Western Newfoundland 2017 Controlled Source Electromagnetic (CSEM) Survey– Environmental Assessment

Final Report

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May 2017

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Executive Summary

Electromagnetic Geoservices Canada, Inc. (EMGS) is proposing to conduct a controlled source electromagnetic (CSEM) survey (Western Newfoundland CSEM Survey 2017; the Project). The Project is proposed for the western offshore waters of insular Newfoundland. The primary objective of the Project is to acquire data to assess the presence of geological structures suitable for the containment and accumulation of hydrocarbons and to determine potential hydrocarbon sources within the Project Area. Exploration drilling is not included in the scope of this Project. The proposed survey is expected to take 5 to 15 days (allowing for weather downtime, most likely less than 10 days) and would be conducted between August and December 2017, pending regulatory approvals.

This document is intended to fulfill requirements for an environmental assessment (EA) in accordance with the requirements of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and the Canada-*Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the Accord Acts). Under the Accord Acts, *m*arine CSEM surveys require a Geophysical Program Authorization (Electromagnetic Program Authorization) from the C-NLOPB. The application for this authorization requires, among other things, an EA of the proposed program.

The Project Area is 5,140 km², located off the western coast of Newfoundland in water depths of approximately 50 to 550 m. The survey will be conducted using one of EMGS's exploration vessels, which will tow the CSEM source above the seafloor. The CSEM source generates low frequency (0.05 to 10 Hz), low electric field strength (<30 mV/m) and low magnetic field strengths (<7,400 nT) emissions. The towed package comprises one streamer. During the survey, approximately 70 receivers will be deployed on the seafloor, each weighted by compacted sand anchors that will remain on the seafloor after the receiver packages are retrieved at the end of the survey. These compacted sand anchors will deteriorate on the seafloor within approximately one year.

Mitigation has been proposed to reduce potential adverse effects on Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk, Sensitive Areas, and Fisheries and Other Ocean Users. Key mitigation to reduce effects on marine wildlife includes: ramp-up and shutdown procedures for the CSEM source; use of a seabird and marine mammal observer on board to record shark, marine mammal and sea turtle observations and oversee ramp up procedures; and routine checks for stranded birds in accordance with Canadian Wildlife Service procedures. Planning of the survey will be conducted in cooperation with fisheries stakeholders and a fisheries liaison officer will be on board the survey vessel to facilitate communication and provide advice and coordination in regard to avoiding fishing vessels and gear.

With the implementation of the proposed mitigation and in consideration of the nature of the program and short survey period, 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.

Abbreviations

3D	three-dimensional
AC	alternating current
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CIS	Canadian Ice Service
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
CNSOPB	Canada-Nova Scotia Offshore Petroleum Board
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSEM	controlled source electromagnetic
CWS	Canadian Wildlife Service
DC	direct current
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DP	dynamic positioning
EA	environmental assessment
EBSA	Ecologically and Biologically Significant Area
ECSAS	Eastern Canadian Seabirds at Sea
EL	Exploration Licence
EM	electromagnetic
EMF	electromagnetic field
EMGS	Electromagnetic Geoservices Canada, Inc.
FFAW-Unifor	Fish, Food and Allied Workers Union
FGI	Fugro GeoSurveys Inc
FLO	Fisheries Liaison Officer
FSC	food, social and ceremonial
GSL-LOMA	Gulf of St. Lawrence-Large Ocean Management Area
HF	high-frequency
IBA	Important Bird Area
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IMO	International Maritime Organization
LAA	Local Assessment Area
LF	low-frequency
MARLANT	Maritime Forces Atlantic
MARPOL	International Convention for the Prevention of Pollution from Ships
MBCA	*Migratory Birds Convention Act*
MCTS	Marine Communications and Traffic Services
MF	mid-frequency

MMSA	Marine Mammal Significant Area
MPA	Marine Protected Area
MSC	Meteorological Service of Canada
NAFO	Northwest Atlantic Fisheries Organization
NOAA	National Oceanic and Atmospheric Administration
OCI	Ocean Choice International
OSRP	Oil Spill Response Plan
PGT	Programmable Generic Transponder
PIROP	Programme intégré de recherches sur les oiseaux pélagiques
PTS	permanent threshold shift
QHSSE	Quality, Health, Safety, Security and Environment
RAA	Regional Assessment Area
RMS	root-mean-square
SARA	*Species at Risk Act*
SEA	Strategic Environmental Assessment
SEL	sound exposure level
SMMO	seabird and marine mammal observer
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	sound pressure level
SPOC	single point of contact
VC	Valued Component

Units of Measure

°C	degrees Celsius
cm	centimetre
dB	decibel
hr	hour
Hz	Hertz
kg	kiligram
kHz	kiloHertz
km	kilometre
km^2	square kilometre
km^3	cubic kilometre
km/h	kilometre per hour
m	metre
µPa	micropascal
µV	micro volt
mm	millimetre
m/s	metres per second
mV/m	millivolt per metre
nT	nano Tesla
nV/cm	nanovolt per centimetre
nV/m	nanovolt per metre
psu	practical salinity unit
s	second

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

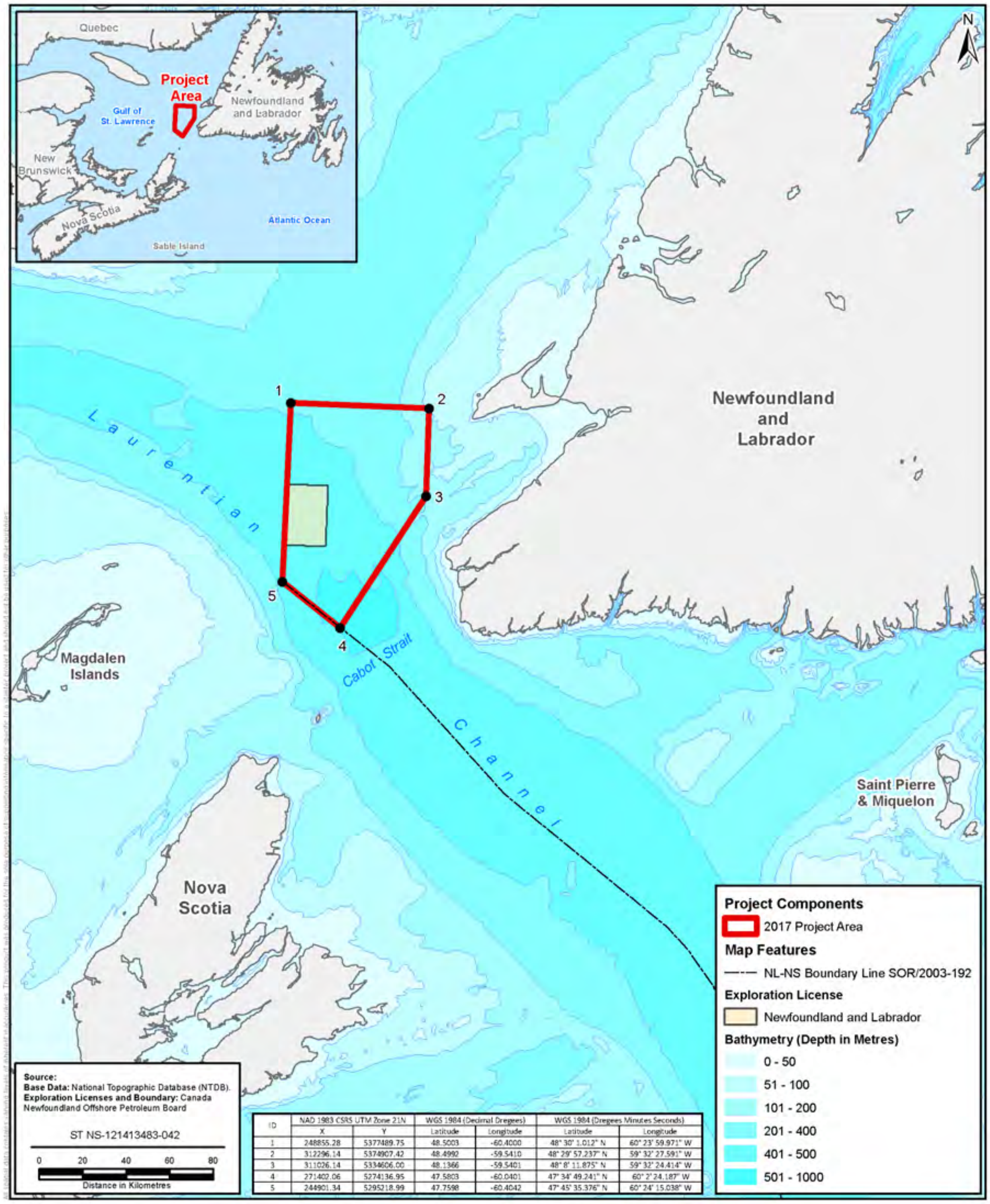
Electromagnetic Geoservices Canada, Inc. (EMGS) is proposing to conduct a controlled source electromagnetic (CSEM) survey (Western Newfoundland CSEM Survey 2017; the Project). The Project is proposed for the western offshore waters of insular Newfoundland (refer to Figure 1.1). CSEM survey data are often used supplemental to seismic data to discriminate petroleum from water, thereby increasing the drilling success rates and reducing the environmental footprint of exploratory programs. The primary objective of the Project is therefore to acquire data to assess the presence of geological structures suitable for the containment and accumulation of hydrocarbons and to determine potential hydrocarbon sources within the Project Area. Exploration drilling is not included in the scope of this Project. The proposed survey is expected to take 5 to 15 days (allowing for weather downtime, most likely less than 10 days) and would be conducted between August and December 2017, pending regulatory approvals.

This document is intended to fulfill requirements for an environmental assessment (EA) in accordance with the requirements of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and the Canada-*Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the Accord Acts). This EA has been prepared in accordance with the Electromagnetic Geoservices Canada, Inc. Controlled Source Electromagnetic Survey, 2017 Western Newfoundland Scoping Document (Scoping Document; C-NLOPB 2016) (Appendix A).

1.2 REGULATORY FRAMEWORK

In accordance with the Accord Acts, marine CSEM surveys require a Geophysical Program Authorization (Electromagnetic Program Authorization) from the C-NLOPB. The application for this authorization requires, among other things, an EA of the proposed program. Marine CSEM surveys are not included on the “Regulations Designating Physical Activities” list under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). As a result, it does not require an EA under CEAA 2012. The EA process is therefore conducted as part of the Geophysical Program Authorization led by the C-NLOPB.

The *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2017) provide information on the application and approval process for a Geophysical Program Authorization.



ID	NAD 1983 CSRS UTM Zone 21N		WGS 1984 (Decimal Dregees)		WGS 1984 (Dregees Minutes Seconds)	
	X	Y	Latitude	Longitude	Latitude	Longitude
1	248855.28	5377489.75	48.5003	-60.4000	48° 30' 1.012" N	60° 23' 59.971" W
2	312296.14	5374907.42	48.4992	-59.5410	48° 29' 57.237" N	59° 32' 27.591" W
3	311026.14	5334606.00	48.1366	-59.5401	48° 8' 11.875" N	59° 32' 24.414" W
4	271402.06	5274136.95	47.5803	-60.0401	47° 34' 49.241" N	60° 2' 24.187" W
5	244901.34	5295218.99	47.7598	-60.4042	47° 45' 35.376" N	60° 24' 15.038" W

Figure 1.1 Proposed Controlled Source Electromagnetic Survey Project Area

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

- *Species at Risk Act* (SARA)
- *Oceans Act*
- *Fisheries Act*
- *Navigation Protection Act*
- *Canada Shipping Act, 2001*
- *Migratory Birds Convention Act, 1994* (MBCA).

1.3 PROPONENT INFORMATION

EMGS is the global market leader in the CSEM industry, with more than 700 surveys conducted in frontier and mature basins across the world, from the Arctic to Australia, in water depths ranging from 30 to 3500 m. The company's primary business is focused towards the use of resistivity data as a direct hydrocarbon indicator.

EMGS currently operates a fleet of two dedicated 3D electromagnetic survey vessels: the M/V *Atlantic Guardian* and S/V *BOA Thalassa,* with extensive experience across the world's mature and frontier offshore basins. EMGS vessels have operated in Newfoundland waters on numerous projects in the past and are also currently involved in an ongoing East Canada project for the eastern offshore region of Newfoundland.

For the purpose of this application, all communications regarding the EA for this Project should be sent to the following:

Operations Manager EMGS ASA
Atle Johan Bull Lund
Stiklestadvn 1
7041 Trondheim
Norway
Cell phone: +47 916 42 636
Email: al@emgs.com

1.4 EMGS QUALITY, HEALTH, SAFETY, SECURITY AND ENVIRONMENT POLICY

EMGS's Quality, Health, Safety, Security and Environment (QHSSE) Policy provides the guiding principles for EMGS QHSSE culture regarding the protection of life, health and the environment while delivering goods and services of the highest quality.

It is the EMGS policy, to demonstrate, build and perpetuate a strong QHSSE culture based on:

COMPLIANCE – An organisation that is in full compliance with all applicable laws and regulations where we conduct our business and enforces more stringent requirements when these do not meet EMGS's minimum criteria.

LEADERSHIP – An organisation whose Line Management has the responsibility for ensuring that priority is given to Quality, Health, Safety, Security and Environment in all parts of our business. We are committed to building a culture that promotes safe behaviour and where employees understand their RIGHT and OBLIGATION to stop unsafe work.

IMPLEMENTATION – An organisation that sets the protection of people first, by systematically identifying and implementing measures to reduce risks to a level as low as reasonably practicable.

CONTINUOUS IMPROVEMENT – An organisation that reports, monitors, learns and acts proactively on incidents and non-conformities and sets itself ambitious QHSSE objectives. An organisation that demonstrates innovation through continuously looking for new and safer ways to deliver our products to the industry.

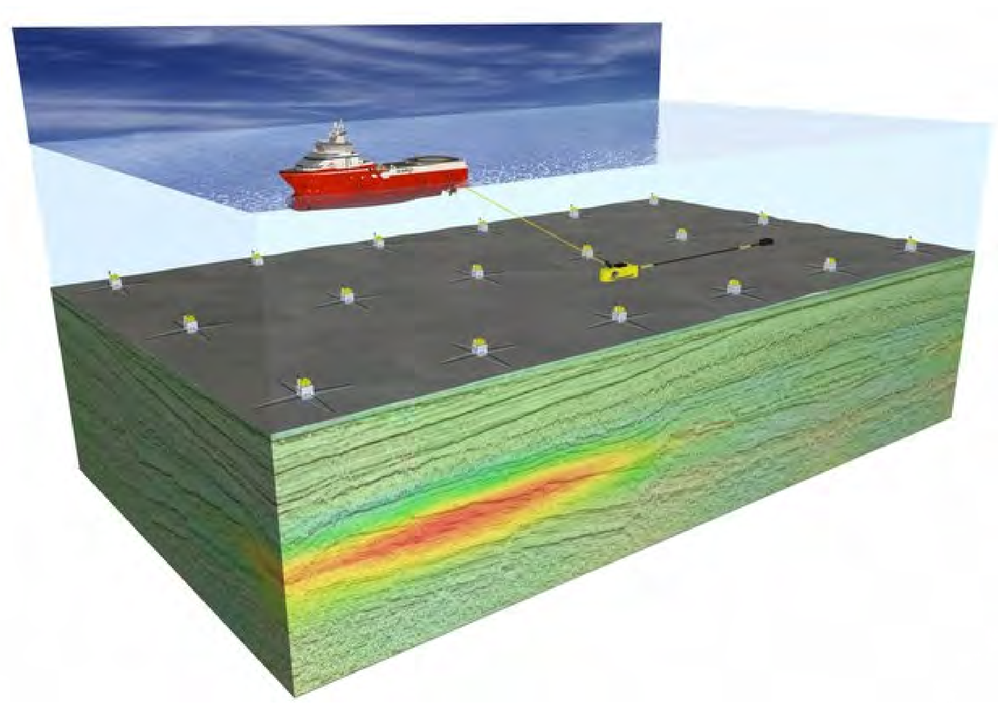
OPENNESS AND INTEGRITY – An organisation that works in a transparent and honest dialog with its stakeholders and the environment in which it operates.

HAPPINESS – An organisation that invests in job satisfaction and a good working environment.

2.0 PROJECT DESCRIPTION

EMGS is proposing to conduct a CSEM survey in Western Newfoundland offshore waters. The program will be very similar to the ongoing East Canada CSEM survey initiated by EMGS in the eastern offshore region of Newfoundland in 2014, although on a much smaller temporal and spatial scale. Pending regulatory approvals, the Western Newfoundland CSEM survey is expected to occur over 5 to 15 days (allowing for weather downtime, most likely less than 10 days) during the period of August to November 2017.

The CSEM survey will be conducted along pre-plotted lines, as per C-NLOPB *Geophysical, Geological, Environmental and Geotechnical Program Guidelines.* Final survey location maps will be submitted to the C-NLOPB four to six weeks prior to acquisition start-up. Prior to conducting the survey, an array of receivers will be placed on the seabed approximately 1 to 3 km apart. Once the receiver array is set up, an electromagnetic (EM) source is deployed and towed behind a survey vessel, approximately 30 m above the seabed. The electromagnetic signal propagates through the subsurface of the seabed and is recorded by the receivers. A typical CSEM survey is illustrated in Figure 2.1.



Source: EMGS 2016

Figure 2.1 Typical CSEM survey with Survey Vessel, Receiver Grid, and CSEM Source

The data are used to infer subsurface resistivity and are often used to supplement seismic data to discriminate petroleum from water (since water and hydrocarbons have differing resistivity), thereby allowing likely reservoirs to be identified more efficiently, reducing the environmental footprint of exploratory programs.

2.1 PROJECT LOCATION

The Project Area is 5,140 km^2 located off the western coast of Newfoundland in water depths of approximately 50 to 550 m. The actual survey area will likely be smaller than the Project Area shown on Figure 1.1 and focus on water depths of approximately 400 to 500 m. A larger Project Area has been defined to provide a more conservative estimate of the Project footprint to encompass all gear deployment and vessel turns while towing. The "corner" coordinates (Decimal degrees, WGS84 projection) of the Project Area are provided in Table 2.1 and on Figure 1.1.

Table 2.1 Proposed Project Area Corner Coordinates

Project Area	
NAD_1983_CSRS_UTM_Zone_21N	
X	Y
248855.3	5377489.8
312296.1	5374907.4
311026.1	5334606.0
271402.1	5274136.9
244901.3	5295219.0

Refer to Section 4.2 and Figure 4.1 for delineation of relevant study area boundaries which consider a buffer zone around the Project Area and beyond to account for potential Project-related and cumulative environmental effects.

2.2 PROJECT COMPONENTS AND ACTIVITIES

The Project will consist of the following primary components:

- survey vessel to conduct the CSEM survey
- a CSEM source
- a number of CSEM receivers.

2.2.1 Survey Vessel Operation

The survey will be conducted using one of EMGS's four exploration vessels. These vessels are not substantially different than offshore supply vessels used on the east coast of Newfoundland. The vessel will have an onboard technical crew from EMGS in addition to the ship's crew. The total crew is expected to consist of 35 to 50 persons on board. The vessel will travel approximately 22 to 24 km/hr (12 to 13 knots) on average while transiting between the survey area and an existing shorebase likely to be located in St. John's, Newfoundland. During the survey, the vessel will travel with an average speed of approximately 4 to 5.5 km/hr (2 to 3 knots). The survey vessel will use dynamic positioning (DP) to hold on station during the deployment and retrieval of the CSEM receivers.

Personnel on the survey vessel include ship's officers and marine crew as well as technical and scientific personnel. The survey vessel will also have a Fisheries Liaison Officer (FLO) and a seabird and marine mammal observer (SMMO) onboard. All Project personnel will have all the required certification as specified by the relevant Canadian legislation and the C-NLOPB.

The survey vessel will comply with applicable regulations under the *Canada Shipping Act, 2001* and applicable International Maritime Organization (IMO) standards. In addition, survey operations will comply with provisions under the Maritime Occupational Health Regulations pursuant to Part II of the Canada Labour Code. The vessel will generate underwater noise, light and air emissions, and waste discharges (refer to Section 2.5 for a discussion of waste discharges and emissions).

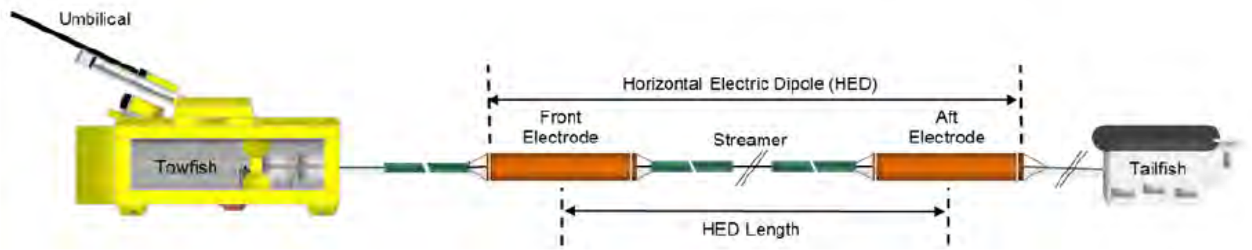
2.2.2 CSEM Source Operation

A CSEM survey uses a frequency-domain EM approach, in which an oscillating current of constant low frequency is generated in a transmitter towed above the seafloor. The oscillating current sets up an oscillating magnetic field at the same frequency (Buchanan *et al.* 2011). This primary EM field (EMF) penetrates the seafloor and creates a secondary electric current and magnetic field via the process of induction. The secondary magnetic field has the same frequency as the primary field, but poses a difference in phase as a result of the properties of the underlying rock. The primary and secondary fields are detected by the surface receivers, which are then used to develop a resistivity profile of the surveyed area (Buchanan *et al.* 2011).

The source system is designed to meet CSEM requirements with respect to performance, physical dimensions, and safety when handling the system. The CSEM source consists of a power supply and control unit (1,250 amp peak output at low frequencies ranging from 0.05 to 10 Hz) at the transmitter mounted on a towed subsea-frame (towfish) with a horizontal electric dipole streamer connected to the towfish.

The topside unit controls the power to generate the predefined EM signal at the electric dipole. The power is transformed to high voltage/low current and transferred via umbilical to the subsea system. The power is transformed back to low voltage/high current at the subsea system. 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.

The general subsea configuration of the CSEM source is illustrated in Figure 2.2. 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 carry additional survey and navigational equipment.



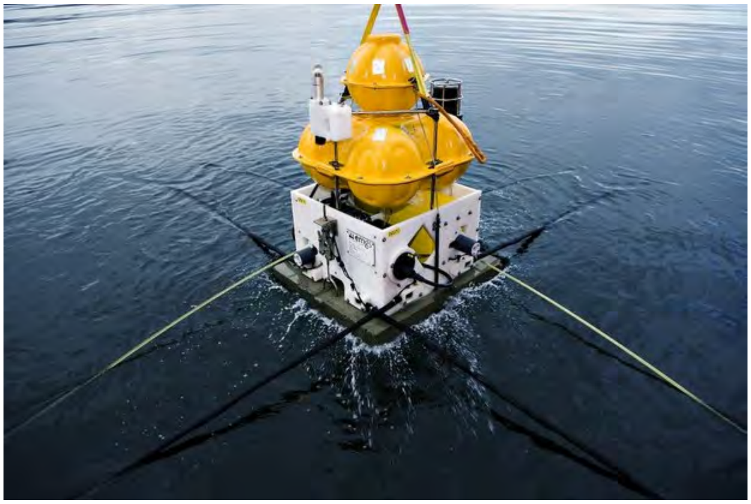
Source: EMGS 2016

Figure 2.2 Schematic Drawing of the CSEM Source

The CSEM streamer (Figure 2.2) consists of tow and conductor cables (approximately 600 m long) and a floatation section which uses thermoplastic rubber (TPR) instead of Isopar M fluid for flotation. The 300 to 500 m long flotation section consists of 5 to 30 buoyancy tubes made of TPR that are braided together. The total length of the tow package is approximately 1 km. Compared to a typical 3D seismic survey, a CSEM towed system consists of only one streamer and it is much shorter in tow length. As such, a CSEM survey occupies relatively little "sea-space" and other vessels can pass safely as close as 1 km astern.

2.2.3 CSEM Receiver Deployment and Retrieval

During the survey, CSEM seabed nodes (receivers) are deployed on the seabed in a grid layout. It is anticipated that a maximum of 70 receivers would be used in the survey. The general composition of the node consists of a data acquisition unit, electrical and magnetic sensors, and a positioning transponder, all attached to compacted sand anchor (920 mm x 810 mm x 102 mm) in order to provide negative buoyancy during deployment and stability while on the seafloor; the anchors remain on the seafloor after receiver retrieval (Figure 2.3). The positioning transponders, also known as Programmable Generic Transponder (PGT), are used on both the towed source and receivers to position them in the water column.



Source: EMGS 2016

Figure 2.3 CSEM Receiver Package

The PGT attached to the receiver has a mechanical release function built into it. This is the primary method of release used to detach the receiver from the compacted sand anchor. By sending an acoustic command from the vessel, a mechanical thread is activated on the PGT which unwinds and releases the anchor wire attached to the receiver. Once fully detached, the positive buoyancy provided by the receiver floats lift the unit upward and it ascends to the surface. The PGT is also equipped with a secondary release system in the form of a burn wire. In the unlikely situation that the primary release fails, the burn wire release will be activated and effectively severs the anchor wire via electric current, allowing the receiver to ascend to the surface once fully detached. The compacted sand anchors that remain behind contain no ingredients harmful to the marine environment. Components include rapid hardening Portland cement, free water, limestone filler, anhydrite, sand (both 0 to 8 mm and 0 to 4 mm) and crushed stone (8 to 16 mm). These anchors are expected to deteriorate on the sea floor within approximately one year after submersion in seawater (Justnes and Johansen 2004).

The PGTs also provide real-time positioning information from the two vessel-mounted Ultra Short Base Line systems. EMGS vessels use two independent Ultra Short Base Line systems (Sonardyne and Kongsberg) for redundancy. Acoustic signals are sent to the PGT from the vessel, which in turn sends a reply signal, enabling its position to be calculated. In this manner, the receiver can be tracked during its descent, its final seabed position, and also throughout its ascent back to the surface.

2.3 LOGISTICAL SUPPORT

Due to the short CSEM survey duration anticipated to take 5 to 15 days (allowing for weather downtime, most likely less than 10 days), it is not likely that support vessels will be required for crew changes. The survey vessel will be equipped with a helicopter deck, although it is not intended that helicopters will be used for this Project. Logistics will likely be coordinated in St. John's. No new shorebase facilities will be established as part of the Project.

2.4 PROJECT SCHEDULE

The CSEM survey is expected to occur in 2017. The estimated duration of the proposed survey is 5 to 15 days (allowing for weather downtime, most likely less than 10 days). Although the Project schedule has not been finalized, the survey is anticipated to occur between August and December 2017. The timing of the survey is subject to EMGS's client priorities and circumstances, weather conditions, contractor availability, and regulatory approvals.

2.5 DISCHARGES AND EMISSIONS

2.5.1 Waste Discharges

Waste discharges associated with the Project will be managed in compliance with the International Convention for the Prevention of Pollution from Ships (MARPOL) of which Canada has incorporated provisions under various sections of the *Canada Shipping Act* and its regulations. All offshore waste that is to be disposed of on land will be kept on board and disposed of to comply with any applicable federal, provincial, and municipal by-laws. Sanitary and food wastes will be macerated to a particle size of 6 mm or less prior to discharge at sea. Organic matter will be dispersed and mixed by wave activity and ocean currents and degraded by bacterial communities. Sanitary and food waste disposed of into the marine environment has the potential to attract birds, fish, and other marine predators. The effects from this activity are expected to be negligible given the transitory nature of the survey vessel, the low volume of discharge over a relatively short period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), compliance with regulatory requirements, and rapid dilution into the marine environment.

2.5.2 Electromagnetic Emissions

The CSEM survey will generate EM fields (EMF) in the marine environment. A comprehensive description of EMF generated by CSEM operations and potential environmental effects are presented in the Environmental Assessment for the East Canada CSEM Survey 2014-2018 (LGL 2014) as well as Buchanan *et al.* (2011). A brief overview of the basics of electromagnetics are discussed below, with a more thorough discussion of their biological implications discussed in Section 6.

EMFs are generated by anything that carries or produces electricity. The EMF consists of an electric field component (E) and a magnetic field component (B), which travel together in space at the speed of light (Buchanan *et al.* 2011). The unit of measurement often used for magnetic fields is the nano Telsa (nT) and electrical fields is the micro volt (µV/m) (Buchanan *et al.* 2011). An EM wave is characterized by frequency (Hz) and wavelength (distance traveled by the wave in one cycle). EM technology uses extremely low frequencies, which are defined as those that are less than 300 Hz. The frequency of EM waves determines the energy content that they possess (Buchanan *et al.* 2011). Low-frequency EMFs carry very low levels of energy compared to high-frequency waves such as gamma rays released by x-rays.

Buchanan *et al.* (2011) (refer to Section 3 of reference) provides a comprehensive description of electromagnetics and how the concept of electrical induction is a key element in understanding how EM emissions could potentially affect marine fauna. As defined by Faraday's Law, an electrical current is generated, or induced in any conductor (*e.g.*, animal) moving through a magnetic field. Magnetic fields have polarity (north/south poles) and the direction of current flow within a conductor is a function of the direction in which the conductor is moving relative to the north-south orientation of the magnetic field. If a conductor moves in one direction, direct current (DC) will be created and will flow in one direction. If a conductor moves back and forth within a magnetic field, the current will flow in opposite or alternate directions, creating an alternating current (AC). Electrical induction is dependent upon movement (*i.e.*, a conductor must move within a magnetic field, or a magnetic field must move past a conductor). If both are motionless, no current is induced (Buchanan *et al.* 2011).

Biological organisms generate internal voltage gradients and electrical currents that are associated with various biological functions including the nervous system, digestion, brain functions, sensory mechanisms, reproductive processes, and membrane integrity and are therefore electrical conductors (Buchanan *et al.* 2011).

An understanding of the Earth's magnetic field is also essential for assessing the potential effects of EMF on marine life. The Earth generates natural geomagnetic fields ranging in the order of 60,000 nano Tesla (nT) near the magnetic poles, to 40,000 to 50,000 nT at mid latitudes, and 30,000 nT at the geomagnetic equator (Buchanan *et al.* 2011). Geomagnetic anomalies affecting intensity of the geomagnetic field can be caused by high concentrations of magnetized rock, plate tectonics in the oceans, solar radiation, and lightning strikes (Buchanan *et al.* 2011). It is widely theorized that the Earth's geomagnetic field is an important navigation aid for animals, although the extent to which it is used and mechanisms by which it may be implemented remain uncertain (Buchanan *et al.* 2011). It has also been theorized that natural and/or anthropogenic interruptions in this field could potentially have adverse effects on fauna by impeding their navigational abilities (Buchanan *et al.* 2011).

CSEM sources, similar to that proposed for this Project, emit extremely low frequencies (0.05 to 10 Hz), low electric field strengths (<30 mV/m) (<300,000 nV/cm), and low magnetic field strengths (<7,400 nT). As a matter of reference, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which has issued guidelines for human exposure to static and time-varying extremely low frequency magnetic fields (ICNIRP 2009, 2010), sets the exposure limit for humans at 200,000,000 nT at 1 Hz. As another point of reference, geomagnetic storms are generally in the range of 120 to 200 nT and may last 24 to 48 hours (Buchanan *et al.* 2011). The ICNIRP also provides guidelines for time-varying electrical fields with a threshold of 10,000,000 mV/m to elicit a behavioural response in humans (ICNIRP 2009, 2010).

Buchanan *et al.* (2011) establishes generic thresholds of effects for magnetic and electric fields generated by EM surveys to be 200 nT and 386 nV/cm, respectively. These effect thresholds are meant to represent an elicited response of some type with no negative or positive implications and were based on more sensitive groups of animals (*e.g.*, elasmobranchs), recognizing many animals may have no reactions to these values and some animals may be able to detect fields below these values. These thresholds were also adopted by LGL (2014) in the EA for the East Canada CSEM Survey 2014-2018.

EMFs dissipate rapidly from the source with the signal strength dissipating in proportion to r^2 (r is the distance to the source). This is opposite to seismic energy which dissipates according to the wave equation, where energy dissipates according to r. EM energy therefore dissipates very rapidly as compared to seismic energy, resulting in more localized effects. For deep-tow EM surveys (*e.g.*, at depths of 1,000 m or greater), most cetaceans, turtles, pinnipeds, and seabirds would be effectively insulated from EM transmissions. However, for surveys in waters shallower than 700-800 m, Buchanan *et al.* (2011) calculate that field strengths in excess of 200 nT could start to penetrate the upper part of the water column, but dropping below 200 nT at or beyond 400 m radial distance from the source. The effects of EMFs on navigation by marine organisms are discussed in Sections 6.2 and 6.3.

2.5.3 Noise Emissions

Underwater noise will be generated by survey vessel operation, including noise from the operation of the vessel engine while steaming to/from the site and towing the survey gear, and use of the DP system.

Underwater noise includes pulsed sounds (*e.g.*, seismic sound) and continuous sounds (*e.g.*, ship noise). Sound can be described using a variety of metrics, the most common ones being sound pressure levels (SPLs) and sound exposure levels (SELs). SPLs can further be measured by either their root-mean-square (RMS) pressure (Richardson *et al.* 1995), which indicates the average SPL over a given amount of time, or by their peak, or maximum pressure (wave amplitude) (Southall *et al.* 2007). Sound level (magnitude) is typically measured on the decibel (dB) scale, with RMS SPLs denoted by dB_{RMS} and peak SPLs denoted by $dB_{0\text{-}p}$. The decibel scale is a logarithmic ratio scale of intensity, and is relative and therefore only meaningful if a reference level is included. In underwater acoustics, a reference pressure of 1 μPa is commonly used to describe SPLs

(Richardson *et al.* 1995). Unlike SPLs, SELs are a measure of the total energy of an acoustic event, and are presented in dB re 1 μPa²s. SELs can also be measured cumulatively, measuring the total noise energy to which an animal is exposed (Southall *et al.* 2007). Cumulative SELs (SEL_{cum})capture the overall sound levels experienced by sound receivers, factoring in all sound pressure levels experienced, and the duration over each level (Southall *et al.* 2007).

Terms referred to in underwater acoustics include both source and received levels. The source level usually represents the SPL at a distance of 1 m from the source, referenced to 1 μPa. Received levels are usually measured at the receiver's position and back-calculated to determine the SPL at 1 m (*e.g.,* 200 dB re 1μPa @ 1m), or predicted through modelling based on the source level and distance to the receiver. The frequency of sound waves is measured in Hz, which is representative of the number of vibrations per second. Sound has to be within a marine animal's hearing range to be audible.

Survey vessels can be characterized as a continuous noise source in the marine environment. The vessels involved in offshore oil and gas operations span a wide range of sizes and power ratings, resulting in a range of emitted underwater noise. The vessel used for the CSEM survey will be in the range of 80 to 115 m in length (EMGS 2016). Vessel noise is mainly attributed to propeller cavitation, propeller singing, and mechanical vibration transferred through the ship's hull. While positioning to deploy and retrieve receivers, the ship will employ its DP system, which employs the use of bow and stern thrusters to remain on station. During transit and when using DP, the ship will be using propellers to either travel or remain on station. In general, larger vessels are associated with greater noise levels at lower frequencies. SPLs produced by the operating survey vessel is expected to be at a peak frequency of 1 to 500 Hz, with SPLs in the range of 170 to 180 dB_{RMS} re 1 μPa @ 1 m.

2.5.4 Light Emissions

Artificial lighting will be used to illuminate the vessel at night during travel to and from the survey site as well as during survey operations. However, deck lighting will be reduced to the extent that worker safety is not compromised.

2.5.5 Air Emissions

Air emissions will be those associated with standard operations for marine vessels, including the CSEM vessel and a potential picket/supply vessel (although not likely required for this Project).

3.0 CONSULTATION AND ENGAGEMENT

The following stakeholders were contacted by EMGS in April 2017 during the preparation of the EA Report with a brief introduction to the project:

- Fish, Food and Allied Workers Union (FFAW-Unifor)
- Ocean Choice International (OCI)
- One Ocean
- Groundfish Enterprise Allocation Council
- Association of Seafood Producers (ASP)
- Save our Seas and Shores
- St. Lawrence Coalition

A presentation was made to OCI on April 28, 2017, and the FFAW-Unifor and One Ocean on April 29, 2017. The presentation was provided to OCI, who distributed it to the Groundfish Enterprise Allocation Council and the Canadian Association of Prawn Producers. ASP indicated that an in-person meeting was not necessary. The presentation was provided to ASP and One Ocean. Letters were emailed to Save Our Seas and Shores and the St. Lawrence Coalition with the offer to contact the undersigned with any comments; no response/acknowledgement was received from either organization.

OCI was interested in the composition of the anchors, the protocol for notifying fishers of a lost receiver (which happens in approximately 1 in 1,000 deployments) and sound generated by the acoustic release of the receivers during retrieval. OCI indicated that there will be no interaction with the offshore fleet during this Project. EMGS provided PDF of presentation to OCI, who will send to Canadian Association of Petroleum Producers and Groundfish Enterprises Allocation Council (who will distribute to other groundfish users).

FFAW-Unifor stressed the need for a Fisheries Liaison Officer (FLO), who, in the past, has usually been drawn from their membership. FFAW-Unifor indicated that there will likely be no interaction with their members during this Project. Once the EA is submitted, FFAW-Unifor will confer with the West Coast members on any potential conflicts. FFAW-Unifor indicated that while there is a west coast fishery in September/October, there is limited activity in the Project Area.

ASP was provided with a copy of the presentation and contacted several times (by phone and email) to set up a meeting to go through the presentation. Scheduling conflicts prevented a meeting; no comments have been received from ASP on the presentation. One Ocean also received a copy of the presentation and indicated they had no questions about the program.

Both OCI and FFAW-Unifor indicated that they have seen an increase in redfish and other groundfish (such as greysole and cod) in the Gulf of St. Lawrence. FFAW-Unifor also indicated there has been an increase in haddock (harvested by longline).

Questions and comments from consultations and where they are addressed in the EA are provided in Table 3.1.

Table 3.1 Comments Raised during Consultations

Comment	Response
General	
Do you need to go through the Canada-Nova Scotia Offshore Petroleum Board process as well?	No, as the survey grid remains on the NL side, just need to adhere to the Canada-Newfoundland and Labrador Offshore Petroleum Board process.
Receiver Deployment/Retrieval	
Are the receivers equipped with a GPS?	No, but the acoustic anchor release acts in the same fashion.
With no GPS how do you account for drift during deployment?	The first receiver deployed basically sets the alignment of the receivers that follow.
How close to target position does the anchor/ receiver need to be?	The goal is to position a receiver within 200 m from a pre-defined target position. Larger allowance can be accepted depending on survey layout. Actual location of receiver is recorded with a high accuracy.
How loud is the acoustic signal of the anchor release? Could there be a “wave” of retrieval	Retrieval of the 74 (or less) receivers will take place over a three-day period, so there will a sound generated during the release approximately once per hour. The receivers themselves are low-noise and the source generates low frequencies ranging from 0.05 to 10.00 Hz.
If an anchor does not settle in the proper location, do you retrieve and replace	No, just set the second receiver to set the second for the remainder of the grid and retrieve both at the end of the survey.
Do you receive data as the survey progresses?	QA/QC data with respect to towing depth, *etc.*, but not EM data. That is processed from retrieved receivers. No real-time monitoring of receivers except tracking during ascent and descent.
Does the source stay at depth due to towing speed?	No, the source (towfish and tailfish) has neutral buoyancy and is water depth-dependent; it is towed 30 m above the seabed. The source is towed approximately 450 m behind the vessel at 500 m water depth (due to 40° angle) and the source itself is 340 m in length.
Receiver Loss	
How often are receivers lost? How are they recovered?	Approximately 1 in 1,000 deployments, through loss of ability to detach from the anchor. Deterioration of the anchor will eventually release the receiver, which will float to the surface. The receiver has a placard with information if found.
If a receiver is lost, is notification of the position provided (*e.g.*, Notice to Shipping (NOTSHIP))	Yes, location is made public to mariners.
Is it possible that the receivers will be caught up in trawls?(question from EMGS)	FFAW-Unifor vessels do not trawl.
Anchor	
How big is the anchor?	The anchor is 170 kg, as is the receiver. The anchor is 1 m x 1 m x 0.1 m, made of patented soluble cement, which dissolves to

Table 3.1 Comments Raised during Consultations

Comment	Response
	reduce the concrete to disaggregated sand. The anchor deteriorates within 6 to 12 months (it deteriorates faster in colder water)
Is the anchor recovered? The video seems to indicate that it is	No, the anchor is left in place and eventually deteriorates. The retrieved receiver is immediately placed on a new anchor for redeployment.
Fisheries Liaison Officer (FLO)	
While there may be only minimal amount of fishing in the Project Area, it is recommended that you use an FLO	It is EMGS's intention to use an FLO. They have contracted a local crewing company to provide logistics for the NL programs, including hire of FLO. While not explicitly stated, it is expected that the FLO would be an FFAW-Unifor member.
Would there be a separate FLOs for the east coast and west coast surveys?	Unlikely given the time frame (approximately 1.5 months for the east coast survey and 10 days for the west coast survey (not including weather down time)), unless EMGS has a crew change between the programs.
When will you know if the survey is proceeding? Need to be able to slot FLO (and SMMO if required) into schedule?	Will probably know by June. A local crewing company will be responsible for hiring FLO.
East coast survey is likely to happen in August/September 22, and west coast survey after that (comment from EMGS)	Most FFAW-Unifor fishers will be available at that time to act as an FLO.
Survey Details	
Where is the Project Area?	The Project Area is primarily over Exploration Licence 1153 ("Old Harry").
Is there much movement when towing the source?	No, use vessel to stay within the grid line. Not much tailfishing; and the solid streamer that is now used provides a more stable tow line. OCI noted there was a 0.5 knot (0.3 m/s) current in the area.
How long will the survey last?	Approximately 10 days (1.5 to 2 days receiver deployment, 3 days survey, 3 days receiver retrieval). Weather down-time could extend this timeframe by a few days.
Will the survey be conducted this year?	Not 100% yes, but things are lining up that indicates that the survey will be conducted this year. However, the west coast survey will only be conducted if the east coast survey goes ahead. Currently planned for last week September/first week October.
Survey is currently planned for last week September/first week October. Will there be any conflict with fishing activity?	OCI's offshore fleet will be fishing east and north, so no interaction with project. FFAW-Unifor indicated that there will likely be no interaction with their members during this Project. FFAW-Unifor indicated that while there is a west coast fishery in September/October, there is limited activity in the Project Area.

