives in the recovery strategy have been developed for the North Atlantic right whale in Atlantic Canada waters. Critical habitat for this species has been designated in the Grand Manan Basin (Bay of Fundy) and Roseway Basin (off southwestern Nova Scotia).
Fin whale (Special Concern)	Fin whales are found in all the oceans of the world, except the Arctic Ocean. Fin whales breed and calve in winter at lower latitudes (DFO 2017a). The North Atlantic population inhabits eastern Canadian coastal waters, mostly in summer (DFO 2017a). Fin whales are expected to be common throughout the Study Area and Regional Area, particularly between June and August. In 2017, DFO released a Management Plan for the fin whale (DFO 2017a).

Table 4.9 Distribution / Habitat / Ecology of SARA Schedule 1 Species at Risk that Could Potentially Occur in the Study Area

Species	Distribution / Habitat / Ecology
Northern bottlenose whale (Scotian Shelf population) (Endangered)	The northern bottlenose whale is found only in the North Atlantic, primarily in offshore waters. The Scotian Shelf population of northern bottlenose whale is the only endangered population. Individuals from this population are found regularly between the Gully, Shortland Canyon, and Haldimond Canyon offshore Nova Scotia (DFO 2016b). There have been sightings of northern bottlenose whale recorded in the Project Area in the DFO sightings database between May and September. However, it is likely that these individuals sighted are associated with the Davis Strait-Baffin Bay-Labrador Sea population (which is not listed on SARA Schedule 1). Northern bottlenose whales from the endangered Scotian Shelf population are expected to be uncommon in the Study Area. A recovery strategy was amended, and an action plan was proposed for the Scotian Shelf population of northern bottlenose whale, updating critical habitat measures (DFO 2016b, 2017b).
Sowerby's beaked whale (Special Concern)	To date, there is little information known on Sowerby's beaked whale in the waters of offshore NL. The majority of information that has been gathered is based on strandings records (Lien and Barry 1990, in Husky 2012). Sowerby's beaked whales are also relatively difficult to detect at sea due to their short surface durations, apparent offshore distribution, and barely detectable blows (Hooker and Baird 1999a, in Husky 2012). They have most often been observed in deep waters and continental shelf edges or slopes (Kenney and Winn 1987, in Husky 2012; COSEWIC 2006b) and presumably make deep dives to forage on medium to large-bodied squid (COSEWIC 2006b). There is one sighting of four Sowerby's beaked whales in the Regional Area in the DFO sightings database (Figure 4.3). The sighting of four individuals was made during a seismic survey in Orphan Basin in September 2005 (Moulton et al. 2006). There are also several stranding records for NL (DFO 2017c). It is considered rare in the Study Area. In 2017, DFO released a management plan for Sowerby's beaked whale (DFO 2017c).
Sea Turtles	
Leatherback sea turtle (Endangered)	Leatherback turtles outfitted with satellite telemetry tags and vessel-based sightings have been reported in the offshore waters off Nova Scotia and Newfoundland (Stewart et al. 2013; Dodge et al. 2014; Archibald and James 2016; Chambault et al. 2017). As of 2006, there were an estimated 34,000 to 94,000 adult leatherback sea turtles throughout the North Atlantic (TEWG 2007). While the size of the seasonal foraging population in Atlantic Canada is not known, sightings data suggest that the population in Canadian Atlantic waters numbers in the thousands (COSEWIC 2012d). Archibald and James (2016) suggested that Canadian waters may have the highest density of foraging leatherbacks anywhere throughout their range. Although critical habitat has not yet been designated for this species in Atlantic Canadian waters (ALTRT 2006), areas previously identified as important foraging habitat have now been identified in the proposed recovery strategy as critical habitat areas for leatherbacks (DFO 2016c). Three proposed critical habitat areas have been identified: (1) the Southwestern Scotian Slope Area, (2) the Gulf of St. Lawrence-Laurentian Channel Area, and (3) the Placentia Bay Area (DFO 2016c). The main threat facing leatherback sea turtles in Canadian waters is bycatch in fisheries, although globally, the species is threatened by ship strikes, marine debris, and oil and gas exploration (COSEWIC 2012d). Hamelin et al. (2017) reported several incidental captures of leatherback sea turtles in fishing gear in the waters off Newfoundland, including on the Grand Banks. There are no sightings of leatherback turtles within the Study Area and only one recorded sighting in the Regional Area (Figure 4.4). However, some leatherback sea turtles have been observed to the south and west of the Regional Area. Occurrence of leatherback sea turtles in the Study Area would be considered rare.

Table 4.9 Distribution / Habitat / Ecology of SARA Schedule 1 Species at Risk that Could Potentially Occur in the Study Area

Species	Distribution / Habitat / Ecology
Loggerhead sea turtle (Endangered)	The loggerhead sea turtle is widely distributed in the Atlantic, Pacific, and Indian Oceans. Nesting populations along the southeast United States and Caribbean coast of Mexico can be found in Atlantic Canada, primarily in offshore waters (COSEWIC 2010). There are no sightings of loggerhead turtles within the Project/Study/Regional Area in the DFO sightings database. Occurrence of loggerhead sea turtles in the Project Area would be considered rare. No Management Plan or Recovery Strategy has been published for the loggerhead sea turtle.
Marine and/or Migratory Birds	
Ivory gull (Endangered)	Ivory gulls nesting in the Canadian Arctic and Greenland and fitted with satellite transmitters wintered from Baffin Bay to the Northeast Newfoundland Shelf (Gilg et al. 2010; Spencer et al. 2016). Individuals from those two nesting populations comprise most of the world's population, so this wintering area has global importance for this species. Ivory gulls were recorded twice during bird surveys at the Bay de Verde Wellsite in the winter of 2014-2015 (Statoil 2015). Ivory gull can be expected to occur in small numbers in the Regional Area during periods when sea ice is present (i.e., late winter and early spring). It probably occurs irregularly south of 50°N among the ice pack during heavier ice years. A Recovery Strategy (Environment Canada 2014) identified critical habitat for Ivory Gull at breeding colonies in Nunavut. Additional critical habitat is to be identified in a future Action Plan for the species.
Ross's gull (Threatened)	Ross's gulls nesting in the Canadian Arctic that have been tagged with geolocators and satellite transmitters have been tracked to a wintering area that reaches from the Labrador Sea to Orphan Basin (Maftei et al. 2015). As a result, this species may be expected to be present in very small numbers in the Regional Area during winter. This species is not likely to be encountered during Project activities due to the planned timing of the survey (May to October). A Recovery Strategy (Environment Canada 2007) has been prepared for this species, although critical habitat has not yet been identified.
Red-necked Phalarope (Special Concern)	Red-necked phalaropes occur in the pelagic waters of the Regional Area as migrants in passage between nesting grounds on the Arctic tundra and pelagic wintering areas in the tropics and sub-tropics. At sea, red-necked phalarope feed at the surface on zooplankton and are thought to forage primarily at ocean fronts bordered by upwelling (Rubega et al. 2000; Tracy et al. 2002). Phalaropes migrate in small flocks in low densities, and are often seen in flight, so they have not been recorded in Orphan Basin during surveys of seabirds at-sea in a sample sufficient to calculate densities (e.g., Moulton et al. 2006; Bolduc et al. 2018). However, they have been recorded off-transect in small numbers from mid-May to early June and during August and September in the Project Area (e.g., Moulton et al. 2006).

There is designated critical habitat within the Study Area or Regional Area for northern and spotted wolffish. The designated northern wolffish critical habitat overlaps the Project Area along a portion of the Northeast Newfoundland Slope (refer to Figure 4.9).

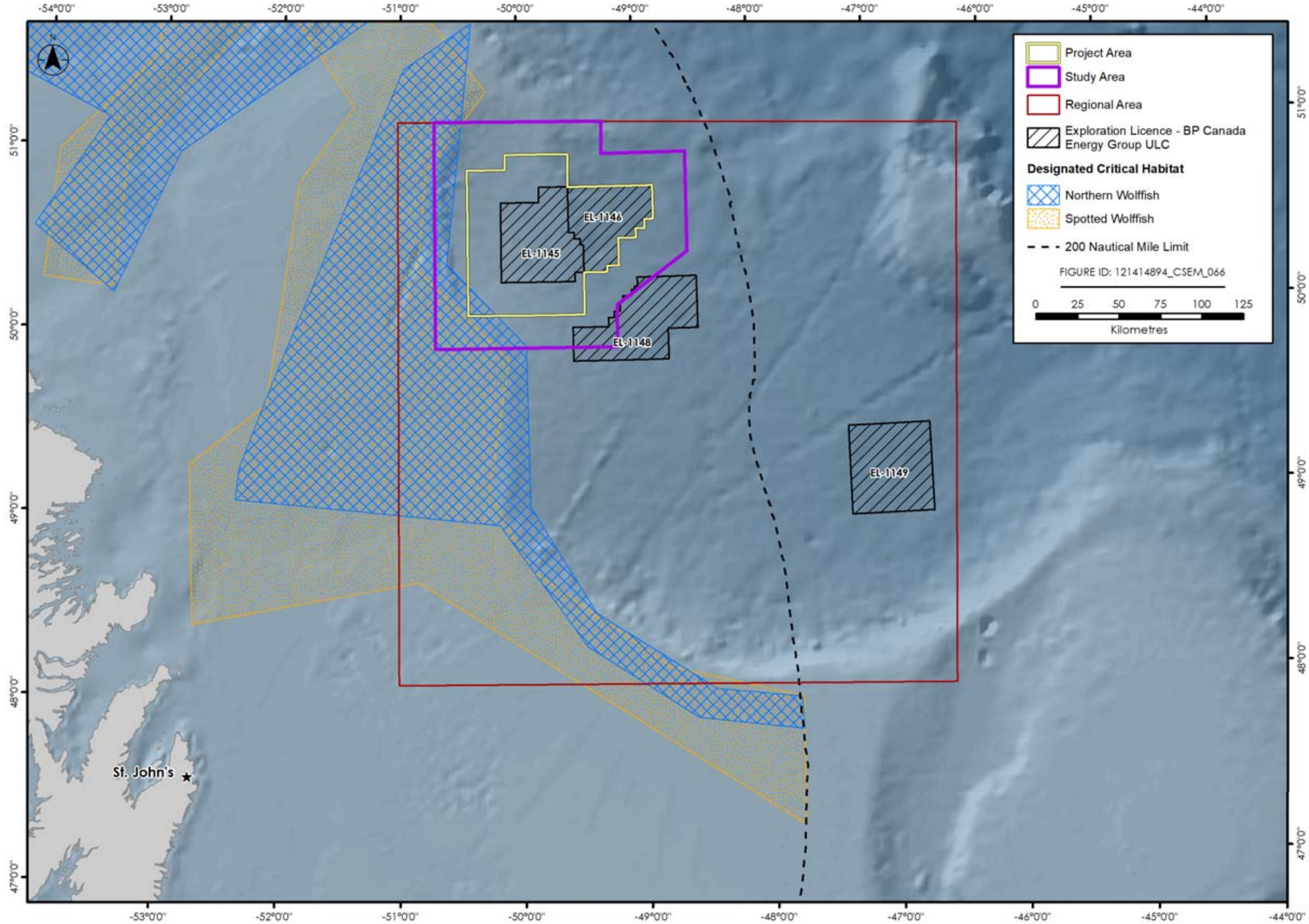


Figure 4.9 Designated Critical Habitat for Northern and Spotted Wolffish

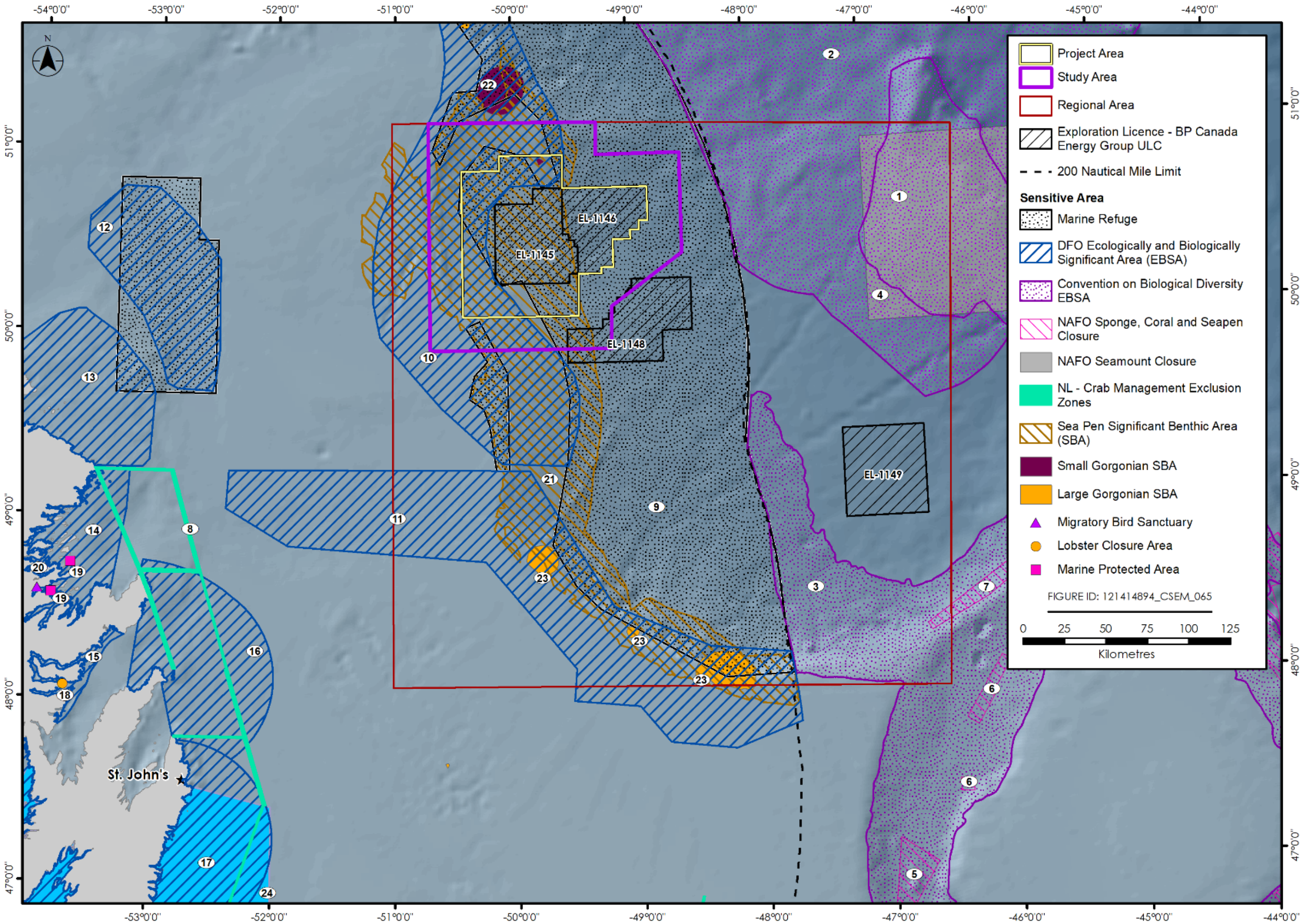
4.6 Sensitive Areas

There are several areas in NL waters that are considered to be important for ecological, historical, or socio-economic reasons. Some of these areas are protected under federal, provincial or international legislation or programs (e.g., marine refuge established under the *Fisheries Act,* critical habitat designated under SARA) and others do not have any formal protection (e.g., Ecologically and Biologically Significant Areas [EBSAs], SBAs) but represent areas of high ecological value. Table 4.10 and Figure 4.10 indicate sensitive areas located within or adjacent to the Regional Area; sensitive areas that intersect the Project Area are shown in boldface type in Table 4.10.

Table 4.10 Sensitive Areas within or Adjacent to the Regional Area

Number[1]	Name of Designated Sensitive Area	Category of Designation
1	Orphan Knoll	Convention on Biological Diversity (CBD) Identified EBSA
2	Seabird Foraging Zone in the Southern Labrador Sea	CBD Identified EBSA
3	Slopes of the Flemish Cap and Grand Bank	CBD Identified EBSA
4	Orphan Knoll	NAFO Seamount Closure
5	Flemish Pass / Eastern Canyon	NAFO Sponge, Coral and Seapen Closure
6	Northwest Flemish Cap	NAFO Sponge, Coral and Seapen Closure
7	Sackville Spur	NAFO Sponge, Coral and Seapen Closure
8	Crab Exclusion Zone	Exclusion
9	**Northeast Newfoundland Slope**	**Marine Refuge**
10	Funk Island Deep	Marine Refuge
11	**Orphan Spur**	**DFO EBSA**
12	Northeast Shelf and Slope	DFO EBSA
13	Notre Dame Channel	DFO EBSA
14	Fogo Shelf	DFO EBSA
15	Eastern Avalon	DFO EBSA
16	Smith Sound	DFO EBSA
17	Lobster Closure Area	Marine Refuge
18	Eastport Marine Protected Area	Marine Protected Area
19	Eastport Migratory Bird Sanctuary	Migratory Bird Sanctuary
20	**Sea Pen Significant Benthic Area (SBA)**	**SBA**
21	Small Gorgonian SBA	SBA
22	Large Gorgonian SBA	SBA
n/a[2]	**Northern Wolffish Critical Habitat**	**SARA-designated Critical Habitat**

[1]Refer to Figure 4.10
[2]Refer to Figure 4.9
Note: Bolded entries indicate intersection with Project Area.



Note: Refer to Table 4.10 for key.

Figure 4.10 Sensitive Areas

Sensitive Areas which intersect with the Project Area include the Orphan Spur EBSA, the Northeast Newfoundland Slope Closure Area (marine refuge), an SBA for sea pens, and critical habitat for the northern wolfish (refer to Section 4.5). EBSAs have been identified by DFO to emphasize marine areas with high ecological or biological activity relative to their surrounding environment (DFO 2005). The Orphan Spur EBSA (of which 2,250 km² intersects the Project Area; 12% of EBSA), is recognized as having a high concentration of corals as well as high densities of sharks and species of conservation concern (e.g., northern, spotted and striped (*Anarhichas lupus*) wolffish, skates, roundnose grenadier, American plaice (*Hippoglossoides platessoides*), redfish). Outside Canada's exclusive economic zone (EEZ), the Conference of the Parties to the Convention on Biological Diversity (CBD) has identified additional EBSAs.

The Northeast Newfoundland Slope Closure marine refuge was designated in December 2017 under the *Fisheries Act* and is closed to bottom contact fishing to help prevent damage to corals and sponges. The Project Area intersects approximately 6,525 km² or 10% of the total area of the marine refuge.

SBAs are defined in DFO's Ecological Risk Assessment Framework as "significant areas of cold-water corals and sponge dominated communities" (DFO 2013). SBAs have been determined using a kernel density estimation, a quantitative analyses technique applied to research vessel data to identify sponge, coral, and sea pen catches (Kenchington et. al. 2016). These areas are not protected; however, they identify key marine species distribution and may indicate areas of future restoration activities. As shown on Figure 4.10, there is a designated SBA for sea pens that encompasses the edge of the Northeast Newfoundland Shelf, including EL 1145, and a small portion of EL 1146. There is a tiny SBA for small gorgonians within the Project Area. There are additional SBAs for small and large gorgonians in the Regional Area along the Northeast Newfoundland Slope.

Within the greater Regional Area, potential transit route of the survey vessel (one planned round trip for the survey) would intersect the Northeast Shelf and Slope EBSA, which is recognized as having high aggregations of Greenland halibut and spotted wolffish, and concentrations of cetaceans, pinnipeds, and corals (AMEC 2014).

4.7 Fisheries and Other Ocean Users

Commercial fishing activity occurs in the waters of offshore Newfoundland and Labrador, including areas that overlap the Study Area and larger Regional Area. The large portion of commercial fishing activity occurs on the Grand Banks, and along the continental shelf and shelf break. This includes areas of the shelf break that overlap with the Study Area.

The Project Area is fully contained in NAFO Unit Area 3Kg, while the Study Area also overlaps partially with NAFO Unit Area 3Kc. The larger Regional Area encompasses all of NAFO Unit Areas 3Kg, ,3Ld, 3Le, and portions 3Kc and 3Kk. With the exception of redfish in Unit Area 3K, DFO maintains jurisdiction over commercial fish species within Canada's 200 nm EEZ and all sedentary species that occur across the extent of Canada's continental shelf. Redfish in Unit Area 35 is co-managed by NAFO and the Northeast Atlantic Fisheries Commission. Outside of the EEZ, NAFO holds jurisdiction over commercial fishing activity for several species and manages the conservation of other environmental features like corals and sponges.

Two sources of data are used below to describe fishing activity within the Project spatial boundaries and are referred below where applicable:

- DFO Geospatial data (DFO 2019a) – Indicates the species, gear type, vessel type, and month of domestic commercial harvesting activity summarized by grid cells at a resolution of 4 nautical miles x 6 nautical miles. Percent weight and percent value are also included as variables and indicate, for a particular grid cell and month, what percent of the weight and values can be attributed to each species / species group.
- DFO Tabular data (DFO 2019b) – indicates the quantity and value harvested for commercially fished species, by year, gear type, and vessel type. The data are summarized by NAFO Unit Area.

Until the early 1990s, the commercial fisheries in the Regional Area were dominated by groundfish (e.g., Atlantic cod, redfish, American plaice). Since the moratoria declared in 1992, northern shrimp, snow crab and turbot have become the principal harvest in the Regional Area (96 to 99%), with small amounts of roughhead grenadier, sea scallop, and redfish comprising the remainder (LGL Limited 2005, 2009, 2012).

Locations of commercial fishing activity for all species and all gear type from 2013 to 2017 are shown in Figure 4.11. Figure 4.12 presents only the locations from 2017 for groundfish, shrimp and crab and provides an indication of where the primary areas for commercial fishing activity are with respect to the Project spatial boundaries.

Snow crab and northern shrimp constitute most landings, in offshore NL. Other prominent species harvested include groundfish such as Greenland halibut, Atlantic halibut, deepwater redfish, and flounder. Within the Project Area, domestic commercial fishing activity appears to be focused primarily on Greenland halibut, along with northern shrimp and snow crab, as shown in Table 4.11. Table 4.11 also indicates the percent of fishing activity that occurs within the Study Area, compared to all commercial fishing activity in NAFO Division 3K.

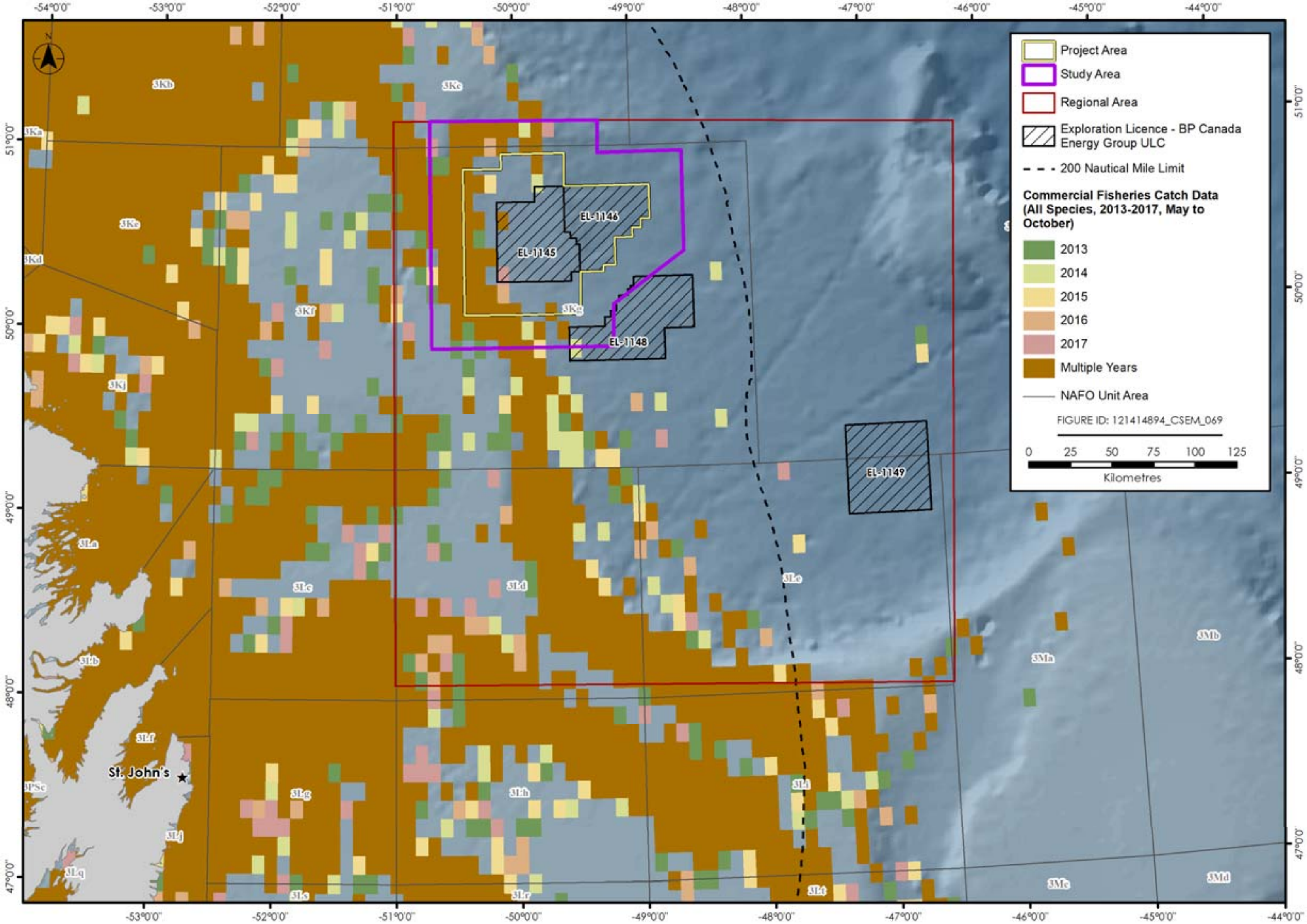


Figure 4.11 Domestic Commercial Fishing Activity, All Species, 2013 to 2017

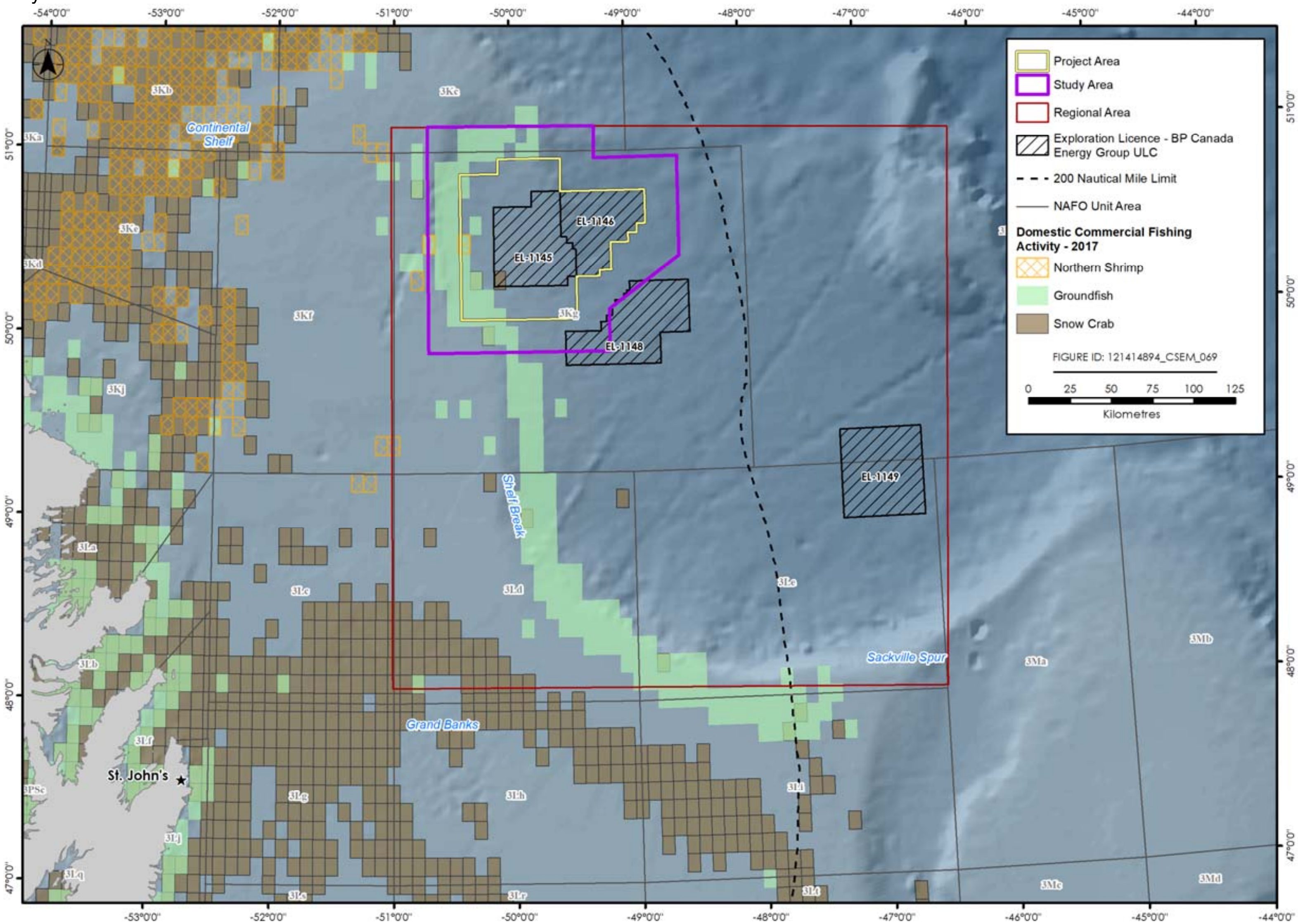


Figure 4.12 Domestic Commercial Fishing Activity for Groundfish, Snow Crab and Northern Shrimp, 2017 only

Table 4.11 Percent of Fishing Occurrences for Commercially Harvested Species that Occurred in the Study Area Compared to All Fishing that Occurred in NAFO Division 3K

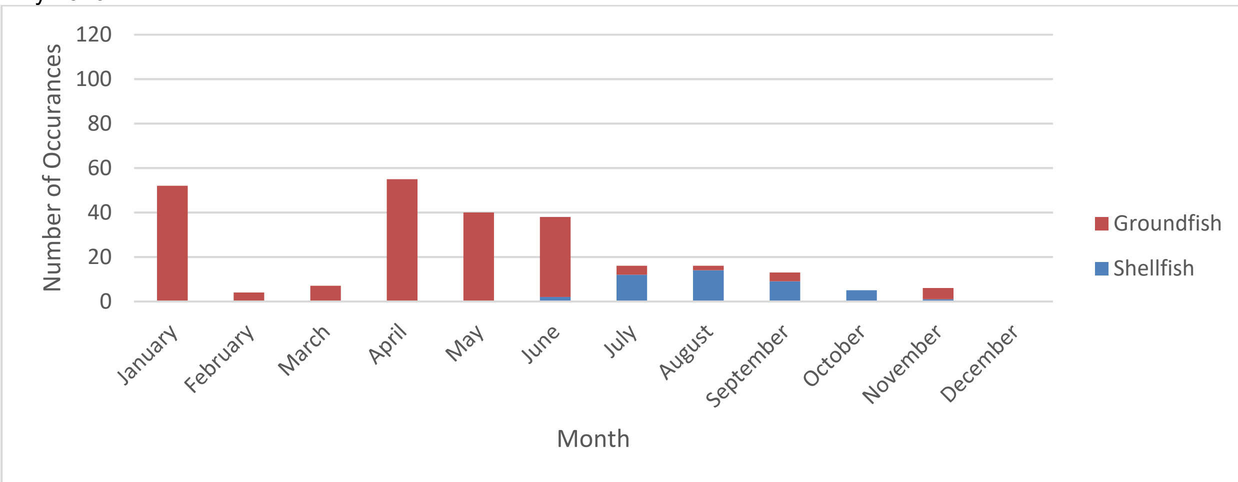
Species	Group	2013	2014	2015	2016	2017	5-year Average
Turbot / Greenland Halibut	Groundfish	81%	37%	33%	34%	64%	50%
Roughhead Grenadier		100%	33%	67%	40%	<1%	48%
Redfish		92%	21%	13%	14%	52%	38%
Greysole / Witch Flounder		50%	26%	14%	22%	64%	35%
Atlantic Halibut		75%	6%	3%	9%	45%	28%
Skate		100%	<1%	33%	<1%	<1%	27%
American Plaice		<1%	4%	3%	<1%	<1%	1%
Atlantic Cod		<1%	<1%	<1%	4%	<1%	1%
Queen / Snow Crab	Shellfish	1%	4%	16%	4%	<1%	5%
Northern Shrimp		3%	-	1%	1%	<1%	1%
Source: DFO 2019a							

Species that are commercially fished with the Study Area are harvested using both fixed and mobile gear types. Table 4.12 indicates the type of mobile or fixed gear, and the species that are commonly harvested using these gear types.

Table 4.12 Species Commonly Harvested Using Fixed and Mobile Gear

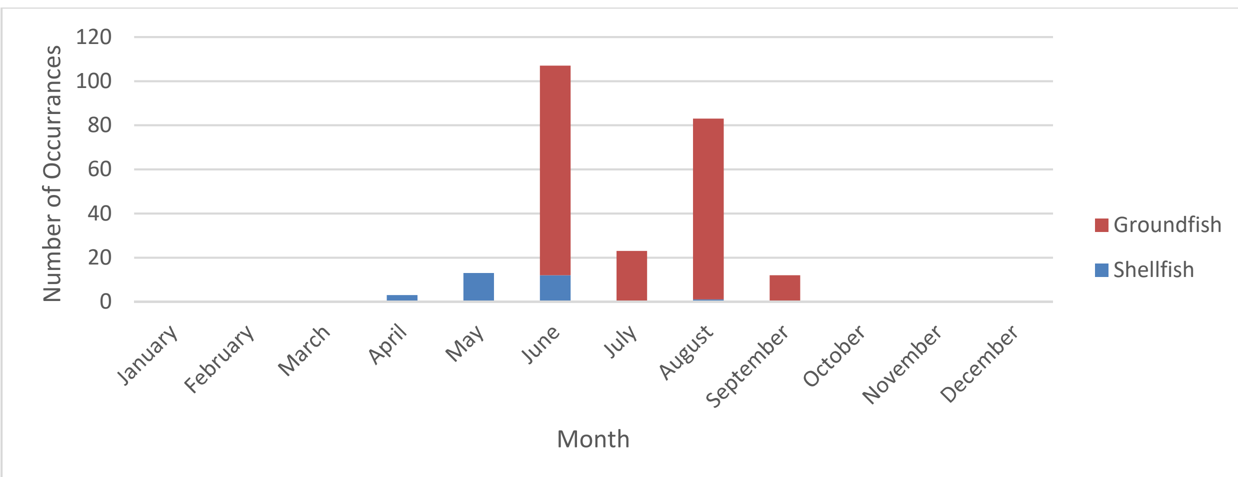
Gear Class	Gear Type	Main Species Harvested
Fixed	Gillnet	Greenland halibut, Redfish
	Pot	Snow crab
Mobile	Bottom Otter Trawl	Greenland halibut, witch flounder, Redfish
	Shrimp Trawl	Northern shrimp
Source: DFO 2019a		

The seasonality for mobile and fixed gear type within the Project Area, summed over a five-year period from 2013-2017, are shown in Figures 4.13 and 4.14, respectively. Although the full year is shown, the months to focus on for the purposes of the Project are May to October. During these months, mobile gear types are used more often to harvest groundfish species in May and June, and for mobile gear in June and August. The Project Area overlaps with a marine refuge area, the Northeast Newfoundland Slope Closure, established in 2017. Within this area, bottom contact fishing activity, such a bottom otter trawls, is prohibited. The change in gear types is not yet reflected in the data provided by DFO, as the most recent year available is 2017.