4.0 ENVIRONMENTAL EFFECTS ASSESSMENT SCOPE AND METHODOLOGY

4.1 OVERVIEW AND APPROACH

The methodology used to conduct the EA for the Project is based on a structured approach used by Stantec for EAs of projects of similar scope. The assessment methodology is structured to:

- focus on issues of greatest concern
- consider key issues raised by Aboriginal peoples, stakeholders, and the public
- integrate design and programs for mitigation and follow-up into a comprehensive environmental planning process.

This methodology is concentrated on the identification and assessment of potential adverse environmental effects of the Project on Valued Components (VCs). VCs are environmental attributes associated with the Project that are of particular value or interest because they have been identified to be of concern to Aboriginal peoples, regulatory agencies, resource managers, scientists, key stakeholders, and/or the general public. It is noted that "environment" is defined to include not only ecological systems but also human, social, cultural, and economic conditions that are affected by changes in the biophysical environment.

The potential environmental effects of Project activities and components are assessed in Section 6 using a standard framework to facilitate individual assessment of each VC. Residual Project-related environmental effects (*i.e.*, those environmental effects that remain after the planned mitigation measures have been applied) are characterized for each individual VC using specific evaluation criteria (*i.e.*, magnitude, geographic extent, duration, frequency, reversibility, and context). The significance of residual Project-related environmental effects is then determined based on pre-defined standards or thresholds (*i.e.*, significance rating criteria).

The environmental effects associated with potential malfunctions and accidental events as well as the effects of the environment on the Project are considered separately in this EA document (Sections 7 and 8, respectively).

Cumulative environmental effects are assessed in Section 9 and consider whether there is potential for the residual environmental effects of the Project to interact cumulatively with the residual environmental effects of other past, present, or reasonably foreseeable physical activities in the vicinity of the Project.

Additional detail on the scoping and EA methods is provided in the following sections.

4.2 SPATIAL AND TEMPORAL BOUNDARIES

Spatial and temporal boundaries are defined by the characteristics of the Project and the VCs. These boundaries encompass those periods and areas within which the VCs are likely to interact with or be influenced by the Project. These boundaries may extend beyond the physical limits of the Project.

The Project Area (which includes the survey area) is 5,141 km^2, located off of the western coast of insular Newfoundland, and represents the potential Project footprint (includes a turning radius for vessel and gear deployment).

The Local Assessment Area (LAA) is defined by an approximately 20-km buffer around the Project Area to account for potential effects such as sound, accidental spills, or EM emissions on marine animals that may occur outside of the Project Area.

The Regional Assessment Area (RAA) is defined as the Gulf of St. Lawrence from Anticosti Island to the north, to Magdalen Islands to the west, to the Strait of Belle Isle to the east, and Port aux Basques to the south. The boundaries of the RAA were defined in recognition of biophysical features including sensitive areas in the region surrounding the Project Area and LAA and other projects and activities occurring in the region (*e.g.*, petroleum exploration licences [ELs]).

Refer to Figure 4.1 for a depiction of the Project Area, LAA and RAA.

The temporal boundaries of the proposed Project are August to December 2017. The duration of the survey is estimated to last from 5 to 15 days (allowing for weather downtime, most likely less than 10 days).

Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects, and any sensitive or critical periods of a VC's life cycle (*e.g.*, spawning, migration). More information on sensitive ecological periods is presented in Sections 5 and 6.

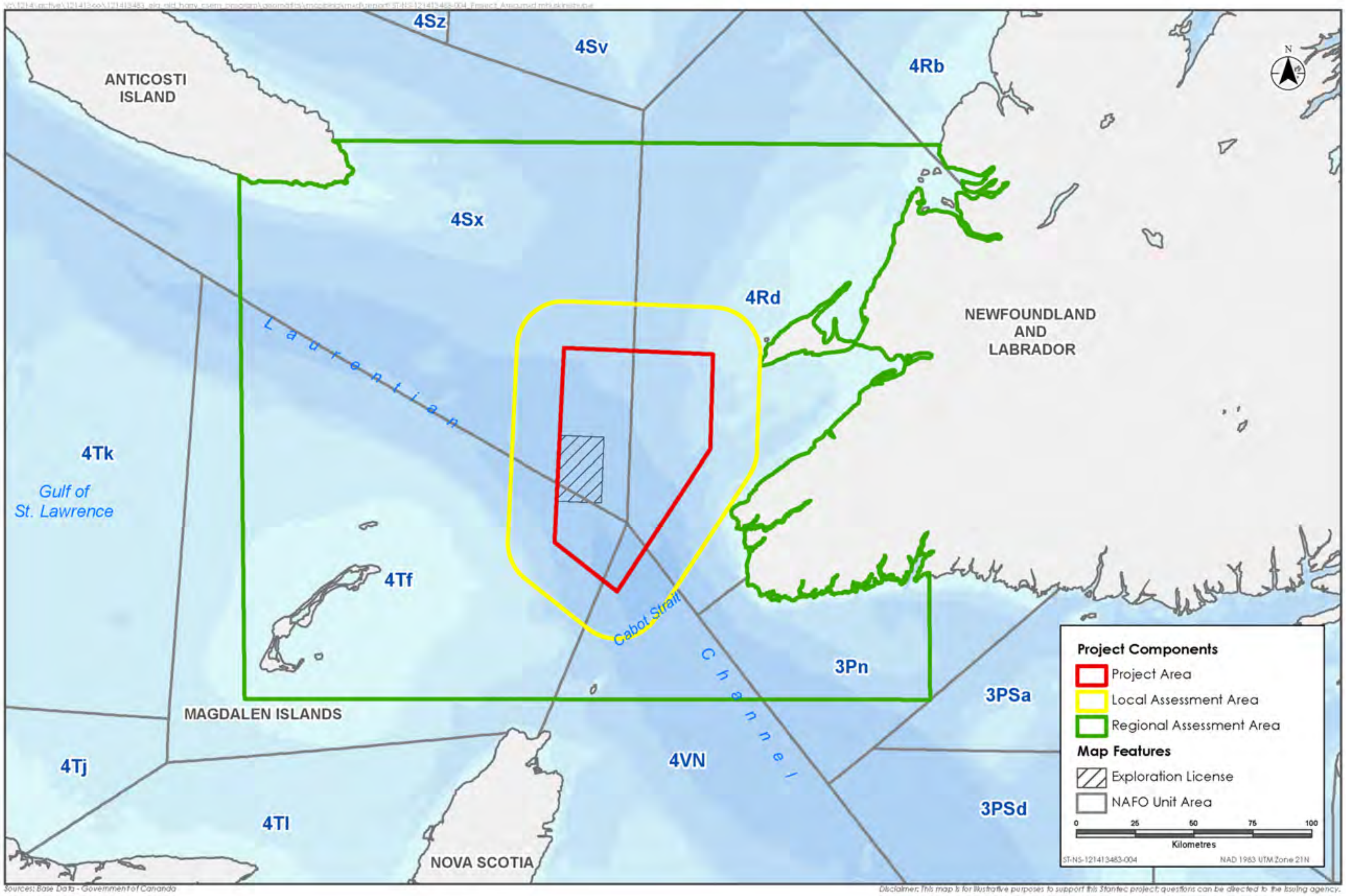


Figure 4.1 Project Area, Local Assessment Area and Regional Assessment Area

Stantec

4.3 ISSUES SCOPING AND SELECTION OF VALUED COMPONENTS

The scope of the proposed Project includes all of the Project components and activities described in Section 2 of this report. To determine the VCs for the proposed Project, an issues scoping exercise was conducted. This involved:

- review of the Scoping Document issued by C-NLOPB (refer to Appendix A)
- consultation with relevant regulatory agencies and other stakeholders
- review of available data and literature related to the existing biophysical environment in western Newfoundland, and of other environmental assessments undertaken for similar projects (*e.g.*, LGL 2014; Buchanan *et al.* 2011)
- review of the Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment (SEA) Update prepared by AMEC (2014) for the C-NLOPB and the EA for the Old Harry Prospect Exploration Drilling Program (Stantec 2013)
- review of the relevant regulations and guidelines related to seismic surveys and offshore activities
- the professional judgment of the study team.

Based on the results of the issues scoping exercise described above, the following VCs are considered in this EA document:

- Marine Fish, Shellfish and Habitat
- Marine Mammals and Sea Turtles
- Marine and/or Migratory Birds
- Species at Risk
- Sensitive Areas
- Fisheries and Other Ocean Users.

The rationale for the selection of these VCs is provided below.

Marine Fish, Shellfish, and Habitat: Marine Fish, Shellfish and Habitat were selected as a VC due to their intrinsic importance to the commercial fishery in Newfoundland and Labrador. Fish and fish habitat is an important consideration in the EA of activities that may influence the marine environment. It should be noted that this VC includes such components of fish habitat as plankton and the benthos. Fish, invertebrates (shellfish) and their habitat are assessed as a single VC as this method provides a comprehensive, ecosystem-based approach while reducing repetition.

Marine Mammals and Sea Turtles: Cetaceans (whales, dolphins, porpoises) and seals are key elements of the biological and social environments of Newfoundland and Labrador and the Gulf of St. Lawrence. Marine mammals are important predators in the marine environment. Cetaceans are highly valued for their tourism value (*i.e.*, whale watching), as well as valued aesthetically, culturally, socially, ecologically and scientifically. Historically, seals have played an important economic and cultural role in Newfoundland and Labrador due to the annual seal hunt. Sea turtles are seasonal visitors to western Newfoundland and the Gulf of St. Lawrence, where they feed on jellyfish and plankton during summer. Although they are relatively uncommon in western Newfoundland, sea turtles are considered a VC due to their declining numbers globally, and due to gaps in knowledge about the distribution and abundance of sea turtle species.

Marine and/or Migratory Birds: The coastal and offshore marine environment is used by marine and/or migratory birds throughout the year, with several bird colonies and important bird areas (IBAs) identified in the RAA. Marine and coastal birds are ecologically important, and are an important resource for tourism and recreational activities, and for scientific study. They are valued socially, culturally, economically, aesthetically, ecologically and scientifically.

Species at Risk: Species at risk, including marine fish, marine mammals, sea turtles, and marine and migratory bird species, are protected under SARA. Species at risk are considered a VC in recognition of their protected status under SARA, and to mitigate potential environmental effects this proposed Project may have on protected species and their required habitat.

Sensitive Areas: Sensitive areas were selected as a VC due to their importance as unique, special or critical habitat for various species or species assemblages, including species at risk. Sensitive areas are important socially, culturally, aesthetically, ecologically and scientifically. Several sensitive areas in western Newfoundland have been identified, though there are no legally protected areas within the Project Area. Sensitive areas include ecologically and biologically significant areas (EBSAs), areas of interest for potential designation as a marine protected area under the *Oceans Act*, important bird areas (IBAs), and other areas identified as important for fish which may be subject to fisheries closures.

Fisheries and Other Ocean Users: The commercial fishery is an important element in Newfoundland and Labrador's (and other Gulf of St. Lawrence jurisdictions) history, as well as its current socio-cultural and economic environment. The fisheries provide direct economic benefits through fishing, processing and transport of products, as well as indirect benefits to communities. Fisheries were selected as a VC because they are an integral component of the economy of Newfoundland and Labrador and other Gulf of St. Lawrence communities and an important renewable resource. This VC was also selected in recognition of Aboriginal fishing and harvesting that may occur in the RAA for commercial and/or food, social and ceremonial (FSC) purposes. Other ocean users include seal and bird hunting, recreation, tourism, commercial vessel traffic, military activities, and scientific research.

4.4 EXISTING CONDITIONS

The existing conditions in the RAA are described for the physical environment as well as for the selected VCs in Section 5. Information regarding existing biophysical and socio-economic conditions have been summarized using existing environmental reports for the western Newfoundland offshore area, including the 2013 Environmental Assessment document for the Old Harry Prospect Exploration Drilling Program (Stantec 2013) and the 2014 Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment (SEA) Update document (AMEC 2014). As directed by the scoping document, emphasis is placed herein on providing updated information on the RAA that is relevant to this Project rather than providing an extensive account of the biophysical and socio-economic conditions of the RAA.

4.5 POTENTIAL PROJECT-VC INTERACTIONS

Interactions between Project activities and each VC are identified and summarized in a tabular format (refer to Section 6). As indicated previously, the effects assessment relies extensively on previous recent EAs conducted for similar projects, given their direct relevance to the Project (*e.g.*, EA for the East Canada CSEM Survey 2014-2018 [LGL 2014]), as well as EA and SEAs that have been conducted previously in the RAA and provide context for baseline conditions and cumulative environmental effects (*e.g.*, AMEC 2014; Stantec 2013).

4.6 CRITERIA FOR CHARACTERIZING RESIDUAL ENVIRONMENTAL EFFECTS AND DETERMINING SIGNIFICANCE

Criteria or established thresholds for determining the significance of an adverse residual environmental effect are identified for each VC in Section 6. These criteria or thresholds establish a level beyond which a residual environmental effect would be significant (*i.e.*, an unacceptable change). For each VC, if an adverse environmental effect does not meet the criteria for a significant environmental effect, it is evaluated as "not significant". Additional criteria (*e.g.*, magnitude, geographic extent, duration, frequency, reversibility, and context) are also identified for each VC to support characterization of the nature and extent of residual environmental effects.

Table 4.1 provides an example of generic criteria used to describe residual environmental effects.

Table 4.1 Generic Characterization of Residual Environmental Effects

Characterization	Description	Quantitative Measure of Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect	**Positive** – an effect that moves measurable parameters in a direction beneficial relative to baseline. **Adverse** – an effect that moves measurable parameters in a detrimental direction relative to baseline. **Neutral** – no net change in measurable parameters relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible** – no measurable change in species populations, habitat quality or quantity **Low** – a measurable change but within the range of natural variability; will not affect population viability **Moderate** – measurable change but not posing a risk to population viability **High** – measurable change that exceeds the limits of natural variability and may affect long-term population viability
Geographic Extent	The geographic area in which an environmental effect occurs	**Project Area** – effects are restricted to the Project Area **Local Assessment Area** – effects are restricted to the LAA **Regional Assessment Area** – effects are restricted to the RAA
Frequency	Identifies how often the residual environmental effect occurs	**Single Event** – effect occurs once **Multiple Irregular Event** – occurs at not set schedule **Multiple Regular Event** – occurs at regular intervals **Continuous** – occurs continuously
Duration	The period of time required until the measurable parameter of the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term** – effect extends for the duration of Project activities or less (*i.e.*., no more than 15 days) **Medium-term** – effect extends for up to a year after the duration of Project activities **Long-term** – effects extend for more than a year after Project activities cease
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 and Socio-economic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed** – area is relatively undisturbed or not adversely affected by human activity **Disturbed** – area has been substantially disturbed by previous human development or human development is still present

Following a characterization of the residual environmental effects, a determination of the significance is provided.

The VC-specific criteria for characterizing residual environmental effects and determining the significance of environmental effects that are defined in Section 6 are applicable for the assessment of Project-related environmental effects (Section 6), the assessment of accidental events (Section 7), and the assessment of cumulative environmental effects (Section 9). Significance criteria for the effects of the environment on the Project are defined in Section 8.

4.7 ASSESSMENT OF PROJECT-RELATED ENVIRONMENTAL EFFECTS

Project-related environmental effects are assessed with consideration of mitigation and environmental protection measures proposed to reduce or eliminate potential adverse environmental effects. Residual environmental effects (*i.e.*, after mitigation has been applied) are then characterized and a determination of the significance of effects is made. Potential accidental effects that could occur over the course of Project activities are assessed separately in Section 7.

4.8 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative environmental effects of the Project are identified in consideration of other past, present, or future projects or activities. If there is potential for a substantive interaction between residual Project-related effects and effects of past, present or future projects or activities that have been or will be carried out, then these cumulative environmental effects, including the contribution of the Project, are evaluated. The assessment of cumulative environmental effects is presented in Section 9.

4.9 FOLLOW-UP AND MONITORING

Follow-up and monitoring to verify environmental effects predictions or assess the effectiveness of planned mitigation are recommended where there may be uncertainty regarding the effects predictions or the efficacy of mitigation.

5.0 EXISTING ENVIRONMENT

5.1 MARINE PHYSICAL ENVIRONMENT

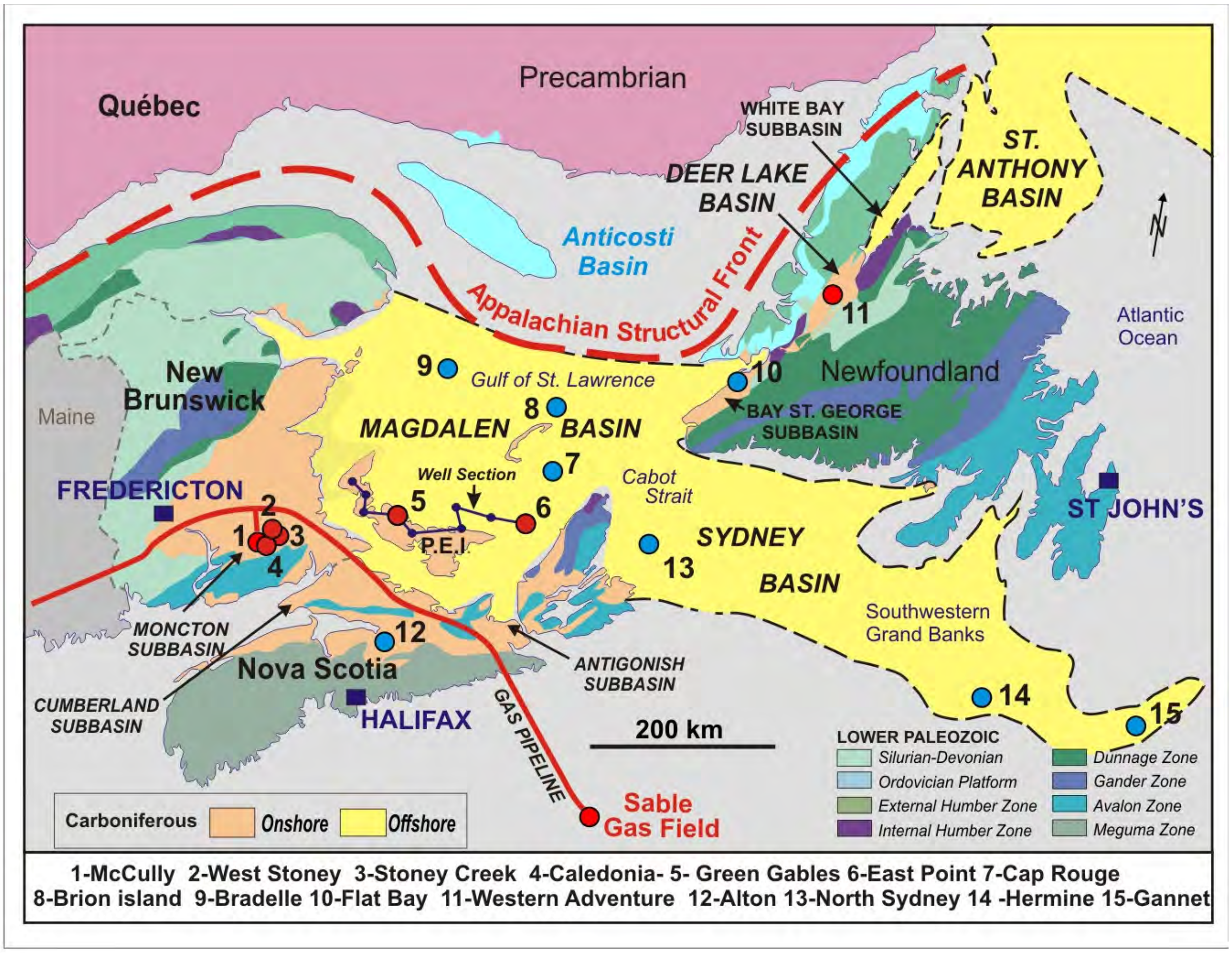
The description of the marine physical environment relies extensively on the Western Newfoundland and Labrador Offshore Area SEA Update (AMEC 2014, Section 4.1) and the EA for the Old Harry Prospect Exploration Drilling Program (Stantec 2013, Section 4)). An overview is provided for context below with updates included where applicable.

5.1.1 Marine Geology and Geomorphology

Marine geological features influence circulation and mixing, which in turn creates habitat characteristics. The geological formations in the Gulf of St. Lawrence are millions of years old. These formations straddle three major geological regions: the Canadian Shield in the northwest; the St. Lawrence Platform bordering the Shield; and the Appalachians in the southeast (DFO 2005a). These geological foundations are many kilometres in depth, with some exposed to the marine environment, and some being covered by sediments varying from a few metres to hundreds of metres in depth. Over the past two million years, these geological features have gone through transformation from four glacial and interglacial periods. During this time period, erosion and sediment deposition, iceberg movement, and human activities have played a role in transforming the seafloor into what exists today (DFO 2005a).

Beneath the Gulf of St. Lawrence, Cabot Strait, southwestern Grand Banks, and northeastern Newfoundland is a large upper Paleozoic sedimentary basin known as the Maritimes Basin, which contains onshore extensions into all five eastern Canadian provinces (Lavoie *et al.* 2009). The Maritimes Basin includes the Magdalen, Sydney, Deer Lake, and St. Anthony basins as well as a number of local sub-basins. The Maritimes Basin covers an area of 250,000 km^2, with 75 percent of this area located offshore (Figure 5.1). The Maritimes Basin overlies a collage of Appalachian crustal zones of varying age and composition, which was deformed during the Middle to Late Ordovician Taconian latitude. The basin developed in the equatorial latitude, within an oblique collisional zone between the Laurussia and Gondwana cratons during the final stages of the assembly of the Pangea supercontinent (Lavoie *et al.* 2009).

The rocks in the Maritimes Basin consist of mostly sandstone, siltstone, and shale, with minor amounts of limestone, gypsum, and salt (Lavoie *et al.* 2009). The Project Area is located in the eastern region of the Magdalen Basin (Figure 5.1).



Source: Lavoie *et al.* 2009
Note: Hydrocarbon discoveries (red dots), select exploration wells (blue dots), and the location of the Magdalen Basin.

Figure 5.1 Regional Setting of the Maritimes Basin

The Project Area is located in an area of low seismicity potential and in an area with gentle undulating topography (Stantec 2013). Fugro GeoSurveys Inc. (FGI) conducted a constraints assessment of the proposed Old Harry exploration well in October 2010, which is located within the Project Area. The Old Harry site is situated on the floor of the Laurentian Channel, which is a glacially deepened u-shaped valley that separates the Magdalen Shelf and the narrow shelf of southwest insular Newfoundland (FGI 2010). The survey revealed that sediments within the site consist of a majority of soft glaciomarine to post-glacial muds, with occasional coarse granular material derived from ice rafting. The consistency of the muds are >60 percent clay, >30 percent silt, and >5 percent sand. Video surveys of the area revealed a smooth mud seabed with burrows formed by benthic invertebrates. Isolated clusters of ice-rafted pebbles can also be seen in places. Surveys also revealed that there are ice-rafted cobble and/or boulders within the near-surface deposits, with Holocene surficial marine mud deposits varying in thickness from 9 to 28 m.

Pockmarks can be found on the seabed of the Project Area. They are concave crater-like features on the seafloor, which typically measure a few hundred metres in diameter and tens of metres in depth (Stantec 2013). The formation of pockmarks is generally caused by the seepage of thermogenic and biogenic gases and the release of pore water. Pockmarks have also been found in areas in which the up-drift of ice has detached from the sub-seafloor and decomposing gas hydrates. They can also be created by the grounding of icebergs as well as anthropogenic activities such as ship anchoring and trawling.

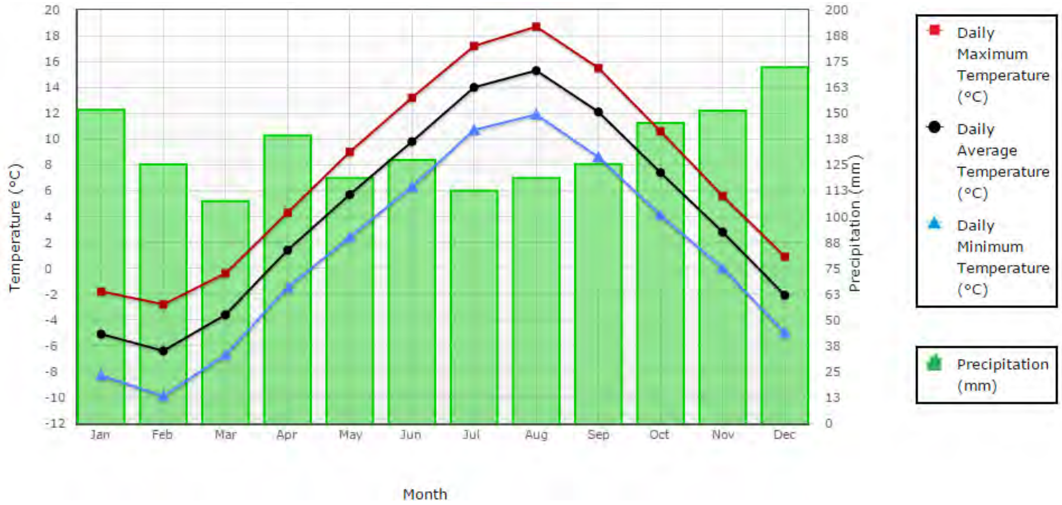
5.1.2 Atmospheric Environment

The climate in the vicinity of the Project Area is heavily influenced by the effects of the Gulf of St. Lawrence water that surround it, as well as the eastward movement of continental air masses and their associated pressure systems (Stantec 2013). The climate in the region can be characterized as maritime temperate. The Gulf of St. Lawrence experiences severe winters and heavy icing; as a result, the presence of weather buoys is limited. Therefore, to assess the historical climate in the Project Area, data were obtained from the Port Aux Basques weather station, located on the southwestern tip of insular Newfoundland approximately 60 km from the Project Area. The climate data are summarized in Table 5.1 and illustrated in Figure 5.2.

Table 5.1 Temperature and Precipitation Climate Data, 1981 to 2010, Port Aux Basques, Newfoundland

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)												
Daily Average	-5.1	-6.4	-3.6	1.4	5.7	9.8	14	15.3	12.1	7.4	2.8	-2.1
Daily Maximum	-1.8	-2.8	-0.4	4.3	9	13.2	17.2	18.7	15.5	10.6	5.6	0.9
Daily Minimum	-8.4	-9.9	-6.7	-1.5	2.4	6.3	10.7	11.9	8.6	4.1	4.1	-5
Extreme Maximum	9.9	8.9	11.2	18.2	22.2	25.3	27.8	27.2	30	25	25	10.7
Extreme Minimum	-23.3	-26.1	-24.1	-13.3	-6.7	-1.1	3.5	2.8	0	-4	-4	-21.2
Precipitation (mm)												
Rainfall	48.7	41.8	57.6	119	116	127	113	119	125	143	127	92.9
Snowfall (cm)	102	81.7	49.1	17.4	2.4	0	0	0	0	2.2	21.8	78.6
Precipitation	152	125	108	139	119	127	113	119	125	145	151	172
Extreme Daily Rainfall	74.2	67.3	60	89.8	85.9	66.8	111	83.8	96.6	65.3	101	88.9
Extreme Daily Snowfall (cm)	57.4	45.7	36.8	11.4	11.4	0.5	0	0	0	14.7	30.5	43
Days with Precipitation												
≥0.2 mm	26.2	21.5	19.4	16.2	15	16.3	16.5	15.2	16.7	18.4	20.1	24.2
≥5 mm	9.2	6.8	6.7	6.7	6.7	6.7	6.5	6.8	7.2	8.3	8.4	9.4
≥10 mm	4.5	3.8	3.4	4.1	4.2	4.4	3.9	4.1	4	4.4	4.7	4.9
≥25 mm	0.88	0.74	0.53	1.1	0.94	1.3	1.3	1.1	1.1	1.4	1.2	1.1

Source: Government of Canada 2017a



Source: Government of Canada 2017a

Figure 5.2 Temperature and Precipitation Climate Normals (1981 to 2010) for Port Aux Basques, Newfoundland

Average daily temperatures in the Project Area range from -6.4°C in February to 15.3°C in August. Extreme maximum temperatures of 30°C have been recorded in September, with extreme minimums (-26.1°C) recorded in February. The highest amount of precipitation was recorded in December, with the lowest amounts recorded during March. October was the month with the highest number of days with precipitation above 25 mm (Government of Canada 2017a).

Vessel icing can be caused from freshwater moisture in the form of fog, freezing rain, drizzle, rain, and snow, or from saltwater sources such as freezing spray and wave wash (Stantec 2013). Icing from advection and evaporating fog can be a problem during the fog months. Icing from precipitation generally occurs when there is a steep drop in air temperatures and is generally limited to spring and fall months. Within the Gulf region, freezing spray is the most frequently reported cause of vessel icing (Stantec 2013). Freezing spray can occur any time from November to April in the Gulf. High concentrations of events occur from December to February, with freezing spray being encountered more than 50 percent of the time in January. Freezing rain occurs in the Gulf from December to April. Super-cooled fog can also create icing conditions from January to March.

Fog can play an important role in inhibiting the visibility of survey ships operating offshore. Table 5.2 displays the historical visibility data at the Port Aux Basques Weather Station from 1971 to 2000. During this period the number of hours with visibility less than 1 km was greatest during the months of June and July. Visibility was the greatest during September and October.

Table 5.2 Hours of Visibility per Month Recorded at the Port Aux Basques Weather Station, 1971 to 2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<1 km	51.9	45.7	47.4	54.4	84.8	106.6	138.6	78.2	33.3	32	27.7	37.4
1 to 9 km	208.6	160.8	139.8	140.3	134.3	132.5	154.1	114.7	76.9	83.4	104.4	182
>9 km	483.6	471	556.9	525.3	525	480.9	451.3	551.1	609.8	628.7	588	524.7

Source: Government of Canada 2017b

Visibility in January, February, and March is generally reduced due to snow. As the months progress from April to July, the air temperature and humidity in the Gulf increases, while the sea surface temperatures remain relatively cool, resulting in a cooling effect on the air above the sea, which results in fog.

Wind is an important factor for survey planning due to its role in the generation of waves and currents, which in turn have effects on survey vessels and the equipment they tow. Mean hourly wind speeds range from 5.3 m/s (July) to 10.1 m/s (December). Wind speeds in excess of 20 m/s occur very infrequently, with the strongest winds most likely to occur in December and January or during August when tropical storms are likely to pass through the region. Prevailing winds between November and March are westerly and northwesterly, while southwesterly and southerly winds are more frequent between May and September (AMEC 2014).

The Gulf of St. Lawrence lies in the path of occasional hurricanes and tropical storms that travel up the eastern coast of North America. Hurricanes in the North Atlantic can occur from June to November, with the highest intensity of storms occurring in August and September (Stantec 2013).

5.1.3 Physical Oceanography

5.1.3.1 Bathymetry

The Project Area is located in the Laurentian Channel in the Gulf of St. Lawrence west of Newfoundland. The water depths range from 50 m to 550 m in the deepest section of the Laurentian Channel (refer to Figure 1.1).

5.1.3.2 Ocean Currents

The current in the Gulf of St. Lawrence flows in a counter-clockwise direction with major current influences originating from the St. Lawrence River, the Strait of Belle Isle, and the Cabot Strait. Current transport in the northwest of the Gulf of St. Lawrence travels from north to south along the Labrador coast from the Strait of Belle Isle toward Anticosti Island. Strong currents flow between the northern coast of Anticosti Island and Quebec into the St. Lawrence Estuary at which point runoff from the St. Lawrence River influences currents to travel eastward along the Gaspe coast. East of the Gaspe coast, currents are influenced by the Laurentian Channel and flow eastward toward the Cabot Strait. However, weaker currents do travel southeast from Gaspe toward Prince Edward Island and around the Magdalen Islands. Current transport along the southern half of the Cabot Strait flows in an eastward direction and forces water out of the Gulf of St. Lawrence, while water is transported into the Gulf of St. Lawrence through the northern half of the Cabot Strait. A major current flows north along the west coast of Newfoundland toward the Strait of Belle Isle (Galbraith *et al.* 2014). During most of the year currents are strongest between 0 to 20 m depth; however, during the winter season current strength is more uniform throughout the entire depth of the Gulf. The slopes of deep channels, areas nearer to the shoreline, inlets, and outlets display the strongest currents (Galbraith *et al.* 2013).

5.1.3.3 Wave Climate

The wave climate in the Gulf of St. Lawrence is driven by atmospheric forcing and undergoes seasonal variability. Wave height is expected to be most significant between October and January with maximum heights reached in December. During December, wave heights could reach up to 9.5 m with a period of 12.9 s from a westerly direction. Wave severity is expected to be at a minimum during the month of July with heights only reaching 4.3 m and a wave period of as much as 9.4 s. Excluding the month of July, wave heights of 5 m are possible during significant events throughout the year (AMEC 2014).

5.1.3.4 Water Mass Characteristics

The water mass characteristics of the Gulf of St. Lawrence shift throughout the year and seasonal fluctuations in temperature, salinity, and mixing occur. The Gulf of St. Lawrence is composed of three distinct layers: the mixed surface layer; the cold intermediate layer; and the deeper water layer. The mixed surface layer extends from the sea surface to depths of 10 to 100 m depending on the season. Water within this layer is well mixed from atmospheric influence and continental runoff. Below the mixed surface layer lies the cold intermediate layer. This layer is characterized by a thermohalocline in which temperature and salinity gradually change with depth. Below the cold intermediate layer, the deeper water layer is composed of warmer and highly saline water (Galbraith *et al.* 2014; Saucier *et al.* 2003).

Temperature and salinity are affected most by seasonal variations in the upper 100 to 200 m (Saucier *et al.* 2003). During the fall, the mixed surface layer is impacted by strong winds, causing it to gradually cool and deepen. The surface layer continues to grow and cool during the winter season and reaches maximum depth during March (Galbraith *et al.* 2014). In the winter season the surface layer and the cold intermediate layer merge to form a near-freezing layer that lasts until spring (AMEC 2014). During the spring warming period, continental runoff and melting sea ice leads to the development of a more stratified surface layer and the re-establishment of the cold intermediate layer. The surface layer is gradually warmed throughout the spring and summer season, reaching a maximum temperature in mid-August (Saucier *et al.* 2003; Galbraith *et al.* 2014).

Between 1985 and 2010 average sea surface temperatures during the ice-free months (May to November) in the Gulf of St. Lawrence were measured to be 9.61°C with temperatures reaching an average maximum of 15.6°C in the second week of August (Galbraith *et al.* 2013). Surface water temperatures in 2013 were above the historic average by 0.4°C between May to November (Galbraith *et al.* 2014).

The thickness and minimum temperature of the cold intermediate layer is variable from year to year. Since the cold intermediate layer is a remnant of the winter near-freezing layer, the temperature index and thickness of the cold intermediate layer can be roughly forecasted through measurements taken of the near-freezing layer in March (Galbraith *et al.* 2014).

The deeper water layer exists at depths greater than 150 m and exhibits little mixing with the overlying surface and cold intermediate layer. Temperatures in this layer range from 1 to 7°C, excluding the Mecatina Trough, which exhibits near-freezing temperatures throughout much of the year. Salinities in the deeper water layer can range from 32.5 to 35 psu (practical salinity unit). Between 1981 and 2010 the average yearly temperature for the deepwater layer in the Gulf of St. Lawrence was 2.52°C at 150 m, 4.44°C at 200 m, 5.33°C at 250 m, and 5.50°C at 300 m. During the same time period, average yearly salinity was measured to be 33.44 psu at 150 m, 34.08 psu at 200 m, 34.48 psu at 250 m, and 34.65 psu at 300 m (Galbraith *et al.* 2014).

5.1.3.5 Sea Ice and Icebergs

Sea ice formation in the Gulf of St. Lawrence originates in the northern part of the Gulf and gradually extends south throughout the ice season. The formation of sea ice typically occurs first in the St. Lawrence Estuary, the northwestern Gulf and along the northern and southeastern coast, with sea ice formation in the western half and northeastern Gulf becoming more prominent in February (Saucier *at al.* 2003). The ice season generally begins in late December and early January and lasts until April (Galbraith *et al.* 2014). Over the last four decades there has been considerable variation in the level of ice coverage in the Gulf of St. Lawrence with an overall declining rate of 4,400 km^2 per year since 1969 (Hammill and Stenson 2014). In 2013 the maximum volume of sea ice in the Gulf was 26 km^3, which was the 6th lowest recorded volume since 1969 (Galbraith *et al.* 2014). The average maximum ice volume for the Gulf of St. Lawrence over the period spanning 1981 to 2010 was 70.8 km^3 (AMEC 2014). Sea ice volumes in the Gulf of St. Lawrence display a high level of variability from year to year, and divergence from the average 30-year volume can occur (Galbraith *et al.* 2014).

Icebergs in the Gulf of St. Lawrence are classified by size, with categories including growlers and bergy bits (5 to 14 m), small icebergs (15 to 60 m), medium icebergs (61 to 120 m), large icebergs (121 to 200 m) and very large icebergs (>200 m). The majority of the icebergs entering the Gulf are transported through the Strait of Belle Isle with fewer icebergs entering through the Cabot Strait. Those icebergs that do enter through the Cabot Strait are generally classified as small icebergs or growlers and bergy bits. Icebergs entering through the Strait of Belle Isle can range from growlers and bergy bits to large icebergs. These icebergs are most often transported along the Quebec coast by the prevailing currents in the area. The presence of very large icebergs in the RAA is extremely unlikely (AMEC 2014).

5.2 MARINE BIOLOGICAL ENVIRONMENT

The following section describes the biological environment in which the Project is located. This description relies extensively on the Western Newfoundland and Labrador Offshore Area SEA Update (AMEC 2014) and the EA for the Old Harry Prospect Exploration Drilling Program (Stantec 2013). Updates have been provided as applicable using more recent data sources.

5.2.1 Plankton

Plankton are a diverse group of very small, free-floating organisms that live in the water column defined by their ecological niche, and can be animals, protists, archaea or bacteria. The distribution of plankton is controlled by currents and turbulent mixing, as they are unable to swim against the current. Plankton can be divided into three groups based on trophic level: bacterioplankton; phytoplankton; and zooplankton. Plankton are an important part of the marine food web as they are eaten by some forms of plankton themselves (*e.g.*, zooplankton), which are in turn consumed by larger organisms, including fish and whales.

In the Gulf of St. Lawrence, phytoplankton growth is highest in the spring when there are high nutrient concentrations, specifically nitrates (Dufour *et al.* 2010). Nutrient variations can occur in response to sea-ice dynamics, runoff, tidal and wind-induced circulation, and wind mixing (Le Fouest *et al.* 2005).

Zooplankton range in size from microscopic >1 mm to approximately 4 cm and consist of animals such as copepods, decapods, invertebrate larvae, fish larvae, and krill. Macrozooplankton, which are mainly adult and juvenile krill, are important in the pelagic ecosystem as food for marine mammals, marine birds, and fish. There are approximately 50 species of ichthyoplankton (fish larvae and eggs) found in the Gulf of St. Lawrence, with the dominant species including the larvae of herring, capelin, snailfish, shanny, and sculpin (White and Johns 1997). Inshore areas are dominated by larval species such as lobster, herring, scallop, cunner, radiated shanny, winter flounder, and capelin species. Redfish and Greenland halibut (turbot) ichthyoplankton are prominent in waters over the Laurentian Channel, and potentially in the Project Area (Stantec 2013).

5.2.2 Marine Fish and Fish Habitat

A high diversity of marine fish and shellfish can be found in the Gulf of St. Lawrence including the western Newfoundland region and is divided into three groups: pelagic fish, those that live and feed close to the surface; demersal or groundfish, those that live and feed close to the bottom; and shellfish, which include crustaceans and bivalves.