Source: DFO 2019a

Figure 4.13 Seasonality of Commercial Fishing Activity in the Project Area Using Mobile Gear, 2013 to 2017



Source: DFO 2019a

Figure 4.14 Seasonality of Commercial Fishing Activity in the Project Area Using Fixed Gear, 2013 to 2017

Figure 4.15 indicates where domestic harvesting (all species) occurred from May to October, 2013 to 2017. Figures 4.16 and 4.17 indicate where domestic fishing occurred from May to October, 2013 to 2017, using mobile and fixed gear, respectively, for the same time period.

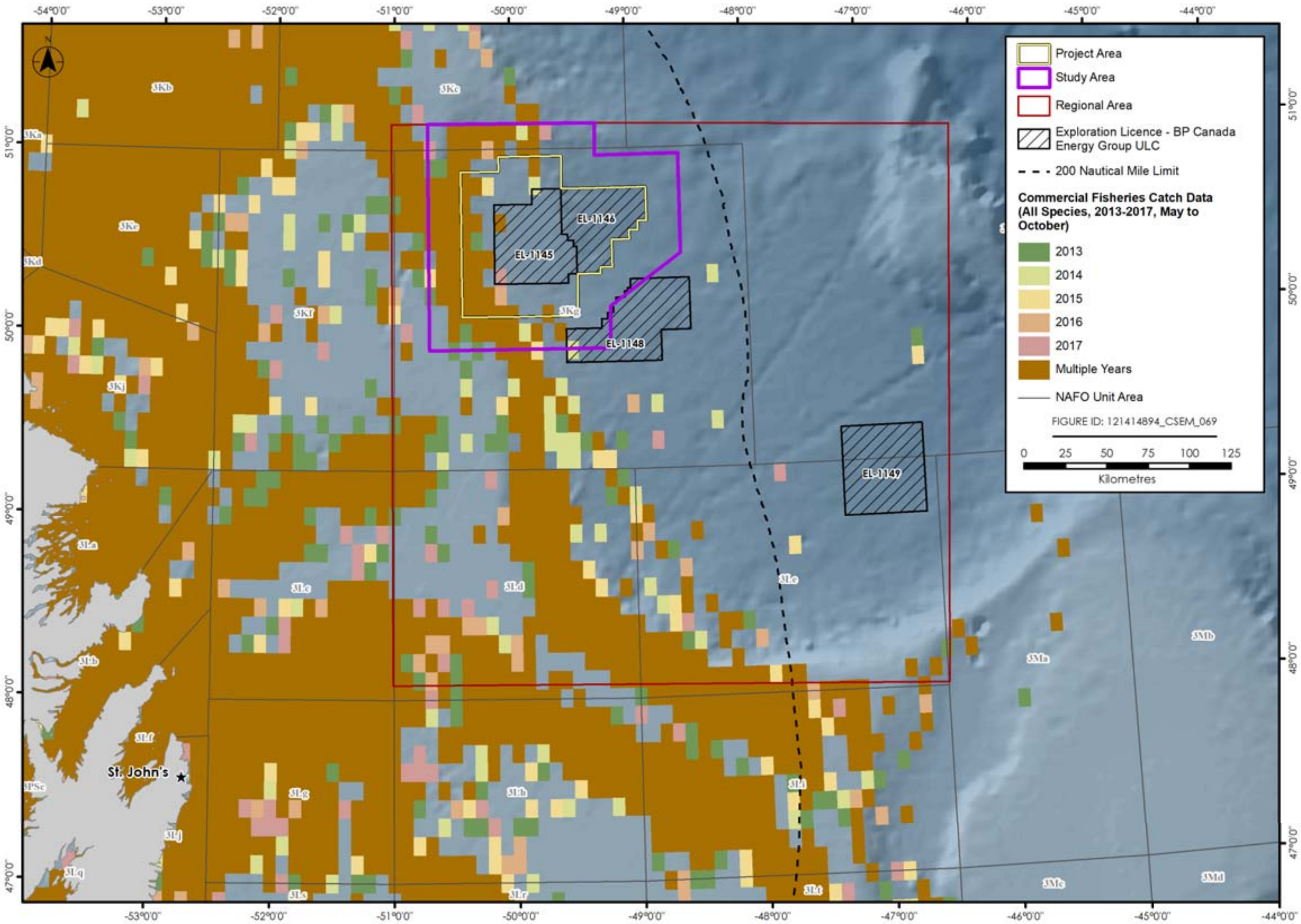


Figure 4.15 Domestic Harvesting Locations, All Species (May to October 2013 to 2017)

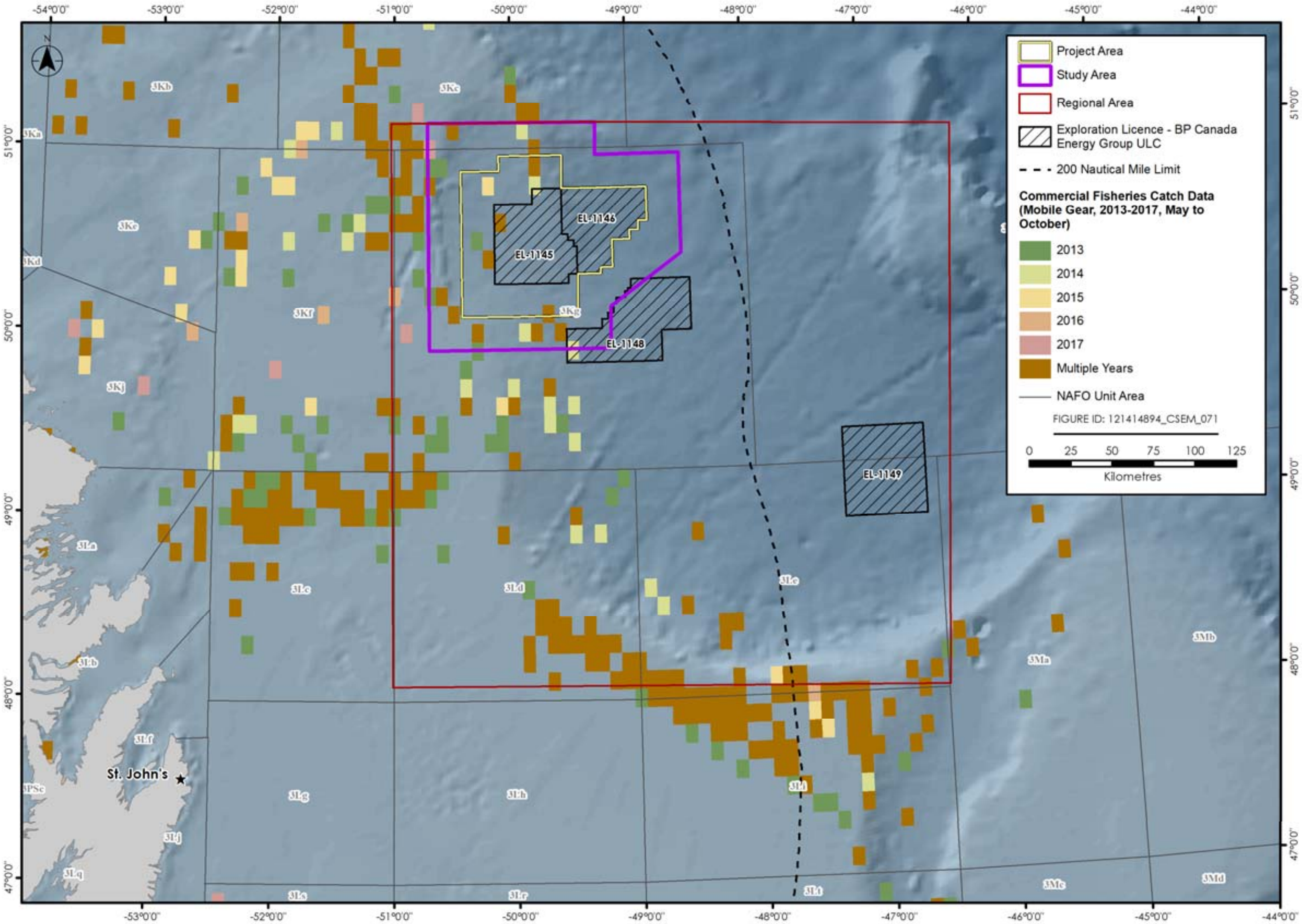


Figure 4.16 Domestic Harvesting Locations – Mobile Gear (May to October 2013 to 2017)

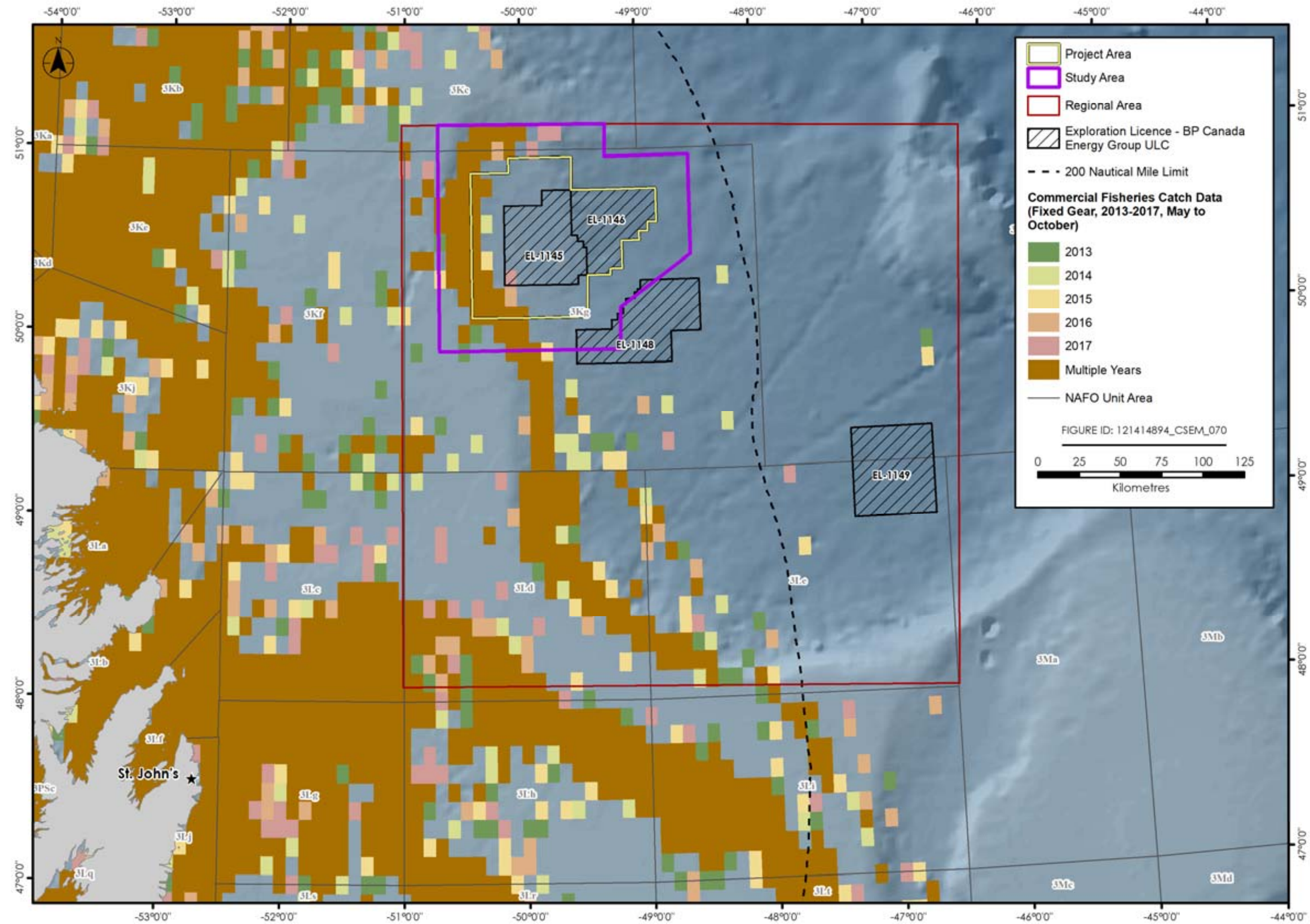


Figure 4.17 Domestic Harvesting Locations – Fixed Gear (May to October 2013 to 2017)

Data for catch weight and catch value are disseminated by NAFO Unit Area (DFO 2019b) and are summarized in Tables 4.13 and 4.14 for Unit Area 3Kg, which is representative of fishing activity within the Project Area. Between 2012 and 2017, Greenland halibut accounted for 76% of the total weight and 83% of the total value for all species harvested in NAFO Unit Area 3Kg. Northern shrimp was the second most harvested species by weight (20%) and value (12%). Values with an X indicate that the information has been redacted by DFO due to privacy screening. Redacted information also appears for the following species, indicating that they are commercially fished in 3Kg, but at a low intensity (by five or less vessels during the full year): American plaice, roughhead grenadier, witch flounder, Atlantic cod, Atlantic halibut, skate and Atlantic herring.

Table 4.13 Catch Weight for Commercially Harvested Species in NAFO Unit Area 3Kg, 2013 to 2017

Species	Catch Weight (tonnes)						
	2013	2014	2015	2016	2017	Total	%
Greenland halibut	734	791	739	924	874	4,062	76
Northern shrimp	711	43	222	78	X	1,054	20
Snow crab	69	73	20	X	X	163	3
Redfish	2	1	1	X	77	80	1
Total	1,516	907	982	1,002	951	5,358	100
Source: DFO 2019b Values with an X indicate that the information has been redacted by DFO due to privacy screening.							

Table 4.14 Value for Commercially Harvested Species in NAFO Unit Area 3Kg, 2013 to 2017

Species	Catch Values (CAD)						
	2013	2014	2015	2016	2017	Total	%
Greenland halibut	$2,158,252	$2,314,405	$2,793,698	$3,500,383	$3,501,542	$14,268,280	83
Northern shrimp	$946,981	$87,704	$861,857	$244,879	X	$2,141,421	12
Snow crab	$299,375	$377,533	$110,485	X	X	$787,392	5
Redfish	$1,244	$487	$339	X	$73,023	$75,092	0
Total	$3,405,852	$2,780,129	$3,766,378	$3,745,262	$3,574,565	$17,272,185	100
Source: DFO 2019b Values with an X indicate that the information has been redacted by DFO due to privacy screening.							

4.7.1 Summary of Key Commercial Fishing Activity in the Project Area

Greenland halibut are commercially fished within the Project Area and account for most of the commercial fishing activity in the Project Area. Key months for harvesting of Greenland halibut are May and June for vessels using mobile bottom otter trawls, and June and August for vessels using fixed gill nets. The main location for harvesting of Greenland halibut along the edge of the continental shelf starting at Sackville Spur and following along the shelf break northward. The Project Area overlaps with a marine refuge area, the Northeast Newfoundland Slope Closure. Within this area, bottom contact fishing activity has been prohibited.

In the Project Area, northern shrimp are mainly harvested from April to June using mobile shrimp trawls. In June, the fishing season for northern shrimp overlaps with harvesting activity for groundfish species, fishing for both species occur in similar areas. The main fishing ground for northern shrimp is to the north east of the Project Area on the continental shelf. NAFO division 3L is currently closed to all harvesting of northern shrimp and a stock conservation management strategy. It was closed in 2015 and is a temporary closure, but will continue into 2020 and 2021 (NAFO 2020).

Snow crab are mainly fished within the Project Area in April, May and June and are harvested using crab pots, a fixed gear type. Thy main crab fishing areas are to the northeast of the Project Area on the continental shelf, and also to the south of the Project Area on the Grand Banks, partially overlapping with the Regional Area.

Redfish are noted as an emerging species, as there appears to be increased interest and activity for commercial harvesting of redfish in 2017. Between 2013 and 2017 total catch weight increased from 2 tonnes to 77 tonnes, an increase of 98 %. As data are not available yet from DFO for 2108 or 2019, it cannot be verified if this trend continues.

4.7.2 Indigenous Fishing

BP Canada is not aware of any FSC fishing or harvesting occurring within the Project Area, but is aware of the potential presence of species in the Project Area that may be harvested by Indigenous peoples outside the Project Area, including Atlantic salmon, American eel, swordfish, and tuna. Birds and seals that could occur in the Project Area may also be harvested by Indigenous peoples for FSC purposes.

4.7.3 Other Ocean Users

In addition to commercial fisheries, other ocean uses in the Regional Area include: marine research; marine transportation (e.g., shipping); other offshore oil and gas exploration; military operations; and existing subsea infrastructure (e.g., subsea cables). Figure 4.18 provides the location of submarine cables and shipwrecks relative to the Project Area and Study Area. There are no known archaeological or historical sites (including shipwrecks) in the Project Area or Study Area. There is one known shipwreck and one known unexploded ordnance legacy site in the Regional Area. Several abandoned submarine cables and one active cable pass through the Project Area.

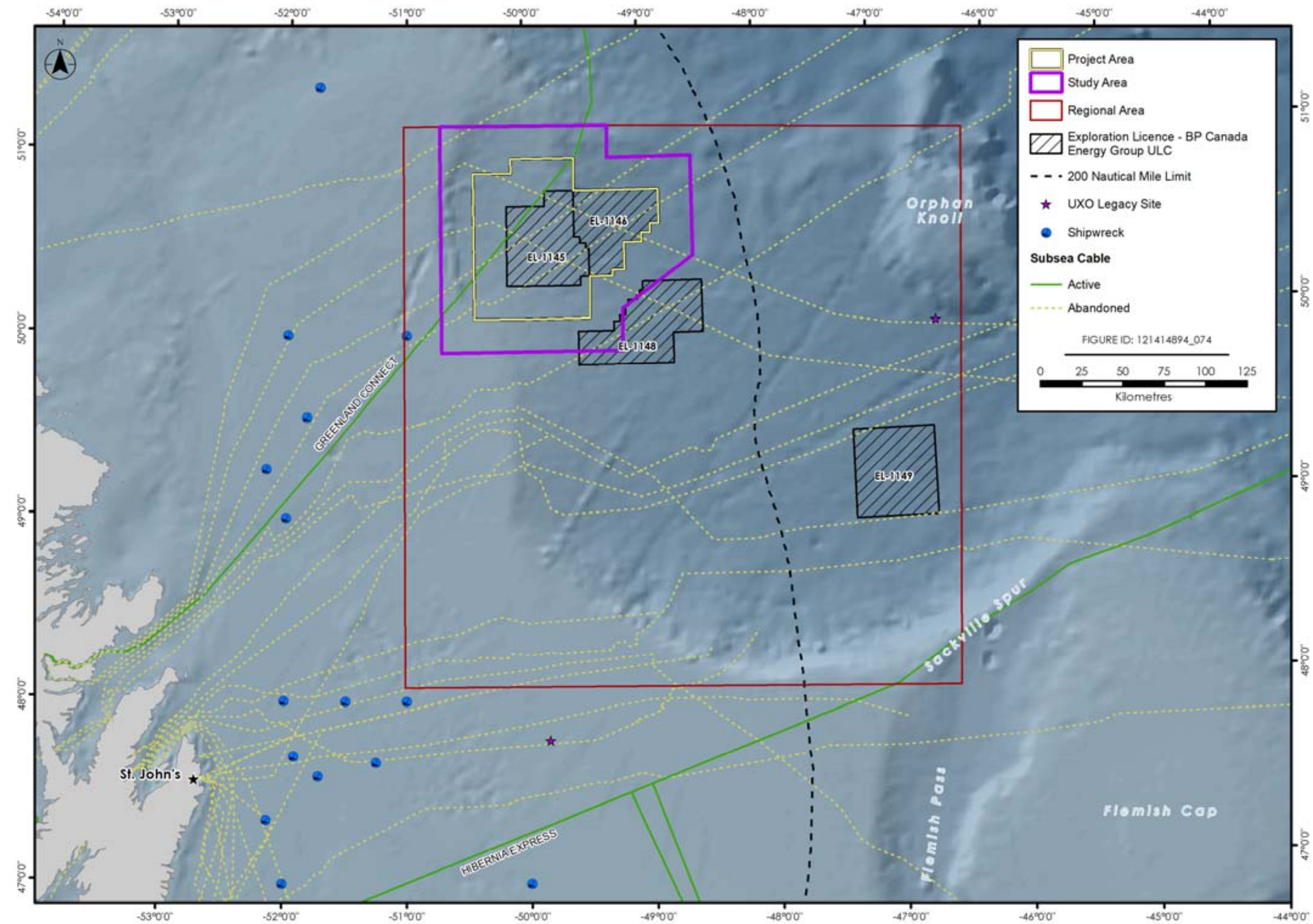


Figure 4.18 Seabed Infrastructure (Cables, Shipwrecks, Unexploded Ordnances)

There are no registered aquaculture operations in or near the Project Area. Marine research activities taking place in the waters offshore Newfoundland relate primarily to biophysical research being carried out by DFO and fishing industry partners. St. John's Harbour is one of the busiest ports on the east coast of Newfoundland, with the oil and gas industry historically accounting for the largest number of vessels entering the harbour.

The oil and gas industry is well-established in the province, with exploration activities beginning in the 1960s and production activities occurring since 1997. There are currently four producing oil fields on the Grand Banks of Newfoundland: Hibernia; Terra Nova; White Rose; and Hebron; these are located outside the Regional Area (Figure 4.19). Exploration drilling and geophysical surveys (e.g., seismic) continue to be a large component of offshore oil and gas related activity for the province. There are ELs within the Regional Area, with potential exploration drilling programs proposed to commence in 2021. BHP Petroleum (New Ventures) Corporation (BHP) is proposing exploration drilling in ELs 1157 and 1158 with an initial well planned for 2021 and a seabed survey within these ELs that could occur between 2020 and 2025 (BHP Petroleum (New Ventures) Corporation 2020). Chevron Canada Limited (Chevron) is proposing to conduct an exploration drilling program within EL 1138 with an initial well planned for 2021 (Chevron 2020).

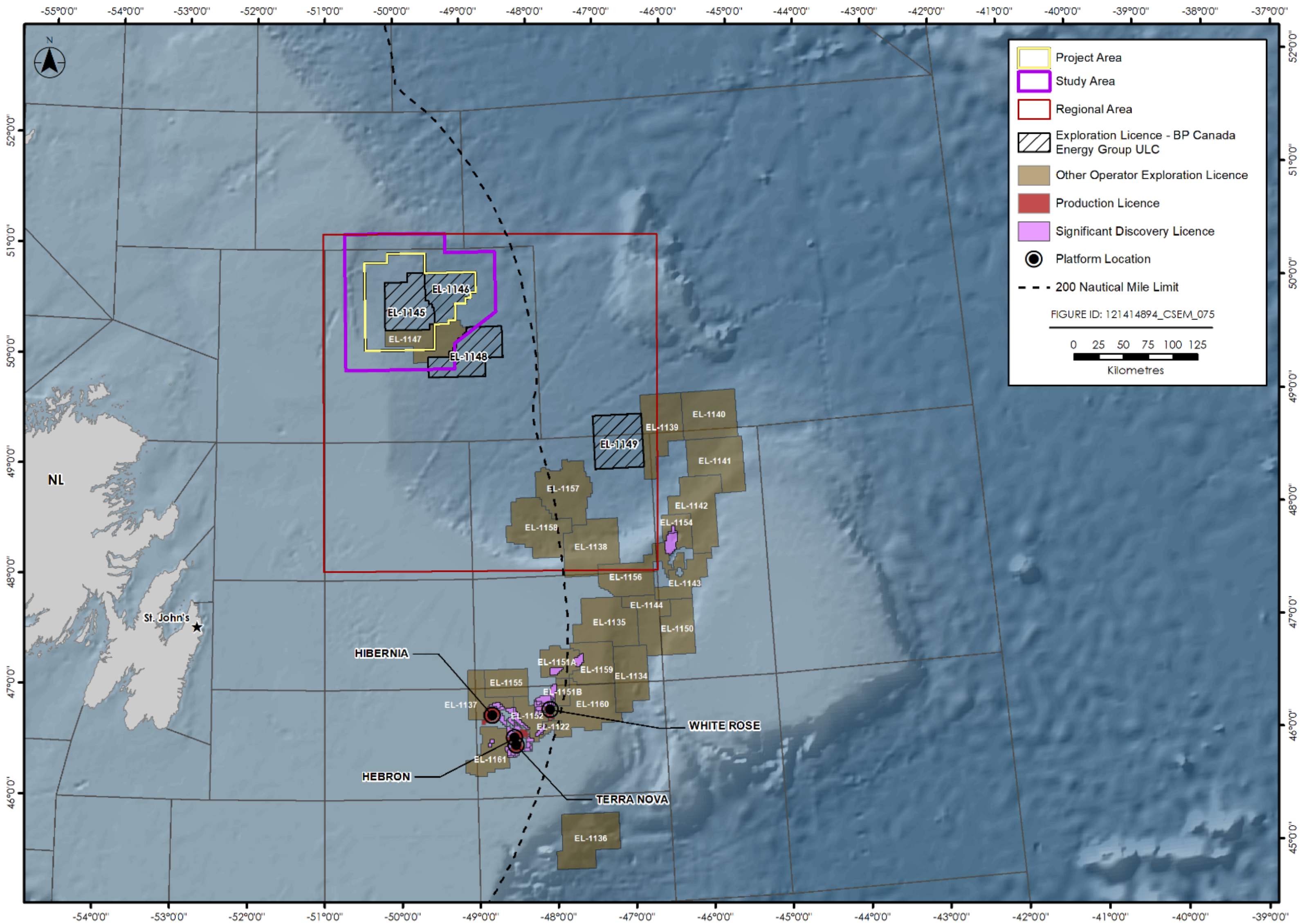


Figure 4.19 Other Oil and Gas Activities

5.0 ENVIRONMENTAL ASSESSMENT METHODS

This EA Report has been prepared to meet requirements in the Scoping Document (C-NLOPB 2020) and has been scoped appropriately to correlate with the level of predicted environmental interaction, focusing on key issues and potential effects. Potential environmental effects of routine Project components and activities are assessed in Section 6; effects associated with potential accidental events are assessed in Section 7. Effects of the environment on Project and cumulative environmental effects (e.g., residual environmental effects of the Project in combination with residual effects of other past, present or reasonably foreseeable physical activities) are presented in Sections 8 and 9, respectively. The general environmental assessment framework used to evaluate these environmental effects is described below.

5.1 Spatial and Temporal Boundaries

Section 2.2 describes the spatial boundaries of the Project. Survey locations would be primarily contained within ELs 1155 and 1156, although Project Area boundaries have been extended to account for survey vessel turning movements. A 20-km buffer has been added to delineate a Study Area in recognition of potential underwater sound and electromagnetic emissions from the survey. A larger Regional Area is delineated to provide context for physical, biological, and socio-economic components assessed within this EA Report. Figure 2.1 shows the location of spatial boundaries considered in this EA Report.

The temporal boundaries for the assessment are May to October 2021 to 2024. It is estimated that a survey would take less than 30 days to complete and the most likely survey timing would be during May to October 2021.

The effects assessment considers the spatial and temporal boundaries of the Project, but also considers spatial and temporal variability within Valued Components which may affect the likelihood of interaction with Project activities and/or sensitivity to effects. Section 4 provides context for seasonal presence and sensitivities of species and timing of socio-economic activities.

5.2 Selection of Valued Components

Based on the Scoping Document (C-NLOPB 2020), a review of other environmental assessments undertaken for other CSEM surveys (e.g., Buchanan et al. 2011; LGL 2014; Stantec 2017) and for different activities within the same geographic area (e.g., BP 2018, BP 2019), a review of relevant regulations and guidelines related to geophysical surveys and offshore activities, and the professional judgement of the study team, the Valued Components (VC) as presented in Table 5.1 have been identified as requiring assessment of potential environmental effects.

Table 5.1 Selection of VCs

VC	VC Rationale
Marine Fish and Shellfish	Marine Fish and Shellfish includes fish and invertebrates (including corals and sponges) as well as essential (spawning, feeding, overwintering) habitat that may be affected by Project activities. Marine Fish and Shellfish was selected as a VC in consideration of the ecological value provided to marine ecosystems, the socio-economic and cultural importance of fisheries resources, the potential for interactions with Project activities, regulatory considerations, and requirements in the Scoping Document.
Marine Mammals and Sea Turtles	The Marine Mammal and Sea Turtle VC includes baleen whales, toothed whales, dolphins, porpoises, seals, and sea turtles that could potentially be affected by Project activities. Marine mammals and sea turtles were selected as a VC in recognition of important habitat for these species in the offshore waters of NL, the cultural and recreational value placed on these species by Indigenous peoples and the general public, the potential vulnerability of marine mammals to underwater sound and vessel movement, regulatory considerations, and requirements in the Scoping Document.
Marine and/or Migratory Birds	Marine and/or Migratory Birds includes oceanic, neritic and littoral zone seabirds, waterfowl, loons, grebes, and shorebirds protected under the MBCA and additional marine-associated birds not protected under the MBCA (i.e., cormorants). Marine and/or Migratory Birds was selected as a VC due to their ecological value to marine and coastal ecosystems, the economic and cultural importance of recreational and subsistence hunts, vulnerability to artificial light attraction, vulnerability to oil on water, regulatory considerations, and requirements in the Scoping Document.
Species at Risk	The Species at Risk VC includes species listed on Schedule 1 of SARA and species assessed as at risk by the COSEWIC. There are various fish, bird, mammal, and sea turtle species at risk that could occur in the Regional Area and potentially be affected by Project activities. Critical habitat has been designated for the northern and spotted wolffish on the Northern Grand Banks (refer to Figure 4.9 which shows a small portion of the Project Area overlapping with northern wolffish critical habitat). Species at Risk were selected as a VC in recognition of their ecological value to marine ecosystems, vulnerability to disturbance, regulatory considerations, and requirements in the Scoping Document.
Sensitive Areas	The Sensitive Areas VC includes areas designated as being of special interest due to their ecological and/or conservation value. This VC includes but is not limited to protected areas designated under federal legislation (e.g., *Oceans Act*, *Fisheries Act*) as well as EBSAs. Of particular relevance to this VC is the Northeast Newfoundland Slope closure, which is a marine refuge closed to bottom contact fishing to protect corals and sponges and overlaps the Project Area. Additional sensitive areas which overlap with the Project Area include a Significant Benthic Area for sea pens, the Orphan Spur EBSA and critical habitat for northern wolffish.
Fisheries and Other Ocean Users	Fisheries and Other Ocean Users is considered a VC because of the commercial and cultural importance fishing has for the province of NL, and the importance of other ocean activities such as offshore research, subsea communications, military training, and shipping activities that occur in offshore waters.

5.3 Potential Project-VC Interactions

BP Canada is proposing to conduct the Project within ELs 1145 and 1146 in the Orphan Basin. Key interactions relate to underwater sound, light emissions and discharges from the survey vessel, risk of collision of a marine mammal or sea turtle with the survey vessel, electromagnetic emissions from the CSEM source, temporary change in benthic habitat from the deployment of receivers and associated anchors on the seabed, and accidental spill of diesel fuel from the vessel. Accidental releases are addressed in Section 7. Potential Project-VC interactions from routine Project activities are identified in Table 5.2 and evaluated in Section 6.

Table 5.2 Project-VC Interaction

Activity	Marine Fish and Shellfish	Marine and/or Migratory Birds	Marine Mammals and Sea Turtles	Species at Risk	Sensitive Areas	Fisheries and Other Ocean Users
Survey Vessel Operation	X	X	X	X	X	X
CSEM Source Operation	X	-	X	X	X	X
Receiver Deployment and Retrieval	X	-	-	X	X	-
Notes: “X” means potential interaction “-“ means interaction not likely						

Any interactions with the survey vessel are assessed under Survey Vessel Operation regardless of whether this interaction occurs while the CSEM source is operating or the while survey vessel is engaged in deploying or retrieving receivers.

5.4 Criteria for Characterizing Residual Environmental Effects and Determining Significance

Significance criteria establish a threshold beyond which a residual environmental effect (after mitigation has been applied) will cause a change that will alter the status or integrity of a VC beyond an acceptable level. Where pre-established standards or thresholds do not exist, significance criteria have been defined qualitatively and justifications for the criteria provided. If an adverse environmental effect does not meet the criteria for a significant environmental effect, it is evaluated as “not significant”. Significance criteria are presented for each VC in Section 6.

Additional criteria to support the characterization of the nature and extent of residual environmental effects include descriptors for magnitude, geographic extent, duration, frequency, reversibility and context of effects. Generic criteria to describe residual environmental effects for each VC are provided in Table 5.3. These criteria are used to characterize effects from routine activities (Section 6) and accidental events (Section 7). Following a characterization of the residual environmental effects, a determination of effects significance is provided for each VC.