This section is informed by multi-species surveys carried out by DFO, as presented in the Western Newfoundland and Labrador Offshore Area SEA Update (AMEC 2014). DFO carries out several long-term monitoring studies in the Gulf of St. Lawrence, which include the: 1) Northern Gulf Multi-Species Survey; 2) Southern Gulf Multi-Species Survey; 3) Fixed and Mobile Gear Sentinel Surveys; 4) Snow Crab Survey; and 5) Herring Acoustic Surveys. The Northern and Southern Gulf Multi-Species Surveys conducted between 2004 and 2011 are the primary source of abundance and distribution data presented in AMEC (2014). These are standardized, trawl-based surveys conducted by DFO research vessels. A random stratified design is used and these surveys take place at a fixed time every year: August in the northern Gulf and September in the southern Gulf.

5.2.2.1 Marine Fish

Approximately two-thirds of all marine fish species known to occur in the Gulf are demersal. Commonly occurring pelagic and demersal marine fish known to inhabit the Gulf in the vicinity of the Project Area are identified in Table 5.3. Fish species at risk are discussed in Section 5.2.6.

Table 5.3 Summary of Fish Species with the Potential to Occur in or Near the Project Area

Common Name	Latin Name	Relative Level of Occurrence in the Project Area	Timing of Presence and Spawning within the Project Area
Atlantic herring	*Clupea harengus*	Moderate	Year-round presence with spring and fall spawning
Capelin	*Mallotus villosus*	Low	Mature fish migrate inshore in spring to spawn
Pollock	*Pollachius virens*	Moderate	Migrate inshore during summer, winter offshore, fall spawning
Atlantic argentine	*Argentina silus*	Low	Year-round presence
Atlantic mackerel	*Scomber scombrus*	Low	May to November (adults)
Haddock	*Melanogrammus aeglefinus*	Low	Move to deeper water in winter; inhabit shallow banks in summer
Swordfish	*Xiphius gladius*	Low (anticipated)	Migrate in summer and fall
Greenland halibut	*Reinhardtius hippoglossiodes*	Moderate	Year-round presence
Longfin hake	*Urophycis chesteri*	High	Year-round presence and fall spawning
Marlin-spike grenadier	*Nezumia bairdi*	High	Year-round presence and fall spawning
Thorny skate	*Raja radiata*	High	Year-round presence
White hake	*Urohycis tenuis*	High	Year-round presence
Witch flounder (greysole)	*Glyptocephalus cynoglossus*	High	Year-round presence
Atlantic hagfish	*Myzine glutinosa*	Moderate	Year-round presence

Table 5.3 Summary of Fish Species with the Potential to Occur in or Near the Project Area

Common Name	Latin Name	Relative Level of Occurrence in the Project Area	Timing of Presence and Spawning within the Project Area
Atlantic halibut	*Hippoglossus hippoglossus*	Moderate	Migrate to shallow waters in summer, return for winter
Atlantic soft pout	*Melanostigma atlanticum*	Moderate	Year-round presence
Black dogfish	*Centroscyllium fabricii*	Moderate	Year-round presence
Lumpfish	*Cyclopterus lumpus*	Moderate	Migrate to shallow waters to spawn, return during fall
Smooth skate	*Raja senta*	Moderate	Year-round presence
Spotted barracudina	*Notolepis rissoi*	Moderate	Year-round presence
White barracudina	*Arctozenus risso*	Moderate	Year-round presence
Atlantic hookear sculpin	*Artediellus atlanticus*	Low	Migrate inshore in the spring; occupy moderately deep waters in winter
Checker eelpout	*Lycodes vahilii*	Low	Year-round presence
Fourbeard rockling	*Enchelyopus cimbrius*	Low	Year-round presence
Greater eelpout	*Lycodes esmarki*	Low	Year-round presence
Monkfish (goosefish)	*Lophius americanus*	Low	Year-round presence
Polar sculpin	*Coltunculus microps*	Low	Year-round presence
Sea raven	*Hemitripterus americanus*	Low	Year-round presence and fall spawning
Silver hake	*Merluccius bilinearis*	Low	Year-round presence
Threebeard rockling	*Gaidropsarus ensis*	Low	Year-round presence
Windowpane flounder	*Scophthalmus aquosus*	Low	Year-round presence
Wrymouth	*Cryptacanthodes maculatus*	Low	Year-round presence
Yellowtail flounder	*Limanda ferruginea*	Low (anticipated)[A]	Move from shallow to deep waters in the fall

Source: Modified from Stantec 2013

The most abundant pelagic species found within or near the Project area include Atlantic herring, Atlantic softpout, capelin, and Pollock (Stantec 2013). Species in the Gulf of St. Lawrence of commercial importance include Atlantic cod, American plaice, bluefin tuna, redfish, and white hake (all which have been assessed as at-risk species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)), and herring, mackerel, capelin, swordfish, Atlantic halibut, Greenland halibut, haddock, longfin hake, monkfish, pollock, witch flounder, and yellowtail flounder. Commercial fisheries are discussed in Section 5.3.1.1. Table 5.4 highlights the annual spawning periods of the principal commercial fish and shellfish species recorded in or near the Project Area.

Most Gulf fish species, such as Atlantic herring, marlin-spike grenadier, pollock, longfin hake, Atlantic hookear sculpin, and sea raven, are anticipated to spawn or mate throughout the spring to fall seasons (Scott and Scott 1988; LGL 2005a; Rodger 2006; FishBase 2010; AMEC 2014). Spawning activities occur at variable depths (Rodger 2006; FishBase 2010). Based on observations of fish maturity during the January pre-spawning aggregation in the Laurentian Channel, peak spawning in the area is anticipated to occur in late spring or early summer (DFO 2010a).

Table 5.4 Summary of Spawning and Hatching Periods for Principal Commercial Fisheries Species with the Potential to Occur in the Project Area

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic halibut		spawning	peak	spawning	spawning							
Atlantic herring				spawning	spawning	spawning	spawning					
Atlantic haddock			spawning	spawning	spawning							
Atlantic mackerel						spawning	spawning					
Atlantic cod					spawning	peak	spawning	spawning	spawning			
Capelin					spawning	spawning	spawning				spawning	spawning
Greenland halibut	spawning	spawning	spawning	spawning							spawning	spawning
Monkfish						spawning	spawning	spawning	spawning			
Pollock	spawning	spawning	spawning	spawning					spawning	spawning	spawning	spawning
Redfish (deepwater and Acadian)			spawning	spawning	spawning	spawning	spawning		mating	mating	mating	mating
White hake					spawning	spawning	spawning	spawning				
Witch flounder (greysole)	pre-spawning	pre-spawning	spawning	peak	peak	peak	peak	spawning	spawning			
Yellowtail flounder					spawning	spawning	spawning					
Lobster					spawning	overlap	overlap	mating				
Snow crab		mating	mating	spawning	spawning	spawning						
Northern shrimp				spawning	spawning			mating	mating	mating	mating	
Rock crab					spawning	spawning	spawning	spawning		mating	mating	
Whelk	spawning	spawning	mating	mating	mating	mating	mating	spawning	spawning	spawning	spawning	spawning
Scallop (potential for multiple species)								spawning	spawning			

Data sources: Scott and Scott 1988; DFO 1997, 1998, 2000a, 2000b, 2002, 2006a, 2009a, 2009b, 2010b, 2010c; Cargnelli *et al.* 1999a, 1999b; LGL 2005a; Rodger 2006
Adopted from Stantec 2013

Key			
spawning	potential spawning and hatching periods	mating	mating period
pre-spawning	pre-spawning aggregation in Laurentian Channel	overlap	overlap of spawning and mating periods
peak	peak spawning period anticipated		

5.2.2.2 Marine Shellfish

The Gulf of St. Lawrence contains a rich variety of marine shellfish. Many of these species are of commercial importance, including Atlantic lobster, snow crab, rock crab, Atlantic sea scallop, whelk, and northern shrimp. In general, the distribution of these species is concentrated in shallow water areas nearshore and along the continental shelf (AMEC 2014). As such, the abundance of these species within the Project Area is relatively low. Shellfish that have been recorded in the Project Area include lobster, snow crab, sea scallops and whelk (Table 5.5). Several other species have been observed in the vicinity of the Project Area. Species that are of commercial value are further discussed in Section 5.3.1.1.

Table 5.5 Summary of Marine Shellfish Known to Occur in or Near the Project Area

Common Name	Scientific Name	Relative Level of Occurrence in the Project Area	Distribution
Northern Shrimp	*Pandalus borealis*	Low	Found in water depths ranging from 150 to 350 m and prefer areas of soft mud and silt substrates. High concentration south of Anticosti Island.
American Lobster	*Homarus americanus*	Low to moderate	Found on nearshore reefs around the island of Newfoundland, including the west coast of Newfoundland, Magdalen Islands, Prince Edward Island, New Brunswick and Nova Scotia.
Atlantic Sea Scallop	*Placopecten magellanicus*)	Low	Occurs on continental shelf in relatively shallow waters (<100 m) High abundance south of Magdalen islands
Snow Crab	*Chionoecetes opilio*	Low	Widespread distribution in the Gulf. Occurs over a broad depth range (50 to 1,300 m). Prefers water temperatures between -1°C and 4°C.
Rock Crab	*Cancer irroratus*	Low to Nil	Congregate in waters typically less than 20 m deep. High abundance around Magdalen Islands and North and northeast of Cape Breton.
Whelk	*Buccinum undatum*	Low to Nil	Found in water depths up to 180 m. Majority are in water <30 m. Occur in high concentrations around Magdalen Islands.

Source: AMEC 2014

5.2.2.3 Corals and Sponges

Deep-water corals are long-lived, slow-growing sessile animals that are colonial and can be an important component of fish habitat. Numerous species of deep-water corals are present in the Gulf of St. Lawrence, with substantial concentrations in the Gulf and the Laurentian Channel (Kenchington *et al.* 2010).

A total of 14 taxa of corals have been documented in the Gulf, the majority of which are the soft corals (Alcyonacea) (Kenchington *et al.* 2010). Sea pens, mostly the genus *Pennatula*, are very common. Important sea pen caches are found on the western slope of the Laurentian Channel, northeast of the Magdalen Islands. Sea pens are not true stony or soft corals but are grouped with octocorals (polyps having eight tentacles). Other species found within the Gulf include two species of large gorgonian corals (*Primnoa resedaeformis* and *Paramuricea* sp.) and the solitary stony cup coral (*Flabellum alabastrum*). A limited number of coral catches have been observed within or near the Project Area, with the most concentrated numbers of corals being located on the slope of the Laurentian Channel.

5.2.3 Marine Mammals

There are approximately 19 species of marine mammals present in the Gulf of St. Lawrence and western Newfoundland waters including seven species at risk that could be expected to occur with varied frequencies in or near the Project Area or LAA.

Table 5.6 lists these species and indicates the potential for occurrence in the LAA based on known distribution and historic sightings. More information on marine mammal species at risk is provided in Section 5.2.6.

"Marine Mammal Significant Areas" (MMSAs) occur throughout the RAA and overlap with the Project Area – see Figure 4.65 of the SEA (AMEC 2014). MMSAs that overlap with the RAA include the Western Shelf of Newfoundland, Entrance to St. Georges Bay, Cape Breton Trough, the Margin of the Laurentian Channel to the South of Anticosti Island, and the Southern Gulf Shelf (ice-covered months) (AMEC 2014). The Entrance to St. Georges Bay MMSA encompasses much of the Project Area and supports a number of marine mammals during the ice-free period, including minke, fin, humpback, pilot and killer whales; harbour porpoises, white-sided and short-beaked common dolphins; and harbour and grey seals (AMEC 2014). Blue whales and killer whales may be present, at least sporadically, during winter. This area's main function is as a feeding ground for the aforementioned species and it is considered moderately unique and moderately important for the aggregation of marine mammals. It is one of the rare known areas where blue whales congregate during winter, although its use as wintering habitat is expected to vary annually. Blue whale biomass within the area has been described at times to be moderate to large, and a loss of access to this area could be expected to have a moderate fitness consequence to blue whales (AMEC 2014).

Table 5.6 Marine Mammals Potentially Present Within or Near the Local Assessment Area

Common Name	Latin Name	Potential for Occurrence in the LAA	Distribution and Seasonality
Mysticetes (Toothless or Baleen Whales)			
North Atlantic right whale[1]	*Eubalaena glacialis*	Low	Only occasionally sighted in the Gulf of St. Lawrence; sightings in the LAA would be very rare
Minke whale	*Balaenoptera acutorostrata*	High	Widespread throughout the Gulf, although less common off the west and southwest coast of Newfoundland
Fin whale[1]	*Balaenoptera physalus*	Moderate	Widely distributed in the Gulf of St. Lawrence and present year-round off western Newfoundland
Sei whale	*Balaenoptera borealis*	Low	Uncommon in the Gulf of St. Lawrence and western Newfoundland; more concentrated off southern Nova Scotia and Labrador Sea
Blue whale[1]	*Balaenoptera musculus*	Moderate-High	Occur in Gulf of St. Lawrence and east of Nova Scotia in spring, summer and fall and off southern Newfoundland in winter
Humpback whale	*Megaptera novaeangliae*	High	Aggregate in Gulf of St. Lawrence in summer to feed; most sightings in the Gulf of St. Lawrence occur in the northeast including off western Newfoundland
Odontocetes (Toothed Whales)			
Harbour porpoise[1]	*Phocoena phocoena*	Moderate	Moderately abundant in the Gulf during ice-free months, including in waters off western Newfoundland
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	High	Sighted throughout the Gulf of St. Lawrence, although most sightings in areas with steep bottom topography along the margins; most common in summer and fall.
White-beaked dolphin	*Lagenorhynchus albirostris*	Low	Most sightings in Gulf are in shallow water (<100m deep)
Short-beaked common dolphin	*Delphinus delphis*	High	Within the Gulf of St. Lawrence, species is found most often off of western Newfoundland

Table 5.6 Marine Mammals Potentially Present Within or Near the Local Assessment Area

Common Name	Latin Name	Potential for Occurrence in the LAA	Distribution and Seasonality
Long-finned pilot whale	*Globicephala melas*	High	Widely distributed and considered relatively common off southwestern and western Newfoundland
Killer whale[1]	*Orcinus orca*	Low	Occur throughout the Gulf of St. Lawrence with occasional sightings reported along western Newfoundland shelf and St. Georges Bay
Beluga whale[1]	*Delphinapterus leucas*	Low	Presence confined primarily to St. Lawrence Estuary and Saguenay Fjord with some uncommon sightings off of western Newfoundland
Northern bottlenose whale[1]	*Hyperoodon ampullatus*	Low	Extremely uncommon in Gulf of St. Lawrence; individuals (most likely from Labrador population) have been sighted off of western Newfoundland
Sperm whale	*Physeter macrocephalus*	Moderate	Known to occur in deep waters off shelf edge of western Newfoundland (*e.g.*, Cabot Strait and St Georges Bay) and occasionally along southwest and west coasts of Newfoundland
Pinnipeds			
Harbour seal	*Phoca vitulina*	High	Occur commonly in the Gulf of St. Lawrence including off of western Newfoundland year-round; primarily coastal
Grey seal	*Halichoerus grypus*	High	Occur commonly in the Gulf of St. Lawrence including off of western Newfoundland; generally summer residents, but can occur year round.
Harp seal	*Phoca groenlandica*	High	Present in the Gulf of St. Lawrence December to May
Hooded seal	*Crystophora cristata*	High	Present in the Gulf of St. Lawrence December to May
Notes: [1] Species at Risk (refer to Section 5.2.7)			

Source: Stantec 2013; AMEC 2014

5.2.3.1 Mysticetes (Toothless / Baleen Whales)

As shown in Table 5.6, there are six species of baleen whales that are known to be present in the waters off western Newfoundland and which could be present in the Project Area or LAA, including three species at risk (refer to Section 5.2.6). Many of these species use the Gulf of St. Lawrence as feeding grounds, particularly the waters in the Laurentian Channel and around the Magdalen Islands (DFO 2005a). Humpback and minke whales are less common off the west and southwest coasts of Newfoundland than elsewhere off the coasts of the Island (LGL 2005a). Humpback whales feed in the Gulf during the summer; however, the majority of their sightings have been in the northeastern part of the Gulf and they prefer to breed in waters with a temperature between 24°C and 28°C in southern latitudes during the winter (DFO 2011a; AMEC 2014). Minke whales can be found in the Gulf from July to September but tend to be more frequent in the northern Gulf (LGL 2005a). Sei whale sightings in the vicinity of the Project Area have also been limited (LGL 2007; AMEC 2014).

5.2.3.2 Odontocetes (Toothed Whales)

As shown in Table 5.6, there are nine species of toothed whales that could potentially be found in the vicinity of the Project Area or LAA including four species at risk (refer to Section 5.2.6). The sperm whale, long-finned pilot whale, and Atlantic white-sided and common dolphin are common in the western Newfoundland offshore region, whereas white-beaked dolphin is uncommon in this area (LGL 2005a; AMEC 2014). The distribution of sperm whale is based on their social structure with adult females and young typically found in tropical and subtropical waters and adult males in higher latitude waters. Sperm and long-finned pilot whales are generally distributed over areas of steep underwater topography (AMEC 2014). Sperm whales are capable of diving to depths greater than 1,200 m to feed and can stay submerged for greater than two hours at a time with the majority of their dives lasting approximately 30 minutes. Sightings of the Atlantic white-sided dolphin in the Gulf were also recorded in areas with steep bottom topography (AMEC 2014).

5.2.3.3 Pinnipeds (Seals)

There are four species of seals potentially found near and within the Project Area or LAA (see Table 5.6). None of these are species at risk. The harp and hooded seals are migratory species, whereas the harbour and grey seals are year-round resident species (DFO 2005a; Dufour and Ouellet 2007). The harp seal is likely common in the western Newfoundland offshore area during late fall to early spring and the hooded seal is common in the spring. The harbour and grey seals are common in the western Newfoundland offshore regions, with the distribution of the harbour seal continuous in the Gulf and the grey seal to be concentrated in the south (LGL 2005a; Hammill *et al.* 2014a, 2014b).

The harp, hooded, and grey seals are hunted commercially on the Atlantic coast of Canada between late March and the end of April (DFO 2008). The majority of the seal hunt occurs off the north and east coasts of Newfoundland and off southern Labrador, depending on ice conditions.

5.2.4 Sea Turtles

Two species of sea turtles, the leatherback sea turtle (*Dermochelys coriacea*) and the loggerhead sea turtle (*Caretta caretta*), are known to frequent the waters of Atlantic Canada. Among these species, only the leatherback sea turtle is considered to frequent the Gulf of St. Lawrence (Dufour and Ouellet 2007). Both of these species are at-risk species and are discussed in Section 5.2.6. The presence of either Kemp's ridley (*Lepidochelys kempii*) or green turtles (*Chelonia mydas*) in or near the Project Area or LAA would be considered very rare.

5.2.5 Marine and/or Migratory Birds

5.2.5.1 Overview

Many species of marine and/or migratory birds occur in the Gulf and these may be divided into four groups:

- **Pelagic seabirds** - typically feed at sea over deep waters and do not have to return to land to rest, only returning to land to breed on rocky cliffs and on islands. Pelagic seabirds known to regularly occur within the Gulf include storm-petrels, shearwaters, and alcids.
- **Neritic seabirds** - feed in shallow waters and shelf areas and tend to return to land to rest overnight. Neritic seabirds known to regularly occur within the Gulf include cormorants, gulls, and terns.
- **Waterfowl** - are highly reliant on nearshore and onshore habitat. Waterfowl can generally be divided into seaducks, bay ducks and dabbling ducks; and for this assessment, also include geese, loons and grebes.
- **Shorebirds** - are highly associated with coastal habitats; particularly during migration. Most shorebirds nest in inland habitats but some species raise their young in coastal environments. Although phalaropes (*Phalaropus spp.*) are taxonomically grouped with shorebirds, they spend a large amount in the pelagic zone, and may be considered pelagic seabirds.

A list of marine birds that could potentially occur in the RAA is provided in Table 5.7. These species include those that are known to regularly visit the Gulf region for breeding, overwintering, or migration. Marine bird species at risk are further discussed in Section 5.2.6.

Table 5.7 Marine and/or Migratory Birds that May Occur in the RAA[1]

Common Name	Scientific Name
Pelagic Seabirds	
Northern Fulmar	*Fulmarus glacialis*
Great Shearwater	*Puffinus gravis*
Sooty Shearwater	*Puffinus griseus*
Manx Shearwater	*Puffinus puffinus*
Wilson's Storm-Petrel	*Oceanites oceanicus*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*

Table 5.7 Marine and/or Migratory Birds that May Occur in the RAA[1]

Common Name	Scientific Name
Northern Gannet	*Morus bassanus*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Great Skua	*Stercorarius skua*
Ring-billed Gull	*Larus delawarensis*
Black-legged Kittiwake	*Rissa tridactyla*
Dovekie	*Alle alle*
Common Murre	*Uria aalge*
Thick-billed Murre	*Uria lomvia*
Razorbill	*Alca torda*
Atlantic Puffin	*Fratercula arctica*
Neritic Seabirds	
Great Cormorant	*Phalacrocorax carbo*
Double-crested Cormorant	*Phalacrocorax auritus*
Black-headed Gull	*Chroicocephalus ridibundus*
Bonaparte's Gull	*Chroicocephalus philadelphia*
Herring Gull	*Larus argentatus*
Thayer's Gull	*Larus thayeri*
Iceland Gull	*Larus glaucoides*
Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Ivory Gull[2]	*Pagophila eburnea*
Caspian Tern	*Hydroprogne caspia*
Roseate Tern[2]	*Sterna dougallii*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Black Guillemot	*Cepphus grylle*
Waterfowl	
Red-throated Loon	*Gavia stellata*
Common Loon	*Gavia immer*
Horned Grebe	*Podiceps auritus*
Canada Goose	*Branta canadensis*
Green-winged Teal	*Anas crecca*
American Black Duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*

Table 5.7 Marine and/or Migratory Birds that May Occur in the RAA[1]

Common Name	Scientific Name
Common Eider	*Somateria mollissima*
Harlequin Duck - Eastern pop.[2]	*Histrionicus histrionicus pop. 1*
Long-tailed Duck	*Clangula hyemalis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Black Scoter	*Melanitta nigra*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye - Eastern pop.[2]	*Bucephala islandica (Eastern pop.)*
Bufflehead	*Bucephala albeola*
Red-breasted Merganser	*Mergus serrator*
Shorebirds	
Black-bellied Plover	*Pluvialis squatarola*
American Golden-Plover	*Pluvialis dominica*
Semipalmated Plover	*Charadrius semipalmatus*
Piping Plover melodus ssp[2]	*Charadrius melodus melodus*
Killdeer	*Charadrius vociferus*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Willet	*Tringa semipalmata*
Spotted Sandpiper	*Actitis macularius*
Hudsonian Whimbrel	*Numenius phaeopus hudsonicus*
Ruddy Turnstone	*Arenaria interpres*
Red Knot rufa ssp[2]	*Calidris canutus rufa*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
White-rumped Sandpiper	*Calidris fuscicollis*
Pectoral Sandpiper	*Calidris melanotos*
Purple Sandpiper	*Calidris maritima*
Dunlin	*Calidris alpina*
Buff-breasted Sandpiper[2]	*Tryngites subruficollis*
Short-billed Dowitcher	*Limnodromus griseus*
Red-necked Phalarope[2]	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicarius*

[1] Excluding rare transients / vagrants, except for species at risk which are known to occasionally occur (*e.g.*, red knot).

[2] Species at risk

5.2.5.2 Seasonal Distribution of Seabirds

Information on the distribution and abundance of marine birds within the RAA was obtained from the PIROP (Programme intégré de recherches sur les oiseaux pélagiques) and Eastern Canadian Seabirds at Sea (ECSAS) databases. The years encompassed in the PIROP data are 1966-1987, and 2006-2016 for the ECSAS data. Observations within these databases are from ship-based surveys and were mapped according to season, including spring (March, April, and May), summer (June, July, and August), fall (September, October, and November), and winter (December, January, and February). Although there are differences in the survey methods used for the ECSAS and PIROP programs, data from both were integrated into common maps to convey information on the relative distribution and abundance of marine birds. Species which were evaluated separately were dovekie, northern fulmar, northern gannet, black-legged kittiwake, and black guillemot. Guildsand/or taxonomic groups were used to convey patterns for other species and included cormorants, gulls, jaegers, large alcids, storm-petrels, phalaropes, shearwaters, skuas, and terns. The distribution and abundance of marine bird observations made during ship-based surveys were considered with respect to the locations of large seabird colonies, but more detailed information on the location of colonies and the types and abundances of species they support are provided in Section 5.2.5.3.

Additional information on the densities of seabirds in the RAA was obtained from Fifield *et al.* (2009), which presents results from a 3.5-year monitoring program for offshore seabirds. This program was intended to assess seabird abundance and distribution in areas of eastern Canada with oil industry activity. Data from Fifield *et al.* (2009) were collected as part of the larger ECSAS initiative, which used distance sampling methods to account for varying seabird detectability. Survey efforts in the Gulf of St. Lawrence marine eco-region focused on the Cabot Strait, Laurentian Channel, along the western coast of Newfoundland north to the Strait of Belle Isle and did not include any winter survey effort (Fifield *et al.* 2009). The majority of surveys were conducted from either oil industry supply ships or DFO research/fishery patrol vessels. A small number of other surveys were conducted from ferries, cargo vessels, seismic ships or sailboats (Fifield *et al.* 2009). Although the data from this study is encompassed in the larger ECSAS database, it has been referenced here because it provides a comparison to other waters of the northeast (particularly the Scotian Shelf – Gulf of Maine, and the Newfoundland and Labrador Shelves).

Information on the spatial distribution, intensity and timing of PIROP and ECSAS survey efforts is provided in Figure 5.3.

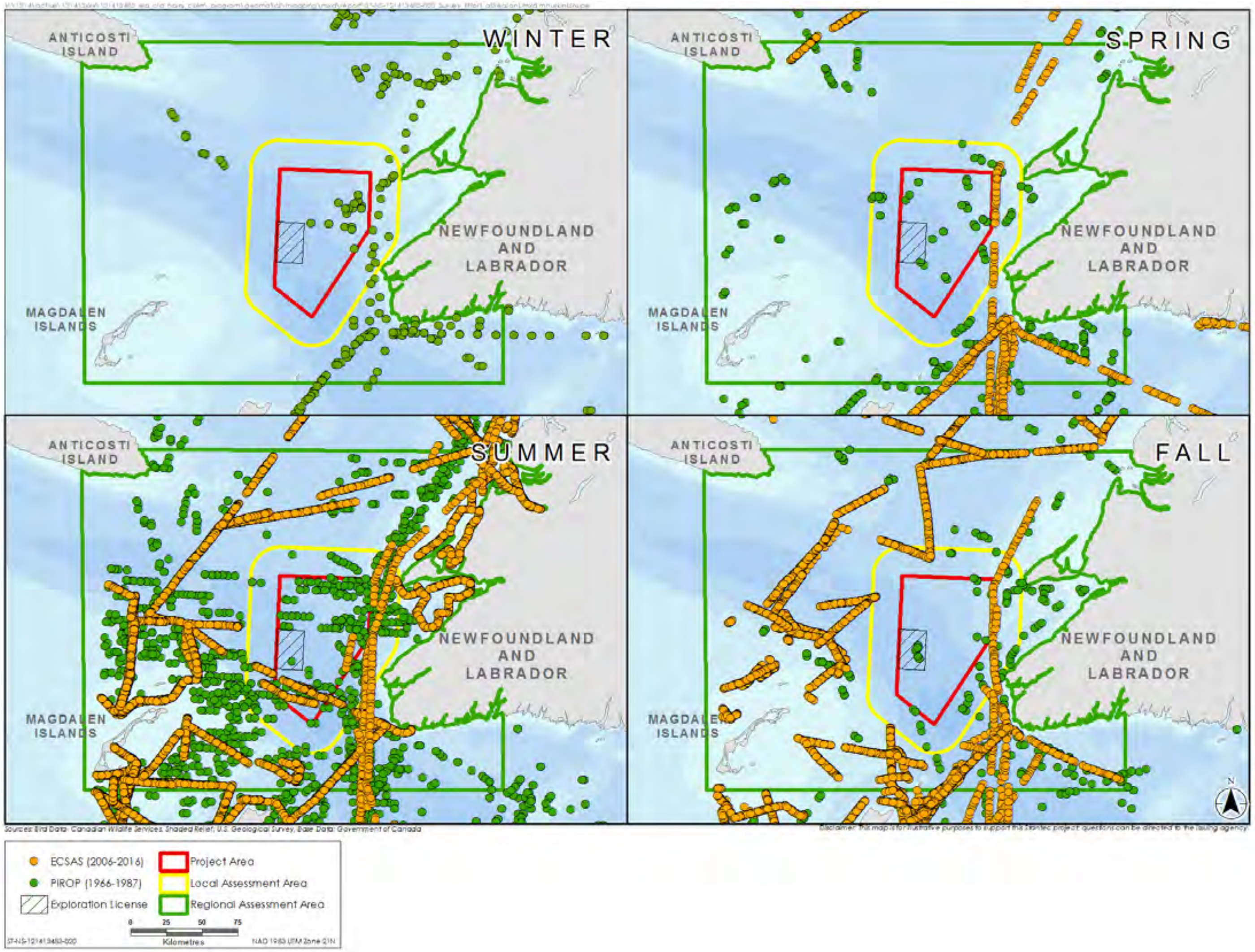


Figure 5.3 Seasonal ECSAS and PIROP Survey Effort in the RAA

Data indicate that survey efforts varies considerably with season, that more effort has been directed at certain locations within the Gulf than others, and that the ECSAS and PIROP data differ in their spatial coverage. In general, ECSAS survey efforts have been relatively high in summer and fall, and comparatively minor in spring and winter. PIROP survey efforts were relatively high during the summer months and much less in spring, winter, and fall. ECSAS surveys have been concentrated in certain areas of the Gulf, including the mouth of the St. Lawrence River, around the Magdalen Islands, and along the western side of Newfoundland (Figure 5.3). ECSAS surveys have been minimal within the Project Area itself. PIROP data coverage is also unevenly distributed throughout the Gulf, but does provide coverage in some areas where ECSAS data are lacking, including the Project Area. A high amount of PIROP records are from areas surrounding the Magdalen Islands, between Cape Breton Island and the southwest corner of Newfoundland, and along the western coast of Newfoundland (Figure 5.3).

Marine birds are present throughout the Gulf during the summer months and were often encountered in relatively high abundance (Figure 5.4). Additionally, PIROP and ECSAS data indicate that a relatively high diversity of marine bird species are present in the Gulf during the summer. The richness and abundance of marine birds in the Gulf during early summer (*i.e.*, June) would be promoted by several factors: seabirds that breed in the Gulf would already have arrived and begun nesting; those that breed mostly in the high Arctic such as dovekie and northern fulmar would still be migrating through the Gulf; and species that breed in the South Atlantic but migrate to the North Atlantic during the austral winter (such as great shearwater) and Wilson’s storm-petrel) would be starting to arrive in the Gulf in June. However, given that large proportions of those species that breed in the Gulf are concentrated in colonies and in their seaward extensions, at-sea observations are not necessarily indicative of species’ abundance within the region at this time. By July, many seabirds are feeding nestlings and adults tend to forage more frequently in seaward extensions to colonies. This would result in a reduction in seabird abundance in areas remote from colony sites such as in parts of the Project Area. In addition, only half of the adult birds would be at sea foraging while the other half would be tending the nestlings. PIROP and ECSAS data indicate that black-legged kittiwake, northern gannet, northern fulmar, herring gull, and great shearwater are the most abundant species recorded during ship-based surveys in and near the RAA during the summer months. Other common species include common murre, Leach's storm-petrel, and Wilson's storm petrel. Data from Fifield *et al.* (2009) suggest that seabird concentrations in the eastern portion of the Gulf are lower in the summer months (based on seasonal weighted median) than in either the Scotian Shelf-Gulf of Maine and the Newfoundland and Labrador Shelf ocean regions (Table 5.8).

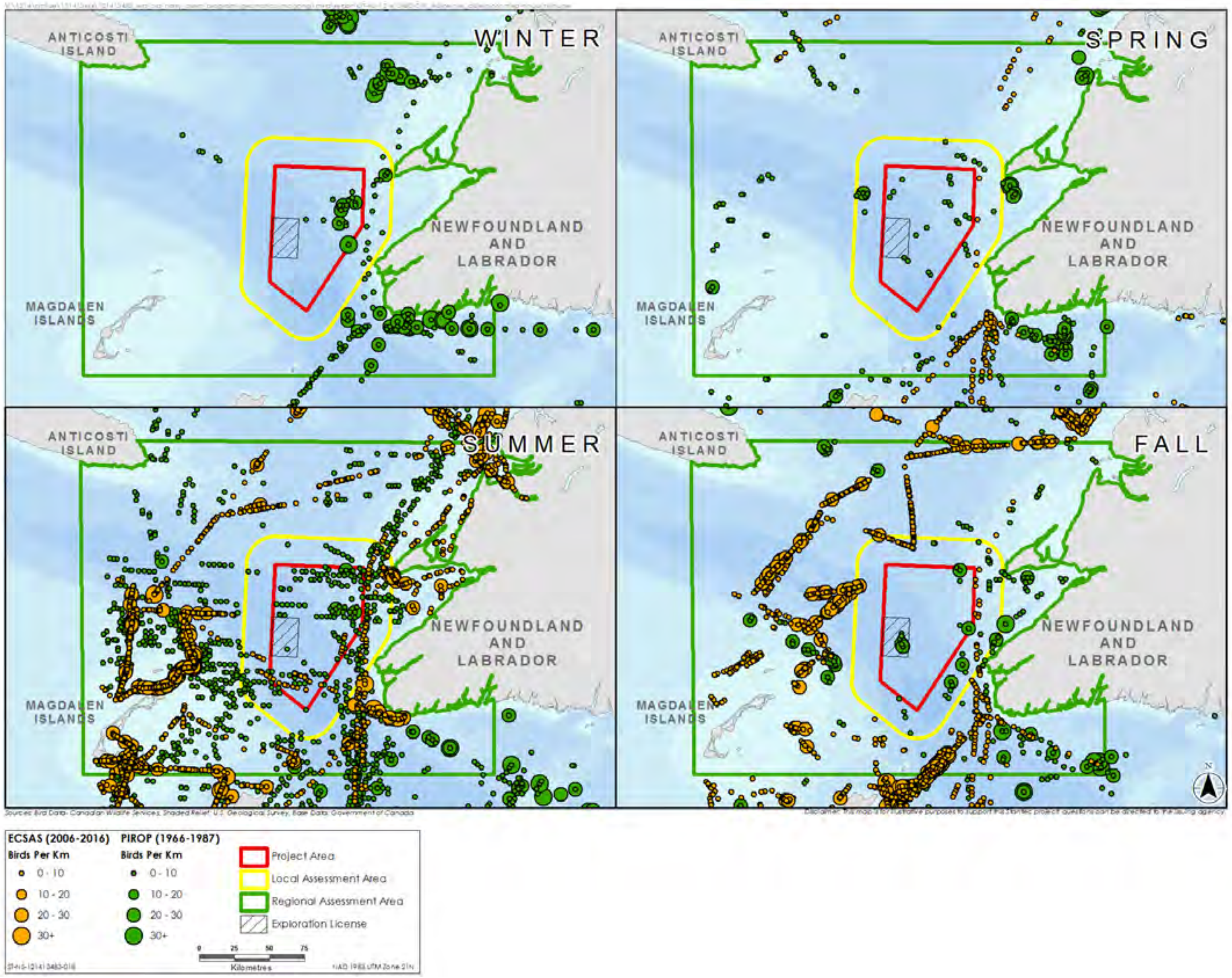


Figure 5.4 Seasonal Distribution of all Seabirds in the RAA

Table 5.8 Seasonal Weighted Median (and Range) of Seabird Densities (birds/km²) in each of the Marine Ecoregions of Atlantic Canada

Species	Season	Scotian Shelf - Gulf of Maine	Gulf of St. Lawrence	Newfoundland and Labrador Shelves
All Seabirds	Spring	7.92 (0.68 to 25.37)	3.10 (0.37 to 4.52)	14.30 (1.89 to 31.77)
	Summer	8.30 (1.73 to 148.56)	5.27 (2.21 to 14.31)	11.51 (0.34 to 48.78)
	Fall	4.23 (0.97 to 21.18)	11.57 (7.41 to 12.11)	9.24 (0 to 46.73)
	Winter	7.67 (4.39 to 29.44)	-	9.53 (2.31 to 45.12)
Northern Fulmars	Spring	0.75 (0 to 4.24)	1.19 (0 to 1.61)	1.00 (0 to 22.44)
	Summer	0.15 (0 to 1.64)	0.64 (0 to 4.19)	0.48 (0 to 24.17)
	Fall	0.30 (0 to 3.31)	0.27 (0.17 to 0.39)	0.65 (0 to 7.59)
	Winter	1.08 (0 to 12.37)	-	1.91 (0 to 36.77)
Shearwaters	Spring	0 (0 to 0.46)	0 (0 to 0)	0 (0 to 6.30)
	Summer	1.78 (0.29 to 84.02)	0.24 (0 to 0.87)	0.12 (0 to 16.39)
	Fall	2.20 (0 to 18.40)	5.06 (0.20 to 8.27)	0.80 (0 to 31.57)
	Winter	0 (0 to 3.74)	-	0 (0 to 7.20)
Storm-Petrels	Spring	0 (0 to 1.36)	0.12 (0 to 0.12)	0.08 (0 to 6.66)
	Summer	0.78 (0 to 12.74)	0 (0 to 0.21)	0.17 (0 to 8.46)
	Fall	0.02 (0 to 1.47)	0 (0 to 0)	0.26 (0 to 4.41)
	Winter	0 (0 to 0)	-	0 (0 to 0.04)
Northern Gannets	Spring	0.40 (0 to 1.03)	0.94 (0 to - 0.94)	0 (0 to 2.75)
	Summer	0 (0 to 1.69)	0.42 (0 to 1.37)	0 (0 to 3.31)
	Fall	0.19 (0 to 2.83)	2.42 (0.88 to 2.42)	0 (0 to 0.83)
	Winter	0.04 (0 to 0.22)	-	0 (0 to 0)
Large Gulls	Spring	1.22 (0 to 21.33)	0.34 (0 to 0.64)	0.74 (0 to 23.43)
	Summer	0.08 (0 to 8.39)	0.40 (0.16 to 1.70)	0.16 (0 to 9.38)
	Fall	0.58 (0 to 2.86)	0.93 (0.28 to 0.93)	0.13 (0 to 4.51)
	Winter	0.62 (0 to 2.31)	-	0.95 (0 to 20.83)
Black-legged Kittiwakes	Spring	0.06 (0 to 3.74)	0.50 (0 to 0.50)	0.72 (0 to 7.06)
	Summer	0 (0 to 0.76)	0.14 (0 to 2.34)	0.38 (0 to 7.87)
	Fall	0.11 (0 to 1.39)	0.79 (0.15 to 5.81)	0.05 (0 to 14.81)
	Winter	1.96 (0 to 21.31)	-	2.45 (0 to 19.93)
Dovekies	Spring	0.71 (0 to 36.98)	0 (0 to 0)	0.59 (0 to 32.10)
	Summer	0 (0 to 2.68)	0 (0 to 0.25)	0.18 (0 to 47.62)
	Fall	0 (0 to 0.25)	0.10 (0.10 to 4.37)	0.20 (0 to 35.76)
	Winter	2.13 (0 to 10.93)	-	0.93 (0 to 11.20)

Table 5.8 Seasonal Weighted Median (and Range) of Seabird Densities (birds/km²) in each of the Marine Ecoregions of Atlantic Canada

Species	Season	Scotian Shelf - Gulf of Maine	Gulf of St. Lawrence	Newfoundland and Labrador Shelves
Murres	Spring	0.88 (0 to 4.37)	0.74 (0 to 2.33)	3.73 (0 to 12.49)
	Summer	0.06 (0 to 2.60)	0.65 (0 to 4.62)	1.79 (0 to 46.57)
	Fall	0 (0 to 0.14)	0 (0 to 0.11)	0.07 (0 to 11.59)
	Winter	0.61 (0 to 7.71)	-	3.05 (0 to 15.21)
Other Alcids	Spring	0.14 (0 to 1.53)	0.20 (0 to 0.20)	0.25 (0 to 9.36)
	Summer	0.04 (0 to 0.91)	0.11 (0 to 4.03)	0.13 (0 to 13.06)
	Fall	0.05 (0 to 0.65)	0.04 (0.04 to 1.12)	0 (0 to 3.16)
	Winter	0.37 (0 to 4.69)	-	0.36 (0 to 3.45)

Source: Modified from Fifield *et al.* 2009

Data indicate that high concentrations of seabirds may be encountered throughout the Gulf during the fall (Figure 5.4). The high abundances observed during this time are expected to primarily reflect the departure of adults and newly fledged young from local seabird colony sites and as well as an influx of wintering species. ECSAS and PIROP data suggest that the most abundant species near the RAA during the fall are herring gull, great shearwater, northern fulmar, northern gannet, great black-backed gull (*Larus marinus*), and black-legged kittiwake. The Gulf is an important nesting area for both northern gannet and black-legged kittiwake and the presence of these species in the area during fall would include fledged young and adults tarrying in the Gulf before migrating. Concentrations of seabirds observed in the Gulf during fall would reflect the presence of migratory species and may also reflect other factors such as higher productivity and prey availability. During migration, the Cabot Strait is a likely migration pathway for pelagic seabirds moving to and from more southern localities, and waterbirds which breed in more northern latitudes may be concentrated in the vicinity of the Strait of Belle Isle. Data from Fifield *et al.* (2009) suggest that the overall abundance of seabirds in the portions of the Gulf that were surveyed were higher than those recorded in the Scotian Shelf-Gulf of Maine and the Newfoundland and Labrador Shelf (Table 5.8). Data indicate that this is largely attributable to the fact that large numbers of northern gannet are not present in these other areas during the fall and higher concentrations of great shearwater are present near the southeastern extent of the Gulf during the fall than in either the Scotian Shelf or the Grand Banks (Fifield *et al.* 2009).

Although the spatial extent of the survey efforts is limited for the winter months, available data indicate that high concentrations of seabirds have been encountered in association with the west coast of Newfoundland during this season (Figure 5.4). ECSAS and PIROP data indicate that relatively high concentrations of gulls occur in the vicinity of the RAA during winter months, particularly black-legged kittiwake, great black-backed gull, and Iceland gull. Other species that may be commonly observed during this season include murres, northern fulmar, dovekie, glaucous gull, herring gull, and other gulls. Much of the Gulf is typically ice-covered by the end of January and seabirds would tend to concentrate in areas of open water.

Although survey efforts were comparatively minimal compared to fall and summer surveys, available data demonstrate that there are high concentrations of seabirds in portions of the Gulf during spring (Figure 5.4). ECSAS and PIROP data indicate that herring gull, black-legged kittiwake, and common murre are the most commonly observed near the RAA. Data from Fifield *et al.* (2009) suggest that seabird concentrations in the eastern Gulf during spring months are lower than in either the Scotian Shelf-Gulf of Maine and the Newfoundland and Labrador Shelf ocean regions (Table 5.8). However, large concentrations of seabirds during late spring are concentrated in colonies and in their seaward extensions and observations during ship-based surveys may not be necessarily indicative of their abundance within the region.

The timing of bird presence in the Gulf varies by species, particularly their breeding and migratory patterns and life history strategies. Table 5.9 provides information on the seasonal occurrence of seabirds in the Gulf of St. Lawrence. Figures on the seasonal distribution of individual species and guilds within the RAA, as indicated by ship-based surveys, are provided in Appendix B.

Table 5.9 Seasonal Distribution of Seabirds in the Gulf of St. Lawrence[1]

Common Name	Seasonal Occurrence in the Gulf of St. Lawrence[2]
Northern Fulmar	Present year-round. Most abundant in spring and summer.
Shearwater (Great, Sooty and Manx)	Most abundant in summer but present in spring - fall. Do not breed in Gulf.
Wilson’s Storm-Petrel	Present spring – fall, most abundant in summer, breed in the southern hemisphere.
Leach’s Storm-Petrel	Present spring – fall, most abundant in summer. Breeds in the Gulf region.
Northern Gannet	Arrive at breeding colonies in April, abundant through summer and fall. Generally absent in winter.
Great Cormorant	Most abundant in summer and fall. Some overwinter in Gulf but the majority migrate south.
Double-crested Cormorant	Most abundant in summer and fall, breed throughout the Gulf region.
Phalaropes (Red-necked and Red Phalarope)	Present in spring, summer and fall, most abundant during fall migration. Do not breed in Gulf.
Jaegers (Long-tailed, Parasitic and Pomarine Jaeger)	Present as migrants during spring to fall.
Great Skua	Uncommon but could be encountered at any time of year; most common in winter.
Black-headed Gull	Present year-round but most common in winter.
Bonaparte’s Gull	Present year-round but most common in winter.
Ring-billed Gull	Present year-round. Breeds in isolated areas.
Herring Gull	Present year-round, breeds throughout.
Thayer's Gull	Present in winter, does not breed in Gulf region.

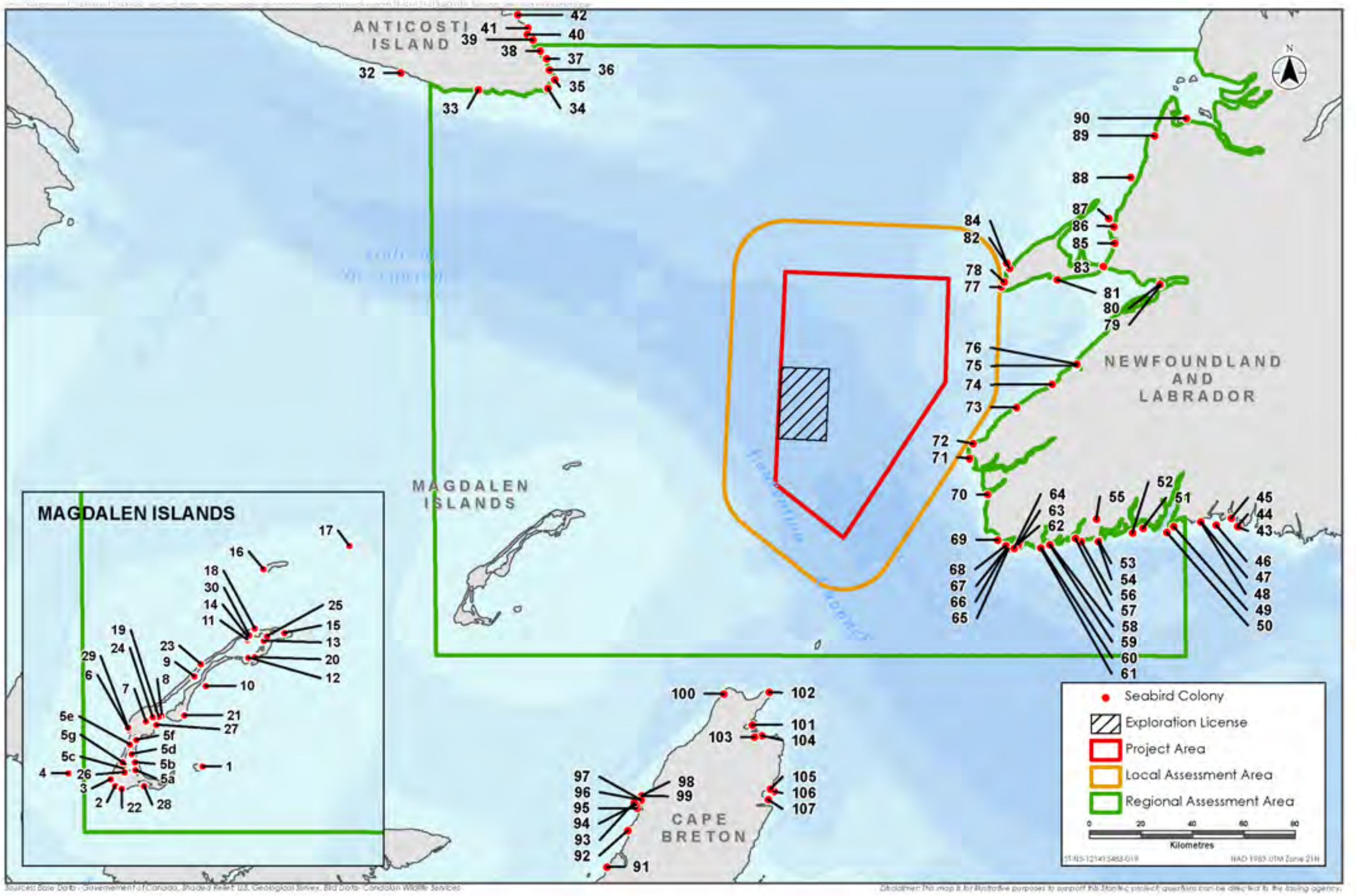
Table 5.9 Seasonal Distribution of Seabirds in the Gulf of St. Lawrence[1]

Common Name	**Seasonal Occurrence in the Gulf of St. Lawrence[2]**
Iceland Gull	Present in winter, does not breed in Gulf region.
Glaucous Gull	Present in winter, does not breed in Gulf region.
Great Black-backed Gull	Present year-round, breeds throughout.
Black-legged Kittiwake	Present year-round, breeds.
Ivory Gull	Present in winter, does not breed in Gulf region.
Terns (Common, Arctic, Roseate, and Caspian)	Present spring - fall. Common, Arctic, and Roseate terns breed in the Gulf region.
Dovekie	Most abundant in late fall and early winter, does not breed in Gulf region.
Common Murre	Present year-round, breeds.
Thick-billed Murre	Present year-round, breeds.
Razorbill	Present year-round, breeds.
Black Guillemot	Present year-round, breeds.
Atlantic Puffin	Present in spring, summer and fall. Colonial nester in late spring and summer

[1]Adopted from Stantec (2013); excluding rare transients / vagrants, except for species at risk which are known to occasionally occur (*e.g.*, Ivory Gull).
[2] Determined with reference to PIROP (Programme intégre de recherches sur les oiseaux pélagiques) and Eastern Canadian Seabirds at Sea (ECSAS) data

5.2.5.3 Seabird Colonies

The Gulf of St. Lawrence and adjacent areas of the Atlantic Ocean support hundreds of colonies of nesting seabirds, ranging in size from a few individuals to thousands of breeding pairs. For example, The Gazetteer of Marine Birds in Atlantic Canada (Lock *et al.* 1994) lists 136 known colonies of seabirds in the Gulf which are considered “vulnerable” to the effects of oil pollution as well as 69 tern colonies. More recent Canadian Wildlife Service (CWS) data (contained in Stantec 2013) indicate that there are additional sites for “vulnerable” seabirds, terns, and gulls within the region. Seabird colonies are distributed in patches within the Gulf, with particularly high abundances of birds being found in association with the Magdalen Islands, the Gaspé Peninsula, the northern shore of Anticosti Island, and parts of the lower north shore of Quebec (refer to Figure 5.5).



Modified from Stantec (2013)

Figure 5.5 Location of Seabird Colonies near the RAA, including the Magdalen Islands, Western Newfoundland, Southern Newfoundland, Cape Breton Island, and the Southern Portion of Anticosti Island

Amongst the largest individual colonies in the Gulf are Bonaventure Island (Gaspé Peninsula), Rochers aux Oiseaux (Magdalen Islands), Falaise aux Goélands (Anticosti Island), Presqu'ile de Forillon (Gaspé Peninsula), and Refuge des Îles Sainte-Marie (lower north shore of Quebec), each of which has been documented to contain over 10,000 breeding pairs (Lock *et al.* 1994). Other sites (including groupings of neighbouring islands) in the Gulf that have hosted and potentially could host 10,000 pairs of seabirds include: Île du Corossol, Archipel Mingan, Refuge de la Baie des loups, Refuge de la Baie de Brador, Île Blanche, Île Bicquette, Île aux Pommes, and Battures aux Loups-Marins in Quebec (EC-CWS, unpublished data, pers. comm. 2012). Additionally, Tabusintac in New Brunswick is considered to have historically hosted 10,000 pairs of breeding seabirds (EC-CWS, unpublished data, pers. comm. 2012). Of particular note is the presence of three northern gannet colonies (Bonaventure Island, Falaise aux Goelands and Rocher aux Oiseaux), which represents half of the northern gannet colonies and 69 percent of all the breeding pairs in Canada (Chardine 2000).

The locations of colonies along coastal portions of the Gulf and adjacent areas of the Atlantic that are in closest proximity to the RAA are provided in Figure 5.5.5, and include the Magdalen Islands, western Newfoundland, southern Newfoundland, Cape Breton Island, and the southern portion of Anticosti Island. Data on the types and abundances of species that are supported by each of these colonies has been provided in Table 1 in Appendix B.

Of the coastal areas in closest proximity to the RAA, the Magdalen Islands supports the greatest concentration of breeding seabirds. More than 30 colonies are distributed throughout the archipelago, the largest of which are Rochers aux Oiseaux colony, Île Brion, Île d'Entrée, Île du Chenal, Havre-aux-Basques, and Île Shag, each of which support more than 2000 individuals (Table 1, Appendix B). The most abundant species within the colonies of the Magdalen Islands include northern gannet, black-legged kittiwake, common murre, common tern, razorbill, black guillemot, great black-backed gull, and herring gull (Table 1, Appendix B). The colonies of the Magdalen Islands also support breeding roseate terns (*i.e.*, particularly the Île du Chenal and the Pointe de l'Est colonies) and other species of conservation concern (Table 1, Appendix B).

Anticosti Island is known to support approximately 27 seabird colonies (EC-CWS 2013; cited in Stantec 2013). The largest of these (Falaise aux Goélands) supports particularly high amounts of black-legged kittiwakes (*i.e.*, 18,000 individuals). Other species which are supported by colonies of Anticosti Island include black guillemot, northern gannett, and double-crested cormorant, along with lesser amounts of razorbill, great cormorant, greater black-backed gull, and Atlantic puffin (EC-CWS 2013; cited in Stantec 2013).

With the exception of the Magdalen Islands, coastal areas in the southeastern portion of the Gulf (including Cape Breton and southwestern Newfoundland) do not support as large a number of seabirds as other areas. The comparatively low numbers of certain types of seabirds on the west coast of Newfoundland and other areas of the southeastern Gulf may be attributable to a general lack of suitable nesting sites and the relatively low productivity of the waters along the coast. However, this portion of the Gulf does provide important nesting habitat for particular species. In particular, the North American population of great cormorant is centered in the eastern part of the Gulf, with the largest concentrations occurring in association with Cape Breton Island (Lock *et al.* 1994).

Available data indicate that there are 20 seabird colonies distributed within the portion of the west coast of Newfoundland that are within the vicinity of the RAA (*i.e.*, as identified in Figure 5.5). These colonies include those found at Shaol Point, Codroy Island, Grebes Head, Wreck Cove, Ship Cove, Crabbe River estuary (Unit 1 and 2), Cliff N of Cape St. George, Cliff S. edge of Big Cove, St. Georges River, Sandbar in St. Georges River, Ship Island, Cape Cormorant, Gravels Pond Island, Red Island, Point Au Mal, Fox Island River, Fox Island, Shag Island, and White Rocks (Figure 5.5 and Table 1, Appendix B). These colonies are known to support nesting black-legged kittiwakes, cormorants, common terns, and gulls. The two largest of these colonies (both of which are located at Cape St. George) support relatively high numbers of black-legged kittiwakes (*i.e.*, 501-1000 pairs at "Cliff North of Cape St. George" and >100 pairs at "Cliff South edge of Big Cove"). Cormorants are present at five of the colonies with the estimated number of breeding pairs being less than 500 for each of these sites. Common terns nest at six of the sites and gulls at nine locations (Table 1, Appendix B). The other colonies along the west coast of Newfoundland primarily support common terns and various species of gulls whereas those along the southern shore of Newfoundland support (in decreasing order of overall abundance) Leach's storm-petrel, cormorants, greater black-backed gull, common tern, ring-billed gull, herring gull, black guillemot, black-headed gull, and black-legged kittiwake (Table 1, Appendix B).

Colonies along the Gulf shore of Cape Breton Island primarily support herring gulls, greater black-backed gulls, cormorants, and terns, with lesser amounts of black guillemots also being present (Table 1, Appendix B). The greatest concentrations of nesting seabirds along the Gulf coast of Cape Breton are located near Cheticamp, which primarily support nesting gulls (Table 1, Appendix B). However, relatively large amounts of cormorants are found in colonies along the Cape Breton Coast. For example, over 250 great cormorants have been counted at the Capes and the colony at Ingonish Island is considered to support over 250 pairs. In addition to these sites, the more eastern portion of Cape Breton contains the colonies of the Bird Islands where the largest colony of great cormorants in North America is located. Several other seabirds nest on the cliffs of the Bird Islands, with the largest concentration of black-legged kittiwakes, razorbills and Atlantic puffins within Nova Scotia. A few hundred nesting pairs of double-crested cormorants and black guillemots are also present on the Bird islands, and Leach's storm-petrels also breed there (IBA Canada 2012).

5.2.5.4 Important Bird Areas

Important Bird Areas (IBAs) support groups of birds, including threatened birds, large groups of birds and birds restricted by range or by habitat and are of various size consisting of terrestrial and marine habitat. Table 5.10 provides a summary of the IBAs in the RAA; many of which encompass seabird colonies described in Section 5.2.5.3.

Table 5.10 Important Bird Areas in the RAA

Location	Site ID	Size (km^2)	Important Bird Area	Bird Species
Insular Newfoundland				
Port aux Basques	NF038	40.3	Grand Bay West to Cheeseman Provincial Park Beach	Piping Plover
Doyles	NF040	35.5	Codroy Valley	Black Guillemot, Common Tern, Glaucous Gull
Doyles	NF041	13.6	Codroy Valley Estuary	American Black Duck, American Green-winged Teal, American Wigeon, Blue-winged Teal, Canada Goose, Common Goldeneye, Common Merganser, Greater Scaup, Northern Pintail, Northern Shoveler, Red-breasted Merganser, Ring-necked Duck, Piping Plover
Nova Scotia				
St. Paul Island	NS032	20.3	St. Paul Island	Leach’s Storm-Petrel
Québec				
Magdalen Islands	QC003	32.8	Lagune du Havre aux Basques et Plage de l'Ouest	American Black Duck, Arctic Tern, Black-bellied Plover, Black-headed Gull, Caspian Tern, Common Tern, Great Cormorant, Greater Yellowlegs, Hudsonian Godwit, Least Sandpiper, Lesser Yellowlegs, Piping Plover, Red Knot (Low Arctic), Roseate Tern, Semipalmated Plover, Semipalmated Sandpiper, Shorebirds, Short-billed Dowitcher, Whimbrel, White-rumped Sandpiper
Magdalen Islands	QC004	3.3	Île Shag	Black Guillemot, Black-legged Kittiwake, Great Black-backed Gull, Great Cormorant, Herring Gull
Magdalen Islands	QC005	7.2	Plages de la Martinique et de Havre-Aubert	Common Tern, Piping Plover
Magdalen Islands	QC006	12.3	Les Rochers aux Oiseaux	Atlantic Puffin, Black-legged Kittiwake, Common Murre, Northern Gannet, Razorbill, Thick-billed Murre
Magdalen Islands	QC007	16.6	Île Brion	Arctic Tern, Atlantic Puffin, Black Guillemot, Black-legged Kittiwake, Common Eider, Common Murre, Common Tern, Great Black-backed Gull, Great Cormorant, Herring Gull, Horned Grebe, Leach's Storm-Petrel, Merlin, Northern Gannet, Piping Plover, Razorbill

Table 5.10 Important Bird Areas in the RAA

Location	Site ID	Size (km²)	Important Bird Area	Bird Species
Magdalen Islands	QC009	31.4	Île de l'Est	American Black Duck , American Golden-Plover, Arctic Tern, Black-bellied Plover, Blue-winged Teal, Caspian Tern, Common Tern, Common/Arctic Tern, Great Black-backed Gull, Greater Scaup, Greater Yellowlegs, Herring Gull, Horned Grebe, Least Sandpiper, Lesser Yellowlegs, Northern Gannet, Piping Plover, Red-breasted Merganser, Ring-necked Duck, Roseate Tern, Sanderling, Semipalmated Sandpiper, Short-billed Dowitcher, Whimbrel, White-rumped Sandpiper
Magdalen Islands	QC012	20.6	Plage de l'Hopital	Piping Plover
Magdalen Islands	QC013	2.9	La Pointe	Piping Plover
Magdalen Islands	QC015	4.6	Bassin aux Huitres	Piping Plover
Magdalen Islands	QC022	0.2	Île Paquet	Common Tern, Common/Arctic Tern, Great Black-backed Gull, Herring Gull, Roseate Tern
Magdalen Islands	QC024	23.2	Dune du Sud	Great Cormorant, Northern Gannet, Piping Plover
Magdalen Islands	QC026	4.2	Ilot C	Common Tern, Great Black-backed Gull, Herring Gull, Horned Lark, Northern Gannet, Northern Pintail, Piping Plover, Roseate Tern, Semipalmated Plover
Magdalen Islands	QC027	1	Île aux Loup Marins	Double-crested Cormorant, Great Black-backed Gull, Great Blue Heron, Herring Gull
Anticosti Island	QC058	52.6	Falaise aux Goelands / Pointe de l'Est	Atlantic Puffin, Black-legged Kittiwake, Common Murre, Great Cormorant, Northern Gannet
Source: http://www.ibacanada.com				

There are no IBAs located within the Project Area, but there are several IBAs in the RAA that support large colonies of seabirds and/or species at risk (refer to Figure 5.6 in Section 5.2.7). For example, Rocher aux Oiseaux at the northeastern edge of the Magdalen Island Archipelago (QC006), which is also a designated Migratory Bird Sanctuary, supports a large seabird colony, including northern gannets, black-legged kittiwakes and common murres. There is also a large seabird colony on Île Brion (QC007) consisting mainly of black-legged kittiwakes, along with smaller numbers of black guillemots, Atlantic puffin, razorbill, great cormorants and common murres. Coastal sites of the Magdalen Islands and western Newfoundland are known to support the *endangered* piping plover, and the *endangered* horned grebe and roseate tern also breed in association with the Magdalen Islands.

The closest IBAs to the Project Area is the Codroy Valley Estuary (NF041) in western Newfoundland. The Codroy Valley Estuary is an important breeding and staging site for numerous waterfowl species in insular Newfoundland.

5.2.6 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 SARA schedule 1 are legally protected under the Act, which states under Section 32(1), "*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). COSEWIC is a body of experts assembled to assess species at risk, and provide designations that inform the SARA.

There are 22 marine fish species at risk that have been known to occur within or immediately adjacent to the RAA, six of which have more than one assessed population with the potential to occur (Table 5.11). Four of these species are listed under Schedule 1 of SARA, including one *endangered* species, two *threatened* species, and one designated as being of *special concern* (Table 5.11). Many of the species or populations that may occur within the RAA are considered to have low to moderate potential to occur within the Project Area because they occur infrequently and/or in low abundance. Marine fish that are considered to have relatively high potential to occur in the Project Area (*i.e.*, the Project Area overlaps with known concentrations of species) include the Atlantic (striped) wolffish, Atlantic cod (Laurentian South population), deepwater redfish (Gulf of St. Lawrence - Laurentian Channel population), Acadian redfish (Atlantic population), American plaice (Maritime population), and white hake (Southern Gulf of St. Lawrence, Atlantic and Northern Gulf of St. Lawrence populations). Many at-risk fish species which occur in the RAA, such as roundnose grenadier, roughhead grenadier, white hake, redfish, and wolffish are anticipated to spawn or mate outside the winter season and spawning activities occur at variable depths (Scott and Scott 1988; LGL 2005a; Rodger 2006; FishBase 2010). Critical habitat has not been identified within the Project RAA for any of the marine fish species at risk.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Marine Fish					
White Shark (Atlantic population)	*Carcharodon carcharias*	Endangered	Endangered	Low	White sharks inhabit waters ranging from the sub-Arctic to tropical regions and have been observed to undergo long distance migrations. They can inhabit coastal and offshore waters, can be found at the surface to depths of 1,280 m, and can tolerate temperatures in the range of 5°C to 27°C. They are most often observed in Canadian waters during August and September but their existence and behavior in the North Atlantic is currently poorly understood (DFO 2006b). There have only been 32 recorded sightings of white shark in Atlantic Canada over 130 years, with most being in the Bay of Fundy and very few in the Gulf region (COSEWIC 2006).
Porbeagle Shark	*Lamna nasus*	Endangered	No Status	Moderate	A cold-temperate pelagic shark found on continental shelves in water between 5°C and 10°C. Migrant in Atlantic Canadian waters. May be found in the Project Area from May to late fall. This species is most often caught in water depths of 35 to 100 m. Mating occurs in late summer to early fall, and birthing occurs in late winter or spring (Campana *et al.* 2003). They feed primarily on groundfish in the fall and pelagic and cephalopod species in the spring.
Shortfin Mako Shark (Atlantic population)	*Isurus oxyrinchus*	Threatened	No Status	Low	A pelagic species which migrates north following food stocks (*i.e.*, mackerel, herring, tuna) and may pass through the Project Area. Any occurrence would be transient in nature. Highly migratory, distribution pattern is dependent on water temperature, but it can withstand substantial changes in temperature as well as food availability. They are ovovivipourous, with a 15 to 18 month gestation period and an estimated 3 year parturition cycle. On average females will give birth to 11 pups every three years and have a theoretical maximum age of 45 (Campana *et al.* 2006).

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Basking Shark (Atlantic population)	*Cetorhinus maximus*	Special Concern	No Status	Low	Found in offshore waters and coastal waters of Newfoundland concentrated between Port aux Basques and Hermitage. May be present within the Project Area feeding on plankton. The Canadian population ranges from approximately 5,000 to 10,000 individuals (COSEWIC 2009b). Believed to be ovoviviparous giving birth during the summer after a gestation period of 2.5 to 3.5 years (Campana *et al.* 2008).
Northern Wolffish	*Anarhichas denticulatus*	Threatened	Threatened	Low	Found in cold continental shelf waters; most commonly inhabiting the seafloor in water depths of 500 to 1,000 m, although they can be found at shallower depths up to the surface (COSEWIC 2012a). Most abundant in the deep waters off northeastern Newfoundland and on the Labrador Shelf and to a lesser extent along the shelf edge of the Grand Bank; only occasionally observed in the Gulf of St. Lawrence (COSEWIC 2012a). They are non-migratory and spawn in the fall; larvae may be present on the seafloor in fall to early winter (Kulka *et al.* 2007).
Spotted Wolffish	*Anarhichas minor*	Threatened	Threatened	Moderate	Bottom-dwelling predatory fish found in cold continental shelf waters, most commonly inhabiting the seafloor in water depths of 200 to 750 m (COSEWIC 2012b). They spawn in summer; eggs/larvae may be present on the seafloor in summer to fall (Kulka *et al.* 2007). Occurs in low densities throughout the majority of the Project Area, but relatively abundant in northeast near St. Georges bay (AMEC 2014).

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Atlantic (striped) Wolffish	*Anarhichas lupus*	Special Concern	Special Concern	Moderate - High	Occupies different habitats depending on its life stage: the eggs are deposited on the bottom, the larvae are pelagic, and the juveniles and adults inhabit near-bottom waters (COSEWIC 2012c). In the Gulf of St. Lawrence, adults occur primarily in coastal areas and on the edge of deep channels and avoids the bottoms of deep channels (Dutil *et al.* 2010). Typically occupy depths less than 150 m in the Gulf of St. Lawrence, but are known to occur at depths to 918 m within Atlantic Canada (COSEWIC 2012c). Prefers temperatures between -0.4°C and 6.0°C, over rocky and sand bottoms (AMEC 2014). Undergo short migrations to spawning in shallow waters during the fall; eggs / larvae may be present on seafloor in fall to early winter (COSEWIC 2012c).
Atlantic Bluefin Tuna	*Thunnus thynnus*	Endangered	No Status	Moderate	Seasonal migrants; there is a commercial fishery in the southern Gulf of St. Lawrence. Form small schools that arrive in summer to feed and migrate south in late fall. They tolerate a wide temperature and depth range. Canadian waters provide feeding grounds only (COSEWIC 2011b).
Atlantic Cod (Laurentian North population)	*Gadus morhua*	Endangered	No Status	Moderate	Cod are a groundfish that feed on fish and shellfish, including capelin, herring, flounder, mussels, and crab. Eggs and larvae are planktonic until they reach a size of approximately 25 to 50 mm and are primarily zooplankton feeders; once they settle,

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Atlantic Cod (Laurentian South population)		Endangered	No Status	High	their primary food source are benthic and epibenthic invertebrates (Scott and Scott 1988). Benthopelagic species that inhabits coastal waters as juveniles. Adults prefer deeper waters up to 500 m. Resident populations are also located within the coastal waters of Newfoundland. Eggs and larvae may be present in upper water column from May to April. Benthopelagic species that migrates from the southern Gulf to the waters of Cape Breton between May to October. The population is distributed throughout the southern Gulf during the summer and overwinters along the side of the Laurentian Channel, with dense aggregations typically occurring in the Laurentian Channel north of St. Paul Island. The entire population is known to use two migration routes, the Cape Breton Trough and the southern slope of the Laurentian Channel and thus can be found in proximity to the Project Area during the spring and fall.
Atlantic Salmon (Anticosti island population)	*Salmo salar*	Endangered	No Status	Low	Atlantic salmon are anadromous; they live in freshwater rivers for their first one to two years before migrating to the sea. They return to their natal river or tributary for spawning. While at sea, they feed on euphausiids, amphipods and fishes such as herring, capelin, small mackerel, sand lance and small cod. They are prey for seals, sharks, pollock (*Pollachius* spp.) and tuna (Scott and Scott 1988). Juveniles migrating from freshwaters streams to the North Atlantic may pass through the Project Area, with any presence being transient in nature.
Atlantic Salmon (South Newfoundland population)		Threatened	No Status	Low	

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Atlantic Salmon (Gaspé-Southern Gulf of St. Lawrence population)		Special Concern	No Status	Moderate	
Atlantic Salmon (Inner St. Lawrence population)		Special Concern	No Status	Moderate	
Atlantic Salmon (Quebec Eastern North Shore population)		Special Concern	No Status	Moderate	
Atlantic Salmon (Quebec Western North Shore population)		Special Concern	No Status	Moderate	
Cusk	*Brosme brosme*	Endangered	No Status	Low	A cod-like fish that can live up to 20 years and grow to a length greater than 100 cm, with at least half of the adults reaching sexual maturity when they are approximately 50 cm in length (five or six years old). They are usually located at depths of 150 to 400 m in relatively warm water (6ºC to 10ºC) (COSEWIC 2012d). Commonly found between the Gulf of Maine and southern Scotian Shelf. Rare along the continental shelf off Newfoundland and Labrador. Very rare within the Gulf.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Deepwater Redfish (Gulf of St. Lawrence - Laurentian Channel population)	*Sebastes mentella*	Endangered	No Status	High	A slow growing, ovoviviparous species with a maximum age of 75 years in some individuals (DFO 2011b). Mating takes place in the fall (September to December) and spawning occurs from April to July (LGL 2005b). Fecundity ranges from 1,500 to 10,700 offspring. Larvae feed mainly on fish eggs and invertebrate eggs (DFO 2011b). Juvenile and adult fish feed mainly on copepods, euphausids and fish species. Juvenile redfish are pelagic for four to five months and can be found at depths from 75 to 175 m. Adults can be commonly found at depths ranging from 100 to 700 m. Adults generally inhabit areas near the bottom, but are considered semi-pelagic as they venture vertically at night to follow prey. Closely associated with the seafloor and commonly found inhabiting waters 350 to 500 m in depth (Atkinson 1987) in the Gulf / Laurentian Channel. Mature individuals expected to occur in the Project Area from May to October. Mating occurs in fall with spawning occurring from April to July.
Acadian Redfish (Atlantic population)	*Sebastes fasciatus*	Threatened	No Status	High	This slow growing, long-lived species is closely associated with the seafloor and commonly found inhabiting waters 150 to 300 m in depth (Atkinson 1987). Mating occurs in fall with spawning occurring from May to August. Juvenile and adult fish feed mainly of copepods, euphausids, and fish (DFO 2011b). Live at depths of 150 to 300 m and could occur in the Project Area from May to October.
Roundnose Grenadier	*Coryphaenoides rupestris*	Endangered	No Status	Low	Inhabits the Northwest Atlantic's continental slops and is associated with the seafloor. Most commonly found inhabiting waters from 400 to 1,200 m in depth (COSEWIC 2008b). Non-migratory spawning occurs in fall. This is a long-lived, slow growing species. Could occur at any time of the year.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Roughead Grenadier	*Macrourus berglax*	Special Concern	No Status	Low	Abundant throughout the North Atlantic and can be located on both the shelf and continental slope (González-Costas and Murua 2007). In the Northwest Atlantic, it shows a continuous distribution along the slope of the continental shelf from the Davis Strait to the southern Grand Bank (COSEWIC 2007a). Closely associated with the seafloor and commonly found in water depths of 400 to 1,300 m on or near the continental slope of the Newfoundland and Labrador Shelves from the Davis Strait to the southern Grand Banks. Spawning may occur within the southern Grand Banks.
Winter Skate (Gulf of St. Lawrence population)	*Leucoraja ocellata*	Endangered	No Status	Moderate	Winter Skate are endemic to the Northwest Atlantic and are found from the northern Gulf of St. Lawrence and Southern Newfoundland to Cape Hatteras, North Carolina. In Canadian waters, they are concentrated in three areas: the Gulf of St. Lawrence, Eastern Scotian Shelf/Southern Newfoundland, and the Western Scotian Shelf/Bay of Fundy/Canadian portion of Georges Bank (COSEWIC 2015). This bottom dwelling fish prefers sand and gravel bottoms and is most common at depths less than 111m, but may occur in depths up to 371 m (COSEWIC 2015). Spawning occurs in the later summer or early fall; winter skate lay egg cases and emerge as juveniles. Their diet consists of various shellfish, amphipods, and small fish (COSEWIC 2015). Over the last three generations, the abundance of mature Winter Skate in the Gulf of St. Lawrence was estimated to have declined by 99% (COSEWIC 2015). Abundance of mature individuals in the Southern Gulf of St. Lawrence is at a historically low level, averaging 50,000 adults in surveys conducted over the past five years (2009-2013). Similar surveys completed from 1971-1975 averaged 3,160,000 adults (DFO 2016a).

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
American Eel[3]	*Anguilla rostrata*	Threatened	No Status	Low - Moderate	Generally live in fresh water and only travel to the sea to spawn. In marine habitats, they prefer shallow protected waters. Benthic features are important in providing cover. Adults migrating from freshwater streams to the Sargasso Sea may pass through the Project Area. Any presence would be transient in nature.
American Plaice (Newfoundland and Labrador population)	*Hippoglossus platessoides*	Threatened	No Status	Low	Prefers depths of 100 to 200 m and sediment suitable for burrowing. Exhibit a seasonal pattern, inhabiting intermediate depths from 80 to 250 m and cold water temperatures (0°C to 1.5°C) during the summer months (Morin *et al.* 2008). During the winter months, the species moves into the deeper channel waters, where they occupy warmer water and cease feeding. Closely associated with the seafloor; commonly found in water depths of 100 to 300 m where sandy/shell fragmented sediments are present. The Newfoundland and Labrador population is located from the Grand Banks north and to the northern tip of Newfoundland.
American Plaice (Maritime population)		Threatened	No Status	High	Closely associated with the seafloor and commonly found in water depths of 100 to 300 m where sandy/shell fragmented sediments are present. Overwinter in the deep waters of the Laurentian Channel and migrate to the shallow waters off the Magdalen Islands to spawn in April and May. Larvae may be present in the water column between May and June.
Atlantic Sturgeon (St. Lawrence populations)	*Ancipenser oxyrinchus*	Threatened	No Status	Low	Highly migratory species capable of travelling great distances and are spread out along the east coast of North America and over the continental shelf regions to at least 50 m depths. Large-bodied, slow-growing, late-maturing anadromous fish

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Atlantic Sturgeon (Maritimes populations)		Threatened	No Status	Low - Moderate	that occurs in rivers (preferably with deep channels), estuaries (with relatively warm and partially saline water), nearshore marine environments and shelf regions to at least 50 m. The St. Lawrence Designated Unit has an estimated 500 to 1,000 adults. Breeding populations are known from the St. Lawrence River and possibly other rivers tributary to the St. Lawrence river. Potential spawning locations occur in the St. Lawrence River and Estuary (COSEWIC 2011c). Population could pass through as transient. The Maritimes Designated Unit has an estimated 1,000 to 2,000 adults (minimum), spawning only occurs within the lower Saint John River area. Project Area overlaps with the extant of occurrence for Maritimes population.
Striped Bass (Southern Gulf of St. Lawrence population)	*Marone saxatilis*	Special Concern	No Status	Low	Females usually spawn at age five (although they can mature at age four) and males mature at year three or four. Spawning occurs in late May or early June, in freshwater and brackish water of the rivers inhabited by each population, triggered by increasing temperatures (+10°C). Development from egg to young-of-the-year corresponds to a gradual movement to salt water. Once yolk sacs are depleted, the larvae feed on zooplankton for approximately one month. Immature and adult striped bass frequent coastal and estuarine habitats. For the first two years, they feed primarily on invertebrates, gradually becoming piscivorous (COSEWIC 2004). During the summer months, migrations are associated with the availability of prey. During the fall, they will migrate upstream to prepare for overwintering in brackish and freshwater. Scientific evidence suggests that populations currently exist in only two Canadian rivers: the Shubenacadie, which flows into the Bay of Fundy; and the Miramichi River, which flows into the southern Gulf of St. Lawrence. The St. Lawrence estuary population is considered extirpated.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
White Hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*	Threatened	No Status	Moderate - High	Slow-swimming cod-like fish that can grow up to approximately 135 cm in length 22 kg in weight (COSEWIC 2013a). Peak spawning for this Designatable Unit occurs from early spring and summer in offshore deep waters (COSEWIC 2013a). This Designatable Unit occurs in the Scotian Shelf, Northern Gulf of St. Lawrence, and Southern Newfoundland.
White Hake (Southern Gulf of St. Lawrence population)		Endangered	No Status	Moderate - High	Slow-swimming cod-like fish that can grow up to approximately 135 cm in length 22 kg in weight (COSEWIC 2013a). Peak spawning for this Designatable Unit occurs from June to September, with peak spawning in mid-June in shallow inshore waters (COSEWIC 2013a). This Designatable Unit occurs in the Southern Gulf of St. Lawrence.
Spiny Dogfish (Atlantic population)	*Squalus acanthias*	Special Concern	No Status	Low	The species can be found inhabiting depths ranging from 0 to 350 m and temperatures from 0 to 12 °C. The spiny dogfish is ovoviviparous with a reproduction cycle lasting two years. Pupping grounds for the species have not been observed. Large aggregations of mature females occur in the deep warm waters off the edge of the continental shelf or in the deep basins of the Scotian Shelf in the winter months. It is believed that pupping occurs in late winter in these locations (Campana *et al.* 2008). Commonly found from the intertidal zone to the continental slope in water depths up to 730 m. Most abundant between Nova Scotia and Cape Hattaras.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Blue Whale (Atlantic population)	*Balaenoptera musculus*	Endangered	Endangered	Moderate - High	During spring, summer and fall, inhabits both coastal and open ocean waters of the north shore of the Gulf and off eastern Nova Scotia, where they are frequently observed in highly productive coastal waters feeding on krill, their primary food source. They mate and give birth during fall and winter in warmer southern waters. Gestation period is 10 to 11 months and two to three years between births. Forages for krill in both coastal and offshore areas of the northern Gulf of St. Lawrence and eastern Nova Scotia during spring, summer and fall. May migrate through the Gulf and western Newfoundland waters during these months. Have been observed in the Gulf from January through November and found within the Project area from August to October (LGL 2005a). The Entrance to St. Georges Bay MMSA is known to be a relatively important location for blue whales as it is one of the rare known areas where they congregate during winter (AMEC 2014).
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	Endangered	Low	Mean age at first reproduction is 10 years for female and is likely similar for males with a gestation period unknown; may be >12 months. The interval of births is between three to five years (AMEC 2014). Rare to waters off western Newfoundland and are only occasionally sighted in the Gulf being seen in the spring and fall seasons in the lower north shore and to the east of the Gaspé Peninsula (DFO 2011a), where it forages for copepods.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Northern Bottlenose Whale (Scotian Shelf population)	*Hyperoodon ampullatus*	Endangered	Endangered	Low	Females and males reach sexual maturity at 8 to 13 years and seven to nine years respectively. Females give birth to a single offspring after a 12-month gestation period. It is estimated that females give birth on average every two years, but this rate may be lower in the Scotian Shelf population (COSEWIC 2011a). Rarely sighted as it is a pelagic, deep water species (>800 m), except that it is common to 'The Gully' off southeastern Nova Scotia, and in the Labrador Sea. Could occur rarely, and in low numbers, in the Gulf where it may feed in deep waters.
Northern Bottlenose Whale (Davis Strait-Baffin Bay-Labrador Sea Population		Special Concern	No Status	Low	Confined to the waters of the northern Atlantic Ocean, with population centres off the Davis Strait / northern Labrador (COSEWIC 2011a). More survey effort is needed to fully describe the distribution and abundance of northern bottlenose whales in Canada, particularly in the northern part of its distribution and around Newfoundland. Females and males reach sexual maturity at 8 to 13 years and seven to nine years respectively. Females give birth to a single offspring after a 12-month gestation period. It is estimated that females give birth on average every two years (COSEWIC 2011a).
Beluga Whale (St. Lawrence Estuary population)	*Delphinapterus leucas*	Endangered	Threatened	Low	Population within the Gulf is believed to be isolated from other populations and doesn't appear to migrate far, as they are uncommon beyond the boundaries of the Gulf (DFO 2011a). Mating occurs from late winter to early spring, gestation period of 13-14.5 months with an average interval between calving of 3.25 years (AMEC 2014). St. Lawrence Estuary represents its southern limit; however, individuals and small groups are occasionally sighted in coastal Atlantic Canada waters, including the Gulf and western Newfoundland.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Fin Whale (Atlantic population)	*Balaenoptera physalus*	Special Concern	Special Concern	Moderate	This species tends to make seasonal migrations travelling alone or in small groups from low latitude areas during the winter to high latitude summer feeding areas. Conception and calving typically occur in the winter and have an average 2.7 years between births (AMEC 2014). Concentrated in the Northwest Atlantic region during the summer months, including coastal and offshore waters of the Gulf and western Newfoundland to feed along oceanic fronts. Less common off the west and southwest coasts of Newfoundland than elsewhere off the coasts of the Island (LGL 2005a) and are present in the Gulf from July to September, migrating through the Laurentian Channel to winter off northern Nova Scotia.
Harbour Porpoise (Northwest Atlantic population)	*Phocoena phocoena*	Special Concern	No Status	Moderate	Occurs in both offshore and coastal waters of the Gulf. Occurs regularly in coastal bays and inlets during summer and can move rapidly following prey or stay in areas where food is abundant for periods of time. Common in the northern portion of the Gulf from July to September with sightings also in the southern and central portions of the Gulf and a distinct population of that is generally seen close to coastlines (LGL 2005a; DFO 2011a). Mature females become pregnant each year with gestational period of 10 to 11 months.
Killer Whale (Northwest Atlantic/ Eastern Arctic population)	*Orcinus orca*	Special Concern	No Status	Low	Males reach sexual maturity at approximately 13 years and females at 14 to 15 years (AMEC 2014). Calving peaks from fall to spring, with an average period between calving of approximately five years (AMEC 2014). Can be found in every ocean bordering Canada; however, the exact extent of their range and distribution in the northwest Atlantic is unknown. Killer whales were historically common in the Gulf of St. Lawrence but are presently only observed in the