Table 5.3 Generic Characterization of Residual Environmental Effects

Criteria	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect relative to baseline	Positive – a residual environmental effect that moves measurable parameters in a direction beneficial to [VC] relative to baseline Adverse – a residual environmental effect that moves measurable parameters in a direction detrimental to [VC] relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	Negligible – no measurable change Biophysical VCs: Low – a detectable change but within the range of natural variability Moderate – a detectable change beyond the range of natural variability, but with no associated adverse effect on the viability of the affected population. High – measurable change that exceeds the limits of natural variability, with an adverse effect on the viability of the affected population. Socio-economic VC: Low – A detectable change that is within the range of natural variability, with no associated adverse effect on the overall nature, intensity, quality / health or value of the affected component or activity. Moderate - A detectable change that is beyond the range of natural variability, but with no associated adverse effect on the overall nature, intensity, quality / health or value of the affected component or activity. High - A detectable change that is beyond the range of natural variability, with an adverse effect on the overall nature, intensity, quality / heath or value of the affected component or activity.
Geographic Extent	The geographic area in which a residual environmental effect occurs	Project Area – residual environmental effects are restricted to the Project Area Study Area – residual environmental effects extend into the Study Area Regional Area – residual environmental effects extend into the RA
Frequency	Identifies how often the residual effect occurs and how often during the Project	Unlikely event – effect is unlikely to occur Single event – effect occurs once Multiple irregular event – effect occurs at no set schedule Multiple regular event – effect occurs at regular intervals Continuous – effect occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	Short-term - for duration of the activity, or for duration of accidental event Medium-term - beyond duration of activity up to end of Project, or for duration of threshold exceedance of accidental event – weeks or months Long-term - beyond Project duration of activity, or beyond the duration of threshold exceedance for accidental events - years

Table 5.3 Generic Characterization of Residual Environmental Effects

Criteria	Description	Quantitative Measure or Definition of Qualitative Categories
		Permanent - recovery to baseline conditions unlikely
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	Reversible – will recover to baseline conditions before or after Project completion Irreversible – permanent
Ecological or Socio-economic Context	Existing condition and trends in the area where residual environmental effects occur.	Undisturbed – The VC is relatively undisturbed in the Regional Area, not adversely affected by human activity, or is likely able to assimilate the additional change Disturbed – The VC has been previously disturbed by human development or human development is still present in the Regional Area, or the VC is likely not able to assimilate the additional change

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Marine Fish and Shellfish

As defined under the *Fisheries Act*, "fish" includes the eggs, sperm, spawn, larvae, spat and juvenile and adult stages of fish, shellfish, crustaceans, and marine animals, while "habitat" includes the abiotic and biotic quality and areas that fish directly or indirectly use to live, including spawning grounds and nursery, rearing, food supply and migration areas. This VC considers relevant fish species, plankton, algae, benthos, and relative components of their habitat, such as water and sediment quality. Fish species at risk are considered under Section 6.4. Other marine animals (marine mammals and sea turtles) are addressed in Section 6.2. Although the effects assessment in this section considers the potential environmental effects on fisheries resources, the potential environmental effects on fisheries are assessed separately in Section 6.6.

6.1.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual effect on Marine Fish and Shellfish** is defined as a Project-related environmental effect that causes a detectable decline in abundance or change in distribution of fish populations within the Regional Area, such that a natural recruitment may not re-establish the population(s) to its original level within one generation.

An adverse effect that does not meet the above criteria is considered to be not significant.

6.1.2 Project Interactions

The survey vessel will generate underwater sound and light emissions, and effluent discharges (in accordance with MARPOL) which could potentially result in sensory disturbance and localized water quality effects. The operation of the CSEM source will generate underwater electromagnetic emissions which could affect marine fish. Receiver deployment will result in localized, temporary changes in benthic habitat.

6.1.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Marine Fish and Shellfish:

- Vessel waste discharges will be managed in accordance with MARPOL.
- An SMMO will be on board to record shark observations and oversee ramp up procedures.
- The electromagnetic source will be ramped up over a 20-minute period. In areas where water depth are greater than 500 m, the electromagnetic source will not be initiated if a shark is observed 30 minutes prior to ramp-up within a 500 m safety zone. Ramp-up will not occur until the animal has moved beyond the 500 m zone or 20 minutes have elapsed since the last sighting.
- The electromagnetic source will be turned off when data are not being collected (e.g., during vessel turns).
- Compacted sand anchors, designed to degrade within one year, will be used for the CSEM receivers.

6.1.4 Assessment of Residual Environmental Effects

6.1.4.1 Survey Vessel Operation

The survey vessel will generate sound and light emissions and effluent discharges which could potentially result in short-term sensory disturbance and localized water quality effects.

Marine fish may experience sensory disturbance as a result of underwater sound emissions from the survey vessel. However, the short-term contribution of underwater sound from the survey vessel is expected to be minimal compared to ongoing vessel activity (e.g., shipping and fisheries) occurring in the region. Although the specific vessel to be used for the survey has not yet been confirmed, it is assumed for the purpose of this assessment it would be similar to a platform supply vessel or construction vessel generating underwater sound source levels of approximately 188.6 dB re 1uPa @ 1 m rms SPL. Damage to fish heavier than 2 g occurs at peak noise levels greater than 206 dB re 1 μPa [Fisheries Hydroacoustic Working Group 2008]). Therefore, it is unlikely operation of the survey vessel will result in direct injury to fish. Some fish may avoid the area in the immediate vicinity of the vessel (Mueller-Blenkle et al. 2008; Fewtrel and McCauley 2012). The survey vessel will not generate much more sound than vessels already transiting the area (fishing vessels can generate 158 dB re 1μPa and commercial freighters can generate 172 dB re 1μPa [Hurley and Ellis 2004]) and will only be in the areas for a short time.

While artificial lighting can affect the light and dark cycle of fish species around the ship, there will be limited underwater lighting from the vessel and the vessel will not be stationary. Effects from artificial lighting from the vessel are expected to be negligible.

Based on the characterization of potential Project interactions with Marine Fish and Shellfish, taking into consideration the limited geographic and temporal scope of survey vessel operations and implementation of mitigation as discussed in Section 6.1.3 and summarized in Section 10, residual environmental effects of survey vessel operation are expected to be low in magnitude, limited in geographic extent to the Study Area, short term, occur as a single event, and be reversible for Marine Fish and Shellfish. Residual environmental effects of survey vessel operation on Marine Fish and Shellfish are predicted to be not significant.

6.1.4.2 CSEM Source Operation

Buchanan et al. (2011) proposed generic thresholds of effects for magnetic and electric fields generated by electromagnetic surveys of 200 nT and 386 nV/cm for magnetic and electric fields, respectively. These generic effects thresholds are based on reported abilities of some of the more sensitive groups of animals (e.g., elasmobranchs [cartilaginous fishes – sharks, rays, and skates]) to detect magnetic and electric fields (Buchanan et al. 2011). As the CSEM source generates a relatively low EMF, it is unlikely that marine fish or shellfish would experience direct physical effects. However, navigational abilities of those species (e.g., elasmobranchs, salmonids) that use geomagnetic fields may be impeded.

Sense of magneto-reception is different in fish species and the basic abilities in spatial orientation, vision, hearing, and olfaction lead to different behaviors in electromagnetic fields (Foroozandeh and Derakhshan-Barjoei 2018); some fish use the Earth's magnetic field for navigation, others for prey detection and predator avoidance (Virginia Coastal Zone Management Program 2018). Trout migration is partially determined by magnetic fields (Normandeau Associates et al. 2011). During migration anadromous brown trout (*Salmo trutta*) juveniles orient and direct themselves using the Earth’s magnetic field (Gill et al. 2012). Yellowfin tuna (*Thunnus albacares*) demonstrate discrimination between magnetic fields (Walker 1984, in Öhman et al. 2007). In the absence of celestial cues, blue sharks (*Prionace glauca*) may use electric fields generated in the ocean, or the Earth's magnetic field, to orient themselves to swim on a constant heading (Carey et al. 1990). Various eels have shown sensitivity to changes in magnetic fields (Öhman et al. 2007), although American eel conditioning to changes in a magnetic field produced equivocal results (McCleave et al., in Öhman et al. 2007; Rommel and McCleave, in Öhman et al. 2007).

Studies on the biological effects of exposure of eels to electrical fields documented an increased heart rate at electrical fields of 7 to 70 µV/cm (7000 to 70,000 nV/cm) and attraction (swimming towards) to the electrically charged anode at levels of 25 µV/m to 15 V/m (Marino and Becker 1977, cited in Foroozandeh and Derakshan-Barjoei 2018). Observations of EMF generated from Marine Renewable Energy Devices indicated that brown crab (*Cancer pagurus*) were drawn to a shelter exposed to EMF over one not exposed to EMF, overriding their natural roaming behaviour (Scott et al. 2019).

A voltage gradient of 0.1 to 1 mV/m can result in avoidance behaviour from swimming sharks and rays while 0.01 mV/m can elicit a response in sedate sharks and rays (unlikely to be present in the Project or Study Areas) (Buchanan et al. 2011). Fish such as eels and shellfish (e.g., crab) are known to be sensitive to magnetic fields greater than 1000 nT) (Fisher and Slater 2010).

The source system that BP Canada may use is capable of transmitting 10,000 A and has a voltage of 135 V; the resulting EM emissions could potentially be detected by animals such as elasmobranchs. The instantaneous areal extent of potential effects would be a maximum of 2 km^2; however, exposure at any one point would be 26 to 45 minutes with a vessel moving at approximately 4 km/h (2 knots), which is anticipated to be too short to interfere with movement, orientation or predator/ prey detection (LGL 2104).

Artificial lighting associated with the towfish will result in light emissions at depth; however, this light will be temporary in any one location and is expected to attenuate quickly.

The effects of the operation of the CSEM source are therefore predicted to be negligible, confined to a portion of the Project Area, occur at a regular frequency but will be short-term in duration, and will be reversible.

6.1.4.3 Receiver Deployment and Retrieval

A trigger will release the receiving equipment from the anchors; the anchors will be left in place. Considering there will be up to approximately 100 receivers, there will be up to approximately 75 m^2 of benthic habitat that would be temporarily disturbed. The receivers will dissolve within six to twelve months into their component parts (limestone and gravel), none of which are harmful to the marine environment. Lights on the receivers will be activated during retrieval once the receiver ascends to within approximately 20 m of the sea surface. The average retrieval time for each receiver (i.e., length of time the receiver will be floating at the surface) is approximately five minutes. Therefore, there will be limited opportunity for fish attraction to the strobe light on the receiver.

The residual environmental effects of receiver deployment and retrieval are predicted to be of low magnitude, limited to a one-time event within specific areas in the Project Area, short term, and reversible.

6.1.5 Determination of Significance

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on Marine Fish and Shellfish are predicted to be not significant.

6.1.6 Follow-up and Monitoring

No monitoring is proposed for Marine Fish and Shellfish with the exception of monitoring of the 500 m safety zone for sharks during ramp-up of the CSEM source.

6.2 Marine Mammals and Sea Turtles

Marine mammals and sea turtles includes baleen whales, large toothed whales, dolphins, porpoises, seals, and sea turtles. Marine mammal and sea turtle species listed under SARA or considered at risk by COSEWIC are assessed within the Species at Risk VC (Section 6.4).

6.2.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect on Marine Mammals and Sea Turtles** is defined as a Project-related environmental effect that causes a detectable decline in abundance or change in the spatial and temporal distribution of marine mammals and sea turtles within the Regional Area, such that natural recruitment may not re-establish the population(s) to its original level within one generation.

An adverse effect that does not meet the above criteria is considered to be not significant.

6.2.2 Project Interactions

Marine mammals and sea turtles may experience sensory disturbance as a result of underwater sound and/or electromagnetic emissions or be at risk of collision with the survey vessel resulting in injury or mortality.

6.2.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Marine Mammals and Sea Turtles:

- Vessel waste discharges will be managed in accordance with MARPOL.
- Low vessel speed (4 to 5.5 km/h [2 to 3 knots]) will reduce underwater noise and the risk of collision with marine mammals and sea turtles.
- SMMOs will be on board to record marine mammal and sea turtle observations and oversee ramp-up procedures.

- The electromagnetic source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the electromagnetic source will not be initiated if a marine mammal or sea turtle is observed 30 minutes prior to ramp-up within a 500 m safety zone. Ramp-up will not occur until the animal has moved beyond the 500 m zone or 20 minutes have elapsed since the last sighting.
- The electromagnetic source will be turned off when data are not being collected (e.g., during vessel turns).
- Any dead or distressed marine mammals or sea turtles and SARA-listed species will be reported to the C-NLOPB and DFO.

6.2.4 Assessment of Residual Environmental Effects

6.2.4.1 Survey Vessel Operation

Marine mammals and sea turtles may experience sensory disturbance as a result of underwater sound emissions from the survey vessel, with SPLs expected to be in the range of 170 to 190 dB RMS re 1 μPa @ 1m at a peak frequency of 1 to 500 Hz. Southall et al. (2019) suggest onset of temporary threshold shifts (i.e., loss of hearing sensitivity) could occur as low as 153 dB cumulative sound exposure level for high frequency hearing cetaceans (e.g., dolphins) from continuous (non-impulsive) sound; thrseholds for other cetaceans and pinnipeds range from 178 to 199 dB cumulative sound exposure level). However, physical injury from exposure to elevated sound levels from a survey vessel are unlikely given that cetaceans would have to remain in close proximity to the sound source in order to maintain a received sound level threshold for 24 hours to sustain injury. Behavioural effects (which can include avoidance behavior) is predicted to occur at lower thresholds (e.g., 120 dB RMS re μ1 Pa @ 1 m) (NOAA undated), therefore continued exposure to elevated sound levels causing injury is unlikely to occur.

Elevated sound levels from a survey vessel is more likely to result in behavioural disturbance and acoustic masking (Nowacek et al. 2007; Bröker 2019). The effect of sound emissions can vary greatly depending on the proximity of the animal to the noise source, received level of the signal by the animal and the animal's hearing sensitivity (Southall et al. 2019). Context of exposure can also strongly influence behavioural effects (Gomez et al. 2016).

Marine mammal responses to vessels are variable and range from avoidance at long distances to little or no response or approach (Richardson et al. 1995). Responses depend on the speed, size, and direction of travel of the vessel relative to the marine mammal; slow approaches tend to elicit fewer responses than fast, erratic approaches (Richardson et al. 1995). Seals often show limited to no response to vessels but can also show signs of displacement in response to vessel traffic. Toothed whales sometimes show no avoidance reactions and occasionally approach vessels; however, some species are displaced by vessels. Baleen whales often interrupt their normal behaviour and swim rapidly away from vessels that have strong or rapidly changing sound emission characteristics, especially when a vessel heads directly towards a whale. Stationary vessels or slow-moving, "non-aggressive" vessels typically elicit very little response from baleen whales.

Sound from shipping, through masking, can also reduce the effective communication distance of a marine mammal if sound levels are higher than relevant biological sound signals, the frequency of the sound source is close to that used by the animal, and the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Jones et al. 2017; Putland et al. 2017). In addition to the frequency and duration of the masking sound, the temporal pattern and location of the introduced sound also play a role in the extent of the masking (e.g., Branstetter et al. 2013, 2016; Finneran and Branstetter 2013). Auditory masking, particularly the physical acoustic and/or biological processing aspects of auditory masking in marine mammals and/or fish with respect to exploration and production sound sources in marine mammals and fish, is poorly understood and is therefore a focus area of research (e.g., Joint Industry Programme on E&P Sound and Marine Life 2018). However, the potential for masking of marine mammal calls and/or important environmental cues is considered limited from the survey vessel given the relatively low source level and attenuation of sound to levels below measured ambient levels in the region.

Some baleen and toothed whales are known to continue calling in the presence of anthropogenic sounds. Some cetaceans are also known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behaviour in response to anthropogenic sounds (e.g., Blackwell et al. 2015). In addition, masking release mechanisms (e.g., spatial release from masking, comodulation masking release, orientation towards the sound) are employed by marine mammals to enhance signal detection and reduce the amount of masking (Erbe et al. 2016).

Baleen whales are thought to be more sensitive to sound at low frequencies that are predominantly produced by vessels than are toothed whales (MacGillivray et al. 2014), possibly causing localized avoidance of vessels. Reactions of gray and humpback whales to vessels have been studied (see Richardson et al. 1995 and Southall et al. 2007 for reviews). More recently, Dunlop et al. (2015) reported that southward migrating humpback whales off Australia decreased their dive time and swim speed slightly in response to a source vessel, which was not operating airguns. However, there is limited information available on the reactions of right whales and rorquals (e.g., fin and blue whales). North Atlantic right whales can often be approached by slowly moving vessels, but swim away from vessels that approach quickly (Watkins 1986). They tend to show little responses to close passages of small steady-moving boats when mating or feeding (Mayo and Marx 1990; Gaskin 1991). The responses of North Atlantic right whales in the Bay of Fundy to ships, sounds from conspecifics, and a signal designed to alert the whales were monitored using multi-sensor acoustic recording tags (Nowacek et al. 2004). The whales reacted overtly to the signal by swimming to the surface, likely increasing rather than decreasing the risk of collision with ships. The whales reacted mildly to controlled exposure to sounds of conspecifics but showed no response to controlled sound exposure to ships as well as actual ships (Nowacek et al. 2004). Right whales have been known to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in the presence of elevated ambient sound levels (e.g., Parks et al. 2007, 2011, 2012b, 2016; Tenessen and Parks 2016).

Williamson et al. (2016) studied the effect of close approaches by small research vessels on the behaviour of humpback whales and suggested that close approaches by small vessels may cause small and temporary behavioural changes in humpback whales, although for female-calf groups, the behavioural change may be greater and longer lasting.