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
					area occasionally. Most sightings occur near the coast of Newfoundland and in the Strait of Bell Isle (COSEWIC 2008a).
Leatherback Sea Turtle (Atlantic population)	*Dermochelys coriacea*	Endangered	Endangered	Moderate	A highly migratory species with a wide global distribution; it is found in the Atlantic, Pacific and Indian oceans. Leatherbacks have a greater ability to withstand colder water than any other sea turtle, and thus have the most northerly distribution. Forages (particularly on jellyfish) along the Scotian Shelf and in the southern Gulf of St. Lawrence from June to October, and is the most likely sea turtle species to occur. In Atlantic Canada, they are most abundant between July and October, and most commonly found on the Scotian Shelf and slope, in the southern Gulf of St. Lawrence and along the southern coast of Newfoundland (DFO 2013). During the winter, they travel to warm, tropical beaches where they mate and nest. Nesting is the only time that these turtles go ashore and they nest on open beaches in the tropics, with females laying on average six clutches per season. The amended Draft Recovery Strategy for the Leatherback Sea turtle - Atlantic Population (DFO 2015) has identified proposed critical habitat for the leatherback sea turtle in the Gulf of St. Lawrence – Laurentian Channel area around the Magdalen Islands which overlaps with the LAA and RAA for the Project.
Loggerhead Sea Turtle	*Caretta caretta*	Endangered	No Status	Low	This species is highly migratory and their distribution is largely constrained by water temperature; they generally do not occur where the water temperature is below 15°C (Brazner and McMillan 2008). They nest in tropical areas in southern United States and lay four clutches per season and will go two to three years between breeding seasons. The largest known nesting assemblages are in southern Florida and Masirah, Oman (COSEWIC 2010). There are no estimates of loggerhead sea turtle abundance in Canadian waters, with data limited to

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
					opportunistic sightings, fisheries bycatch, strandings, and limited survey information (DFO 2010d). Widely distributed in pelagic (>200 m) waters where they feed mainly on jellyfish. Juveniles concentrate along the edge of the Gulf Stream. Occurs in the offshore parts of the Gulf and western Newfoundland, particularly in summer months.
Eskimo Curlew[2]	*Numenius borealis*	Endangered	Endangered	Low	Likely extinct (COSEWIC 2009a) and extremely unlikely to be encountered in the Gulf. Historically known to nest in arctic and subarctic tundra and to use a variety of inland and coastal habitats during fall migration. Associated with tallgrass and eastern mixed grass prairies during spring migration (COSEWIC 2009a).
Horned Grebe (Magdalen Islands population)	*Podiceps auritus*	Endangered	Endangered	Low	Found in freshwater ponds, marshes and shallow bays of lakes during breeding season; generally feeds at waters of breeding site (Environment Canada 2013a). During the winter the horned grebe migrates away from the Magdalen Islands and is present along the Atlantic Canada coastline (Environment Canada 2013a). Small (approximately 15 adults), isolated population breeds on the Magdalen Islands during summer months, where critical habitat has been identified. Wintering grounds include the coastline of Atlantic Canada.
Ivory Gull[2]	*Pagophila eburnea*	Endangered	Endangered	Moderate	Breeding range is restricted to the high arctic where they are ground nesters, laying eggs in late May to early June and chick rearing from mid-June to early August (AMEC 2014). Occur in offshore and coastal areas outside the breeding season, and restricted to offshore waters the rest of the year (AMEC 2014). May occur in the Gulf during winter months, on pack ice, both offshore and in coastal areas.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Piping Plover *melodus* subspecies[2]	*Charadrius melodus melodus*	Endangered	Endangered	Low	Present in the breeding grounds from April to September where they nest on wide sand, gravel, or cobble beaches; barrier island sandpits; or peninsulas in marine coastal areas (Environment Canada 2012). Breeds and forages on Atlantic Canada beaches during summer, including on the Magdalen Islands and in western Newfoundland, where critical habitat is present.
Red Knot *rufa* subspecies[2]	*Calidris canutus rufa*	Endangered	Endangered	Low	Breeds in the Canadian Artic and could potentially migrate through the Gulf of St. Lawrence on route to their wintering grounds in South America and the southern U.S. During migration the red knot is reliant on coastal areas with sand or mud flats to obtain food (COSEWIC 2007b). Frequent open sandy inlets, coastal mudflats, sand flats, salt marshes, sandy estuaries and areas with rotting kelp deposits during fall migration, from mid-August through late September (Garland and Thomas 2009; NLDEC 2012a).
Buff-breasted Sandpiper	*Tryngites subruficollis*	Special Concern	Special Concern	Low	Uncommon passage migrant during fall. Breeds in tundra habitat of the Canadian Arctic. Adults migrate south to the wintering grounds through the interior of North American but juveniles often travel along the Atlantic and Pacific coasts.
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	No Status	Low	Migrant in offshore waters during spring and fall. Breed in Arctic wetlands near open water features but found in open ocean during migration and winter months where they concentrate in areas where prey is forced to the surface by convergence and upwelling.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Low - Moderate	Nests in low numbers on the Magdalen Islands from April to early August, where critical habitat has been identified. This species exhibit high site fidelity and are unlikely to occur in western Newfoundland or elsewhere in the Gulf. Nests in colonies on small islands but sometimes will breed on mainland spits. Usually reach breeding age by third year and lay one egg clutch per year. Mean clutch size is 1.7 eggs per breeding pair (Environment Canada 2010).
Barrow's Goldeneye (Eastern population)[3]	*Bucephala islandica*	Special Concern	Special Concern	Low	Occurs in association with the boreal forest of eastern North America during their breeding period where they breed on high altitude lakes and nest in trees (Environment Canada 2013b). Molts and winters in small numbers off the coast of Eastern Canada. Occur in coastal areas of the St. Lawrence Estuary and Gulf from October to late April, where they feed.
Harlequin Duck (Eastern population)[3]	*Histrionicus histrionicus*	Special Concern	Special Concern	Low	Maintains a presence around the Gulf year round. During the summer, fall, and winter they can be found foraging around coastal headlands, offshore islands, rocky coastlines, and in nearshore marine waters. In the spring time they move inland to breed along rivers (COSEWIC 2013b). Breeds in fast-flowing streams and occurs in coastal waters during both spring and fall staging at the mouths of nesting streams (AMEC 2014). Could occur off western Newfoundland and coastal areas of the Gulf year-round.
Yellow Rail	*Cortunicops noveboracensis*	Special Concern	Special Concern	Low	Unlikely to be encountered; prefers freshwater and coastal marshes. Breeds in southern Canada and the northern United States during the summer season and winters along the Gulf of Mexico. Breeding populations exist in Southern Quebec, New Brunswick, and Northern Nova Scotia (COSEWIC 2001). Breeds in wet meadows and marshes across Canada. Migrates to the Southeastern coastal United States during the winter season.

Table 5.11 Species at Risk Occurring in the RAA

Common Name	Species Name	COSEWIC Status	SARA Schedule 1 Status	Potential for Occurrence in Project Area[1]	Distribution and Life History Characteristics
Peregrine Falcon - anatum/ tundrius	*Falco peregrinus pop. 1*	Special Concern	Special Concern	Low	Landbird species with coastal affinity but may migrate over Project Area. Migrates along coastal areas in fall and preys on concentrations of migrating shorebirds, including along the coast of western Newfoundland (AMEC 2014).
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern	Low	Landbird species with coastal affinity but may migrate over Project Area. Occurs in low numbers along the west coast of Newfoundland where it nests in association with barrens and grasslands (AMEC 2014).
Bank Swallow	*Riparia riparia*	Threatened	No Status	Low	Landbird species with coastal affinity but may migrate over Project Area. Nests on the west coast of Newfoundland in burrows constructed in steep banks created through coastal erosion (AMEC 2014).

[1]High - area overlaps with known concentrations of species (*i.e.*, occurs frequently and in abundance relative to other areas); Moderate - species not concentrated in area but may occur regularly in low abundance or during migration; Low - species occurs infrequently and in low abundance relative to other areas (*i.e.*, based on habitat association and distribution)

[2]Also listed as *endangered* under the Newfoundland and Labrador Endangered Species Regulation

[3]Also listed as *vulnerable* under the Newfoundland and Labrador Endangered Species Regulation

There are seven marine mammal species at risk that have been known to occur within or immediately adjacent to the RAA (Table 5.11). Five of these species are listed under Schedule 1 of SARA, including three designated as *endangered*, one designated as *threatened*, and one designated as a species of *special concern.* Blue whales have been observed in the Gulf from January through November and found within the Project Area from August to October (LGL 2005a). The entrance to St. Georges Bay MMSA is known to be a relatively important location for blue whales as it is one of the rare known areas where they congregate during winter, although its use as wintering habitat is expected to vary annually. North Atlantic right whales are rare to waters off western Newfoundland and are only occasionally sighted in the Gulf in the spring and fall seasons in the lower north shore and to the east of the Gaspé Peninsula (DFO 2011a). Fin whales are less common off the west and southwest coasts of Newfoundland than elsewhere off the coasts of the island (LGL 2005a) and are present in the Gulf from July to September, migrating through the Laurentian Channel to winter off northern Nova Scotia.

The harbour porpoise is common in the western Newfoundland offshore region, whereas the northern bottlenose whale, killer whale (*Orcinus orca*), and beluga whale are uncommon in this area (LGL 2005a). The harbour porpoise is common to the northern portion of the Gulf from July to September with sightings also in the southern and central portions of the Gulf; a distinct population of harbour porpoise noted to exist in the Gulf that is generally seen close to coastlines (LGL 2005a; DFO 2011a). Similarly, the beluga population within the Gulf is also believed to be isolated from other beluga populations and does not appear to migrate far, as they are uncommon beyond the boundaries of the Gulf (DFO 2011a). The northern bottlenose whale is found in deep waters (>500 m) off the east coast of Canada. Major population concentrations have been observed off the northern coast of Labrador, the southern extent of the Baffin Bay, the Davis Strait and the deep canyons of the Scotian Shelf (COSEWIC 2011a). Killer whales can be found in every ocean bordering Canada; however, the exact extent of their range and distribution in the northwest Atlantic is unknown. Killer whales were historically common in the Gulf of St. Lawrence but are presently only observed in the area occasionally. Most sightings occur near the coast of Newfoundland and in the Strait of Bell Isle (COSEWIC 2008a). Critical habitat has not been identified within the RAA for any of the marine mammal species at risk.

There are 14 marine-associated bird species at risk that have been known to occur within or immediately adjacent to the RAA, six of which have been designated as *endangered* under Schedule 1 of the SARA and six others are listed as *special concern* under the Act and/or by COSEWIC (Table 5.11). Of these, the ivory gull and red-necked phalarope are the most likely to occur within the Project Area. Ivory gull winters along the edge of pack ice in the North Atlantic Ocean, particularly in the north Gulf, Davis Strait, the Labrador Sea and the Strait of Belle Isle. The red-necked phalarope is primarily a pelagic species outside of its breeding period and may occur within the Project Area during its fall and spring migration to and from its breeding grounds in the Arctic. Eskimo curlew is likely extinct (COSEWIC 2009a) and extremely unlikely to be encountered in the Gulf. Other marine birds, including horned grebe, piping plover, red knot, roseate tern, buff-breasted sandpiper, Barrow’s goldeneye, Harlequin duck and yellow rail, have strong coastal affinities and are therefore unlikely to be encountered within the Project Area.

There are also several land-based bird species with coastal affinities that are known to occur in the RAA, particularly peregrine falcon, short-eared owl, and bank swallow. Although largely restricted to coastal habitats, these landbirds and others (*e.g.*, olive-sided flycatcher, bobolink, and common nighthawk have potential to migrate over offshore waters and could occur within the Project Area at that time.

Critical habitat has been identified for the horned grebe, piping plover, and roseate tern within the RAA. Critical habitat for the horned grebe, Magdalen Islands population, includes 52 ponds which were either identified as suitable nesting habitat for this species or where horned grebe was observed feeding or is suspected of having nested (Environment Canada 2013a). Critical habitat for the piping plover melodus subspecies has been identified at a number of beaches in the RAA, including on the Magdalen Islands, where approximately 40 pairs are present each year (AMEC 2014), and western Newfoundland. Critical habitat in western Newfoundland occurs at Stephenville Crossing, Sandy Point, Flat Pay Peninsula, Little Codroy, J.T. Cheeseman Provincial Park, Big Barrachois, and Second Beach (Government of Canada 2013). On the Magdalen Islands, critical habitat has been defined for the roseate tern on the terrestrial habitats of Paquet and Chenal Islands, and portions of the aquatic habitat extending 200 m offshore (Environment Canada 2010).

There are two sea turtle species at risk that have been known to occur within the RAA: the SARA-listed *endangered* leatherback sea turtle and the COSEWIC-assessed *endangered* loggerhead sea turtle. The leatherback turtle is a highly migratory species with a wide global distribution and in Atlantic Canada. They are most abundant between July and October and are most commonly found on the Scotian Shelf and Slope, in the southern Gulf of St. Lawrence, and along the southern coast of Newfoundland (DFO 2013). Similar to the leatherback, the loggerhead sea turtle is highly migratory and breeds in more southern localities. The distribution of the loggerhead turtle is largely constrained by water temperature, and they generally do not occur where temperatures are below 15°C (Brazner and McMillan 2008). Although both species have the potential to occur within the Project Area, the leatherback turtle is the most likely species to be encountered. Proposed critical habitat for the leatherback sea turtle has been identified in the Gulf of St. Lawrence – Laurentian Channel area around the Magdalen Islands which overlaps with the LAA and RAA for the Project (DFO 2015).

5.2.7 Sensitive Areas

Sensitive areas found in the RAA include Ecologically and Biologically Significant Areas (EBSAs), an Area of Interest for potential designation as a Marine Protected Area (MPA) under the *Oceans Act*, and sensitive fisheries areas (*e.g.*, cod spawning area, a potential redfish larvae extrusion area, and a potential redfish mating area (Figure 5.6). These sensitive areas are discussed further below. Critical habitat for species at risk listed in Schedule 1 of SARA is outlined in Section 5.2.6 and information on IBAs is outlined in Section 5.2.5.4. As noted in Section 5.2.3, there are also MMSAs within the RAA including the Western Shelf of Newfoundland, Entrance to St. Georges Bay, Cape Breton Trough, the Margin of the Laurentian Channel to the South of Anticosti Island, and the Southern Gulf Shelf (ice-covered months) (AMEC 2014). The Entrance to

St. Georges Bay MMSA encompasses much of the Project Area and supports a number of marine mammals during the ice-free period.

5.2.7.1 Ecologically and Biologically Significant Areas

Protection of marine sensitive areas is provided by DFO's *Oceans Act*, which authorizes DFO to provide enhanced protection to marine areas that are determined to be ecologically or biologically significant (DFO 2004). The proposed Project is within an area currently being considered as part of an Integrated Management process for the Gulf of St. Lawrence Large Ocean Management Area (GSL-LOMA) (DFO 2009c). As part of this plan, DFO has identified EBSAs, which may require management measures. Within the GSL-LOMA, ten areas have been designated as EBSAs, three of which are located within the RAA (Figure 5.6). As outlined in Table 5.12 these include the West Coast of Newfoundland EBSA, the South Fringe of the Laurentian Channel, and the Western Cape Breton EBSA.

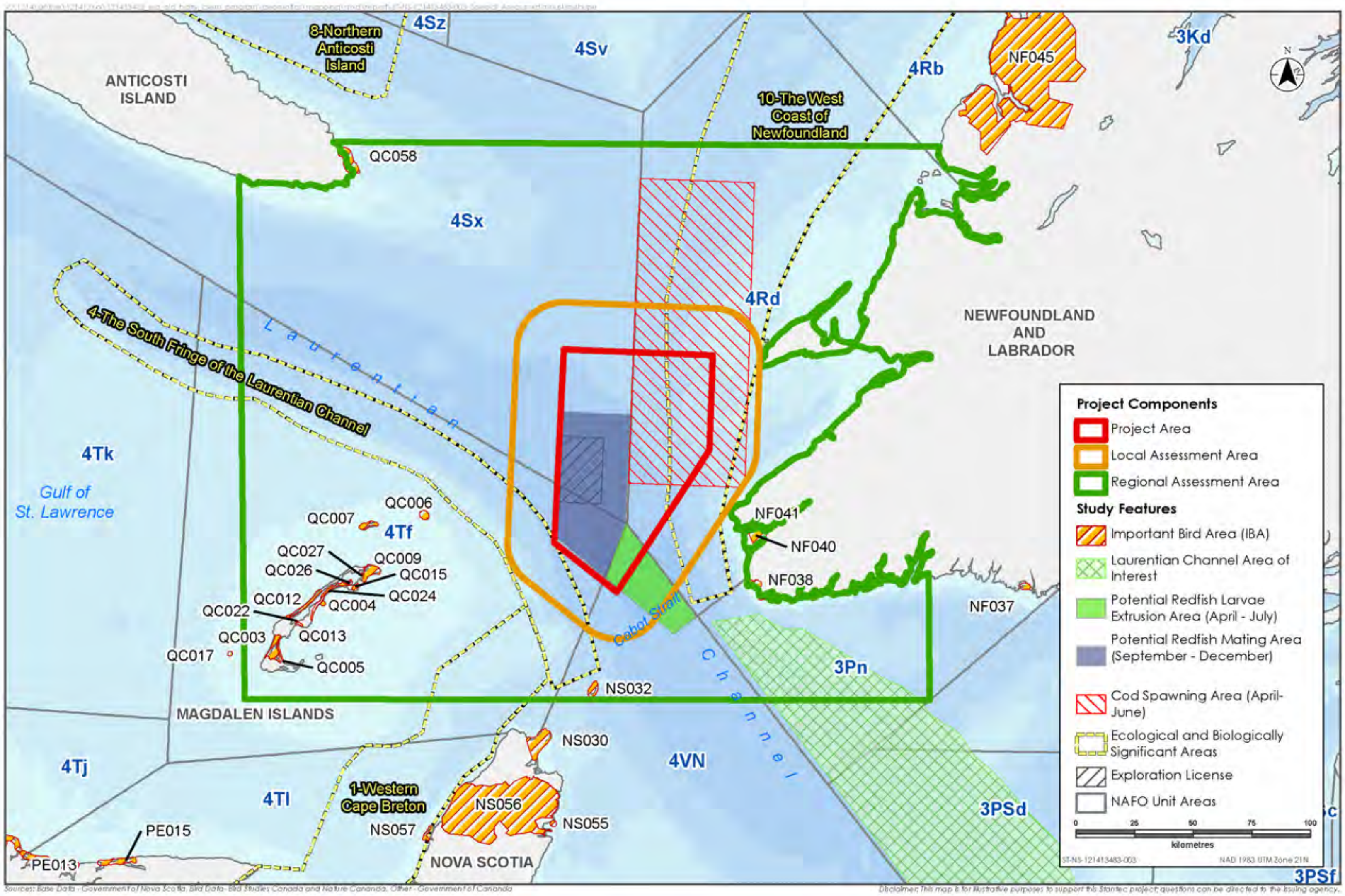


Figure 5.6 Sensitive Areas

Table 5.12 EBSAs in the Project Area

EBSA	Size (km²)	Significance
Western Cape Breton	8,198	Major feeding and spawning area for several meroplankton and groundfish.
		Highest meroplankton abundance (eggs and larvae) among all the identified areas in the Gulf.
		Cape Breton Channel is a migration corridor in spring and fall towards the Atlantic for the COSEWIC assessed Atlantic cod and white hake.
		Important summer feeding area for witch flounder and COSEWIC assessed white hake.
Southern Fringe of the Laurentian Channel	5,941	Important feeding ground and wintering area for pelagic fish and groundfish.
		The middle of the channel serves as wintering areas for groundfish species such as Atlantic cod. The EBSA only partially covers an important wintering area for the Atlantic cod, leaving out the southern slope in the Cabot Strait.
		The southeastern boundary of this area serves as a spring and fall migration corridor for southern Gulf species such as Atlantic cod, coastal white hake and other groundfish species.
West Coast of Newfoundland	18,238	Important for groundfish as a spawning area and nursery for juveniles.
		Concentration area for the COSEWIC assessed juvenile Atlantic cod, redfish, American plaice and SARA-listed Atlantic wolffish.
		The channel in the Cabot Strait represents a migration corridor and refuge for several species of pelagic fish such as Atlantic herring, capelin, silver hake and pollock.

Source: DFO 2007

5.2.7.2 Areas of Interest

The Laurentian Channel Area of Interest overlaps with the southeastern corner of the RAA (Figure 5.6). In 2010, the Laurentian Channel (to the southeast of Cabot Strait and approximately 100 km from the Project Area) was announced as an Area of Interest for potential designation as a MPA under the *Oceans Act* (DFO 2011c). The Laurentian Channel was designated as an Area of Interest due to its ecological and biological significance, including hosting the highest concentration of black dogfish in Canadian waters and being the only place where their young occur. It is an important spawning, nursery and feeding area for a variety of species including smooth skate, monkfish, pollock, and the COSEWIC-assessed porbeagle shark and white hake, and a migration route for marine mammals (DFO 2011c). This Area of Interest also provides overwintering habitat for cod and redfish stocks whose populations have been identified by COSEWIC as *threatened* or *endangered*.

5.2.7.3 Other Marine Fish Sensitive Areas

A cod spawning area, a potential redfish larvae extrusion area and a potential redfish mating area are present in the RAA, and overlap with the Project Area (Figure 5.6). The cod spawning area is located west of the Port au Port Peninsula and is closed to groundfish harvesting between April 1 and June 15. This area was originally established in 2002 and was resized since then (LGL 2007). Redfish mate during the fall (September to December) (Ni and Templeman 1985; Lambert *et al.* 2003), and the Project Area lies within the boundaries of the Potential Redfish Mating Area. The southern tip of the Project Area also overlaps with a Potential Redfish Larvae Extrusion Area for the April to July period.

5.3 SOCIO-ECONOMIC ENVIRONMENT

5.3.1 Marine Fisheries

5.3.1.1 Commercial Fisheries

Marine fisheries in the Gulf of St. Lawrence are an important component of the economy for Quebec and all four Atlantic provinces. There is no foreign fleet, with the exception of Saint Pierre and Miquelon (Stantec 2013). Fisheries are also culturally important in this region, and have a strong history in Atlantic Canada. Management of the commercial fishing activity in the Gulf by DFO is conducted through the Quebec, Maritimes, Gulf, and Newfoundland and Labrador Regional offices (DFO 2011d). Many of the major species are fished according to quota systems (*i.e.*, groundfish and crab), while others are fished according to availability (*i.e.*, herring and mackerel) or specific season lengths (*i.e.*, lobster and crab).

For administrative purposes, the Northwest Atlantic Fisheries Organization (NAFO) regulatory areas are split into subareas, divisions and subdivisions (unit areas). DFO quotas and licenses are set for each division and subdivision. The Gulf of St. Lawrence is in NAFO subarea four, and falls within four unit areas: 4Rd, 4Ss, 4Tf and 4VN. Landings data for these unit areas were acquired from DFO and are presented in Tables 5.13 to 5.16. Landings are provided by weight and value by species between 2010 and 2015. The NAFO Unit Areas 4Rd, 4Ss, 4Tf and 4VN cover an area substantively more expansive than the Project Area. However, general information on trends associated with the fishery for this division could provide insight and knowledge for the general region in which the Project will occur. The geo-referenced harvesting locations in relation to the Project Area, LAA and RAA for 2011to 2015 for all species during all months is shown in Figure 5.7. Figure 5.8 shows the locations of fishing for August to December (2011 to 2015) and Figure 5.9 shows locations for fishing September and October (2011 to 2015) which is the most likely timeframe for the survey. Species-specific harvesting locations for Atlantic cod, Greenland halibut, witch flounder, Atlantic halibut, herring, mackerel, snow/queen crab and redfish are provided in Appendix C.

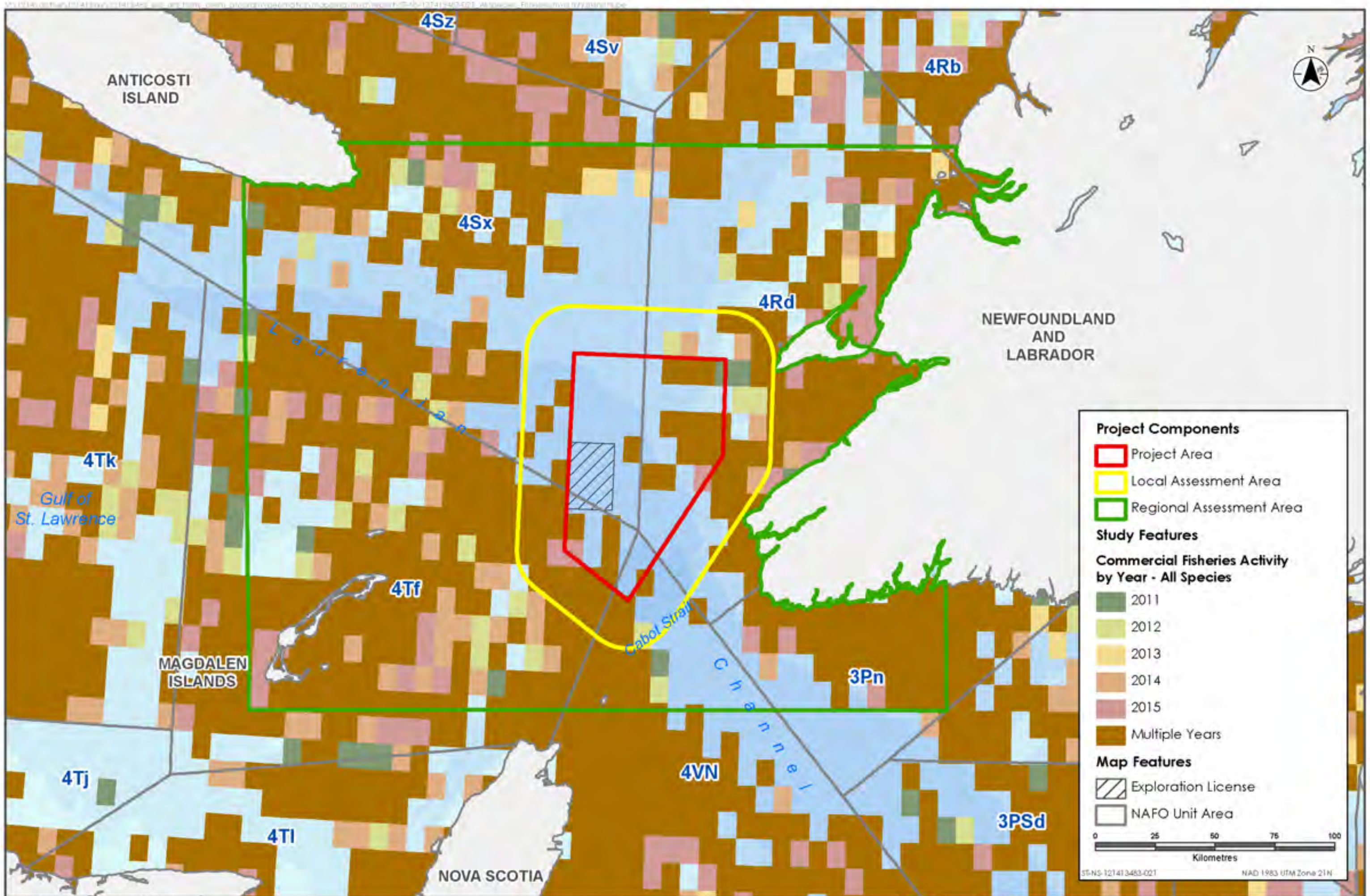


Figure 5.7 Commercial Fishing Locations, All Species, All Months, 2011-2015

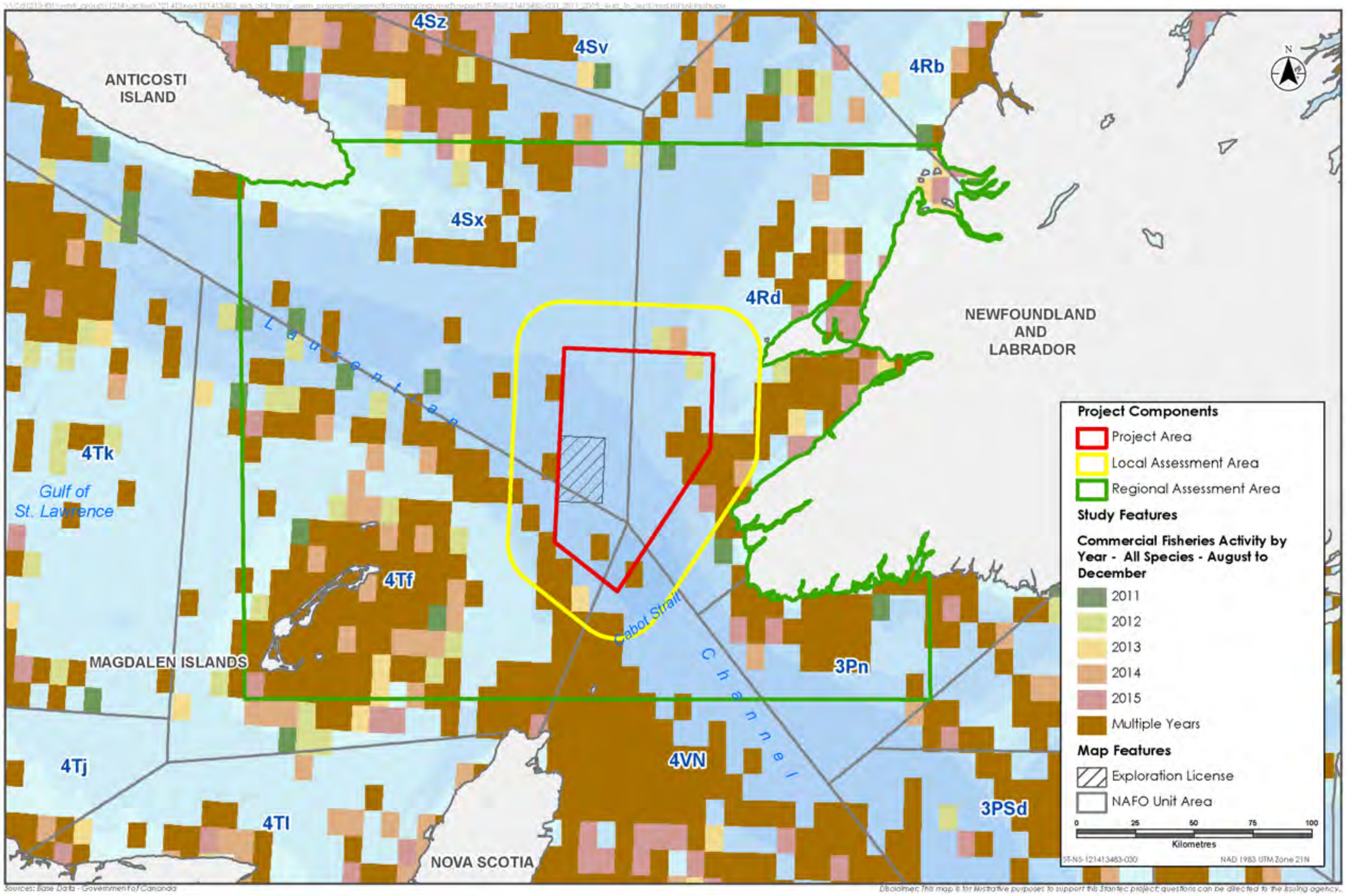


Figure 5.8 Commercial Fishing Locations, All Species, August to December (2011-2015)

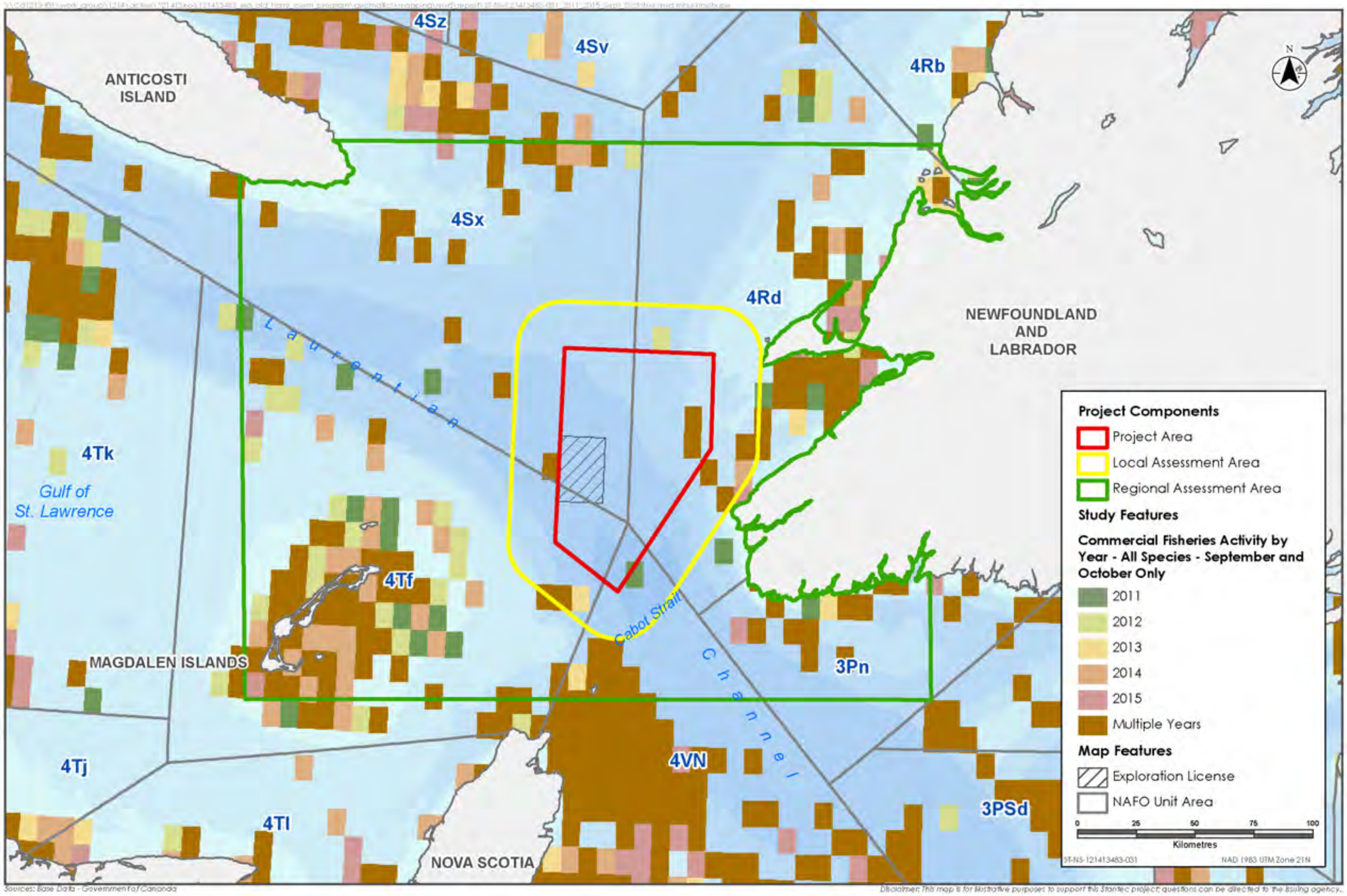


Figure 5.9 Commercial Fishing Locations, All Species, September and October (2011-2015)

Table 5.13 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Rd, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Groundfish												
American Plaice	53,882	45,984.71	44,169	30,501.63	56,307	47,309.52	29,830	19,467.91	X	X	129*	70*
Catfish (Striped Wolffish)	3,812	1,271.38	2,303	1,016.8	2,435	968.69	1,622	738.04	X	X	X	X
Cod, Atlantic	223,661	22,2171.62	82,310	93,937	67,017	75,293.13	99,221	126,536.97	43,030*	62,017*	54,432*	63,164*
Cusk	37	9.98	36	12.21	26	20.14	27	7.65	0	0	0	0
Grey Sole/Witch Flounder	117,450	82,487.28	316,587	275,992.51	222,099	217,890.16	132,566	137,317.4	X	X	X	X
Haddock	22	22	9	15.79	6	8.68	7	4.62	X	X	X	X
Hake, White	3,462	2,579.64	3,076	2,772.07	3,699	3,500.33	2,496	2,326.97	X	X	X	X
Halibut – Atlantic	23,697	147,773.39	187,90	132,259.76	31,949	259,643.87	28,436	242,378.7	33,435	302,735	35,562*	396,731*
Livers, Cod	393	173.6	0	0	0	0	0	0	0	0	0	0
Monkfish (American Angler)	836	828.15	1,818	3,573.52	3,470	6,479.56	436	312.96	X	X	X	X
Pollock	193	114.29	181	170.62	1,959	1,757.4	910	504.25	X	X	X	X
Redfish	157,972	106,055.79	106,728	92,752.5	137,663	103,339.06	60,613	52,177.13	X	X	X	X
Roe, Lumpfish	0	0	0	0	20	90.7	0	0	0	0	0	0
Skate	2112	457.36	2,023	602.37	8,518	3,207.76	2030	623.38	0	0	X	X
Turbot/Greenland Halibut	4305	9,048.68	4,977	15,493.97	1,870	3,572.15	2,159	5,230.04	X	X	X	X
Winter Flounder	42	25.72	0	0	58	28.63	0	0	X	X	0	0
Yellowtail Flounder	0	0	0	0	0	0	0	0	X	X	X	X

Table 5.13 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Rd, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Pelagic												
Capelin	133,180	16,148.7	1,984,526	354,386.43	146,894	25,593.07	377,797	75,793.82	X	X	X	X
Eels	17,473	58,035.25	1,693	9,799.11	17,173	101,003.25	5,022	19,972.85	X	X	X	X
Herring, Atlantic	8,227,631	1,632,699.42	6,488,798	1,702,339.32	4,696,350	1,553,051.79	2,423,643	667,902.82	1,585,414	349,524	356,133	88,720
Mackerel	3,711,313	1,636,409.8	303,839	301,432.05	61,482	46,789.79	0	0	430,541*	234,448*	X	X
Shark, Mako	511	476.36	0	0	0	0	0	0	0	0	0	0
Shark, Porbeagle	0	0	0	0	46	184.03	0	0	0	0	0	0
Shark, Unspecified	0	0	384	154.84	0	0	0	0	0	0	0	0
Smelts	0	0	0	0	0	0	1,554	11,98.75	0	0	0	0
Shellfish												
Crab, Queen/Snow	52,699	156,855.82	161,121	763,691.35	211,364	908,648.22	188,063	815,144.84	212,759	1,097,546	206,010	1,121,831
Lobster	323,554	2,356,440.08	249,676	2,144,582.72	259,386	2,320,861.82	254,348	2,041,660.91	264,677	2,208,596	276,047	3,217,113
Scallop, Sea	4,141	6,468	14,418	26,810	8,196	16,253.27	696	1,620.05	X	X	X	X
Squid, *Illex*/Shortfin	0	0	0	0	42	42	0	0	0	0	0	0

NOTES:

X indicates where DFO has withheld all landings data for confidentiality purposes.

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Sources: Stantec 2013, DFO 2017

Table 5.14 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Ss, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Groundfish												
American Plaice	2,752	1,831	2,912	1,811	435	335	2,539	1,858	X	X	X	X
Catfish	484	373	0	0	0	0	0	0	0	0		
Cod, Atlantic	14,043	19,562	17,859	27,119	9,195	18,060	6,148	10,388	10,266*	19,078*	17,940*	33,320*
Flounder, Unspecified	0	0	0	0	0	0	0	0	0	0	X	X
Grey Sole/Witch Flounder	15	12	19	32	43	38	0	0	0	0	0	0
Groundfish, Unspecified	77	0	186	179	49	0	0	0	X	X	0	0
Hake, White	611	361	1,037	669	721	483	425	240	X	X	X	X
Halibut – Atlantic	9,908	57,965	32,000	236,147	25,837	220,672	10,992	91,465	53,561*	481,009*	53,264*	529,722*
Monkfish (American Angler)	537	214	368	76	97	38	446	153	X	X	X	X
Pollock	0	0	25	23	49	10	132	73	0	0	0	0
Redfish	45,807	30,778	31,764	26,082	159,453	153,542	108,102	90,404	46*	7*	X	X
Skate	0	0	0	0	311	138	0	0	0	0	0	0
Turbot/Greenland Halibut	199,019	424,491	134,249	311,477	25,196	66,284	78,164	237,595	26*	85*	100*	321*
Windowpane Flounder	0	0	0	0	0	0	53	0	0	0	0	0
Pelagic												
Herring, Atlantic	139	70	225	109	162	100	87	45	X	X	0	0
Mackerel	250	85	414	319	0	0	0	0	0	0	0	0
Shark, Blue	36	73	0	0	0	0	0	0	X	X	0	0

Table 5.14 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Ss, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Shark, Mako	0	0	0	0	77	154	0	0	0	0	0	0
Shark, Porbeagle	0	0	0	0	80	160	0	0	0	0	0	0
Shellfish												
Crab, Queen/Snow	167,773	562,461	218,533	1,351,294	321,405	1,419,741	333,302	1,512,766	420,665	2,280,815	222,528*	1,220,712*
Crab, Stone/King	0	0	0	0	11	49	4	18	X	X	0	0
Lobster	168,726	1,531,059	149,209	1,530,092	204,578	2,163,156	275,133	2,482,072	366,912	3,463,750	408,219	5,135,863
Shrimp, *Pandalus borealis*	5,540,717	6,116,517	5,679,726	8,269,729	4,373,581	7,980,157	3,266,917	4,983,409	1,435,669*	2,590,189*	454,223	1,210,764

NOTES:

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Sources: Stantec 2013, DFO 2017

Table 5.15 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Tf, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Groundfish												
American Plaice	83,638	108,765	57,372	89,916	20,919	29,193	6,670	9,628	X	X	X	X
Argentine	0	0	0	0	0	0	0	0	X	X	0	0
Catfish	4	3	10	10	6	7	0	0	X	X	X	X
Catfish (Striped Wolffish)	0	0	19	18	8	7	0	0	X	X	X	X
Cod, Atlantic	56,173	71,354	61,718	87,303	69,705	104,896	26,854	38,861	17,698*	30,451*	21,068*	38,287*
Cod, Rock	10	11	5	5	8	6	0	0	X	X	X	X
Cusk	4	2	0	0	0	0	0	0	0	0	X	X
Dogfish	0	0	0	0	2	2	10	4	X	X	0	0
Grey Sole/Witch Flounder	89,428	82,348	88,960	85,741	84,735	82,271	128,130	139,124	X	X	X	X
Haddock	106	173	200	313	114	121	88	83	179*	215*	460*	676*
Hake, Red	0	0	0	0	0	0	0	0	X	X	0	0
Hake, White	12,706	9,234	18,066	14,870	9,775	8,556	14,719	14,237	1,840*	1,702*	4,042*	3,729*
Halibut – Atlantic	96,953	819,677	111,061	1,030,196	147,913	1,444,905	114,421	1,179,670	81,438*	885,192*	148,183*	1,796,426*
Lumpfish	0	0	2	2	0	0	0	0	0	0	0	0
Monkfish (American Angler)	2,938	3,080	1,991	2,736	2,585	2,206	2,348	1,581	X	X	X	X
Ocean Pout/Eel Pout	2	2	12	13	4	4	0	0	X	X	X	X
Pollock	94	58	24	14	908	703	1,241	1,024	X	X	X	X
Redfish	321,073	224,208	467,947	409,575	362,523	268,570	272,841	235,690	45,058*	46,990*	114,442*	126,098*
Sculpin	2,745	275	8,617	1,275	17,532	2,388	21,688	2,400	8,276*	6,770*	9,804*	7,556*

Table 5.15 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Tf, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Skate	541	154	1,470	512	1,278	588	565	312	X	X		
Sturgeon	48	168	0	0	0	0	0	0	0	0		
Tomcod	17	18	24	23	60	55	3	3	X	X	X	X
Tongues, Sounds, Cheeks	0	0	2	0	0	0	0	0				
Turbot/Greenland Halibut	21,338	37,586	32,506	74,242	23,330	34,797	20,129	38,086	1,178*	3,723*	X	X
Windowpane Flounder	134,451	201,123	169,947	317,031	86,051	164,040	100,122	270,800	51,903*	145,919*	25,200*	83,968*
Winter Flounder	242,779	340,428	243,948	445,026	235,006	445,474	163,453	436,517	160,144*	435,084*	140,468*	454,399*
Yellowtail Flounder	185,847	276,492	179,796	329,176	110,912	209,543	82,390	219,104	69,931*	187,482*	72,168*	239,674*
Pelagic												
Alewife/Gaspreau	40	0	3	0	0	0	0	0	0	0	0	0
American Shad	2	2	0	0	0	0	0	0	0	0	0	0
Capelin	0	0	23,970	3,116	0	0	0	0	X	X	X	X
Cunners	1	0	6	7	0	0	0	0	0	0	0	0
Eels	0	0	45	250	47	223	43	201	X	X	0	0
Herring, Atlantic	569,739	131,737	48,094	10,759	228,821	75,576	3,252,954	894,888	1,964,601	434,051	9,999*	2,212*
Mackerel	447,016	258,022	179,741	166,467	294,678	206,896	118,161	125,755	66,468*	99,829*	119,388*	131,095*
Roe, Capelin	16	35	158	1,298	0	0	0	0	0	0	0	0
Shark, Blue	103	103	66	98	0	0	137	194	0	0	X	X
Shark, Mako	173	173	370	651	0	0	57	114	X	X		
Shark, Porbeagle	331	399	275	476	0	0	44	88	0	0	X	X
Shark, Unspecified	169	229	113	227	0	0	158	174	0	0	0	0

Table 5.15 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4Tf, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Smelts	0	0	91	250	90	250	90	250	0	0	0	0
Tuna, Bluefin	1,413	19,159	340	401	0	0	0	0	0	0	0	0
Shellfish												
Clam, Bar	259,243	214,621	243,100	204,405	256,703	226,283	288,602	270,122	44,971*	51,038*	18,096*	16,960*
Clam, Razor	24,015	40,790	26,873	43,543	13,238	22,254	9,830	17,301	X	X	X	X
Clam, Soft-Shell	905	3,168	67	235	767	2,618	1,112	3,754	1,256	4,216	845	2,486
Clam, Stimpson's Surf	7,529	5,797	40,916	31,505	87,953	85,847	99,622	98,629	X	X	X	X
Crab, Atlantic Rock	611,473	538,089	618,799	680,676	565,896	623,103	529,698	699,213	480,723	634,538	454,128*	649,396*
Crab, Queen/Snow	1,682,076	7,103,771	2,160,930	15,260,139	4,973,868	25,930,781	4,900,142	24,174,261	4,360,720*	27,914,875*	5,314,157	32,427,764
Crab, Spider/Toad	181,381	119,710	145,698	96,160	135,087	101,314	124,590	93,949	164,984	124,654	157,168	148,220
Lobster	3,179,286	27,078,878	2,797,421	28,728,842	2,829,805	29,787,569	2,928,942	25,974,397	3,487,182	32,647,264	3,645,784	46,528,063
Mussel	68	238	0	0	135	473	180	630	0	0	0	0
Scallop, Sea	371,058	737,718	391,656	964,289	363,202	895,415	374,308	1,103,430	442,950	1,423,506	374,490	1,215,567
Shrimp, *Pandalus borealis*	0	0	0	0	599	1,072	0	0	0	0	0	0
Whelk	150,475	132,415	265,381	314,724	238,815	313,827	326,675	431,201	15,078	19,901	X	X

NOTES:

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Sources: Stantec 2013, DFO 2017

Table 5.16 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4VN, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Groundfish												
American Plaice	1,381	1,395.93	2,691	3,223.6	14,32	2,054.82	867	859.81	X	X	X	X
Argentine	0	0	0	0	0	0	0	0	X	X	0	0
Catfish (Striped Wolffish)	90	17.54	49	27.45	0	0	315	113.22	X	X	X	X
Cod, Atlantic	24,199	37,918.64	27,021	48,928.14	32,000	61,308.35	30,987	44,409.21	32,514*	54,392*	23,551*	54,226*
Cusk	496	436.07	94	94.51	266	208.64	0	0	X	X	X	X
Dogfish, Black	42	0.42	0	0	0	0	122	1.22	0	0	0	0
Dogfish, Unspecified	0	0	0	0	0	0	0	0	X	X	0	0
Flounder, Unspecified	0	0	0	0	0	0	0	0	X	X	0	0
Grey sole/Witch Flounder	106,538	82,011.37	150,098	136,418.21	108,776	105,821.53	90,753	80,406.16	X	X	96,805*	87,286*
Groundfish, Unspecified	0	0	0	0	0	0	0	0	X	X	0	0
Haddock	308	403.65	394	688.06	101	206.62	342	509.46	570*	718*	821*	1,222*
Hake, Silver	0	0	51	32.8	0	0	0	0	0	0	0	0
Hake, White	2,4042	26,222.59	37,313	38,353.15	15,201	15,199.67	16,691	17,956.49	21,484*	22,883*	34,550	40,087
Halibut – Atlantic	67,033	64,7895.21	92,270	1,009,810.39	10,5324	1,197,378.53	140,251	1,829,705.52	152,685*	2,077,223*	152,438*	2,129,038*
Monkfish (American Angler)	910	1,302.75	2,690	3,450.91	4,374	4,548.96	2,202	1,744.52	X	X	1,457*	1,598*
Northern Wolffish	0	0	0	0	0	0	24	13.22	X	X	0	0
Pollock	279	228.53	227	163.53	748	757.31	238	209.33	X	X	X	X
Redfish	667,559	463,357.75	454,450	359,981.46	706,622	444,396.45	742,478	654,227.14	670,974*	555,206*	14,885*	16,370*

Table 5.16 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4VN, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Sculpin	0	0	0	0	96	112.53	121	102.49	X	X	0	0
Skate	0	0	211	159.61	46	35.2	56	44.82	X	X	X	X
Tomcod	0	0	0	0	0	0	4	0	X	X	0	0
Turbot/Greenland Halibut	12,559	20,544.37	22,304	29,933.24	26,850	30,203.6	14,233	21,051.66	18,189*	25,846*	14,749*	22,308*
Wolffish, Unspecified	0	0	0	0	0	0	0	0	X	X	X	X
Pelagic												
Alewife/Gaspareau	4,673	2,898.34	32,248	29,860.79	36,651	35,119.09	17,470	6,986.43	21,814	18,087	45,343	47,921
American Shad	0	0	0	0	0	0	1	1.92	0	0	0	0
Eels	0	0	517	2,728.28	0	0	2,480	11,385.55	X	X	X	X
Elvers	0	0	890	2,354,849.39	0	0	0	0	0	0	0	0
Hagfish/Slime Eel	1,451	472.74	0	0	0	0	91,801	100,974.31	0	0	0	0
Herring, Atlantic	1,037	276.45	551	156.75	4,993	1,905.98	47,207	17,959.58	1,573*	769*	X	X
Mackerel	6,248	4,956.94	1,533	1,779.91	143,368	182,298.05	143,168	98,814.38	32,083*	40,959*	11,534*	60,445*
Shark, Blue	0	0	0	0	0	0	0	0	X	X	X	X
Shark, Mako	283	795.05	70	104.94	51	70.42	163	526.8	X	X	X	X
Shark, Porbeagle	184	202	255	285.92	88	86.68	57	54.84	X	X	X	X
Shark, Unspecified	0	0	0	0	0	0	56	55.23	0	0	X	X
Striped Bass	0	0	0	0	0	0	2	1	0	0	0	0
Swordfish	147	1,170.51	269	1,883.45	0	0	0	0	0	0	X	X
Tuna, Bluefin	626	9,867.9	242	4,936.56	166	4,248.94	633	18,189.54	0	0	0	0

Table 5.16 Landings Values of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit Area 4VN, 2010-2015

Species	2010		2011		2012		2013		2014		2015	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Shellfish												
American Oyster	1,661	1,029.33	0	0	0	0	0	0	X	X	0	0
Clam, Soft-Shell	2,044	3,592.49	1,253	2,207.08	0	0	932	2,234.57	0	0	X	X
Clam, Unspecified	0	0	84	180.43	377	743.66	185	444.49	X	X	X	X
Crab, Atlantic Rock	169,456	119,411.63	165,949	151,607.04	119,599	111,660.64	86,854	97,295.97	80,087	112,561	50,429	84,028
Crab, Jonah	634	12.61	2,629	2,999.26	507	629.35	1,066	1,472.36	X	X	X	X
Crab, Queen/Snow	848,805	3,380,478.21	1,194,271	7,641,555.42	1,447,036	7,259,070.56	1,716,944	5,008,859.51	1,516,766	8,505,964	1,113,741	2,936,515
Crab, Spider/Toad	0	0	0	0	0	0	0	0	0	0	X	X
Lobster	2,430,362	21,906,560.97	2,585,461	27,981,559.96	2,619,474	26,893,472.76	3,645,522	34,796,728.16	3,703,023	37,795,538	3,699,228	49,881,674
Scallop, Sea	47,401	64,734.62	57,472	82,451.58	49,381	109,116.64	40,907	106,753.53	32,301	82,362	18,024	54,608
Sea Urchins	88,012	171,532.24	103,223	270,363.65	181,776	525,338.78	157,844	539,140.82	X	X	X	X
Shrimp, *Pandalus borealis*	132,739	1580,79.85	15,351	32,697.47	5,971	12,741.93	21,671	31,354.31	430,047	1,100,700	103,592	356,146
Squid, Unspecified	0	0	48	0.48	0	0	0	0	0	0	0	0
Whelk	0	0	0	0	575	568.02	0	0	0	0	X	X

NOTES:

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* indicates where DFO has withheld landings data for certain gear types for confidentiality purposes. When all applicable gear types are considered, the actual weight and landed value may be higher than presented in this table.

Sources Stantec 2013, DFO 2017

Within NAFO unit 4Rd, pelagic fish, groundfish, and shellfish are all caught within the Project Area, although most activity is concentrated nearshore and within Bay St. George and the highest abundance of landings for pelagic fish and shellfish are concentrated in Bay St. George. Groundfish are somewhat more distributed, and are caught in high abundance not only in the bay, but also along the Cape Anguille shoreline. Commercial landings in NAFO unit 4Rd are dominated by lobster and queen/snow crab. Queen/snow crab is caught within the Project Area; lobster fishing occurs along the Quebec coastline and Anticosti Island (See Figure 4.112 in AMEC 2014). Other key commercial pelagic and groundfish species caught within 4Rd include Atlantic herring, Atlantic halibut, capelin, grey sole/witch flounder and Atlantic cod.

The landings in NAFO unit 4Ss are dominated by shellfish, which include shrimp, lobster, and queen/snow crab. The vast majority of these shellfish landings occur along the southern shore of Anticosti Island, which is at a considerable distance from the Project Area. Moderate landing values are obtained for a few species of groundfish, including turbot/Greenland halibut, Atlantic halibut, cod and redfish. These species are caught within the Project Area or LAA (see species-specific harvesting locations in Appendix C.

Within NAFO unit 4Tf, lobster and queen/snow crab have by far the highest landing values. The shellfish fishery is dominant in this unit, with sea scallop, Atlantic rock crab, and whelk also all earning large value. Snow crab is harvested in high abundance in the deeper waters farther from the Magdalen Islands (see Figure 7 in Appendix C). Key pelagic and groundfish species within 4Tf include Atlantic halibut, winter flounder, Atlantic herring, redfish, and yellowtail flounder.

The landings in NAFO unit 4VN follow the same pattern as the other three units, with lobster and queen/snow crab dominating landing values. The third most valuable species is a groundfish – Atlantic halibut. All three groups of fish are harvested on the continental shelf, north and northeast of Cape Breton.

Approximately two-thirds of all marine fish species known to occur in the Gulf are groundfish. Species harvested within the Project Area include Atlantic cod, Greenland halibut, Atlantic halibut, redfish, and witch flounder. Within the Project Area, the distribution of all these species is concentrated within the northeast. Winter flounder, yellowtail flounder and windowpane flounder do not appear within the Project Area; fisheries for these three species are concentrated around the Magdalen Islands.

Various types of gear are used to harvest fish and shellfish offshore Newfoundland and Labrador including purse seine, shrimp trawl, tuck seine, gillnet, pot, and longline (AMEC 2014). The use of the purse seines accounted for approximately 64% of the total fish landings from 2005 to 2011 within NAFO Unit Areas 4Rb, 4Rc and 4Rd (AMEC 2014). Fishing locations by gear type is provided in Figure 4.100 of the Western NL Offshore Area SEA (AMEC 2014).

Historical Fisheries

The commercial fishery has been an important component to the western Newfound region's history, shaping its people, communities and culture (AMEC 2014). The cod fishery in particular has been important to the local economy; however, it has been over-exploited offshore western Newfoundland in the past with cod landing peaking at 2,000,000 t (Stantec 2013). Cod landing began to decline in the early 1990s and in 1993 a moratorium was imposed. The cod fishery re-opened in 2003 with a total allowable catch imposed (Stantec 2013). The commercial fishery of white hake was also historically important to the region and considered the third or fourth most important groundfish fishery between 1960 to 1994 (Stantec 2013). A moratorium was imposed for white hake in NAFO Unit Area 4T in 1995 following a substantial decrease in landing values (DFO 2005b in Stantec 2013).

Additional detail on historical fisheries is provided in Section 3.4.4.2 of the 2005 Western Newfoundland SEA (LGL 2005a) and Section 3.3.2.1 of the 2007 Western Newfoundland SEA Amendment (LGL 2007).

5.3.1.2 Recreational Fisheries

The majority of recreational fisheries occur in nearshore and inshore areas of the Gulf, with the most commonly fished species including Atlantic salmon, striped bass, chain pickerel, gaspereau, yellow perch, Atlantic sturgeon, trout species, shad species, smelt, eel, and white perch. Recreational fishing is regulated both federally and provincially including licensing, catch limits, gear restrictions, size limits, fishing season, and area closures (AMEC 2014).

5.3.1.3 Aboriginal Fisheries

Aboriginal fisheries normally occur near shore and are not expected to interact with the Project Area. In the Gulf region, there are 14 First Nations and two Native councils (the New Brunswick Aboriginal Peoples Council and the Native Council of PEI). The Atlantic Integrated Commercial Fisheries Initiative was created to provide the 34 Mi'kmaq and Maliseet First Nations affected by the Marshal decision with the means to develop commercial fisheries, build business management skills and have an effective voice in fisheries co-management (DFO 2012a). Aboriginal Communal Fishing Licenses are granted by DFO to First Nations to allow for the harvest of fish for food, social or ceremonial purposes. In 2007, in the Gulf region these licenses generated over $22 million of revenue; lobster and snow crab accounted for 95 percent of this revenue (DFO 2011d).

The Qalipu Mi'kmaq First Nation Band is sole owner of Mi'kmaq Commercial Fisheries Inc., owning five core enterprises with vessels under 39'11" in NAFO Division 4R. A groundfish license is held by all five enterprises, a lobster license is held by four of the enterprises, three posses a crab quota, and three have pelagic fixed gear licences. One of the enterprises holds a groundfish licence that is currently being used by an Aboriginal person (DFO 2011e).

The Aboriginal Aquatic Resource and Oceans Management program provides funding to qualifying Aboriginal groups to establish aquatic resource and oceans management bodies, providing access to commercial fishery opportunities including vessels and gear. Under this program, the Qalipu Mi'kmaq First Nation Band and Miawpukek First Nation formed the Mi'kmaq Alsumk Mowimsikik Koqoey Association, holding four enterprises with vessels less than 39'11". Each enterprise holds a lobster licence, with two of the enterprises holding a groundfish and snow crab quota, and three enterprises holding pelagic fixed gear licences (DFO 2011e).

5.3.2 Other Ocean Users

5.3.2.1 Hunting

The commercial seal hunt in Atlantic Canada dates back over 200 years, growing throughout the 20th century, largely to meet the demand for fur (Alexander *et al.* 2010). Although today the number of sealers is greatly reduced, the hunt remains a valuable economic and cultural practice in the Gulf and Newfoundland and Labrador regions, occurring annually from November 15 to June 14, with the majority of sealing occurring between March and May (AMEC 2014). Two species are harvested in the Gulf, harp seal and grey sea. On average, the sealing industry has been worth over $55 million per year to the Newfoundland and Labrador economy (Government of Newfoundland and Labrador n.d.)

The main groups of birds hunted in coastal zones are the seaducks (eiders, scoters and long-tailed ducks), Common and thick-billed murres, mergansers, geese, and snipe. Common and thick-billed murres (referred by residents as "turrs") have been hunted in Newfoundland and Labrador since early settlement and aside from Aboriginal peoples, residents of the province are the only people in North America who can legally hunt turrs. The turr hunt, pursued traditionally for food, has become recognized in recent years as a recreational activity and is still conducted in coastal areas of western Newfoundland and southern Labrador.

5.3.2.2 Petroleum Industry

While there are several ELs in the coastal waters of western Newfoundland, none exist in the offshore Project Area other than those held by Corridor Resources.

5.3.2.3 Military Use

The Department of National Defense Royal Navy and/or Air Force could potentially be present in the RAA, conducting surveillance and monitoring operations and/or training operations. There are no recorded shipwrecks or Department of National Defense Unexploded Explosive Ordnances Legacy sites within the Project Area (AMEC 2014).

5.3.2.4 Scientific Research

DFO carries out stock assessment surveys and research activities throughout the maritime marine environment, which may overlap with proposed Project activities. In particular, DFO carries out several long-term monitoring studies in the Gulf of St. Lawrence, which include the: 1) Northern Gulf Multi-Species Survey; 2) Southern Gulf Multi-Species Survey; 3) Fixed and Mobile Gear Sentinel Surveys; 4) Snow Crab Survey; and 5) Herring Acoustic Surveys.

5.3.2.5 Other Marine Traffic

The Gulf region contains one of the major seaways of the world, and the majority of ship traffic enters and exits via the Cabot Strait (or Strait of Belle Isle in summer) bound for the St. Lawrence Seaway, accommodating approximately 6,400 commercial vessel transits annually (Alexander *et al.* 2010; AMEC 2014). Additionally, a number of major commercial ferry routes exist throughout the Gulf including: North Sydney, Nova Scotia to Port aux Basques, Newfoundland; St. Barbe, Newfoundland to Blanc Sablon, Québec; Caribou, Nova Scotia to Wood Islands, Prince Edward Island; Souris, Prince Edward Island to Cap aux Meules, Quebec; and within Quebec, a number of coastal ferries service ports along the Quebec North Shore (Alexander *et al.* 2010; Gaudet and Leger 2011).

The Project is adjacent to the major shipping route that traverses the St. Lawrence River estuary and across the Gulf immediately south of Anticosti Island (LGL 2005a; AMEC 2014). Traffic density in this vicinity is four to eight ships per day, many of which are container vessels (LGL 2005a).
Tourism and Recreational Activities

Marine tourism and recreation is an industry experiencing growth throughout the Gulf, including increased cruise ship activity, offshore excursions (whale watching and marine tours), recreational boating, and recreational use of coastal areas (hiking, diving, kayaking) occurring from spring to fall.

The western Newfoundland region coastal scenery provides abundant opportunities for viewing whales, making the region popular for sightseeing and leisure hiking, particularly along the coastal trails from the Codroy Valley estuary to the headlands of the Labrador Straits. There is a network of national, provincial, municipal, and private parks, historic sites, and conservation areas throughout the Gulf.

Marine-related recreation, such as sea kayaking, is growing in interest and popularity among residents and visitors. This also includes yachting focused principally in the Bay of Islands, recreational boating throughout much of the inshore areas of the Gulf, a Humber Valley Rowing Club, and scuba diving in the Bay of Islands, Port au Port Bay, and in Port aux Choix. Growth in other recreational activities in the region includes swimming, camping, hiking, whale and bird watching (DFO 2011e, 2011f), and cottage development (Alexander *et al.* 2010).

Cruise ships travel through the Gulf of St. Lawrence to ports in Charlottetown, Prince Edward Island, and Sydney, Cape Breton. Cruise ships also come into several locations on the west coast of Newfoundland, with the nearest cruise ship port in Corner Brook, and also travel to Gros Morne National Park, which is a major tourist attraction in the western Newfoundland region.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 OVERVIEW OF PROJECT INTERACTIONS AND POTENTIAL EFFECTS

This section of the EA identifies and discusses the potential interactions between Project activities and components and the potential environmental effects as identified in Table 6.1.

Table 6.1 Potential Project-VC Interactions

Project Activities and Physical Works	Valued Component					
	Fish, Shellfish and Habitat	Marine Mammals and Sea Turtles	Marine and/or Migratory Birds	Species at Risk	Sensitive Areas	Fisheries and Other Users
Survey Vessel Operation (noise, lights, marine discharges, towing operation)	X	X	X	X	X	X
Operation of CSEM Source	X	X		X	X	X
Receiver Deployment and Retrieval	X			X	X	

The survey vessel will emit noise and light emissions as well as permitted marine discharges during operation, thereby potentially affecting: Fish, Shellfish and Habitat; Marine Mammals and Sea Turtles; Marine and/or Migratory Birds; and Species at Risk. Potential effects on species using Sensitive Areas are primarily captured in their respective VCs (*e.g.*, Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk) to avoid duplication of effects assessment, although potential changes to habitat quality of Sensitive Areas is also considered with respect to changes in water quality and light and sound emissions). There is also the potential for interaction with Fisheries and Other Ocean Users who may be transiting the area.

The operation of the CSEM source will generate underwater EM emissions potentially affecting: Fish, Shellfish and Habitat; Marine Mammals and Sea Turtles; and Species at Risk. Potential effects on species using Sensitive Areas are primarily captured in their respective VCs (*e.g.*, Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk) to avoid duplication of effects assessment, although potential changes to habitat quality of Sensitive Areas due to EMFs are also considered. To the extent that these emissions temporarily affect the local distribution of commercial fish species, Fisheries and Other Ocean Users could also potentially be affected by this activity.

Receiver deployment will result in localized, temporary changes in benthic habitat, thereby potentially affecting: Fish, Shellfish and Habitat; Species at Risk; and Sensitive Areas. Potential effects on species using these Sensitive Areas are primarily captured in their respective VCs (*e.g.*, Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk) to avoid duplication of effects assessment, but effects on benthic habitat within Sensitive Areas are also considered.

These interactions and potential effects are discussed by VC in the sections that follow.

6.2 MARINE FISH, SHELLFISH AND HABITAT

Marine Fish, Shellfish and Habitat includes the physical (*e.g.*, substrate, temperature, water depth), chemical (*e.g.*, nutrients), and biological (*e.g.*, benthic invertebrates, marine plants) attributes of the environment that are required by marine fish to carry out life cycle processes (*e.g.*, spawning, rearing, feeding, overwintering, migration). Several commercial species of fish and shellfish have spawning, feeding and nursery habitats within the Western Newfoundland/Gulf of St. Lawrence region. Environmental effects of the Project activities on fish and fish habitat resulting from a CSEM survey are assessed in this section. Marine Fish, Shellfish and Habitat is selected as a VC because of the potential for direct interaction with the Project. Specifically, it was selected as a VC because of:

- specific regulatory requirements of the *Fisheries Act*
- requirements of the Project-specific Scoping Document (refer to Appendix A)
- the direct interaction between marine habitat and proposed Project activities
- the ecological, recreational and commercial importance of marine habitat and fish and shellfish species to the public.

Species of marine fish listed under SARA or considered at risk by COSEWIC are assessed within the Species at Risk VC (Section 6.5). The environmental effects of accidental events are assessed in Section 7. Cumulative environmental effects in consideration with other projects and/or activities are assessed in Section 8.

6.2.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect** on Marine Fish, Shellfish and Habitat is defined as one that affects fish and/or shellfish populations, or a portion thereof, in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations. Natural recruitment (reproduction and in-migration from unaffected areas) may not re-establish the population to its original (*i.e.*, pre-Project) level within several generations or avoidance of the area becomes permanent.

The provisions of the *Fisheries Act* are also considered to be an essential part of the framework for the assessment of adverse residual environmental effects on Marine Fish, Shellfish and Habitat.

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

6.2.2 Project Interactions

Project activities can interact with Fish, Shellfish and Fish Habitat through the operation of the survey vessel, operation of the CSEM source, and deployment and retrieval of the receivers. The survey vessel will emit noise and light emissions, which could potentially result in temporary attraction or avoidance behaviour by fish species. Vessel waste discharges will be managed in compliance with applicable waste management and pollution prevention regulations (refer to Section 2.5.1); therefore, any effects associated with these discharges are expected to be negligible and are not considered further.

EM emissions generated by the CSEM source can potentially result in physiological and/or behavioural changes in fish species, particularly those that are able to sense weak EM currents and/or rely on geomagnetic cues for migration.

Deployment of the receivers to the seafloor will result in temporary, localized benthic disturbance.

6.2.3 Mitigation

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

- Vessel waste discharges will be managed in accordance with MARPOL.
- An SMMO will be on board to record shark (and marine mammal and sea turtle) observations and oversee ramp up procedures.
- The EM source will be ramped up over a 20-minute period. In areas where water depth are greater than 500 m, the EM 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 EM 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.

6.2.4 Assessment of Residual Environmental Effects

Survey Vessel Operation

Although there have been numerous studies on the effects of anthropogenic noise on fish species, most of these studies have focused on pulsed types of noise, including impact pile driving, seismic surveys, and explosive devices, rather than continuous noise sources such as vessel traffic. Studies have illustrated that peak levels of noise that are above 206 dB re 1 µPa and cumulative SELs of 187 dB re 1 µPa are needed to elicit damage for fish 2 grams or heavier (Fisheries Hydroacoustic Working Group 2008). Noise emitted from the survey vessel will likely be in the range of 170 to 180 dB_{RMS} re 1 µPa @ 1 m; therefore, it will be extremely unlikely that direct injury to fish will occur due to the operation of the survey vessel. The avoidance of some fish, including invertebrate species, may occur in the immediate vicinity of the vessel, including startle responses (Mueller-Blenkle *et al.* 2008; Fewtrel and McCauley 2012).

Artificial lighting can also affect fish species in the area of influence around the ship. Artificial light can affect the light and dark cycle of fish and invertebrates, causing physiological stress to the circadian rhythm, or attract prey and predator fish species. Given the limited underwater lighting from the survey vessel, the transient movement, and relatively brief survey period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), effects from vessel lighting on Fish, Shellfish and Fish Habitat are expected to be negligible.

Overall, residual effects of survey vessel operation on Marine Fish, Shellfish, and Fish Habitat are predicted to be negligible to low, occur within the LAA, are reversible, and will be continuous only over a short duration (5 to 15 days (allowing for weather downtime, most likely less than 10 days)).

Operation of CSEM Source

Given the relatively low EM emissions generated by the CSEM source levels, direct physical effects are not likely to occur on marine fish or shellfish. However, organisms which use geomagnetic fields for navigation may experience an impedance of their navigational abilities as a result of interference from EM energy generated by the CSEM source.

Sensitivities to EM emissions vary substantially by species. Elasmobranchs (*e.g.*, sharks, skates) are considered to be "electoreceptive" as they are noted to have a high sensitivity to low-frequency electric fields (Buchanan *et al.* 2011); some species are sensitive to levels as low as 1 nV/m (Fisher and Slater 2010). Electrosensitivity may also be a function of the depth at which animals live, with species inhabiting deeper regions of the ocean where sunlight doesn't penetrate, relying more heavily on electroreception (Buchanan *et al.* 2011). Elasmobranch fish use their ability to detect electric fields to locate potential predator and prey species as well as other individuals for reproduction (Normandeau et al. 2011).

Swimming sharks and rays have exhibited avoidance responses when subjected to voltage gradients of 0.1 to 1 mV/m (Buchanan *et al.* 2011). Sedate sharks and rays responded to an EMF with a voltage gradient of 0.01 mV/m.

It has also been proposed that the elasmobranchs can navigate via the Earth's geomagnetic field (Buchanan *et al.* 2011; Walker *et al.* 2003). Evidence of elasmobranchs detecting magnetic fields has been limited to laboratory studies. Behavioural responses to shifts in geomagnetic fields have been documented for leopard sharks, round stingrays, sandbar sharks, and scalloped hammerhead sharks (Buchanan *et al.* 2011). Behavioural laboratory studies have shown that stingrays and juvenile sharks can be conditioned to respond to the presence or absence of imposed magnetic fields (Normandeau *et al.* 2011). Adult hammerhead sharks were tracked in Mexico between mid-water seamounts separated by a distance of approximately 20 km. The pattern of the sharks movements was strongly correlated with changes in magnetic field intensity along the migration route. The behaviour was consistent with magnetic orientation and possibly navigation, although the mechanism by which the sharks use to navigate remains unknown.

Other groups of fishes (*e.g.*, eels, shellfish) are known to be more sensitive to magnetic fields, with sensitivities to magnetic fields on the order of a few µT (*i.e.*, greater than 1000 nT) (Fisher and Slater 2010).

Buchanan *et al.* (2011) contains a comprehensive description of electromagnetics (see Section 3 of reference) as well as effects of EM emissions (see Section 6.4 of reference) and proposes thresholds of effects for assessment. Conservative generic effects thresholds of 200 nT for magnetic fields and 386 nV/cm for electric fields are used to represent levels whereby some of the more sensitive groups of animals (*e.g.*, elasmobranchs) may demonstrate an ability to detect fields but do not necessarily elicit a response with negative or positive implications. The sensitivity of sedate sharks and rays noted above respond to an EMF with a voltage gradient of 100 nV/cm, which is below the 386 nV/cm generic effects threshold. However, sedate sharks and rays are not among the species that could be present in the Project Area or LAA (refer to Table 5.3).

Assuming survey source levels of 7,400 nT and 300,000 nV/cm, and recognizing that EM signal strength dissipates in proportion to r^2 (r is the distance to the source), modelling by Buchanan *et al.* (2011) predicts a maximum 400 m radius for the zone of influence for the magnetic field and 800 m for the electric field at the assumed effects threshold levels. The instantaneous geographic areal extent of effects would be 0.5 km^2 to 2 km^2, with duration of exposure of a fixed point along the axis of the tow on the order of 12 to 21 minutes with the vessel moving at 2 knots (LGL 2014).

The duration of exposure of individuals (including elasmobranchs) at these conservative effects thresholds is too short to interfere with known processes such as orientation, movements, migration or predator/prey detection.

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.

Receiver Deployment and Retrieval

While the receiving equipment will be triggered to release from the anchors and be retrieved, the compacted sand anchors will remain on the seafloor. A total of 7 m^3 of material (70 anchors each 1 m x 1 m x 0.1 m) will be left on the seafloor; this is expected to degrade into its component ingredients (see Section 2.2.3), none of which are harmful to the marine environment. 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 (less than one year), and reversible.

6.2.5 Determination of Significance

In consideration of the proposed mitigation measures and the limited spatial and temporal scale of Project activities, residual environmental effects on Marine Fish, Shellfish and Habitat are predicted to be not significant.

6.2.6 Follow-up Monitoring

No follow-up monitoring is proposed for Marine Fish, Shellfish and Habitat.

6.3 MARINE MAMMALS AND SEA TURTLES

Marine Mammals and Sea Turtles were selected as a VC as they play a critical role in the marine ecosystem, the significance of which is manifested in regulatory protection, scientific study, and public concern. Specifically, Marine Mammals and Sea Turtles were included as a VC because of:

- specific regulatory requirements of the *Fisheries Act*
- requirements of the Project-specific Scoping Document (refer to Appendix A)
- the direct interaction between marine mammals and sea turtles and proposed Project activities
- the ecological, recreational and commercial importance of marine mammals to the public.

The assessment of marine mammals includes baleen whales (Mysticetes), toothed whales (Odontocetes), dolphins (Delphinids), and seals (Pinnipeds). Species of marine mammals and sea turtles listed under SARA or considered at risk by COSEWIC are assessed separately as Species at Risk (Section 6.5). Those species that are not considered at risk and may interact with the Project are considered within this VC. The effects of accidental events on marine mammals and sea turtles are assessed in Section 7. Cumulative environmental effects on marine mammals and sea turtles in consideration with other Projects and/or activities are assessed in Section 9.

6.3.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect on Marine Mammals and Sea Turtles** is defined as one that affects a marine mammal or sea turtle population or portion thereof or their associated habitat in such a way as to cause a decline or change in abundance and/or distribution of the population over one or more generations. Natural recruitment (reproduction and in-migration from unaffected areas) may not re-establish the population to its original (*i.e.*, pre-Project) level within several generations or avoidance of the area becomes permanent.

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

6.3.2 Project Interactions

Underwater noise associated with survey vessel operation and EMFs generated by the CSEM source can temporarily affect habitat quality and use by cetaceans and sea turtles, and potentially result in physiological and behavioural effect, including effects on migratory behaviour. There is also the potential risk of vessel collision with marine mammals and sea turtles during transit and survey operations.

6.3.3 Mitigation

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

- An SMMO will be on board to record shark, marine mammal and sea turtle observations and oversee ramp-up procedures.
- The EM source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the EM 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 EM source will be turned off when data are not being collected (*e.g.*, during vessel turns).
- Vessel waste discharges will be managed in accordance with MARPOL.
- Low vessel speed (4 to 5.5 km/hr [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.

6.3.4 Assessment of Residual Environmental Effects

Survey Vessel Operation

Underwater Noise

Marine mammals use underwater sound to communicate, detect predators, locate prey, and, in some odontocete species, for echolocation. Underwater sound can result in changes to the marine environment that can result in behavioral and/or physiological effects on marine mammals. The extent of these effects depends on a variety of factors related to the sound source itself and/or the affected species. For example, effects may differ depending on the sound source type (continuous or pulsed), frequency, and/or sound pressure levels, as well as the hearing capabilities (functional hearing range), and activity context (*e.g.*, feeding, nursing) of the affected marine mammal. Table 6.2 classifies marine mammals by functional hearing groups, indicating functional hearing ranges.

Table 6.2 Functional Hearing Ranges of Marine Mammals and Sea Turtles

Functional Hearing Group	Functional Hearing Range
Low-Frequency (LF) Cetaceans (Mysticetes)	7 Hz to 35 kHz
Mid-Frequency (MF) Cetaceans (Odontocetes)	150 Hz to 160 kHz
High-Frequency (HF) Cetaceans (*e.g.*, Harbour Porpoise)	275 Hz to 160 kHz
Pinnipeds	50 Hz to 86 kHz
Sea Turtles	100-900 Hz
Notes: Source of marine mammal functional hearing groups and frequency ranges: A combination of Southall *et al.* (2007) and National Marine Fisheries Service (2016) so as to provide the broadest expected range. Source of sea turtles' generalized hearing range: Office of Naval Research (2002); Environment Australia (2003); Ketten and Bartol (2005).	

Noise emitted from the survey vessel will be of low frequency (*e.g.*, 1 to 500 Hz) and likely be in the range of 170 to 180 dB_{RMS} re 1 μPa @ 1 m. DFO has not yet set regulatory thresholds for levels of underwater sound to be avoided to reduce potential for injury or behavioural disturbance effects to marine mammals or sea turtles. In the absence of formal Canadian thresholds, published literature reviews and US regulatory and draft regulatory thresholds for reducing risk of potential impacts to marine mammals are used. Draft guidelines issued by the National Marine Fisheries Service (2016) establish an acoustic threshold for permanent threshold shift (PTS) at a cumulative sound exposure level of 173 dB re 1 μPa^2s over 24 hours for high-frequency cetaceans. Thresholds for other functional hearing groups of marine mammals are established at 198 dB re 1 μPa^2s or higher. Sound emissions at the predicted levels for the survey vessel are therefore not expected to result in changes in hearing sensitivity (either temporary or permanent) of marine mammals or sea turtles.

Regarding behavioral effects, the National Oceanic and Atmospheric Administration (NOAA) has used 120 dB re 1 µPa RMS SPL as a behavioural threshold value for marine mammals exposed to continuous sounds (*e.g.*, shipping) (NOAA nd). At received sound levels above this, marine mammals may exhibit a variety of behavioural responses which could include changes in vocalizations and call length, diving rates, foraging or travelling patterns, breeding and/or migration routes, and in some cases of intense source levels, avoidance of the area of increased sound.

Masking can occur when an anthropogenic noise is strong enough to impair detection of biologically important sound signals, including communication signals, echolocation clicks, and passive detection cues that are used to navigate and find prey (OSPAR 2009). This results in a shortening of the range over which communication sounds can be detected and over which species can communicate with one another. It should be noted that most species use a range of frequencies to communicate and it would be unlikely that the full range of frequencies would be masked for extended periods. If biologically important functions, such as foraging or mating, are interrupted by masking events over prolonged periods, this can potentially lead to adverse effects at the individual and potentially the population level. Some species also use areas of thousands of square kilometres to communicate and masking may shrink the distance over which communications can be detected (OSPAR 2009).