Off New England, fin whales had shorter than usual surfacing and dive times when whale-watch and other vessels were nearby (Stone et al. 1992). Watkins (1981) and Watkins et al. (1981) noted that fin whales showed little response to slowly moving vessels but avoided boats that altered course or speed quickly. During marine mammal monitoring from a high-speed, catamaran car ferry transiting the Bay of Fundy during the summers of 1998 to 2002, most baleen whales (including fin, humpback and minke whales) sighted from the ferry appeared to exhibit avoidance behaviour including heading away, changing heading, or diving (Dufault and Davis 2003). Fin whale sightings in the western Mediterranean were negatively correlated with the number of vessels in the area (Campana et al. 2015). Fin and blue whales in the St. Lawrence estuary either moved away from ships or remained near a vessel but changed direction or dove; the most marked reactions occurred when vessels approached quickly or erratically (Edds and Macfarlane 1987). Fin whales and blue whales have been shown to increase the source levels of their calls, shift their peak frequencies, or otherwise change their vocal behaviour in the presence of elevated sound levels such as from shipping (e.g., McKenna 2011; Castellote et al. 2012; Melcón et al. 2012). Physical presence of vessels, not just ship sounds, has also been shown to disturb the foraging activity of blue whales (Lesage et al. 2017). McKenna et al. (2015) noted a dive response by blue whales when a vessel approached, but no lateral avoidance, which could lead to an increase in collision risk. Baleen whales (e.g., North Atlantic right whale, fin whale, blue whale) are believed to be more sensitive to sound at low frequencies predominantly produced by vessels than are toothed whales (e.g., northern bottlenose whale, Sowerby's beaked whale) (MacGillivray et al. 2014) possibly causing localized avoidance of the survey vessel. However, in some cases, whales react to underwater acoustic sounds by swimming to the surface, likely increasing risk of collision (Nowacek et al. 2004). Sound levels from vessel operation associated with the Project are not expected to be high enough to cause physical effects on marine mammals or sea turtles (including species at risk), but the operation of the vessel may present a collision risk to marine mammals and sea turtles, potentially resulting in physical injury or mortality.

Mysticetes (baleen whales) are known to be more vulnerable to vessel strikes than odontocetes and pinnipeds (Laist et al. 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). All baleen whale species that may occur in the Project Area are documented to have been struck by ships (Jensen and Silber 2003), with fin whales being the most frequently struck followed by humpback and right whales (Laist et al. 2001; Jensen and Silber 2003; Panigada et al. 2006; Douglas et al. 2008). While it is not clear why whales are unable to avoid ship strikes, even when vessels are traveling slowly, there is evidence showing that strikes may be more likely in areas where large numbers of whales congregate to feed (Panigada et al. 2006) as well as evidence that vessel sound signatures are louder from the side and stern of the vessel than from the bow (Allen et al. 2012; McKenna et al. 2012), making detection of an approaching vessel more difficult for a whale in front of the vessel. Most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 km/h; Laist et al. 2001). Reducing vessel speed has been shown to reduce the number of marine mammal deaths and severe injuries due to vessel strikes (Vanderlaan and Taggart 2007; Vanderlaan et al. 2008, 2009; van der Hoop et al. 2015). Lethal strikes are considered infrequent at vessel speeds <14 knots and rare at speeds <10 knots (18.5 km/h; Laist et al. 2001).

Propeller and collision injuries from boats and ships are common in sea turtles, at least in U.S. waters (NMFS 2008). In Australia, Hazel et al. (2007) demonstrated that the proportion of green sea turtles maneuvering to avoid a vessel decreased with increased vessel speed suggesting that turtles may not avoid faster moving vessels.

The vessel will travel approximately 22 km/h (12 knots) on average while transiting to and from the Project Area. During the survey, the vessel will travel at an average speed of approximately 4 to 5.5 km/h (2 to 3 knots). At these speeds, the risk of collision with marine mammals and sea turtles will be reduced. In the event that a marine mammal or sea turtle is detected in proximity to the vessel, vessel speed will be reduced to avoid collision. With respect to effects from underwater sound, the short-term contribution of underwater sound from the survey vessel is expected to be minimal compared to ongoing vessel activity (e.g., shipping and fisheries) occurring in the region.

6.2.4.2 CSEM Source Operation

Evidence of use of geomagnetic fields by marine mammals and sea turtles is limited and is mostly based on theoretical inferences. Some cetacean species (e.g., bottlenose dolphin, Cuvier's beaked whale, humpback whale and harbor porpoise) have magnetite in their outer membrane of the brain and/or in tongues and jawbones, suggesting evidence that these animals may use geomagnetic fields for navigation (Normandeau et al. 2011). Some studies of cetacean strandings correlate to geomagnetic disturbances (Klinowska 1985; Kirschvink et al. 1986) supporting a hypothesis that marine mammals rely on geomagnetic cues for navigation, while other studies of strandings (e.g., Hui 1994; Brabyn and Frew 1994) appear to show no evidence of geomagnetic navigation.

Sea turtles undergo extensive migrations during all life stages. Hatchlings use visual cues, wave direction, and the Earth's magnetic field to navigate during their first few days in the ocean (Irwin and Lohmann, 2002). Lohmann et al. (2004) found that as sea turtles mature, they acquire the ability to exploit magnetic information in a more complex way than hatchlings. Therefore, it is possible (though not documented) that electromagnetic emissions from CSEM surveys may affect perception of navigational cues for migrating sea turtles.

Buchanan et al. (2011) suggested 200 nT and 386 nV/cm as generic thresholds of effects for magnetic and electric fields generated by electromagnetic surveys, noting that "effects in this case simply mean an elicited response of some kind with no negative or positive connotations. It is recognized that many animals will have no reactions to these levels while others may be able to detect fields below these values".

For the worst case scenario of operating a source system with a source output of 10,000 A at a lower frequency of 0.25 Hz, modelling predicted a maximum zone of influence radii (based on above effects thresholds) of 800 m and 1,400 m for the magnetic and electric fields, respectively (see Tables 2.2 and 2.3). With the vessel moving at approximately 4 km/h (2 knots) when the source is active, the duration of exposure of a fixed point along the axis of the tow would be on the order of 26 to 45 minutes. However, it should be noted that for deep-tow electromagnetic surveys such as what is proposed for this Project, most cetaceans, turtles, and pinnipeds would be effectively insulated from electromagnetic transmissions. Although EMF emissions may potentially be detectable by marine mammals and sea turtles within these zones of influence, given the slow speed of the vessel and rapid attenuation of the EMFs, marine mammals and sea turtles would be able to avoid these small areas of high intensity if they chose to do so. Emissions generated by the CSEM source are therefore not predicted to interfere with marine mammal and sea turtle navigation. Furthermore, there are no reported health effects on mammals from extremely low frequency electromagnetic emissions (LGL 2014).

6.2.5 Determination of Significance

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on Marine Mammals and Sea Turtles are predicted to be not significant.

6.2.6 Follow-up and Monitoring

As per the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019), a seabird and marine mammal observation program will be conducted for the duration of the survey (including transit to and from the Project Area) by designated observer(s) trained in marine mammal and seabird observations. Data from these monitoring programs will be included in the EA mitigation and monitoring report submitted to the C-NLOPB within six months after termination of the field work.

The marine mammal monitoring protocol will be conducted in accordance with Environmental Studies Research Fund Report #156 Recommended Seabird and Marine Mammal Observation Protocols for Atlantic Canada (Moulton and Mactavish 2004).

Data collected by the SMMOs concerning marine mammal and sea turtle observations during the CSEM program will be compiled and provided to C-NLOPB and DFO.

6.3 Marine and Migratory Birds

The Marine and Migratory Birds VC includes oceanic (i.e., beyond the continental shelf), neritic (continental shelf), and littoral zone (intertidal, splash, and spray zones) seabirds, waterfowl, loons, grebes, and shorebirds that are protected under the MBCA and additional marine-associated birds not protected under the MBCA (i.e., cormorants). Species of birds listed under SARA or considered at risk by COSEWIC are assessed within the Species at Risk VC (Section 6.4).

6.3.1 Residual Environmental Effects Significance Criteria

A significant adverse residual environmental effect on Marine and/or Migratory Birds is defined as a Project-related environmental effect that causes a detectable decline in abundance or change in the spatial and temporal distribution of marine and migratory birds within the Regional Area, such that natural recruitment may not re-establish the population(s) to its original level within one generation.

An adverse effect that does not meet the above criteria is considered to be not significant.

6.3.2 Project Interactions

Operation of the survey vessel is the only predicted routine Project activity to potentially interact with marine and migratory birds. The CSEM source will be towed just above the seabed at water depths averaging 1350 m and would have no effect on marine and/or migratory birds, including diving birds. The deployment and retrieval of the receivers will also have negligible interaction with marine and migratory birds, including diving birds.

The survey vessel will transit from an onshore base to the offshore Project area to conduct the survey and therefore could potentially interact with nearshore and pelagic birds. During transit and survey operations, the vessel will be operating on a 24-hour basis and therefore will require night lighting, which could attract birds and potentially lead to strandings. Effluent discharges from the vessel (including sewer and /or food waste) could also potentially attract birds.

6.3.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Marine and Migratory Birds:

- Vessel waste discharges will be managed in accordance with MARPOL.
- Lighting on the survey vessel will be kept to a minimum at night to the extent that it does not affect crew / vessel safety.
- The survey vessel will avoid transiting within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations, 2015* to reduce disturbance to colonies.
- Routine systematic checks will be conducted daily on the survey vessel for stranded birds. Handling and documentation of stranded birds will be done in accordance with the Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016). A Live Seabird Salvage permit will be acquired from Canadian Wildlife Service (CWS) prior to operations and any stranded birds (or mortalities) will be reported to CWS in accordance with the permit.

6.3.4 Assessment of Residual Environmental Effects

6.3.4.1 Survey Vessel Operation

The key interaction between routine Project components and activities and marine and migratory birds relates to the operation of the survey vessel. The survey vessel may affect marine and migratory birds through artificial lighting, atmospheric and underwater sound, and marine discharges.

Marine and migratory bird attraction to offshore platforms and vessels is well documented (Imber 1975; Wiese et al. 2001; Gauthreaux and Belser 2006; Montevecchi 2006; Montevecchi et al. 2009; Bruinzeel and van Belle 2010; Rodríguez et al. 2015; Ronconi et al. 2015). Attraction of nocturnally-active birds may result in direct mortality or injury through collisions with facility infrastructure, predation, or through stranding (i.e., birds are unable to return to the sea) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; Davis et al. 2017).

Among marine birds, attraction to artificial lighting and related grounding appears to be widespread among procellariform species such as fulmarine and gadfly petrels, shearwaters, and prions (Procellariidae), storm-petrels (Hydrobatidae), and diving-petrels (Pelecanoididae), with the exception of albatrosses (Diomedeidae). Light attraction has also been reported in the Atlantic puffin in coastal areas near nesting colonies in both Scotland and Newfoundland (Miles et al. 2010; Wilhelm et al. 2013).

The stranding of seabirds from artificial lighting can occur at all times of the year but tends to be more common at the end of the nesting season (Telfer et al. 1987; Le Corre et al. 2002; Miles et al. 2010). In the NL offshore area, strandings of Leach's storm-petrels on drilling and production platforms and geophysical vessels peak sharply when fledglings and adults abandon nesting colonies from mid-September to mid-October (Davis et al. 2017). In studies in which the age of the grounded seabirds has been determined, the majority of individuals have been newly fledged young, particularly in strandings near seabird nesting colonies, suggesting that juvenile inexperience is a factor (Imber 1975; Telfer et al. 1987; Wiese et al. 2001; Gauthreaux and Belser 2006; Poot et al. 2008; Rodríguez and Rodríguez 2009; Miles et al. 2010; Rodríguez et al. 2015).

Several studies report greater numbers of bird strandings around artificial lighting when there is a low cloud ceiling, particularly when accompanied by fog or rain (Telfer et al. 1987; Black 2005; Poot et al. 2008; Davis et al. 2017). In fog or drizzle, the moisture droplets in the air refract the light and greatly increase the illuminated area, thereby extending the distance to which artificial light interacts with birds (Wiese et al. 2001).

Davis et al. (2017) summarizes bird salvage logs from geophysical exploration vessels and supply vessels operating in the NL offshore area from 2003 to 2014. The vessels were engaged in exploration programs initiated as early as 7 May and terminated as late as 26 November; however, most were conducted during some portion of the months of June through September. In total, seabird stranding monitoring spanned 2,197 days over 38 voyages. Over the 11-year period 1,029 birds were found stranded on these vessels, of which 1,012 were marine birds, and 994 of these were Leach's storm-petrels. Strandings peaked sharply from 21 September to 10 October despite few vessels conducting programs after September. Almost all the storm-petrels stranded on the streamer and air gun array decks of seismic vessels, which are open only at the stern, or in similar partially-enclosed spaces. Very few stranded on open decks of geophysical vessels or on supply vessels despite the fact that storm-petrels are frequently seen approaching the lights on the open afterdecks of those vessels. This suggests that the storm-petrels are stranding on vessels and platforms because they enter partially-enclosed spaces and are then unable to find their way out to the open sea.

It is difficult to quantify the mortality rate of birds attracted to artificial lighting because the available estimates rely on recovery of birds on platforms and vessels, and it is not known how many birds are killed but not recovered due to scavenging or falling into the sea (Bruinzeel et al. 2009; Bruinzeel and van Belle 2010; Ellis et al. 2013). These recoveries are often conducted on an incidental basis, which provides limited spatial and temporal coverage compared to a systematic observer-based monitoring system (Ronconi et al. 2015). Of those marine birds that are recovered from platforms and vessels, most are not injured during the stranding. Of the 994 storm-petrels that stranded on geophysical vessels and supply vessels, 15.7% were found dead or died during rehabilitation (Davis et al. 2017). Most of that mortality was due to the birds' plumage being fouled by hydraulic fluid upon landing on the deck or in drip-trays under the numerous winches on streamer and air gun array decks, then succumbing to hypothermia as a result. However, since the large majority of birds that were uninjured and unoiled were unable to escape the vessels, it is clear that they would also have died were they not retrieved and returned to the sea.

In addition to the attraction of birds to artificial lighting, vessel lighting at night can attract fish to the surface, which in turn attracts great black-backed gull and other gull species (Davis et al. 2017). Leach's storm-petrels attracted to the NL offshore area drilling and production platforms have been documented to suffer predation in late summer and fall from great black-backed gulls attracted by the fish drawn to the surface at night by the artificial lighting (Montevecchi et al. 1999; Davis et al. 2017). However, the success rate of the gulls in capturing storm-petrels is unknown. Similarly, the release of organic wastes by the survey vessel can attract birds, which may increase the potential for interactions including risk of predation, collision, and exposure to contaminants. However, this will be reduced with proper waste management practices and adherence to associated MARPOL requirements.

The various bird species that occupy the Project Area will not likely be affected by the survey vessel due to its transitory nature and thus, its short-term presence at any one location, and because it is generally consistent with the overall marine traffic that has occurred throughout the region for years. Mitigation measures outlined in Section 6.3.3 will be in place during Project operations to reduce the effects of bird attraction due to artificial lighting from the survey vessel. Regular searches of the vessel deck will be undertaken and accepted protocols for the collection and release of birds that become stranded will be implemented by qualified and experienced personnel, in accordance with applicable regulatory guidance and requirements and the CWS bird handling permit.

6.3.5 Determination of Significance

Residual effects associated with the operation of the survey vessel are predicted to be low in magnitude, localized primarily to the Project Area (with the exception of vessel transit through the Regional Area), short-term but regular in frequency, and reversible.

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on Marine and Migratory Birds are predicted to be not significant.

6.3.6 Follow-up and Monitoring

In addition to the routine systematic checks that will be conducted daily on the survey vessel for stranded birds, as per the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019), a seabird and marine mammal observation program will be conducted for the duration of the survey (including transit to and from the Project Area) by designated observer(s) trained in marine mammal and seabird observations. Data from these monitoring programs will be included in the EA mitigation and monitoring report submitted to the C-NLOPB within six months after termination of the field work.

In particular, seabird monitoring will be conducted in accordance with the Canada Wildlife Service Eastern Canada Seabirds at Sea Standardized Protocol for Pelagic Seabird Surveys from Moving and Stationary Platforms (Gjerdrum et al. 2012).

6.4 Species at Risk

For the purpose of this report, species at risk are defined as those listed as endangered, threatened or of special concern under Schedule 1 of SARA, or by COSEWIC. Only species listed under Schedule 1 of SARA are legally protected under the Act, as per Section 32(1), which states "no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, and endangered species, or a threatened species". Sections 33 and 58(1) of SARA include prohibitions that protect the residences and critical habitat of species that are listed as endangered, threatened, or extirpated (if a recovery strategy has recommended the reintroduction of the species into the wild in Canada). As described in Section 4.5, there are 36 species at risk (22 fish, 9 marine mammal, 2 sea turtle, 3 marine and migratory birds) which may occur in the vicinity of the Project Area; 13 of these are listed on Schedule 1 of SARA.

The potential for occurrence of marine fish species at risk in the Project Area ranges from migratory / transient to high, with deepwater redfish, northern wolffish, roughead grenadier, and roundnose grenadier having the highest potential for occurrence in the Project Area. With the exception of the fin whale which could be common in the Project Area year-round, the occurrence of other marine mammal, sea turtle and bird species at risk would be considered rare or uncommon in the Study Area.

6.4.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect on Species at Risk** is defined as a Project-related environmental effect that:

- jeopardizes the achievement of self-sustaining population objectives or recovery goals;
- is not consistent with applicable allowable harm assessments;
- results in a permanent loss of critical habitat as defined in a recovery plan or an action strategy; or
- for which an incidental harm permit would not likely be issued.

An adverse effect that does not meet any of the above criteria is considered to be not significant.

6.4.2 Project Interactions

Potential interactions between Species at Risk and Project activities are as described previously for marine fish, marine and/or migratory birds, and marine mammals and sea turtles. The survey vessel will generate underwater sound and light emissions, and effluent discharges (in accordance with MARPOL) which could potentially result in sensory disturbance and localized water quality effects for marine fish species at risk. The survey vessel also presents a risk for vessel strikes for marine mammal and sea turtle species at risk. Artificial lighting may attract bird species at risk and result in collisions and/or strandings. The operation of the CSEM source will generate underwater electromagnetic emissions which could potentially affect marine fish species at risk and to a lesser extent, marine mammal and sea turtle species at risk. Receiver deployment will result in localized, temporary changes in benthic habitat for marine fish species at risk.