The greatest potential for masking exists for marine mammals that produce and perceive sounds within the range of sound frequencies produced by vessels. Odontocete communication frequency ranges from 2 to over 100 kHz (Au and Hastings 2008), which would only partially be overlapped by the low frequency (1 Hz to 500 Hz) range of vessel noise. Mysticetes vocalize in lower frequencies, from 100 Hz to 30 kHz; therefore, their communication has a greater potential to overlap with noise created from vessels (Clark 1990; Erbe 2002). Baleen whales will be the most susceptible to increased levels of noise from offshore vessel traffic (*i.e.*, below 500 Hz). Some species can alter their communications to avoid being masked by anthropogenic sounds, although these alterations are not optimal behaviour for these species. It is thought that these alterations are potentially costly for the survival and reproductive success of marine mammals (Wright 2008). However, given the relatively limited spatial extent and short time frame (5 to 15 days (allowing for weather downtime, most likely less than 10 days)) of the survey and relatively small contribution of the survey vessel to existing shipping noise in the area, the Project is not expected to result in behavioral or masking effects on marine mammals.

At this time, there are no data on the effects of shipping sounds (or other continuous sources such as DP) on sea turtles, and no numeric thresholds have been proposed for which to predict adverse effects. Studies have suggested that sea turtles have greatest hearing sensitivity to low-frequency sounds (Office of Naval Research 2002; Environment Australia 2003; Ketten and Bartol 2005). While there is a general lack of research or scientific data on the effects of sound on sea turtles or the relative importance of their acoustic environment, there is also little to suggest that they would be more sensitive to underwater sounds than marine mammals (Popper *et al.* 2014) and are therefore expected to experience similar effects as described above for marine mammals.

Vessel Collision

Physical injuries or mortality due to vessel collision with marine mammals or sea turtles could occur, although unlikely to happen given the low vessel transit speed to the Project Area (22 to 24 km/hr [12 to 13 knots]) and even slower speed during survey activities in the Project Area (4 to 5.5 km/hr (2 to 3 knots]). Studies have shown that reducing vessel speed reduces the number of deaths and severe injuries by vessel impact (Vanderlaan and Taggart 2007; Vanderlaan *et al.* 2008, 2009; van der Hoop *et al.* 2012). Lethal strikes to whales have been noted to be infrequent at vessel speeds less than 25.9 km/hour (14 knots) and rare at speeds less than 18.5 km/hour (10 knots) (Laist *et al.* 2001).

There is limited information with respect to the frequency of vessel collisions and sea turtles, although as observed for cetaceans, the risk of collision appears to be linked to vessel speed. In an Australian field study examining behavioural effects of vessel speed on green sea turtles, Hazel *et al.* (2007) demonstrated that the proportion of turtles that moved away to avoid the vessel decreased significantly as vessel speed increased. Turtles that moved away from "moderate" (11 km/hour; 6 knots) and "fast" approaches (19 km/hour; 10 knots) did so at significantly shorter distances from the vessel compared to "slow" (4 km/hour; 2 knots) approaches. This research suggests that vessel operators cannot rely on green sea turtles to actively avoid being struck by the vessel if speeds exceed 4 km/hour (2 knots) (Hazel *et al.* 2007).

An SMMO will be on board to record marine mammal and sea turtle observations and any dead or distressed marine mammals or sea turtles will be reported to the C-NLOPB and DFO.

In summary, residual environmental effects on marine mammals and sea turtles as a result of survey vessel operation are predicted to be negligible to low in magnitude, restricted to the LAA, continuous over a short period of time (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), and will be reversible.

Operation of CSEM Source

Given challenges associated with studying marine mammals (*e.g.*, size, mobility, and limited population sizes), evidence of use of geomagnetic fields is limited and mostly theoretical. The evidence that marine mammals may be able to detect geomagnetic cues is based on anatomical evidence of magnetized material in some marine mammals and in consideration of data from mass strandings relative to geomagnetic anomalies (Buchanan *et al.* 2011; Normandeau *et al.* 2011; Kirschvink *et al.* 1986).

Anatomical evidence of the ability of marine mammals to use geomagnetic fields for navigation has been found in marine mammals. Magnetite has been reported in the outer membrane of the brain of some cetaceans including bottlenose dolphin, Cuvier's beaked whale, and the humpback whale, and in the tongues and jawbones of the harbour porpoise (Normandeau *et al.* 2011).

While there appears to be some species of marine mammals that use geomagnetic cues for navigation, this navigational method is not consistent across all species or regions. Klinowska (1985) analyzed 3000 marine mammal strandings from a 70-year period in the United Kingdom. This analysis correlated active strandings of live animals with instances where geomagnetic contour lines ran perpendicular to or cut across the coastline. These live strandings were also correlated with geomagnetic disturbances that in most cases, occurred one to two days post-disturbance. From these results, it was hypothesized that the marine mammals possess a highly developed sensitivity to the Earth's geomagnetic field and where unfamiliar with the coastal area, relying on geomagnetic cues for navigation. Kirschvink *et al.* (1986) found similar results studying U.S. strandings of cetaceans, which supported this hypothesis of geomagnetic navigation. However, other studies of strandings appear to show no evidence of geomagnetic navigation by cetaceans (Hui 1984; Brabyn and Frew 1994). It is therefore difficult to ascertain the extent and mechanisms by which species acquire, process and exploit magnetic data (Buchanan *et al.* 2011).

Sea turtles undergo extensive migrations during the course of their lifetime. Studies have shown hatchling and juvenile loggerhead leatherback sea turtles can detect changes in their geomagnetic environment, although there is little evidence indicating that adult sea turtles use geomagnetic navigation to any extent (Buchannan *et al.* 2011; LGL 2014).

It is assumed that CSEM survey source levels will be 7,400 nT and 300,000 nV/cm and that magnetic field emissions will drop to below 200 nT within a 400 m radius from the source, and electric field emissions will drop below 386 nV/cm within an 800 m radius. The instantaneous geographic areal extent of effects would be 0.5 km^2 to 2 km^2, with duration of exposure of a fixed point along the axis of the tow on the order of 12 to 21 minutes with the vessel moving at 2 knots (LGL 2014). Although EMF emissions may potentially be detectable by marine mammals and sea turtles within these zones of influence, given the slow tow 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 not predicted to interfere with marine mammal and sea turtle navigation.

In summary, residual environmental effects of the CSEM source on marine mammals and sea turtles are predicted to be negligible to low, restricted to portions of the Project Area, continuous over a short-term duration (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), and reversible.

6.3.5 Determination of Significance

In consideration of the significance criteria and the implementation of proposed mitigation measures, as well as in limited spatial and temporal scale of Project activities, residual environmental effects on Marine Mammals and Sea Turtles are predicted to be not significant.

6.3.6 Follow-up and Monitoring

An SMMO will be on board to record marine mammal and sea turtle observations during the CSEM program. Any dead or distressed marine mammals or sea turtles will be reported to the C-NLOPB and DFO.

6.4 MARINE AND/OR MIGRATORY BIRDS

Marine and/or migratory birds were selected as a VC because of potential interactions with Project activities that could affect their habitat, behaviour, breeding success, and ecological role. Marine and/or migratory birds are protected under the *Migratory Bird Convention Act, 1994* administered by Environment Canada.

Specifically, Marine and/or Migratory Birds were included as a VC because of:

- specific regulatory requirements of the *Migratory Bird Convention Act, 1994*
- requirements of the Project-specific Scoping Document (refer to Appendix A)
- the direct interaction between Marine and/or Migratory Birds and proposed Project activities
- the ecological, recreational and commercial importance of Marine and/or Migratory Birds to the public.

The following families of birds occur within the RAA and could potentially be affected: Procellariidae (fulmars and shearwaters), Hydrobaridae (storm-petrels), Sulidae (gannets), Phalaropodinae (phararopes), Laridae (gulls, terns, kittiwakes, jaegers, skuas), and Alcidae (dovekie, murres, razorbills, puffins). Additionally, there is potential for migratory landbirds to be affected, depending on the timing of Project activities.

In this section, the potential effects of Project activities on marine and/or migratory birds are evaluated. Species of birds listed under SARA or considered at risk by COSEWIC are assessed within the Species at Risk VC (Section 6.5). The effects of accidental events on marine and/or migratory birds are assessed in Chapter 7. Cumulative environmental effects in consideration with other projects and/or activities are assessed in Section 9.

6.4.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect** on Marine and/or Migratory Birds is one that affects bird populations (*e.g.*, direct mortality, change in migratory patterns, habitat avoidance) in a way that causes a decline in abundance or change in distribution of a population(s) of bird species within the RAA 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.

6.4.2 Project Interactions

Pelagic seabirds spend the majority of their lives on the open ocean, only coming to shore to breed, and are therefore most likely to be affected by Project activities. As a result of survey vessel traffic associated with this Project, there is potential for Project interaction with nearshore birds.

While the RAA extends to the coastal areas of western Newfoundland and the Magdalen Islands, the zones of influence of Project activities are generally limited to the Project Area. The key concern with respect to coastal areas and marine birds will therefore be disturbance to vulnerable seabird nesting sites by passing ships or helicopters (if applicable).

Other than potential interactions with the survey vessel, no other Project activities are considered likely to interact with marine and/or migratory birds. The CSEM source will be towed just above the seabed with emissions attenuating fairly rapidly. Diving birds would not be expected to dive to depths near the source tow line and therefore would not be affected. Although the receivers will cause limited disturbance in the water column during their descent (deployment) and ascension (retrieval), this movement is expected to have negligible effects on marine and/or migratory birds, including diving birds.

Artificial lighting on ships has been shown to attract nocturnally active birds, potentially causing disorientation, strandings, and collisions, thereby affecting risk of mortality to birds. Vessel waste discharges will be managed in compliance with applicable waste management and pollution prevention regulations (refer to Section 2.5.1); therefore, any effects associated with these discharges are expected to be negligible and are not discussed further. The analysis of Project effects on marine and/or migratory birds therefore focuses on potential interactions associated with vessel operation (*e.g.*, light attraction).

6.4.3 Mitigation

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

- Vessel waste discharges will be managed in accordance with MARPOL.
- Vessel lighting will be minimized to the extent practical without compromising safe operations.
- An SMMO will be on board to conduct routine checks for stranded birds and CWS bird handling and release procedures (*e.g.*, Environment Canada 2015) will be implemented if stranded birds are encountered on the vessel.
- In accordance with the MBCA, a Federal Migratory Bird Permit will be obtained from the CWS for handling stranded birds that may be encountered on the vessel. A salvage report will be filed with CWS as required by the permit.
- Vessels will follow established shipping lanes in proximity to shore and will travel at speeds not exceeding 24 km/hour (14 knots), except as needed in the case of an emergency.
- Helicopters transiting to and from the survey vessel (if required during unplanned events) will fly at altitudes greater than 300 m (with the exception of approach and landing activities) and/or at a lateral distance of 2 km around active colonies when possible.

6.4.4 Assessment of Residual Environmental Effects

Artificial lighting on ships regularly attract nocturnally active marine birds and nocturnally migrating land and water birds, sometimes in large numbers (Imber 1975; Montevecchi *et al.* 1999; Wiese *et al.* 2001; Gauthreaux and Besler 2006; Montevecchi 2006). Nocturnally active birds can be attracted to vessel lighting, especially during periods when the visibility of celestial cues is low. These birds can become disoriented and fly into vessel infrastructure, injuring themselves and becoming stranded on the vessel. During periods of increased moisture in the air, such as drizzle or fog, water droplets can refract vessel lighting, thus increasing the illuminated area and enhancing the attraction of birds. Bird mortality is increased during periods of migration and poor weather, as large numbers of birds travel at relatively low heights (Wiese *et al.* 2001).

Attraction to lighting can also result in the attraction and continuous circling of migrating birds. This results in the use of energy, delayed foraging, and migration, which can ultimately result in starvation. Small songbirds are commonly attracted to lighting from offshore ships during migration, which can lead to mortality. An additional effect of artificial lighting on marine birds and migratory birds is the potential for increased predation. During shipboard studies, Leach's storm-petrels were observed being attacked by great black-backed gulls after they became confused by the vessel lighting (Wiese and Montevecchi 2000).

Project vessels will be illuminated at night and therefore may attract marine and/or migratory birds, potentially leading to stranding. Because the anticipated Project schedule (*i.e.*, August to December) overlaps with the period of fall migration, nocturnally migrant landbirds that pass over the Project Area may be considered particularly susceptible to interactions with survey vessels. However, given the implementation of mitigation outlined above and in recognition of the short survey period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), the magnitude of residual effects of the Project on marine and/or migratory birds is expected to be low. Daily vessel searches will facilitate release and/or rehabilitation of birds, thereby reducing risk of mortality due to light attraction.

With respect to helicopter traffic, research has shown that seabirds react most strongly to low-level flights and the effects of these responses tend to be short-lived. Helicopter overflights at 300 m failed to cause a visible reaction among moulting sea ducks in the North Sea, while overflights at 100 m resulted in short-term avoidance reactions (Ward and Sharp 1974). Although unlikely to be required for this Project, helicopters, if used, will avoid major colonies and known nesting sites for species at risk, and will fly at a minimum of 300 m above sea surface whenever possible, limiting potential for disturbance.

6.4.5 Determination of Significance

In consideration of the proposed mitigation measures and the limited spatial and temporal scale of Project activities, residual environmental effects on Marine and/or Migratory Birds are predicted to be not significant.

6.4.6 Follow-up and Monitoring

An SMMO observer will be on board the vessel during the 5- to 15-day survey (allowing for weather downtime, most likely less than 10 days) and will conduct daily vessel searches to detect dead or stranded birds. Handling of birds and reporting of encounters will be conducted in accordance with CWS guidelines and the Federal Migratory Bird Permit. No further follow-up or monitoring is identified.

6.5 SPECIES AT RISK

Species at Risk are considered a VC because certain fish, marine mammal, sea turtle, and bird species may occur within the LAA or RAA that have legal protection under SARA. Once a species is listed on Schedule 1 of SARA, measures to protect it and its critical habitat and help its recovery are implemented. Section 32 of SARA prohibits harming, harassing, killing, capturing, or collecting and selling those species listed on Schedule 1 as *extirpated*, *endangered*, and *threatened*. 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). Species designated as special concern under SARA are not protected by the prohibitions of Sections 32 to 36, but do require that provincial or regional management plans are developed to protect the species. Species designated by COSEWIC, but not listed under Schedule 1 of SARA are also considered in this VC.

Specifically, Species at Risk were included as a VC because of:

- specific regulatory requirements of SARA
- requirements of the Project-specific Scoping Document (refer to Appendix A)
- the direct interaction between Species at Risk and proposed Project activities
- the importance of Species at Risk to the public.

A total of 45 Species at Risk have been identified to have the potential to occur within the RAA, including 22 marine fish, seven marine mammals, 14 marine and/or migratory birds, and two sea turtles. Of these species, 22 have populations that are listed on Schedule 1 of SARA, including four marine fish, five marine mammals, twelve marine and/or migratory birds, and one sea turtle. Effects on Species at Risk are primarily discussed with respect to legally protected (*i.e.*, Schedule 1) species, but those designated by COSEWIC, though not listed under SARA. are also considered. Further information on effects of the Project on species not legally protected under Schedule 1 of SARA are outlined in the Marine Fish, Shellfish and Habitat; the Marine Mammals and Sea Turtles; and the Marine and/or Migratory Birds VCs. This assessment is also closely related to the Sensitive Areas VC. The effects of accidental events on Species at Risk are assessed in Section 7 and cumulative environmental effects in consideration with other projects and/or activities are assessed in Section 9.

6.5.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect** on Species at Risk is one:

- that jeopardizes the achievement of self-sustaining population objectives or recovery goals;
- is not consistent with applicable allowable harm assessments;
- results in 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 environmental effect that does not meet the above criteria is considered to be not significant.

6.5.2 Project Interactions

Project interactions with Species at Risk would be the same as those identified in the Marine Fish, Shellfish and Habitat; Marine Mammals and Sea Turtles; and Marine and/or Migratory Bird VCs. Project activities can interact with Species at Risk through the operation of the survey vessel, operation of the CSEM source, and deployment and retrieval of the receivers. The survey vessel will emit noise and light that could potentially result in temporary attraction or avoidance behaviour by Species at Risk (*i.e.*, fish may be attracted or may avoid the survey vessel, birds may be attracted to the light, and marine mammal and sea turtle prey species may be attracted to the vessel while marine mammals themselves may avoid the vessel noise). The presence of the survey vessel itself could also result in collisions with Species at Risk, particularly marine mammals and sea turtles. EM emissions generated by the CSEM source can potentially result in physiological and/or behavioural changes in fish Species at Risk. Deployment and retrieval of the receivers has the potential to interact with benthic Species at Risk.

6.5.3 Mitigation

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

- An SMMO will be on board to record shark, marine mammal and sea turtle observations and oversee ramp-up procedures.
- The EM source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the EM 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.
- In areas where water depths are less than 500 m, the EM source will be shut down if a SARA-listed species is observed within 500 m of the energy source.
- The EM 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.
- Vessel waste discharges will be managed in accordance with MARPOL.
- Low vessel speed (4 to 5.5 km/hr [2 to 3 knots]) will reduce underwater noise and the risk of collision with marine mammals or sea turtles and SARA-listed species.
- Any dead or distressed marine mammals or sea turtles and SARA-listed species will be reported to the C-NLOPB and DFO.
- Routine checks for stranded birds will be conducted and CWS bird handling and release procedures (*e.g.*, Environment Canada 2015) will be implemented if stranded birds are encountered on the vessel.

- In accordance with the MBCA, a Federal Migratory Bird Permit will be obtained from the CWS for handling stranded birds that may be encountered on the vessel. A salvage report will be filed with CWS as required by the permit.
- Vessel lighting will be minimized to the extent practical without compromising safe operations.

6.5.4 Assessment of Residual Environmental Effects

Many of the Project-related activities are limited to the Project Area; therefore, they would only interact with Species at Risk that are likely to occur in or within close proximity to Project activities. Species at Risk known to occur within the RAA and information on their likely occurrence within the Project Area is provided in Table 6.3. Many of the species at risk are unlikely to be encountered within the Project Area due to limited spatial overlap (*e.g.*, because they are uncommon and/or because of their range and/or habitat associations) or limited temporal overlap. Water depths in the Project Area vary from 50 to 550 m which influences the marine fish species at risk that are likely to occur.

Of the marine fish species at risk listed in Schedule 1 of the SARA, white shark and northern wolffish are considered to have a low potential for occurrence in the Project Area. The white shark is an infrequent transient to the area and the northern wolffish is expected to be present in low abundance because of their habitat associations (*e.g.*, these species typically occur at greater depths than are present in the Project Area) and restrictions in their distribution. However, the Atlantic wolffish and spotted wolffish are known to be relatively common in portions of the Project Area (AMEC 2014), particularly the Atlantic wolffish which may be encountered along the slope of the Laurentian Channel and the coast of western Newfoundland (COSEWIC 2012c) and is likely to occur within the western portion of the Project Area.

Although unlikely to occur in abundance, marine mammal and sea turtle species listed on Schedule 1 of the SARA have a moderate potential to spatially and temporally overlap with Project activities, including the blue whale, North Atlantic right whale, fin whale, harbour porpoise, and leatherback sea turtle. Because of the anticipated timing of the Project and/or affinities for coastal environments, none of the bird species at risk are likely to utilize the Project Area for breeding purposes during the anticipated Project schedule. However, the August to December period for the CSEM survey of 5 to 15 days (allowing for weather downtime, most likely less than 10 days) does overlap with the period of fall migration and bird species at risk that are passing through the area and which could potentially interact with the Project at that time. Although the ivory gull has a moderate potential to occur within the Project Area, Project activities will not temporally overlap with the presence of this species because the survey will be conducted during the ice-free season. Furthermore, effects to marine bird colonies are not considered likely considering the nature of Project activities, the anticipated survey schedule (*i.e.*, which is outside the breeding period for colonial nesters), and mitigation to avoid helicopter activity (if required) near colonies.

Table 6.3 Relative Occurrence of Species at Risk within the Project Area

Common Name	COSEWIC Status	SARA Schedule 1 Status	Recovery Strategy or Management Plan	Critical Habitat in RAA	Potential for Occurrence in Project Area[1]
Marine Fish					
White Shark (Atlantic population)	Endangered	Endangered	No	No	Low
Porbeagle Shark	Endangered	No Status	No	No	Moderate
Shortfin Mako Shark (Atlantic population)	Threatened	No Status	No	No	Low
Basking Shark (Atlantic population)	Special Concern	No Status	No	No	Low
Northern Wolffish	Threatened	Threatened	Yes	No	Low
Spotted Wolffish	Threatened	Threatened	Yes	No	Moderate
Atlantic (striped) Wolffish	Special Concern	Special Concern	Yes	No	Moderate - High
Atlantic Bluefin Tuna	Endangered	No Status	No	No	Moderate
Atlantic Cod (Laurentian North population)	Endangered	No Status	No	No	Moderate
Atlantic Cod (Laurentian South population)	Endangered	No Status	No	No	High
Atlantic Salmon (Anticosti island population)	Endangered	No Status	No	No	Low
Atlantic Salmon (South Newfoundland population)	Threatened	No Status	No	No	Low
Atlantic Salmon (Gaspé-Southern Gulf of St. Lawrence population)	Special Concern	No Status	No	No	Moderate
Atlantic Salmon (Inner St. Lawrence population)	Special Concern	No Status	No	No	Moderate
Atlantic Salmon (Quebec Eastern North Shore population)	Special Concern	No Status	No	No	Moderate
Atlantic Salmon (Quebec Western North Shore population)	Special Concern	No Status	No	No	Moderate
Cusk	Endangered	No Status	No	No	Low
Deepwater Redfish (Gulf of St. Lawrence - Laurentian Channel population)	Endangered	No Status	No	No	High

Table 6.3 Relative Occurrence of Species at Risk within the Project Area

Common Name	COSEWIC Status	SARA Schedule 1 Status	Recovery Strategy or Management Plan	Critical Habitat in RAA	Potential for Occurrence in Project Area[1]
Acadian Redfish (Atlantic population)	Threatened	No Status	No	No	High
Roundnose Grenadier	Endangered	No Status	No	No	Low
Roughhead Grenadier	Special Concern	No Status	No	No	Low
Winter Skate (Gulf of St. Lawrence population)	Endangered	No Status	No	No	Moderate
American Eel[3]	Threatened	No Status	No	No	Low - Moderate
American Plaice (Newfoundland and Labrador population)	Threatened	No Status	No	No	Low
American Plaice (Maritime population)	Threatened	No Status	No	No	High
Atlantic Sturgeon (St. Lawrence populations)	Threatened	No Status	No	No	Low
Atlantic Sturgeon (Maritimes populations)	Threatened	No Status	No	No	Low - Moderate
Striped Bass (Southern Gulf of St. Lawrence population)	Special Concern	No Status	No	No	Low
White Hake (Atlantic and Northern Gulf of St. Lawrence population)	Threatened	No Status	No	No	Moderate - High
White Hake (Southern Gulf of St. Lawrence population)	Endangered	No Status	No	No	Moderate - High
Spiny Dogfish (Atlantic population)	Special Concern	No Status	No	No	Low
Marine Mammals					
Blue Whale (Atlantic population)	Endangered	Endangered	Yes	No	Moderate - High
North Atlantic Right Whale	Endangered	Endangered	Yes	No	Low
Northern Bottlenose Whale (Scotian Shelf population)	Endangered	Endangered	Yes	No	Low
Northern Bottlenose Whale (Davis Strait-Baffin Bay-Labrador Sea Population	Special Concern	No Status	No	No	Low

Table 6.3 Relative Occurrence of Species at Risk within the Project Area

Common Name	COSEWIC Status	SARA Schedule 1 Status	Recovery Strategy or Management Plan	Critical Habitat in RAA	Potential for Occurrence in Project Area[1]
Beluga Whale (St. Lawrence Estuary population)	Endangered	Threatened	Yes	No	Low
Fin Whale (Atlantic population)	Special Concern	Special Concern	Yes	No	Moderate
Harbour Porpoise (Northwest Atlantic population)	Special Concern	No Status[4]	No	No	Moderate
Killer Whale (Northwest Atlantic/ Eastern Arctic population)	Special Concern	No Status	No	No	Low
Sea Turtles					
Leatherback Sea Turtle (Atlantic population)	Endangered	Endangered	Yes	Proposed	Moderate
Loggerhead Sea Turtle	Endangered	No Status	No	No	Low
Marine / Migratory Birds					
Eskimo Curlew[2]	Endangered	Endangered	Yes	No	Low
Horned Grebe (Magdalen Islands population)	Endangered	Endangered	Yes	Yes (ponds on the Magdalen Islands)	Low
Ivory Gull[2]	Endangered	Endangered	Yes	No	Moderate
Piping Plover *melodus* subspecies[2]	Endangered	Endangered	Yes	Yes (beaches on the Magdalen Islands and western Newfoundland)	Low
Red Knot *rufa* subspecies[2]	Endangered	Endangered	Yes	No	Low
Buff-breasted Sandpiper	Special Concern	Special Concern	No	No	Low
Red-necked Phalarope	Special Concern	No Status	No	No	Low
Roseate Tern	Endangered	Endangered	Yes	Yes (Magdalen Islands)	Low - Moderate

Table 6.3 Relative Occurrence of Species at Risk within the Project Area

Common Name	COSEWIC Status	SARA Schedule 1 Status	Recovery Strategy or Management Plan	Critical Habitat in RAA	Potential for Occurrence in Project Area[1]
Barrow's Goldeneye (Eastern population)[3]	Special Concern	Special Concern	Yes	No	Low
Harlequin Duck (Eastern population)[3]	Special Concern	Special Concern	Yes	No	Low
Yellow Rail	Special Concern	Special Concern	Yes	No	Low
Peregrine Falcon - anatum/tundrius	Special Concern	Special Concern	Yes	No	Low
Short-eared Owl	Special Concern	Special Concern	Yes	No	Low
Bank Swallow	Threatened	No Status	No	No	Low

[1]High - area overlaps with known concentrations of species (*i.e.*, occurs frequently and in abundance relative to other areas); Moderate - species not concentrated in area but may occur regularly in low abundance or during migration; Low - species occurs infrequently and in low abundance relative to other areas (*i.e.*, based on habitat association and distribution)

[2]Also listed as *endangered* under the Newfoundland and Labrador *Endangered Species Regulation*

[3]Also listed as *vulnerable* under the Newfoundland and Labrador *Endangered Species Regulation*

Project activities are not considered likely to interact with critical habitat for species at risk. Although critical habitat for birds (specifically the horned grebe, piping plover, and roseate tern) occurs within the RAA, it is restricted to the Magdalen Islands and coastal areas of western Newfoundland which are outside of the Project Area. Critical habitat has not been identified within the Project RAA for any of the marine fish, marine mammal, or sea turtle species at risk.

Survey Vessel Operation

Marine Fish Species at Risk

Effects of survey vessel operation on marine fish species at risk include the effects of noise and lights, but residual environmental effects are expected to be negligible in consideration of the nature of Project activities. Although noise may result in the avoidance of some fish in the immediate vicinity of the vessel, including startle responses (Mueller-Blenkle *et al.* 2008; Fewtrel and McCauley 2012), noise emitted from the survey vessel are not considered to cause direct injury to fish. Most available literature indicates that the effects of noise on fish are transitory, and if short-lived and outside a critical period, are expected not to translate into biological or physical effects. In most cases, it appears that behavioural effects on fish because of noise should result in negligible effects on individuals and populations. Similarly, although artificial lighting can affect fish species near the ship (*e.g.,* artificial light can affect the light and dark cycle of fish and invertebrates, causing physiological stress to the circadian rhythm, or attract prey or predator species of marine fish species at risk), effects to marine fish species at risk are expected to be negligible in consideration of the limited underwater lighting from the survey vessel, the transient movement, and relatively brief survey period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)) of the Project. Potential effects of survey vessel operation are further lessened by consideration of the likely occurrence of marine fish species at risk within the Project Area. For example, white shark and northern wolffish are considered to have a low potential to occur within the Project Area. Although the Atlantic wolffish and spotted wolffish are relatively common along the slope of the Laurentian Channel, these and other groundfish (*e.g.*, Atlantic cod and American plaice) are unlikely to be influenced by vessel operation because of their benthic association. Additional discussion on the potential residual environmental effects of survey vessel operation on fish is provided in Section 6.2.4.

Marine Mammal and Sea Turtle Species at Risk

The survey vessel operation has the potential to result in adverse environmental effects on marine mammal and sea turtle species at risk, including the blue whale, North Atlantic right whale, fin whale, harbour porpoise, leatherback sea turtle, and other species. However, effects are considered minor in consideration of the nature of Project activities and information on the likely occurrence of species. In consideration of injury thresholds proposed by Southall *et al.* (2007) and NMFS (2016) for non-impulsive (*i.e.*, continuous) sound sources for different functional hearing groups and the likely SPLs produced by the survey vessel (170-180 dB_{RMS} re 1 µPa @ 1 m), neither temporary nor permanent threshold shift effects are predicted to occur on marine mammals (and by extension, to sea turtles) as a result of underwater noise from the Project.

Dow Piniak *et al.* (2012) determined that the leatherback sea turtle hearing sensitivity overlaps with frequencies produced by low-frequency anthropogenic sources, including seismic sources, offshore drilling, and vessel traffic. Juvenile sea turtles responded to stimuli between 50 and 1,200 Hz and have maximum sensitivity between 100 and 400 Hz in water, with optimal hearing below 1,000 Hz (Dow Piniak *et al.* 2012). The maximum sensitivity for the loggerhead sea turtle has been measured between 200 and 400 Hz (Martin *et al.* 2012).

Physical injuries or mortality due to vessel collision with marine mammals or sea turtles could occur, although unlikely to happen given the low vessel transit speed to and from the Project Area (22 to 24 km/hr [12 to 13 knots]) and even slower speed during survey activities in the Project Area (4 to 5.5 km/hr [2 to 3 knots]). Additional discussion on the potential residual environmental effects of survey vessel operation on marine mammals and sea turtles is provided in Section 6.4.4.

Marine and/or Migratory Bird Species at Risk

The August to December period does overlap with the period of fall migration and bird species at risk that are passing through the area, which could potentially be attracted to the lights of survey vessels at that time, particularly nocturnal migrants such as the olive-sided flycatcher, the bobolink, and the common nighthawk. The red-necked phalarope is also known to occur in waters of the Gulf during migration and could be influenced by vessel operation. However, in recognition of the short survey period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)) and mitigation measures, effects of the survey vessel operation on marine and/or migratory bird species at risk are predicted to be minor. Effects on other bird species at risk are unlikely in consideration of their coastal affinities and/or the timing and nature of Project activities. Additional discussion on the potential residual environmental effects of survey vessel operation on marine and/or migratory birds is provided in Section 6.3.4.

Operation of CSEM Source

Marine Fish Species at Risk

Given the relatively low EM emissions generated by the CSEM source levels, direct physical effects are not likely to occur on marine fish species at risk. However, organisms which use geomagnetic fields for navigation may detect a change in EMFs within a limited spatial and temporal extent due to the survey.

Elasmobranchs (*e.g.*, sharks) have been shown to use EMFs. Buchanan *et al.* (2011) compared industry data with published EM sensitivity data on elasmobranchs and calculated that environmental effects from a typical EM source would quickly attenuate and occur within a 400 m radius for a short (approximately 15 to 20 minutes) time frame (*i.e.*, the EM source is moving, not stationary, as are most sensitive species). It is unlikely that the resulting exposure duration would interfere with orientation processes of animal movements.

Outside of the elasmobranch family of fish (discussed in Section 6.2.4.2), most research on geomagnetic orientation has focused on two groups of fish; salmon and eels, both of which undergo extensive migrations during their life history. Salmon hatch from freshwater streams and migrate out to sea to undergo feeding migrations where they can travel hundreds to thousands of kilometres (Buchanan *et al.* 2011). After spending their adult lives at sea, salmon migrate back to their native streams to spawn. Eels carry out the opposite life cycle, spending the majority of their adult lives living in freshwater streams and migrate to the ocean to spawn. In the Atlantic, the European eel migrates to spawning grounds in the Sargasso Sea, located off the southeast coast of the US. The American eel migrates from rivers in the US and Canada to the same area of the Atlantic Ocean. Newly hatched eels are carried north in the North Atlantic Gyre, where they disperse back to rivers in the US, Canada and Europe. The fact that these species carry out long-distance migrations makes them ideal candidates to carry a geomagnetic guidance system.

As mentioned above, migratory fish species such as salmonids and anguillid eels are likely to use EMFs during stages of their lives, predominantly during migration (Gill and Bartlett 2010). Some of these species are known to be sensitive to EMF. Although they do not possess specialized receptors, they can detect induced voltage gradients associated with water movement or geomagnetic emissions. A few literature reviews have been published on the topic, with the consistent conclusion that there is a deficit of scientific literature available covering salmonid and eel species, relating to their response to anthropogenic EMFs (Gill and Bartlett 2010). Some laboratory-based studies suggest that EMF emissions in the environment will likely have no net effect on fish and invertebrate species, while others have shown a range of developmental and physiological responses for some marine invertebrates (Gill and Bartlett 2010).

Electrical field strengths ranging from 7 to 70 mV/m have been reported to elevate the heart rate of salmon and eels (Fisher and Slater 2010). Shuddering of gills and fins is exhibited in fish when exposed to 50 to 7,500 mV/m, and the anode reaction (when a fish swims towards an electrically charged anode) occurs at field strengths ranging from 25 to 15,000 mV/m. Harmful physiological effects such as electronarcosis or paralysis occur in fish at field strengths of 15,000 mV/m or more.

Richardson *et al.* (1976) exposed Atlantic salmon to low-frequency EMFs over a ten-day period, and showed no changes in locomotor behaviours. They also failed to show conditioned or trained behaviours in movement cycles when the magnetic fields were turned on and off. The same study also looked at EM effects on American eels and showed that there was no physiological or behavioural response to EMFs at ten times more than geomagnetic levels in controlled laboratory experiments.

Assuming survey source levels of 7,400 nT and 300,000 nV/cm, and recognizing that EM signal strength dissipates in proportion to r^2 (r is the distance to the source), modelling by Buchanan *et al.* (2011) predicts a maximum 400 m radius for the zone of influence for the magnetic field and 800 m for the electric field at the assumed effects threshold levels. The instantaneous geographic areal extent of effects would be 0.5 km^2 to 2 km^2, with duration of exposure of a fixed point along the axis of the tow on the order of 12 to 21 minutes with the vessel moving at 2 knots (LGL 2014).

The duration of exposure of individuals (including fish species at risk) at these conservative effects thresholds is too short to interfere with known processes such as orientation, movements, migration or predator/prey detection.

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.

Marine Mammal and Sea Turtle Species at Risk

Walker (1992) performed statistical simulations on fin whale sightings from Cape Cod to Cape Hatteras to determine if whale positions were random with respect to geomagnetic gradients and bathymetry during migrations. It was determined that the sighting positons were statistically associated with areas of higher geomagnetic field gradients during the summer and with lower field gradients and intensities during the fall months (Normandeau *et al.* 2011). Associations with bathymetric profiles were not observed in any season. The authors concluded that fin whales and other mysticetes may recognize and associate with geomagnetic field features independently of other geographic features during migrations.

Research indicates that young loggerhead sea turtles may rely on magnetic field cues during their migration from hatching sites on the shores of Florida, offshore to the Gulf Stream and the North Atlantic gyre (Cain *et al.* 2005). Experiments have revealed that hatchling loggerheads can distinguish between different geomagnetic inclination angles and that these elicit orientation responses in hatchling sea turtles that are likely important for reducing the mortality rate for this species (Cain *et al.* 2005; Normandeau *et al.* 2011).

It is assumed that CSEM survey source levels will be 7,400 nT and 300,000 nV/cm and that magnetic field emissions will drop to below 200 nT within 400 m radius from the source and electric field emissions will drop below 386 nV/cm within an 800 m radius. The instantaneous geographic areal extent of effects would be 0.5 km^2 to 2 km^2, with duration of exposure of a fixed point along the axis of the tow on the order of 12 to 21 minutes with the vessel moving at 2 knots (LGL 2014). Although EMF emissions may potentially be detectable by marine mammals and sea turtle species at risk within these zones of influence, given the slow tow speed of the vessel and rapid attenuation of the EMFs, marine mammals and sea turtles species at risk would be able to avoid these small areas of high intensity if they chose to do so. 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.

In summary, residual environmental effects of the CSEM source on marine mammals and sea turtle species at risk are predicted to be negligible to low, restricted to portions of the Project

Area, continuous over a short-term duration (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), and reversible.

Receiver Deployment and Retrieval

Receiver anchors will be deposited on the seafloor and therefore will interact with the benthic environment. Although interactions with adult marine fish species at risk are unlikely because of the limited size of the anchors, likely abundance of marine fish species at risk on the seafloor, and their ability to avoid physical interactions with deployed equipment, anchors do have some minor potential to interact with non-mobile life stages for marine fish species at risk. For example, the eggs of the northern wolffish are probably deposited in the benthic environment (COSEWIC 2012a) and could therefore be potentially affected by anchor deployment. However, effects are considered negligible in consideration of the spatial extent of any disturbance. Furthermore, the compacted sand anchors do not contain any ingredients harmful to the marine environment and are expected to degrade in 9 to 12 months. The residual environmental effects of receiver deployment and retrieval on marine fish species at risk are predicted to be low in magnitude, limited to a one-time event within specific areas in the Project Area, short term (less than one year), and reversible. No interaction is predicted to occur between receiver deployment and retrieval and marine mammal, sea turtle, or marine and/or migratory bird species at risk.

6.5.5 Determination of Significance

In consideration of the nature and timing of Project activities, adverse residual environmental effects of the Project on Species at Risk are predicted to be not significant. The Project is not predicted to jeopardize the achievement of self-sustaining population objectives or recovery goals for Species at Risk and will not result in 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, effects are not expected to be inconsistent with applicable allowable harm assessments, or to necessitate a request for an incidental harm permit. Project-related residual environmental effects are not expected to contravene the prohibitions under Sections 32(1), 33, or 58(1) of SARA.

6.5.6 Follow-up and Monitoring

An SMMO will be on board the vessel during the 5- to 15-day survey (allowing for weather downtime, most likely less than 10 days). No further follow-up or monitoring is required.

6.6 SENSITIVE AREAS

Sensitive Areas are often associated with rare or unique marine habitat features, habitat that supports sensitive life stages of valued marine resources, and/or critical habitat for Species at Risk. Sensitive areas were selected as a VC due to their importance as unique or important habitat for various species or species assemblages.

Seven Sensitive Areas have been identified within the RAA, five of which overlap with the boundaries of the Project Area:

- Southern Fringe of the Laurentian Channel EBSA
- West Coast of Newfoundland EBSA
- Cod Spawning Area (April – June)
- Potential Redfish Larvae Extrusion Area (April – July)
- Potential Redfish Mating Area (September – December)

Additional Sensitive Areas located with the Project RAA and LAA include the Western Cape Breton EBSA (*i.e.*, located approximately 30 km to the southwest of the Project Area) and the Laurentian Channel Area of Interest for potential designation as an MPA (*i.e.*, approximately 50 km to the southeast of the Project Area). No IBAs or designated areas of critical habitat for species at risk are present within the Project Area (see Sections 6.4 and 6.5).

As many of the Sensitive Areas being considered here were created in relation to marine fish, particularly species at risk, this assessment is closely linked to the Marine Fish, Shellfish and Habitat VC, as well as the Species at Risk VC. The effects of accidental events on Sensitive Areas are assessed in Section 7. Cumulative environmental effects on Sensitive Areas in consideration with other Projects and/or activities are assessed in Section 9.

6.6.1 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 Sensitive 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; or
- results in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy.

6.6.2 Project Interactions

Project activities can interact with Sensitive Areas through the operation of the survey vessel, operation of the CSEM source, and deployment and retrieval of the receivers. The survey vessel will emit noise and light, which could potentially result in temporary attraction or avoidance behaviour by fish species. EM emissions generated by the CSEM source can potentially result in physiological and/or behavioural changes in fish species, particularly those that can sense weak EM currents and/or rely on geomagnetic cues for migration. The deployment of the receiver packages will require dropping anchors on the seafloor, which would result in disturbance to potentially important benthic habitat within the Sensitive Areas.

Project activities are not expected to interact with critical habitat for species at risk. Although critical habitat for birds (specifically the horned grebe, piping plover, and roseate tern) occurs within the RAA, it is restricted to the Magdalen Islands and coastal areas of western Newfoundland and will not interact with Project activities. Critical habitat has not been identified within the Project RAA for any of the marine fish, marine mammal, or sea turtle species at risk.

6.6.3 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.
- An SMMO will be on board to record shark, marine mammal and sea turtle observations and oversee ramp-up procedures.
- The EM source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the EM 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 EM 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.

6.6.4 Assessment of Residual Environmental Effects

Potential Project effects on Sensitive Areas would be limited to the LAA. Because of the anticipated schedule, Project activities are not expected to overlap with sensitive time periods of key resources for some of the Sensitive Areas found within the Project Area. The CSEM survey is anticipated to occur between August and December 2017, which is outside the April to July period identified for the Potential Redfish Larvae Extrusion Area, and the April to June timeframe for the Cod Spawning Area. Furthermore, because the boundaries of the Southern Fringe of the Laurentian Channel EBSA do not substantially overlap with the Project Area, Project activities are not considered likely to have the potential to influence the biological resources in this EBSA. The Project does have potential to interact both spatially and temporally with the biological resources captured by the designation of the Potential Redfish Mating Area (September to December) and the West Coast of Newfoundland EBSA.