6.4.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Species at Risk:

- Vessel waste discharges will be managed in accordance with MARPOL.
- Low vessel speed (4 to 5.5 km/h [2 to 3 knots]) will reduce underwater noise and the risk of collision with marine mammals and sea turtles.
- SMMOs will be on board to record observations and oversee ramp-up procedures.
- The electromagnetic source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the electromagnetic source will not be initiated if a shark, marine mammal or sea turtle is observed 30 minutes prior to ramp-up within a 500 m safety zone. Ramp-up will not occur until the animal has moved beyond the 500 m zone or 20 minutes have elapsed since the last sighting.
- The electromagnetic source will be turned off when data are not being collected (e.g., during vessel turns).
- Any dead or distressed marine mammals or sea turtles and SARA-listed species will be reported to the C-NLOPB and DFO.
- Lighting on the survey vessel will be kept to a minimum at night to the extent that it does not affect crew / vessel safety.
- The survey vessel will avoid transiting within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations, 2015* to reduce disturbance to colonies.
- Routine systematic checks will be conducted daily on the survey vessel for stranded birds. Handling and documentation of stranded birds will be done in accordance with the Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016). A Live Seabird Salvage permit will be acquired from CWS prior to operations and any stranded birds (or mortalities) will be reported to CWS in accordance with the permit.

6.4.4 Assessment of Residual Environmental Effects

6.4.4.1 Survey Vessel Operation

Marine Fish Species at Risk

Four fish species at risk are listed under SARA (northern, spotted, and Atlantic wolffish and white shark). The northern wolffish has a high potential for occurrence in the Project Area, the spotted wolffish has a moderate potential for occurrence in the Project Area and Atlantic wolffish and white shark have a low potential for occurrence in the Project Area. Wolffish are bottom dwellers and are found between 150 and 1,000 m, depending on the species and are unlikely to be affected by underwater sound generated by the survey vessel. Shark are a pelagic species and occur from just below the surface down to 1,200 m. As described in Section 6.1.4., survey operations will generate underwater sound emissions. In a series of experiments with reef and coastal sharks and white shark, Chapuis et al. (2019) found that a relatively low sound level (150 dB re 1 μPa) could elicit a change in behaviour in some sharks. The survey vessel could generate 170 to 190 dB re 1 μPa. The survey vessel will not generate much more sound than vessels already transiting the area (fishing vessels can generate 158 dB re 1μPa and commercial freighters can generate 172 dB re 1μPa [Hurley and Ellis 2004]) and will only be in the areas for a short time. The at-risk fish species (including COSEWIC-assessed species) have same limited potential for interaction with the vessel as not-at-risk species.

Marine Mammal and Sea Turtle Species at Risk

As described in Section 6.2.4, survey vessel operations will generate underwater sound emissions which may cause sensory disturbance and behavioural changes for marine mammal and sea turtle species at risk. Baleen whales (e.g., North Atlantic right whale, fin whale, blue whale) are thought to be more sensitive to sound at low frequencies that are predominantly produced by vessels than are toothed whales (MacGillivray et al. 2014), possibly causing localized avoidance of vessels.

The survey vessel may also present a collision risk potentially resulting in physical injury or mortality for marine mammal and sea turtle species at risk. However, the likelihood of a vessel strike occurring during Project activities is very low given the rare or uncommon occurrence of most marine mammal and sea turtle species at risk, the low vessel speed, and avoidance measures that will be taken to help prevent vessel strikes.

Mysticete species are more susceptible to vessel strikes than odontocetes, with fin whales and right whales being among the most frequently struck whales (Laist et al. 2001; Jensen and Silber 2003; Panigada et al. 2006; Douglas et al. 2008). Strikes may be more likely in areas where large numbers of whales congregate to feed (Panigada et al. 2006), and the most lethal and severe injuries to large whales resulting from documented ship strikes have occurred when vessels were travelling at ≥14 knots (25.9 km/h; Laist et al. 2001). Lethal strikes are considered infrequent at vessel speeds <14 knots and rare at speeds <10 knots (18.5 km/h; Laist et al. 2001). Risk of sea turtle collision with vessels also decreases as vessel speed is reduced (Hazel et al. 2007).

Marine and Migratory Bird Species at Risk

As described in Section 6.3.4, the survey vessel may affect marine and migratory birds through artificial lighting, atmospheric and underwater sound, and marine discharges.

Ivory gull and Ross's gull may overwinter in the Regional Area but are expected to be rare or uncommon between May and October. Red-necked phalaropes have been recorded in small numbers from mid-May to early June and during August and September in the Project Area (Moulton et al. 2006). Project interactions with these species are expected to be rare. Of more relevance is the potential attraction of Leach's storm-petrel, a species assessed as Vulnerable by the International Union for Conservation of Nature (IUCN) (BirdLife International 2018) and whose population in Newfoundland has experienced a significant decline (Wilhelm et al. 2015, 2019).

Storm-petrels are known to be attracted to artificial lighting (Wilhelm et al. 2013; Davis et al. 2017), making them vulnerable to direct mortality or injury through collisions with facility infrastructure, predation, or through stranding (i.e., birds are unable to return to the sea) (Baird 1990; Montevecchi et al. 1999; Wiese et al. 2000; Davis et al. 2017). Refer to Section 6.3.4.1 for more information on storm-petrel strandings in the Newfoundland offshore area.

In addition to the attraction of birds to artificial lighting, vessel lighting at night can attract fish to the surface, which in turn attracts great black-backed gull and other gull species (Davis et al. 2017). Leach's storm-petrels attracted to the NL offshore area drilling and production platforms have also been documented to suffer predation in late summer and fall from great black-backed gulls attracted by the fish drawn to the surface at night by the artificial lighting (Montevecchi et al. 1999; Davis et al. 2017). However, the success rate of the gulls in capturing storm-petrels is unknown. Similarly, the release of organic wastes by the survey vessel can attract birds, which may increase the potential for interactions including risk of predation, collision, and exposure to contaminants. However, this will be reduced with proper waste management practices and adherence to associated MARPOL requirements.

Effects of survey vessel operation on bird species at risk are expected to be minor due to the short term and transitory nature of operations and mitigation measures to reduce the effects of bird attraction due to artificial lighting from the survey vessel (refer to Section 6.3.3). Regular searches of the vessel deck will be undertaken and accepted protocols for the collection and release of birds that become stranded will be implemented by qualified and experienced personnel, in accordance with applicable regulatory guidance and requirements and the CWS bird handling permit.

6.4.4.2 CSEM Source Operation

Marine Fish Species at Risk

Elasmobranchs (sharks, rays, and skates) and salmonids are the species most susceptible to EMF generation. The white shark is the only EMF-sensitive SARA-listed species that could occur in the Regional Area (with a low potential for occurrence in the Project Area). COSEWIC-assessed species that are sensitive to EMF that could occur in the Regional Area include Atlantic salmon (migratory / transient, with a low potential to occur in the Project Area), shortfin mako shark, winter skate, and smooth skate (all have low potential to occur in the Project Area), and porbeagle shark and thorny skate (both have moderate potential to occur in the Project Area). Salmon migration is partially determined by magnetic fields (Normandeau Associates et al. 2011). Pacific salmon have demonstrated geomagnetic imprinting; sockeye salmon have demonstrated a change in migration routes into their natal rivers can be affected by geomanetic field drift (Putnam et al. 2013) and chinook salmon have demonstrated the use of a "magnetic map" to lead them to marine feeding areas (Putnam et al. 2014). Invertebrate prey species can generate a weak bioelectrical field of 14 to 28 mVs, which can be detected by elasmobranchs between 22 to 40 cm away (Bedore and Kajiura 2013). Shark movement, governing where and when to swim, are probably the results of several factor, including magnetic gradient (Sundström et al. 2001), as sharks can detect changes in the Earth's geomagnetic field (Meyer et al. 2005).

The instantaneous areal extent of potential effects from the proposed 10,000 A source system would be a maximum of 2 km^2; however, exposure at any one point would be 26 to 45 minutes with a vessel moving at approximately 4 km/h (2 knots), too short to interfere with movement, orientation or predator/ prey detection (LGL 2104). The effects of the operation of the CSEM source on marine fish species at risk are therefore predicted to be negligible, confined to a portion of the Project Area, occur at a regular frequency but will be short-term in duration, and will be reversible.

Marine Mammal and Sea Turtle Species at Risk

Section 6.2.4 assesses the effects of the CSEM source operation (and associated electromagnetic emissions) on marine mammals and sea turtles. For deep-tow electromagnetic surveys such as what is proposed for this Project, most cetaceans, turtles, and pinnipeds would be effectively insulated from electromagnetic emissions.

In close proximity to the source where emissions may potentially be detectable by marine mammals and sea turtles within affected zones of influence, given the slow speed of the vessel and rapid attenuation of the electromagnetic fields, marine mammals and sea turtles including species at risk would be able to avoid these small areas of high intensity if they chose to do so. There is no critical habitat for marine mammal and sea turtle species at risk in proximity to the Project Area. The likelihood of a species at risk being present within the zone of influence at any given time is low, but even if overlap did occur, the length of time of exposure would be very limited and not expected to result in adverse effects. Refer to Section 6.2.4.2 for more information on the effects of the CSEM source operation on marine mammals and sea turtles.

6.4.4.3 Receiver Deployment and Retrieval

Marine Fish Species at Risk

Wolffish are bottom dwellers and are found between 150 and 1,000 m, depending on the species. White shark can be found from the surface to approximately 1,200 m deep. Skate are also bottom-dwellers. Of the EMF-sensitive COSEWIC-assessed skates that could occur in the Regional Area, only thorny skate have a moderate potential to occur in the Project Area; they typically occur at water depths of less than 200 m. The receivers will primarily be deployed in a water depth of approximately 1,350 m, so it is unlikely there will be interaction between species at risk and the anchors. As the anchors are comprised of limestone and gravel and will dissolve into their component parts within six to twelve months, the effects of the receiver deployment and retrieval on marine fish species at risk are therefore predicted to be negligible, confined to a portion of the Project Area, occur once, will be short-term in duration, and will be reversible.

6.4.5 Determination of Significance

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on species at risk are predicted to be not significant. This prediction is made with a moderate level of confidence in recognition of the limited information available concerning the life history of some species at risk (e.g., northern and spotted wolffish). Project activities are not predicted to jeopardize the achievement of self-sustaining population objectives or recovery goals or result in a permanent loss of critical habitat as defined in a recovery plan or an action strategy. Although species at risk may occur within the vicinity of Project activities, the Project is not predicted to contravene the prohibitions of SARA (e.g., s. 32[1], 33, 58[1]) protecting individuals or designated critical habitat or necessitate a request for an incidental harm permit.

6.4.6 Follow-up and Monitoring

No follow-up and monitoring is proposed specifically for species at risk. Refer to monitoring programs that will be conducted for marine mammals and sea turtles (Section 6.2.6) and marine and migratory birds (Section 6.3.6). Monitoring of the 500 m safety zone prior to CSEM source ramp-up will focus on marine mammals and sea turtles, as well as sharks (which could include white sharks).

6.5 Sensitive Areas

Sensitive Areas which intersect with the Project Area include the Orphan Spur EBSA, the Northeast Newfoundland Slope Closure Area (marine refuge), an SBA for sea pens and a small portion of critical habitat for northern wolffish. The Orphan Spur EBSA is recognized as having a high concentration of corals as well as high densities of sharks and species of conservation concern. The Northeast Newfoundland Slope Closure marine refuge is closed to bottom contact fishing to help prevent damage to corals and sponges. A designated SBA for sea pens encompasses EL 1145, and a small portion of EL 1146 within the Project Area.

6.5.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect on Sensitive Areas** is defined as a Project-related environmental effect that alters the valued habitat physically, chemically or biologically, in quality or extent, to such a degree that there is a decline in abundance lasting more than one generation of key species (for which the special area was designated) or a change in community structure, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not sustain the population or community in the sensitive area and would not return to its original level within one generation.

An adverse effect that does not meet the above criteria is considered to be not significant.

6.5.2 Project Interactions

The operation of the CSEM source will generate underwater electromagnetic emissions which could affect marine fish habitat. Receiver deployment will result in localized, temporary changes in benthic habitat. The survey vessel will generate sound and light emissions, as well as permitted waste discharges.

6.5.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Sensitive Areas:

- Vessel waste discharges will be managed in accordance with MARPOL.
- A SMMO will be on board to record shark, marine mammal and sea turtle observations and oversee ramp-up procedures.
- The electromagnetic source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the electromagnetic source will not be initiated if a shark, marine mammal or sea turtle is observed 30 minutes prior to ramp-up within a 500 m safety zone of the energy source.

Ramp-up will not occur until the animal has moved beyond the 500 m zone or 20 minutes have elapsed since the last sighting.

- The electromagnetic source will be turned off when data are not being collected (e.g., during vessel turns).
- Compacted sand anchors, designed to degrade within one year, will be used for the CSEM receivers.

6.5.4 Assessment of Residual Environmental Effects

6.5.4.1 Survey Vessel Operation

The survey vessel will transit through and conduct survey activities in sensitive areas (Orphan Spur EBSA and Northeast Newfoundland Slope Closure marine refuge), although underwater sound and emissions associated with Project activities are not expected to affect these sensitive areas to the extent that the ecological value of the sensitive area and the functions it provides would be compromised.

6.5.4.2 CSEM Source Operation

The CSEM source will be towed approximately 30 m above the seabed during the survey. At this height, there is no expected direct interaction between the towed source and the benthic habitat. However, assuming a worst-case scenario of a CSEM source output of 10,000 A operating at a frequency of 0.25 Hz, modelling of electromagnetic emissions predicted a maximum zone of influence radii of 800 and 1,400 m for the magnetic and electric fields, respectively. Electromagnetic emissions are not expected to be detectable by sensitive species outside the Project Area where the survey operations will be taking place.

Sensitive areas within the Project Area are known to provide important habitat to sharks and several fish species (including species at risk) and corals; these areas could experience elevated levels of electromagnetic emissions, although exposure of a fixed point along the axis of the tow would be on the order of 26 to 45 minutes assuming a vessel speed of approximately 4 km/h (2 knots). Adverse effects on these sensitive areas as a result of CSEM source operation would therefore be limited in spatial and temporal extent. Valued habitat within affected sensitive areas would not be altered physically, chemically or biologically, in quality or extent, to such a degree that there is a decline in abundance of key species or a change in community structure (Section 6.1.4.2).

6.5.4.3 Receiver Deployment and Retrieval

Up to approximately 100 receivers will be deployed to the seabed for the survey. The receivers are attached to sand anchors to provide negative buoyancy. Each anchor block is approximately 920 mm (length) x 810 mm (width) x 102 mm (height) and is composed of ingredients found in natural gravel, limestone and/or seawater (no organic admixtures).

As the receivers sink through the water column, they may produce temporary, localized turbidity near the seafloor with sediment resuspension and physically disturb (e.g., crush, smother or injure) benthic organisms (including corals and sponges which may be present). Each anchor will cover an area of the seabed of approximately 0.75 m^2. Considering there will be up to approximately 100 receivers, there will be up to approximately 75 m^2 of benthic habitat that could be directly disturbed within the Project Area. As resuspended sediments settle, water clarity is expected to return to background conditions within minutes to a few hours. Disturbed sediments will be recolonized through larval settlement and migration from adjacent areas. Following release and recovery of the receivers, the anchors remain on the seabed. These sand anchors are expected to degrade to natural substances within approximately six to twelve months after their deployment. Sediment grain size may be temporarily altered (i.e., increased sand content) but effects are expected to be limited. Disturbed sediments will be recolonized through larval settlement and migration from adjacent areas.

The Northeast Newfoundland Slope Closure Area (marine refuge) is 55,251 km^2 and the SBA for sea pens is 41,323 km^2.The approximately 75 m^2 of benthic habitat that could be directly disturbed within the Project Area represents a very small percentage of benthic impact within these sensitive areas.

6.5.5 Determination of Significance

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on Sensitive Areas are predicted to be not significant.

6.5.6 Follow-up and Monitoring

No follow-up or monitoring is proposed with regard to effects on sensitive areas.

6.6 Fisheries and Other Ocean Users

Fisheries and Other Ocean Users includes commercial, recreational and Aboriginal fisheries as well as other ocean activities such as offshore research, subsea communications, military training, and shipping activities that occur in offshore waters.

6.6.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect on Fisheries and Other Ocean Users** is defined as a Project-related environmental effect that results in:

- an adverse change in fishing activity (including traditional, commercial, recreational and Indigenous / subsistence) in the Study Area including overall timing and intensity, resulting in a measurable reduction in overall activity levels of fishing activity, and/or the economic returns gained from commercial fishing activities due to reduction in quality or quantity of fish landings, for one or more fishing seasons. Can include uncompensated damage to fishing gear; or
- an adverse change in other ocean uses such as marine-based research or military training, including location and timing of these activities, that results in a measurable reduction in the quality or applicability of these activities over multiple years.

An adverse effect that does not meet the above criteria is considered to be not significant.

6.6.2 Project Interactions

Project activities have potential to interact with fisheries and other ocean users which may be operating in or transiting through the Project Area during the survey. The operation of the CSEM source will generate underwater electromagnetic emissions and to the extent that these emissions may temporarily affect the local distribution of commercial fish species, fisheries and other ocean users could also be potentially affected.

6.6.3 Mitigation

The following mitigation will be used to reduce adverse environmental effects on Fisheries and Other Ocean Users:

- Planning will be conducted in cooperation with fisheries stakeholders in advance of the survey to avoid high concentrations of fishing vessels in the Project Area and along the transit route.
- Survey lines will be provided to the C-NLOPB, fisheries stakeholders, and Indigenous groups, six weeks prior to survey start.
- Advance communication with DFO and Department of National Defense during survey planning, including provision of survey lines, will eliminate any potential conflict with research vessel cruises or military activities.
- An FLO will be on board the survey vessel to facilitate communication with fishers and provide advice and coordination with regard to avoid fishing vessels and gear throughout the survey. A single point of contact will be established to respond to queries and concerns from other ocean users including but not limited to MARLANT and DFO.
- A Notice to Mariners will be issued prior to conducting the survey. The Notice to Mariners will outline the area where operations will be conducted and will also include a request for a minimum safe distance, as applicable.
- A Navigation Warning will be broadcasted the day the vessel is heading to position to undertake the survey.
- Any contact with fishing gear will be reported to the C-NLOPB immediately. If gear contact is made during operations it will not be retrieved or retained by the survey vessel.
- In the unlikely event that Project activities damage fishing gear compensation will be handled in accordance with the Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2017).

6.6.4 Assessment of Residual Environmental Effects

6.6.4.1 Survey Vessel Operation

Operation of the survey vessel has potential to interact with fisheries and other ocean users; however, the location and timing of survey activities will be communicated in advance with fisheries stakeholders and other ocean users to avoid space conflicts. The Project is not expected to cause any interruption to harvesting or research activities, impede access to fishing grounds or result in lost or reduced catch. An FLO will be on board the survey vessel to facilitate communication with fishers and provide advice and coordination with regard to avoid fishing vessels and gear throughout the survey. Given the length of a survey, it is not expected that there would be a crew change during the survey; therefore, the vessel will only transit to / from the site once each way, reducing the likelihood that the survey would interfere with the fixed Greenland halibut fishery. In the unlikely event of fishing gear loss or damage due to Project activities, BP Canada will adhere to the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017).

6.6.4.2 CSEM Source Operation

As noted in Section 6.2.4, the Project could potentially interact with targeted fisheries species. However, residual environmental effects on Marine Fish and Shellfish are predicted to be not significant due to the proposed mitigation measures and the limited spatial and temporal scale of Project activities. As a result, any indirect effects on fisheries due to potential residual environmental effects on fish species is expected to be negligible.

6.6.5 Determination of Significance

Residual environmental effects of the Project with respect to potential interactions with Fisheries and Other Ocean Users are predicted to be negligible to low in magnitude, restricted to the Project Area (with the exception of vessel transit to the Project Area), of short duration and single frequency (one survey in 2020). Adverse residual environmental effects would be reversible given that compensation would be awarded to replace or repair damaged gear.

In consideration of the nature and duration of Project activities and implementation of proposed mitigation measures, adverse residual environmental effects of the Project on Fisheries and Other Ocean Users are predicted to be not significant.

6.6.6 Follow-up and Monitoring

No follow-up or monitoring is proposed with regard to effects on fisheries and other ocean users.

7.0 ACCIDENTAL EVENTS

Although unlikely to occur, a small hydrocarbon release could occur as a result of a hydrocarbon leak from the CSEM source, a small on-deck spill, or an accidental release of vessel fuel. Solid streamers on the CSEM source eliminate the risk of a spill due to a streamer break.

The towfish device associated with the CSEM source contains approximately 400 L of hydraulic oil in the main canister and approximately 20 L of silicone oil in the junction box. As part of standard practice, routine equipment checks, including of towfish devices, are conducted before and after deployment. The frame, hoses and oil-filled containers will be checked to confirm no sign of a leak. Any sign of a hydrocarbon leak would result in the towfish device rendered unusable until the source of the leak is found and repaired.

If an on-deck spill was to occur, it would be immediately contained, and the risk of pollution to the marine environment would be very low.

Lubricants and hydraulic fluid consist primarily of mineral oils and would rapidly evaporate and/or disperse upon reaching the marine environment. Of greater risk to the marine environment would be a diesel fuel spill from the vessel. However, marine diesel also has a low viscosity and high aromatic content. Surface oil would be expected to rapidly evaporate and disperse into the water column following a release.

The survey vessel will have spill response equipment and a SOPEP which will outline contingency measures to be implemented in the unlikely event of a spill and reduce the risk of adverse effects on the marine environment.

A diesel spill could potentially interact with marine fish, marine and/or migratory birds, marine mammals and sea turtles, species at risk, sensitive areas, and fisheries and other ocean users. However, the spatial and temporal extent of interaction is expected to be limited given the nature of the hydrocarbons to rapidly disperse and evaporate and the ability of marine fish, marine mammals and sea turtles to avoid oil spills. Marine and/or migratory birds would be most at risk, recognizing that exposure to a small amount of hydrocarbons can result in physical injury or mortality of birds, through external exposure (e.g., oiling of feathers), inhalation (e.g., inhalation of volatile hydrocarbons), or ingestion (e.g., as a result of preening oiled feathers or drinking contaminated water). Oiling of feathers can result in thermal and buoyancy deficiencies and affect flight, which can result in death from a combination of heat loss, starvation, and/or drowning (Leighton 1983; O'Hara and Morandin 2010; Boertmann and Mosbech 2011; Morandin and O'Hara 2016; Tuarze et al. 2019). The severity of effects can depend on the location of the spill, species affected, type of oil, weather conditions, time of year, volume of the spill, and duration of exposure (Gorsline et al. 1981; Wiese et al. 2001; Montevecchi et al. 2012; Fox et al. 2016).

Given the limited volume and nature of hydrocarbon materials on board the survey vessel, the probability of interaction with sensitive areas is very low. Spilled diesel fuel would disperse and/or evaporate relatively quickly and would not be expected to interact with the water column or benthic environment at depth. BP Canada is aware of the CWS Response Plan Guidance for Birds and Oil (ECCC 2017a). In the event of a spill, BP Canada will consult with ECCC-CWS for appropriate response, handling, and monitoring of marine and/or migratory birds as applicable which is consistent with the CWS Response Plan Guidance.

Depending on the volume, location, and timing of a diesel spill, fisheries and other ocean users could potentially be affected through fouling of gear and perceived tainting of catch by petroleum hydrocarbons. It is unlikely that a diesel spill from a survey vessel would be of such magnitude that it would result in a fisheries closure. Implementation of the SOPEP and communication with the Canadian Coast Guard, the C-NLOPB and fishers will limit the interaction with fishing gear. In the unlikely event of gear damage from a spill, compensation will be handled in accordance with the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activities (C-NLOPB and CNSOPB 2017).

Given the nature of the hydrocarbons and implementation of a SOPEP and a compensation plan as applicable, an accidental spill, including a diesel spill from the survey vessel, is not predicted to result in a significant adverse environmental effect on Marine Fish and Shellfish, Marine and/or Migratory Birds, Marine Mammals and Sea Turtles, Species at Risk, Sensitive Areas, or Fisheries and Other Ocean Users.

8.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Section 4.1 describes the physical environment of the Study Area. The key physical environment factors that could affect the Project are ice and weather conditions (e.g., wind / waves / visibility).

Reduced visibility, high wind and wave conditions, and other severe and/or extreme weather conditions may delay survey activities. These conditions could also increase the potential for vessel collisions and in extreme cases, cause injury or fatality.

A significant adverse residual environmental effect of the environment on the Project would be one that causes damage to the Project vessel or equipment resulting in a residual environmental effect that exceeds the VC-specific residual environmental effects significant criteria (as defined in Section 5.4) or resulting in harm to Project workers or the public (e.g., fishers and/or other ocean users).

The timing of the survey window (May to October) has been selected to reduce risk of ice and severe weather. The survey vessel will avoid sea ice and icebergs (if present) and will have systems for storm tracking and weather forecasting services. Operations will be delayed/suspended if wind or wave conditions reach operating limits that could potentially affect safety of operations and/or quality of data collection.

The Safety Plan for the Project, which will be submitted as part of the Geophysical Program Authorization process, will address details on operating limits and procedures for delaying/suspending operations as required to maintain safe operations.

In consideration of the above significance criteria and mitigation to manage effects of the environment, the adverse residual effects of the physical environment on the Project area predicted to be not significant.

9.0 CUMULATIVE ENVIRONMENTAL EFFECTS

Residual environmental effects from the Project could potentially interact cumulatively with effects from other past, present or likely future projects and activities in the Regional Area, including other environmental or geophysical programs, oil and gas exploration and production activities, fisheries, research programs, and shipping. However, the incremental contribution of Project-related effects to cumulative effects is considered to be minor or negligible given the short time frame (less than 30 days) and temporary nature/reversibility of effects, limited geographic scope of Project effects, the non-intrusive nature of Project activities, and implementation of mitigation described in this report.

Within the Regional Area, BHP is proposing exploration drilling in ELs 1157 and 1158 with an initial well planned for 2021 and a seabed survey within these ELs that could occur between 2020 and 2025 (BHP 2020). Chevron is proposing to conduct an exploration drilling program within EL 1138 with an initial well planned for 2021 (Chevron 2020). These exploration drilling activities could overlap temporally with the Project. Like BP Canada's Project Area, the project area for the BHP Canada Exploration Drilling Project overlaps with the Northeast Newfoundland Slope Closure marine refuge. Therefore, cumulative adverse effects from these projects on the marine benthos within this special area are possible. BP Canada is proposing to conduct exploration drilling within the Project Area with an initial well planned for 2022. Any longer term effects on the marine benthos associated with receiver deployment could potentially combine with future effects on the marine benthos associated with drilling waste discharges, resulting in adverse cumulative effects on the marine benthos for portions of the Project Area. However, BP Canada's Newfoundland Orphan Basin Exploration Drilling Program will require a pre-drilling benthic survey to identify environmental sensitivities in the vicinity of the proposed well site and establish a baseline assessment of benthic conditions. A post-drilling benthic survey will also be conducted to validate drill waste dispersion modelling and environmental effects predictions. BHP has also committed to conducting these surveys as part of its exploration drilling program (BHP 2020).

There may also be seismic exploration programs occurring in the Regional Area in 2021 which could potentially overlap temporally with the Project. BP Canada will consult with the C-NLOPB to understand the likelihood and location of seismic exploration programs which could occur concurrently with the Project to better understand and reduce potential cumulative effects, particularly with regard to potential effects on fisheries and other ocean users.

Cumulative adverse effect on fisheries and other ocean users are expected to be limited given the short temporal and small spatial scope of the survey and limited adverse biological effects on species of interest to these ocean users. The Project will not require the establishment of a safety (exclusion) zone, however, fisheries in the area could potentially experience a short-term disruption within the survey area, and safety (exclusion) zones for BHP and Chevron's exploration drilling programs may be in effect within the Regional Area during the temporal scope of the Project, contributing to potential cumulative adverse effects on fisheries and other ocean users through restrictions on fishing activities. Communication with fisheries stakeholders and other ocean users in advance of the Project, and communication of safety (exclusion) zones for drilling programs and potential seismic programs will help to mitigate potential conflicts and cumulative adverse effects on fisheries and other ocean users.

Fishing activities cause direct mortality and disturbance to targeted fish species and may cause incidental mortality and indirect disturbance to non-targeted fish species, marine and migratory birds, marine mammals and sea turtles. Other offshore oil and gas exploration and production, research programs, and/or shipping may also cause incidental mortality or indirect disturbance to these marine wildlife components. The Project is not predicted to cause mortality of marine species, but there could be cumulative disturbance effects, particularly with regard to underwater sound and artificial lighting in the Regional Area.

Operation of the survey vessel will result in a temporary, localized increase in underwater sound levels within an acoustic environment that is already dominated by sound emissions produced by shipping and seismic surveys. The survey vessel represents a negligible, short-term contribution to the overall vessel traffic off Eastern Newfoundland. Nevertheless, the survey vessel will create potential incremental risks of vessel collision with marine mammals and sea turtles, and attraction of marine and/or migratory birds. These risks of cumulative effects will be mitigated through control of vessel speed and detection and proper management of stranded birds.

Environmental effects of marine discharges from the survey vessel over the survey period will be negligible due to adherence to the *Canada Shipping Act, 2001* MARPOL and any other applicable standards for the prevention of pollution, including a SOPEP. No adverse cumulative effects are therefore predicted with respect to marine water quality during routine operations. In the unlikely event of an accidental hydrocarbon release from the survey vessel, temporary and localized effects on water quality may act in combination with other oil pollution events (e.g., illegal bilge disposal) unrelated to the Project to result in a cumulative effect on marine water quality and the biological VCs which may be present in the affected area.

With the application of proposed Project-related mitigation, residual cumulative effects on Marine Fish and Shellfish, Marine and/or Migratory Birds, Marine Mammals and Sea Turtles, Species at Risk, Sensitive Areas, or Fisheries and Other Ocean Users are predicted to be not significant. No additional mitigation measures beyond those in place to mitigate the Project’s direct effects (and standard mitigation in place for other projects and activities) are needed to address potential cumulative effects.

10.0 SUMMARY AND CONCLUSIONS

BP Canada is proposing to conduct the Project over ELs 1145 and 1146 in the Orphan Basin offshore NL in order to collect data to confirm prospectivity for a proposed future exploration drilling program within these ELs. The Project is proposed to be conducted between May and October 2021 (although may occur in the same seasonal window between 2022 and 2024), with a duration of less than 30 days.

Mitigation will be implemented to reduce potential adverse environmental effects to a negligible or low magnitude for Marine Fish and Shellfish, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk, Sensitive Areas, and Fisheries and Other Ocean Users. A summary of mitigation measures is provided below:

- Vessel waste discharges will be managed in accordance with MARPOL.
- An SMMO will be on board to record shark, marine mammal and sea turtle observations and oversee ramp up procedures.
- The electromagnetic source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the electromagnetic source will not be initiated if a shark, marine mammal or sea turtle is observed 30 minutes prior to ramp-up within a 500 m safety zone. Ramp-up will not occur until the animal has moved beyond the 500 m zone or 20 minutes have elapsed since the last sighting.
- The electromagnetic source will be turned off when data are not being collected (e.g., during vessel turns).
- Compacted sand anchors, designed to degrade within one year, will be used for the CSEM receivers.
- Low vessel speed (4 to 5.5 km/h [2 to 3 knots]) will reduce underwater noise and the risk of collision with marine mammals and sea turtles.
- Any dead or distressed marine mammals or sea turtles and SARA-listed species will be reported to the C-NLOPB and DFO.
- Lighting on the survey vessel will be kept to a minimum at night to the extent that it does not affect crew/vessel safety.
- The survey vessel will avoid transiting within 300 m of migratory bird nesting colonies during the nesting period and will comply with provincial *Seabird Ecological Reserve Regulations, 2015* to reduce disturbance to colonies.
- Routine systematic checks will be conducted daily on the survey vessel for stranded birds. Handling and documentation of stranded birds will be done in accordance with the Procedures for Handling and Documenting Stranded Birds Encountered on Infrastructure Offshore Atlantic Canada (ECCC 2016). A Live Seabird Salvage permit will be acquired from CWS prior to operations and any stranded birds (or mortalities) will be reported to CWS in accordance with the permit.
- Planning will be conducted in cooperation with fisheries stakeholders in advance of the survey to avoid high concentrations of fishing vessels in the Project Area and along the transit route.
- Survey lines will be provided to the C-NLOPB, fisheries stakeholders, and Indigenous groups, six weeks prior to survey start.
- Advance communication with DFO and Department of National Defense during survey planning, including provision of survey lines, will eliminate any potential conflict with research vessel cruises or military activities.

- An FLO will be on board the survey vessel to facilitate communication with fishers and provide advice and coordination with regard to avoid fishing vessels and gear throughout the survey. A single point of contact will be established to respond to queries and concerns from other ocean users including but not limited to MARLANT and DFO.
- A Notice to Mariners will be issued prior to conducting the survey. The Notice to Mariners will outline the area where operations will be conducted and will also include a request for a minimum safe distance, as applicable.
- A Navigation Warning will be broadcasted the day the vessel is heading to position to undertake the survey.
- Any contact with fishing gear will be reported to the C-NLOPB immediately. If gear contact is made during operations it will not be retrieved or retained by the survey vessel.
- In the unlikely event that Project activities damage fishing gear compensation will be handled in accordance with the Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2017).
- The survey vessel will have spill response equipment and an SOPEP that will outline contingency measures to be implemented in the unlikely event of a spill and reduce the risk of adverse effects on the marine environment.
- The Safety Plan for the Project, which will be submitted as part of the Geophysical Program Authorization process, will address details on operating limits and procedures for delaying/suspending operations as required to maintain safe operations.

Follow-up programs are not proposed for marine fish and shellfish, species at risk, sensitive areas, or commercial fisheries and other ocean users. As per the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2019), a seabird and marine mammal observation program will be conducted for the duration of the survey (including transit to and from the Project Area) by designated observer(s) trained in marine mammal and seabird observations. An EA mitigation and monitoring report will be submitted to the C-NLOPB within six months after termination of the field work. In addition to the data collected during the seabird and marine mammal observation program, this report will include a description of the mitigation and monitoring measures identified in the EA including those implemented during the program and assessment of effectiveness of these measures.

Residual environmental effects of the Project (including effects of planned activities and accidental events) are predicted to be not significant. There are also no predicted significant cumulative environmental effects and no significant environmental effects associated with potential effects of the environment on the Project.

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