The Potential Redfish Mating Area and the West Coast of Newfoundland EBSA are designated as sensitive areas because of their importance for fish. The western side of the Project Area overlaps with the Potential Redfish Mating Area and vessel operations are scheduled to occur during the September to December period when redfish mate. Similarly, vessel activities in the northeastern portion of the Project Area will occur within the West Coast of Newfoundland EBSA, which has been designated because of its importance for groundfish and pelagic species.

Survey Vessel Operation

Artificial lighting from the vessel can affect fish species in the area of influence around the ship. Although redfish are a benthic species, they rise off the bottom and feed on pelagic organisms (primarily zooplankton) in the water column at night (Scott and Scott 1988; DFO 2010e; DFO 2011g) and therefore have the potential to be attracted to the vessel lights at that time. However, given the limited underwater lighting from the survey vessel, the transient movement, and relatively brief survey period (5 to 15 days (allowing for weather downtime, most likely less than 10 days)), effects from vessel lighting on redfish within the Special Areas are expected to be negligible. Similarly, vessel lighting is not considered likely to have a measurable effect on fish within the West Coast of Newfoundland EBSA, which has been identified as important for pelagic and groundfish, including Atlantic cod, redfish, American plaice, Atlantic wolffish, Atlantic herring, capelin, silver hake and Pollock (refer to Section 6.2 for an assessment of Project effects on Marine Fish, Shellfish and Habitat).

Operation of CSEM Source

EM emissions generated by the CSEM source are unlikely to result in physiological and/or behavioural changes in fish species that are acknowledged for the designation of the Sensitive Areas. The Sensitive Areas within the Project Area are not acknowledged for supporting important concentrations of elasmobranchs (*e.g.*, sharks, rays) or other species that sense weak EM currents and/or rely on geomagnetic cues for migration.

Receiver Deployment and Retrieval

The deployment of the receiver packages will require dropping anchors on the seafloor. When the receiver packages are retrieved, the anchor remains on the seafloor and is not retrieved. A total of 7 m^3 of material (70 anchors each 1 m x 1 m x 0.1 m) will be left on the seafloor; this is expected to degrade into its component ingredients (see Section 2.2.3), none of which are harmful to the marine environment. This temporary change in benthic habitat is not predicted to affect the 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 Sensitive 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. There is no critical habitat for species at risk designated in the Project Area within which effects of receiver deployment and retrieval would be limited.

Summary

Effects on Sensitive Areas are expected to be low in magnitude, limited to the Project Area, will occur once for the survey program (over 5 to 15 days (allowing for weather downtime, most likely less than 10 days), with degradation of the anchors taking approximately a year), and will be reversible.

6.6.5 Determination of Significance

The Project is predicted to have limited interaction with Sensitive Areas. The Project is not expected to alter habitat of Sensitive Areas 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 Sensitive 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. The Project is not predicted to result in permanent and irreversible loss of critical habitat as defined in a recovery plan or an action strategy. Adverse residual environmental effects on Sensitive Areas are therefore predicted to be not significant.

6.6.6 Follow-up and Monitoring

No additional VC-specific mitigation is required and no follow-up or monitoring is proposed.

6.7 FISHERIES AND OTHER OCEAN USERS

Historically, the fishery has played an important role in the economy and social fabric of various communities that border the Gulf, including those in Newfoundland and Labrador, and has helped to define much of the region’s character. The fishery remains an integral component of the economy of the region. In addition to commercial, recreational and Aboriginal fisheries, research and sentinel fisheries which are undertaken to monitor the status and health of under-utilized species, species under moratoria and listed species at risk are considered fisheries as part of this VC. Fisheries and Other Ocean Users was selected as a VC because of the potential for direct interaction with the Project. Specifically, Fisheries and Other Ocean Users was selected as a VC because of:

- specific regulatory requirements of the *Fisheries Act*
- requirements of the Project-specific Scoping Document (refer to Appendix A)
- the direct interaction between CRA fisheries species and proposed Project activities (addressed in Section 6.1)
- the cultural and commercial importance and historic relevancy of the fisheries to the region
- potential interactions between the Project and other non-fisheries ocean users.

Aquaculture, sealing, bird hunting, and tourism and recreation activities normally occur in the nearshore and are not expected to interact with Project activities. Although there is an active EL within the Project Area, there is currently no approved exploration activity planned to occur; therefore, there will be no interaction with offshore oil and gas operations. Project vessels will transit to and from the Project Area from St. John’s and are not expected to interfere with other ocean use activity. The focus of this VC will therefore be on fisheries, marine traffic, scientific research, and military use that could potentially interact with the Project.

As described in Section 5.3.2, the Project Area is adjacent to a major shipping route, with traffic density in the vicinity of the Project Area estimated at four to eight ships per day. As well, DFO carries out stock assessment surveys and research activities throughout the maritime marine environment, which may overlap with proposed Project activities.

The effects of accidental events on Fisheries and Other Users are assessed in Section 7. Cumulative environmental effects in consideration with other Projects and/or activities are assessed in Section 9.

6.7.1 Residual Environmental Effects Significance Criteria

A **significant adverse residual environmental effect** on Fisheries is one that has a measurable and sustained adverse effect on fishing incomes.

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

A **significant adverse residual environmental effect** on Other Ocean Users is one that has a detrimental effect on the use of the Gulf of St. Lawrence and Cabot Strait by marine traffic and military activity causing a long-term change in the established traffic patterns or interference with military activities.

An adverse environmental effect on Other Ocean Users that does not meet the above criteria is considered to be not significant.

6.7.2 Project Interactions

The survey vessel will emit noise and light, as well as permitted marine discharges during operation. Although it will be moving at slow speeds, particularly during towing operations, there is the potential for interaction with Fisheries and Other Ocean Users who may be transiting the area.

The operation of the CSEM source will generate underwater EM emissions. To the extent that these emissions temporarily affect the local distribution of commercial fish species, Fisheries and Other Ocean Users (*e.g.*, DFO research surveys) could also potentially be affected by this activity.

6.7.3 Mitigation

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

- Vessel waste discharges will be managed in accordance with MARPOL.
- Compacted sand anchors, designed to degrade within one year, will be used for the CSEM receivers.
- A FLO will be present onboard the survey vessel to facilitate communication with fishers and provide advice and coordination in regard to avoiding fishing vessels and fishing gear.
- 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.
- A Single Point of Contact (SPOC) will be established to respond to queries and concerns from other ocean users.
- The timing and location of proposed activities will be communicated by means of a Notice to Mariners and Notice to Shipping.
- Advance communication with DFO and DND during survey planning will eliminate any potential conflict with research vessel cruises or military activities.
- In the unlikely event that Project activities damage fishing gear, compensation will be awarded to affected parties in accordance with the Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2002).

6.7.4 Assessment of Residual Environmental Effects

As noted in Section 6.2.5, the Project could potentially interact with targeted fisheries species. However, residual environmental effects on Marine Fish, Shellfish and Fish Habitat 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.

Damage to fixed fishing gear will be avoided by use of fisheries mitigations, such as Notice to Mariners, the presence of a FLO on board and a SPOC. In addition, the CSEM vessel moves very slowly (approximately 3 to 4 km/h (1.5-2 knots)) and thus there is sufficient time for all parties to react and avoid other gear or vessels. If gear is damaged, the compensation program will alleviate any financial losses.

Residual environmental effects of the Project with respect to potential interactions with fishing vessels and gear are predicted to be negligible to low in magnitude, restricted to the Project Area, of short duration (within 5 to 15 days (allowing for weather downtime, most likely less than 10 days)), and single frequency (one survey in 2017). Adverse residual environmental effects would be reversible given that compensation would be awarded to replace or repair damaged gear.

EMGS will engage Maritime Forces Atlantic (MARLANT) to discuss proposed survey timing and confirm no conflict with planned Allied marine (including submarine) activities. Advance communication with DFO and DND will eliminate any potential conflict with research vessel cruises or military activities. Residual environmental effects of potential effects on these other ocean users are expected to be negligible in consideration of pre-survey planning and avoidance.

6.7.5 Determination of Significance

In consideration of the criteria for significant environmental effects and the implementation of proposed mitigation, as well as recognition of the limited spatial and temporal scale of Project activities, residual environmental effects of the Project on Fisheries and Other Ocean Users are predicted to be not significant.

6.7.6 Follow-up and Monitoring

As indicated for mitigation, EMGS will communicate proposed Project activities (including location and timing) to fisheries stakeholders and other ocean users. In the unlikely event of accidental Project vessel contact with fishing gear, EMGS will notify the C-NLOPB immediately and fishing gear would be retrieved from the water only by the gear owner; it will not be retrieved by the survey vessel. EMGS will notify the C-NLOPB prior to compensating gear damage claims.

7.0 ACCIDENTAL EVENTS

Although unlikely to occur, there is a possibility of an accidental hydrocarbon release as a result of a small on-deck spill (*e.g.*, lubricants), or vessel fuel spill. The use of a solid streamer instead of one using Isopar™ M fluids eliminates the risk of a spill due to a streamer break.

Diesel fuel, lubricants and hydraulic fluid are all categorized as light oils/middle distillates. Of these, diesel fuel is the most toxic due to its higher aromatics content (Buchanan *et al.* 2011). However, it is light and in the event of a spill, most of it would quickly spread to a thin film and usually evaporates or naturally disperses within a day or less (NOAA 2016). Diesel oil is readily and completely degraded by naturally occurring microbes, under time frames of one to two months (NOAA 2016). Lubricants and hydraulic fluid consist primarily of mineral oils and pose the lowest risk to the marine environment.

On-deck spills will be immediately contained since all large oil consumers on EMGS vessels have a second barrier such as a spill tray and SOPEP equipment in close vicinity. Therefore, the risk of pollution to the marine environment in the event of an on-deck spill is very low.

In the unlikely event of a hydrocarbon release, the measures outlined in EMGS' Shipboard Oil Pollution Emergency Plan (SOPEP) will be implemented. The SOPEP will be filed with the C-NLOPB as part of the Operations Authorization. The implementation of best management practices (*e.g.*, preventative maintenance, material handling procedures) and mitigation outlined below will help reduce the likelihood of a spill occurring and reduce the magnitude and geographic extent of adverse effects of a spill if one does occur:

- EMGS will develop and implement (if necessary) a SOPEP
- Refueling will occur in port by a certified refueling company
- EMGS will employ timely and clear communications procedures with fisheries and other ocean users to advise on Project activities and survey location. This will include the use of FLOs for advice and coordination with fishers and posting of advisories with the Canadian Coast Guard and the CBC Fisheries Broadcast
- Survey vessel(s) will adhere to International Convention for the Prevention of Pollution from Ships (MARPOL).

Given the nature of Project components and activities and the implementation of the above mitigation measures, there is a low likelihood of a spill to the marine environment occurring. However, potential adverse environmental effects are considered for each VC.

Given the relatively small volume of hydrocarbon product that could potentially be spilled, the nature of these hydrocarbons to rapidly disperse and evaporate limiting the spill's spatial and temporal extent, and the ability of marine fish, marine mammals and sea turtles to avoid oil spills, effects are likely to be not significant for Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, including species at risk.

It is recognized that marine and/or migratory birds are vulnerable to hydrocarbon spills and that even small amounts of hydrocarbons can have serious effects on birds (particularly those species that spend most of their time on the water). Physical alteration of feathers through oiling and ingestion of oil can result in physiological changes which can result in mortality or decrease long-term survival (Ainley *et al.* 1981; Williams 1985; Frink and White 1990; Fry 1990). Severity of effects can vary depending on species affected, type and volume of hydrocarbon spilled, time of year, weather conditions, and duration of the spill (Gorsline *et al.* 1981). Over 50 species of marine and/or migratory birds, including waterfowl, shorebirds, pelagic and neritic seabirds may occur in or near the Project Area (refer to Tables 5.7 and 5.9) during the spring, summer, or fall. Given the low likelihood of a spill occurring, the nature of these hydrocarbons to rapidly disperse and evaporate (limiting the geographic extent of an affected area), and spill response procedures, significant adverse residual environmental effects are not predicted to occur on non-listed marine and/or migratory bird species. Marine and/or migratory bird species at risk known to occur within the RAA are unlikely to interact with a hydrocarbon spill because they either have strong coastal affinities and are unlikely to occur in the Project Area (*i.e.*, horned grebe, piping plover, red knot, buff-breasted sandpiper, roseate tern, Barrow's goldeneye, Harlequin duck, yellow rail) or occur in winter (*i.e.*, ivory gull), which is outside the time frame of the Project. The red-necked phalarope is associated with pelagic environments during its migration through the region and could be present during Project activities. In the unlikely event of a spill, any birds that are observed to be oiled will be reported to the CWS.

In consideration of the likely limited spatial extent of an accidental hydrocarbon release, and the identified and seasonal distributions of marine and/or migratory birds (including species at risk) in the vicinity of the Project, residual environmental effects of an accidental event on marine and/or migratory birds (including species at risk) are predicted to be not significant.

The Project Area is within a redfish mating area (September to December), a cod spawning area (April to June) and an EBSA, and extends into a redfish larvae extrusion area (April to July) in the southern end. Other sensitive areas in the immediate vicinity of the Project Area include other EBSAs, IBAs, and an Area of Interest for potential designation as a Marine Protected Area. Generally, there is likely to be a not significant environmental effect to Sensitive Areas given the nature of the hydrocarbon materials onboard the CSEM vessel (*i.e.*, a spill would be surface-borne, evaporate and disperse rapidly), and the resulting lack of an interaction with these areas. In the event of a spill, significant environmental effects to this area are not likely given the nature of the material and implementation of the SOPEP.

The probability is very low of an accidental spill being of large enough magnitude to cause a significant environmental effect on offshore commercial fisheries. The issues related to a hydrocarbon spill and the commercial fishery relate to fouling of fishing gear and perceived tainting of catch by petroleum hydrocarbons. In the event of a spill, the implementation of the SOPEP and communication with the Canadian Coast Guard, the C-NLOPB and fishers will reduce the geographic extent and duration of an event to the extent feasible. Compensation will be considered in the event of a spill large enough to affect fishing gear. EMGS will advise the C-NLOPB prior to compensating and settling valid fouled gear/income claims. With the exception of exclusion from an area while spill recovery efforts are undertaken, other users (*i.e.*, mariners) would not be affected. Adverse residual environmental effects on the commercial fishery or other ocean users as a result of an accidental hydrocarbon release are predicted to be not significant.

8.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

This section considers how local environmental conditions and natural hazards (*e.g.*, extreme weather) could adversely affect the Project and thus result in potential effects on the environment (*e.g.*, accidental events). Potential adverse effects of the environment on a project are typically a function of project design and environmental conditions that could affect the project. These effects are generally mitigated through engineering and environmental design criteria, industry standards, and environmental monitoring.

Aspects of the environment that could potentially affect the Project include: fog; extreme weather conditions; and sea ice, icebergs and superstructure icing.

8.1 FOG AND EXTREME WEATHER CONDITIONS

Section 5.1.2 describes existing environmental conditions pertaining to fog and extreme weather in the RAA. The anticipated timing of the survey during the period of August to December 2017 will avoid the months that have historically had the poorest visibility (June and July) and overlap with the months that have historically had the greatest visibility (September and October) (refer to Table 5.2). However, the survey will also overlap temporally with hurricane season in the North Atlantic Ocean (June to November) and the months with the highest intensity storms (August and September).

Fog and other environmental conditions resulting in poor visibility can hinder marine navigation, potentially resulting in delay of survey operations. Poor visibility can also increase the risk of an accidental event (*e.g.*, a vessel collision potentially resulting in a spill). Extreme wind and wave conditions have the potential to result in suspension or delay of Project activities, accidental events, and in extreme cases – loss of life. In the unlikely event of a spill, extreme weather conditions could also potentially affect spill response operations, including the availability and effectiveness of response methods.

The implementation of standard operating procedures, such as reducing vessel speed, using appropriate sound and/or light signals, and relying on radar and navigation equipment as appropriate, will help Project vessels to navigate safely during foggy conditions. Obstruction lights, navigation lights and foghorns will be kept in working condition on-board Project vessels to maintain navigational safety at all times during the Project. Radio communication systems will be in place and in working order for contacting other marine vessels as necessary.

EMGS will regularly monitor weather forecasts during the survey to forewarn the Project vessel of heavy fog or inclement weather before it poses a risk to their activities and operations. Extreme weather conditions that are outside the operating limits of the Project vessel will be avoided if possible. The Captain will have the authority and obligation to suspend or modify operations in case of poor visibility or adverse weather that compromises the safety of crew and vessel operations.

Marine weather observations, forecast bulletins and warnings are issued for Canadian marine areas by Environment and Climate Change Canada through the Meteorological Service of Canada (MSC), public services such as the Weatheradio Canada network, and regional storm prediction centres. Weatheradio continuously broadcasts weather reports over VHF or FM radio and includes observations from coastal stations and offshore buoys. Marine forecast bulletins are available on Weatheradio, MSC's Automated Telephone Answering Device, and the Canadian Coast Guard's Continuous Marine Broadcast, and are updated at regular intervals or whenever necessary. The Newfoundland and Labrador Weather Office in Gander provides year-round marine weather and wave height information, consisting of a weather watch, warning and amendment service, for the waters around Newfoundland and Labrador out to approximately 250 nautical miles in the waters of the Gulf of St. Lawrence (DFO 2016b). The frequency of these marine forecasts is indicated in Table 8.1.

Table 8.1 Marine Forecast Schedule for Newfoundland and Labrador

Forecast Name	Details	Issue Time (NDT/NST)
Technical Marine Synopsis	Provides the positions and trends of the main weather systems for the forecast period covering Days 1 and 2.	03:00, 10:00, 15:30, 20:00
Marine Forecast	Provides information on: synoptic warnings, wind, visibility, precipitation and freezing spray. It may include air temperature as appropriate. Valid for Days 1 and 2.	03:00, 10:00, 15:30, 20:00
Extended Marine Forecast	Meant for longer-range planning purposes, it provides an extended marine wind outlook for Days 3, 4, and 5.	03:00, 15:30
Wave Height Forecast	Provides information on significant wave heights for Days 1 and 2.	06:00, 18:00
Marine Weather Statement	Issued when deemed necessary to provide additional information on marine conditions.	As needed
Marine Weather Advisory	Issues when deemed necessary to provide information on potentially hazardous marine conditions.	As needed

Source: DFO 2016b

8.2 SEA ICE, ICEBERGS, AND SUPERSTRUCTURE ICING

Section 5.1.3.5 describes existing environmental conditions pertaining to sea ice and icebergs in the LAA. The anticipated timing of the survey during the period of August to December 2017 is expected to avoid the main ice season, which generally begins in late December and early January and lasts until April.

Sea ice and icebergs are hazards to navigation that can hinder marine navigation, potentially resulting in delay of Project vessel movement to and from the Project Area. In the unlikely event that any icebergs are present in the Project Area at the time of the survey, it could become necessary for the Project vessel to change course or otherwise modify or suspend operations to avoid collision. Sea ice and icebergs can also increase the risk of an accidental event (*e.g.*, a vessel collision potentially resulting in a spill).

The accumulation of ice on a vessel’s superstructure can raise the centre of gravity, lower vessel speed, and cause difficulty in maneuvering. It can also create problems with cargo handling equipment (DFO 2012b). Superstructure icing can cause Project delays because vessel operations are slowed or suspended to remove or avoid ice accumulations.

Although unlikely to occur given the proposed Project schedule, measures to reduce superstructure icing hazards on Project vessels will be implemented if necessary and may include (DFO 2012b):

- reducing vessel speed in heavy seas;
- placing gear below deck and covering deck machinery, if possible;
- moving objects that may prevent water drainage from the deck;
- making the ship as watertight as possible; and
- manual removal of ice if required under severe icing conditions.

The Canadian Ice Service (CIS) produces ice forecasts, bulletins, warnings, and charts that are published and/or broadcast through various means by CIS and Marine Communications and Traffic Services (MCTS) Centres. Although ice forecasts and warnings are not broadcast via the Weatheradio network, details about hazardous ice conditions can be obtained from the CIS website or by contacting the regional MCTS Centre (DFO 2012b).

EMGS will regularly monitor available ice forecasts, bulletins, warnings, and charts during the survey as applicable to forewarn the Project vessel of hazardous ice conditions before they pose a risk to their activities and operations. Although unlikely to be encountered, sea ice conditions that are outside the operating limits of Project vessels will be avoided if possible and the Project vessel will also plan its operations to avoid potential interactions with any icebergs that may be present in or around the Project Area. The Captain will have the authority and obligation to suspend or modify operations in case of ice-related conditions that compromise the safety of the crew and vessel operations.

8.3 DETERMINATION OF SIGNIFICANCE

A **significant adverse residual environmental effect** of the environment on the Project is defined as one that results in one or more of the following:

- damage to the Project vessel or equipment resulting in a residual environmental effect that exceeds the VC-specific residual environmental effects significance criteria (as defined in Section 6) for one or more VCs;
- damage to the Project vessel or equipment resulting in harm to Project workers or the public; or
- damage to the Project vessel or equipment such that survey activities must be postponed beyond December 2017 in order to conduct repairs and/or damage resulting in repairs that cannot be technically or economically implemented.

In consideration of the above significance criteria and the environmental context and mitigation described in the preceding sections, the adverse residual environmental effects of the physical environment on the Project are predicted to be not significant.

9.0 CUMULATIVE ENVIRONMENTAL EFFECTS

Effects of the Project could potentially combine with effects from other projects and activities to result in cumulative environmental effects. Other projects and activities which could potentially interact with the Project to result in cumulative effects include marine transportation (commercial transportation, pleasure boats, DND vessels), commercial fisheries, research surveys, oil and gas exploration and hunting (seabirds, seals).

9.1 CONTEXT FOR CUMULATIVE ENVIRONMENTAL EFFECTS

While there are ELs in the coastal waters of western Newfoundland, none exist in the offshore Project Area or LAA other than those held by Corridor Resources (EL 1153). Two other ELs, held by Ptarmigan Energy Inc. (EL 1120) and Shoal Point Energy (1070) exist in the RAA in the nearshore of western Newfoundland, although a review of the C-NLOPB EA Registry (http://www.cnlopb.ca/assessments/) indicates there is no approved EA for work on these licences and no additional fillings for proposed geophysical programs in western Newfoundland waters. Corridor Resources has filed an EA for exploration drilling on the Old Harry Prospect within EL 1153 although this EA has not yet been approved and no work is planned to occur in 2017. There are therefore no likely residual environmental effects from offshore petroleum exploration that could potentially interact cumulatively with residual environmental effects of the Project.

Black Spruce Exploration Corp. filed a project description with the C-NLOPB in 2015 to initiate the EA process under the Accord Acts for an exploration drilling program on EL 1120 in the nearshore of western Newfoundland (Lark Harbour) to occur in 2015. Although this project still appears as "active" on the C-NLOPB's EA Registry (http://www.cnlopb.ca/assessments), the EA process was not completed and no additional reports have been filed since 2015. It is therefore unlikely that this exploration drilling program would proceed in 2017.

As described in Section 4.3.6.1 of the Western Newfoundland and Labrador Offshore Area SEA Update (AMEC 2014), the Gulf of St. Lawrence accommodates approximately 6,400 commercial vessel transits annually through the Cabot Strait. The Project Area is adjacent to the major shipping route with a traffic density of four to eight ships per day, many of which are container vessels (LGL 2005a). Port aux Basques, NL is the closest major port to the Project Area, handling international cargo shipping, and to a greater extent, domestic cargo shipping and ferry services. Marine traffic is therefore a key consideration in establishing a context for cumulative environmental effects assessment for this Project.

Marine traffic will generate underwater sound emissions, release waste discharges to the marine environment, generate artificial lighting, and present risk of collision with marine mammals and sea turtles (including species at risk) as well as with other ocean users. Marine traffic is therefore likely to result in potential adverse environmental effects on Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk, Sensitive Areas, and Fisheries and Other Ocean Users which could potentially cumulatively interact with predicted residual environmental effects of the Project on these VCs.

Regional fishing activity (refer to Section 5.3.1) also contributes to potential adverse environmental effects in terms of marine traffic (see above for discussion of effects associated with marine traffic) and will also have adverse effects on fish and fish habitat through harvesting (including bycatch) of marine species and for some fisheries, interaction with the seafloor. Effects of fishing could therefore potentially interact cumulatively with predicted residual environmental effects of the Project.

Seal and seabird hunting activities in the marine environment occur primarily in the nearshore, which could occur in the LAA or RAA, and result in adverse effects on targeted species present in the RAA and potential cumulative environmental effects with the Project on marine mammals and sea turtles (including species at risk).

9.2 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS

Sections 6 and 7 predict residual environmental effects of the Project which are characterized to be negligible to low in magnitude, limited in geographic scope to portions of the Project Area and/or LAA, of relatively short duration (5 to 15 days (allowing for weather downtime, most likely less than 10 days) for most effects; up to one year for anchor deterioration) and reversible. The potential for adverse cumulative environmental effects with existing activities in the RAA is therefore low. For example, the addition of one survey vessel for a 5- to 15-day period (allowing for weather downtime, most likely less than 10 days) to the existing marine traffic (including fishing and research vessels) in the RAA is not expected to have any measurable cumulative environmental effect on any VCs.

Fishing activities, by their nature, cause mortality and disturbance to fish populations and may cause incidental mortalities or disturbance to non-target fish species, marine and/or migratory birds, marine mammals, sea turtles, and species at risk. It is predicted that the CSEM survey will not cause any mortality to these VCs and thus, there will be either no or negligible cumulative mortality effect with fishing activities. Similarly, the Project is not expected to result in mortality or physical injury effects to marine mammals or marine and/or migratory birds; therefore, cumulative environmental effects associated with hunting activities in the nearshore are predicted to be negligible.

In consideration of the temporal and spatial scope of the Project, implementation of mitigation measures, and definitions for significant adverse residual environmental effects, no significant cumulative environmental effects are predicted to occur as a result of the Project on any of the VCs.

9.3 FOLLOW-UP AND MONITORING

No follow-up and monitoring is proposed to address potential cumulative environmental effects beyond those mitigation measures proposed to reduce adverse residual environmental effects associated with Project (refer to Section 10 for a summary of mitigation).

10.0 SUMMARY AND CONCLUSIONS

EMGS's Western Newfoundland CSEM survey will be a short-term (5 to 15 days allowing for weather downtime, most likely less than 10 days) survey within a relatively small area (5,141 km^2) in waters off western Newfoundland in the Gulf of St. Lawrence. Mitigation will be implemented to reduce potential adverse environmental effects to a negligible or low magnitude for Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Marine and/or Migratory Birds, Species at Risk, Sensitive Areas, and Fisheries and Other Ocean Users.

A summary of mitigative and monitoring commitments made by EMGS for this Project 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 EM source will be ramped up over a 20-minute period. In areas where water depths are greater than 500 m, the EM 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.
- In areas where water depths are less than 500 m, the EM source will be shut down if a SARA-listed species is observed within 500 m of the energy source.
- The EM 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/hr [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.
- Vessel lighting will be minimized to the extent practical without compromising safe operations.
- Routine checks for stranded birds will be conducted and CWS bird handling and release procedures (*e.g.*, Environment Canada 2015) will be implemented if stranded birds are encountered on the vessel.
- In accordance with the MBCA, a Federal Migratory Bird Permit will be obtained from the CWS for handling stranded birds that may be encountered on the vessel. A salvage report will be filed with CWS as required by the permit.
- Vessels will follow established shipping lanes in proximity to shore and will travel at speeds not exceeding 24 km/hour (14 knots), except as needed in the case of an emergency.

- Helicopters (if required) transiting to and from the survey vessel will fly at altitudes greater than 300 m (with the exception of approach and landing activities) and/or at a lateral distance of 2 km around active colonies when possible.
- A Fisheries Liaison Officer (FLO) will be present onboard the survey vessel to facilitate communication with fishers and provide advice and coordination in regard to avoiding fishing vessels and fishing gear.
- 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.
- A Single Point of Contact (SPOC) will be established to respond to queries and concerns from other ocean users.
- EMGS will employ timely and clear communications procedures with fisheries and other ocean users to advise on Project activities and survey location. This will include the use of FLOs for advice and coordination with fishers and posting of advisories with the Canadian Coast Guard and the CBC Fisheries Broadcast.
- The timing and location of proposed activities will be communicated by means of a Notice to Mariners and Notice to Shipping.
- Advance communication with DFO and DND during survey planning will eliminate any potential conflict with research vessel cruises or military activities.
- In the unlikely event that Project activities damage fishing gear, compensation will be awarded to affected parties in accordance with the Compensation Guidelines Respecting Damages Related to Offshore Petroleum Activity (C-NLOPB and CNSOPB 2002).
- EMGS will develop and implement (if necessary) a SOPEP.
- Refueling will occur in port by a certified refueling company.
- Survey vessel(s) will adhere to International Convention for the Prevention of Pollution from Ships (MARPOL).
- EMGS will regularly monitor weather forecasts (including ice forecasts) during the survey to forewarn Project vessels of heavy fog or inclement weather before it poses a risk to their activities and operations. Extreme weather conditions that are outside the operating limits of Project vessels will be avoided if possible. Captains will have the authority and obligation to suspend or modify operations in case of poor visibility or adverse weather that compromises the safety of the crew or vessel operations.
- Measures to reduce superstructure icing hazards on Project vessels will be implemented if necessary and may include (DFO 2012b):
- reducing vessel speed in heavy seas;
- placing gear below deck and covering deck machinery, if possible;
- moving objects that may prevent water drainage from the deck;
- making the ship as watertight as possible; and
- manual removal of ice if required under severe icing conditions.

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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APPENDIX A
C-NLOPB SCOPING DOCUMENT

Electromagnetic Geoservices Canada, Inc.
Controlled Source Electromagnetic Survey, 2017
Western Newfoundland

Scoping Document

Prepared by:
Canada-Newfoundland and Labrador Offshore Petroleum Board
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December 14, 2016

ISBN: 978-1-927098-70-7

1 Purpose

This document provides scoping information for the Environmental Assessment (EA) of the proposed controlled source electromagnetic (CSEM) survey in the western portion of the Canada-Newfoundland and Labrador Offshore Area and all other related activities (the Project). Electromagnetic Geoservices Canada, Inc. (EMGS) is proposing to undertake a CSEM survey in 2017. The primary objective of the Project is to acquire data to assess the presence of geological structures suitable for the containment and accumulation of hydrocarbons and to determine the hydrocarbon sources.

Included in this document is a description of the scope of the project that will be assessed, the factors to be considered in the assessment, and the scope of those factors.

2 Regulatory Considerations

The Project will require authorizations pursuant to Section 138 (1) (b) of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and Section 134(1) (b) of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (*Accord Acts*).

The C-NLOPB formally delegates the responsibility for preparation of an acceptable environmental assessment report and any supporting documents to Electromagnetic Geoservices Canada, Inc., the project proponent.

3 Scope of the Project

The project to be assessed consists of the following components:

3.1 EMGS is proposing to conduct one CSEM survey in 2017 within its proposed 5140 km^2 Project Area. Grid and survey line spacing will range from approximately 1 to 3 km. Receivers mounted on compacted sand anchors will be deployed on the seabed in a grid layout to record the electromagnetic signal. An electromagnetic source is towed behind the survey vessel 30 m above the seabed over up to 200 receivers. The duration of the survey is estimated to be 5 to 10 days.

3.2 Operation of an exploration vessel and picket/supply vessel associated with the above activities.

4 Factors to be Considered

The EA shall include a consideration of the following factors:

4.1 The purpose of the project;

4.2 The environmental effects of the Project, including those due to malfunctions or accidents that may occur in connection with the Project and any change to the Project that may be caused by the environment. Environmental effect is defined as: any change that the project may cause in the environment, including any effect of any such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and any change to the project that may be caused by the environment, whether any such change occurs within or outside Canada;

4.3 Cumulative environmental effects of the Project that are likely to result from the project in combination with other projects or activities that have been or will be carried out;

4.4 The significance of the environmental effects described in 4.2 and 4.3;

4.5 Measures, including contingency and compensation measures as appropriate, that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;

4.6 The significance of adverse environmental effects following the employment of mitigative measures, including the feasibility of additional or augmented mitigative measures; and

4.7 Report on consultations undertaken by EMGS with interested other ocean users who may be affected by program activities and/or the general public respecting any of the matters described above. The One Ocean documents *Fact Sheet for Non-One Ocean Petroleum Members* and *One Ocean Protocol for Consultation Meetings: Recommendations for the Fish and Petroleum Industries in Newfoundland and Labrador* can assist in planning these consultations.

5 Scope of the Factors to be Considered

EMGS will prepare and submit to the C-NLOPB an EA for the above-described physical activity, and as described in "*Project Description- Western Newfoundland CSEM Survey 2017*" (Stantec July 8, 2016). The EA will address the factors listed above; the issues identified in Section 5.2 (following), and document any issues and concerns that may be identified by the proponent through regulatory, stakeholder, and public consultation.

Program activities are proposed for the western portion of the Canada-Newfoundland and Labrador Offshore Area which has been studied in recent EAs and the *Western Newfoundland & Labrador Offshore Area Strategic Environmental Assessment Update* (April 2014) (Western SEA Update). For the purposes of this assessment, the information provided in the Western SEA Update should support the EA to avoid unnecessary duplication of information. Appropriate references should be included in the EA.

It is recommended that the “valued environmental component” (VEC) approach be used to focus its analysis. A definition of each VEC (including components or subsets thereof) identified for the purposes of environmental assessment, and the rationale for its selection, shall be provided.

The scope of the factors, to be considered in the EA, will include the components identified in Section 5.2 - Summary of Potential Issues, setting out the specific matters to be considered in assessing the environmental effects of the project and in developing environmental plans for the project, and the “Spatial Boundaries” identified below (Section 5.1). Considerations relating to definition of “significance” of environmental effects are provided in the following sections.

Discussion of the biological and physical environments should consider the data available from recent EAs and the Western SEA Update for the Project and Study Areas. Where data gaps exist, the EA should clearly identify the lack of data available.

5.1 Boundaries

The EA shall consider the potential effects of the proposed CSEM survey program within spatial and temporal boundaries that encompass the periods and areas during and within which the project may potentially interact with, and have an effect on, one or more VECs. These boundaries may vary with each VEC and the factors considered, and should reflect a consideration of:

- the proposed schedule/timing of the CSEM survey program;
- the natural variation of a VEC or subset thereof;
- the timing of sensitive life cycle phases in relation to the scheduling of CSEM survey activities;
- interrelationships/interactions between and within VECs;
- the time required for recovery from an effect and/or return to a pre-effect condition, including the estimated proportion, level, or amount of recovery; and
- the area within which a VEC functions and within which a project effect may be felt.

The proponent shall clearly define, and provide the rationale for the spatial and temporal boundaries that are used in its EA. The EA report shall clearly describe the spatial boundaries (e. g. Study Area, Project Area) and shall include figures, maps and the corner-point coordinates. Boundaries should be flexible and adaptive to enable adjustment or alteration based on field data. The Study Area will be described based on consideration of potential areas of effects as determined by the scientific literature, and project-environment interactions. A suggested categorization of spatial boundaries follows.

5.1.1 Spatial Boundaries

Project Area

The area in which CSEM survey activities are to occur, including the area of the buffer zone normally defined for vessel turning activities.

Study Area

The area which could potentially be affected by project activities beyond the "Project Area."

Regional Area

The area extending beyond the "Study Area" boundary. The "Regional Area" boundary will also vary with the component being considered (e.g., boundaries suggested by bathymetric and/or oceanographic considerations).

5.1.2 Temporal Boundaries

The temporal scope should describe the timing of project activities. Scheduling of project activities should consider, at a minimum, the timing of sensitive life cycle phases of the VECs in relation to physical activities and the timing (and location) of active commercial fishing activities and other marine users.

5.2 Summary of Potential Issues

The EA shall contain descriptions and definitions of EA methodologies employed in the assessment of effects. Where information is summarized from existing EA reports, the sections referenced should be clearly indicated. Effects of relevant Project activities on those VECs most likely to be in the defined Study Area shall be assessed. Discussion of cumulative effects within the Project area and with other relevant marine projects shall be included. Issues to be considered in the EA shall include, but not be limited to, the following:

Physical Environment

5.2.1 The Western SEA Update (April 2014) provides information on the western Newfoundland offshore physical environment. This SEA Update provides descriptions of the meteorological and oceanographic characteristics, including extreme conditions. Only new information for the Study Area that has become available since the publication of the above noted document, and that is relevant to the consideration of environmental effects, should be provided in the EA.

Biological Environment

5.2.2 The Western SEA Update (April 2014) provides information on the western Newfoundland offshore biological environment. This SEA Update provides descriptions of: marine birds; fish and fish habitat; marine mammals and sea turtles; species at risk; sensitive areas; and human activities, including marine fisheries. Only relevant new information for the Study Area that has become available since the publication of the above noted document should be provided in the EA, in particular species at risk, sensitive areas, and marine fisheries. The project EA shall note/acknowledge data gaps identified in the Western SEA Update relative to marine fish/fish habitat, species at risk, sensitive areas, and marine fisheries, and how the project EA will describe the relevance of such gaps for the conduct of the project EA.

5.2.3 Marine and/or Migratory Birds

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- Spatial and temporal species distributions (observations from prior programs should be included);
- Species habitat, feeding, breeding, and migratory characteristics of relevance to the Study Area;
- Disturbance from survey activities, including both direct effects (physiological), or indirect effects (foraging behaviour, prey species, adult attendance at the nest);
- Physical displacement as a result of vessel presence (e.g. disruption of foraging activities);
- Attraction of, and increase in, predator species as a result of waste disposal practices (i.e., sanitary and food waste);
- Nocturnal disturbance from light (e.g. increased opportunities for predators, attraction of birds to vessel lighting and subsequent collision, disruption of incubation);
- Procedures for handling birds that may become stranded on survey vessels;
- Means by which bird mortalities associated with project operations may be documented and assessed;
- Effects of hydrocarbon spills from accidental events, including operational discharges (e.g. deck drainage, gray water, black water);
- Means by which potentially significant adverse effects upon birds may be mitigated through design and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.4 Marine Fish and Shellfish

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- Distribution and abundance of marine fish and invertebrate species utilizing the Study Area with consideration of critical life stages (e.g., spawning areas, overwintering, juvenile distribution, migration);
- Description, to the extent possible, of location, type, diversity and areal extent of marine fish habitat in the Study Area. In particular, those indirectly or directly supporting traditional, aboriginal, historical, present or potential fishing activity, and including any essential (e.g. spawning, feeding, overwintering) habitats;
- The means by which potentially significant adverse effects upon fish (including critical life stages) and commercial fisheries may be mitigated through design, scheduling, and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.5 Marine Mammals

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- Spatial and temporal distribution;
- Description of marine mammal life stages/life histories relevant to the Study Area;
- Disturbance to/displacement of marine mammals due to noise and the possibility of ship strikes;
- Means by which potentially significant adverse effects upon marine mammals (including critical life stages) may be mitigated through design, scheduling, and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.6 Sea Turtles

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- Spatial and temporal distribution;
- Description of sea turtle life stages/life histories relevant to the Study Area;
- Disturbance to/displacement of sea turtles due to noise and the possibility of ship strikes;
- Means by which potentially significant adverse effects upon sea turtles (including critical life stages) may be mitigated through design, scheduling, and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.7 Species at Risk (SAR)

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- A description of SAR as listed in Schedule 1 of the *Species at Risk Act (SARA)*, and those under consideration by COSEWIC in the Study Area, including fish, marine mammal, sea turtles, and seabird species. It is advised that the SARA Registry and COSEWIC website be referred to for the most recent information;
- A description of critical habitat (as defined under SARA), if applicable, to the Study Area;
- Monitoring and mitigation, consistent with recovery strategies/action plans (endangered/threatened) and management plans (special concern);
- A summary statement stating whether project effects are expected to contravene the prohibitions of SARA (Sections 32(1), 33, 58(1));
- Means by which adverse effects upon SAR and their critical habitat may be mitigated through design, scheduling, and/or operational procedures; and
- Assessment of effects (adverse and significant) on SAR and critical habitat, including cumulative effects.

5.2.8 "Sensitive" Areas

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- A description, to the extent possible, of any 'Sensitive" Areas in the Study Area deemed important or essential habitat to support any of the marine resources identified;
- Environmental effects due to the project, including cumulative effects, on those "Sensitive" Areas identified; and
- Means by which adverse effects upon "Sensitive" Areas may be mitigated through design, scheduling and/or operational procedures.

Marine Use

5.2.9 Noise/Acoustic Environment

The EA shall provide information on the following:

- Disturbance/displacement of VECs and SAR associated with CSEM survey activities;
- Means by which potentially significant effects may be mitigated through design, scheduling and/or operational procedures; and
- Effects of CSEM activities (direct and indirect) including cumulative effects, on the VECs and SAR identified within the EA. Critical life stages should be included.

5.2.10 Presence of CSEM Survey Vessel(s)

The EA shall provide information on the following:

- Description of project-related traffic, including routings, volumes, scheduling and vessel types;
- Effects upon access to fishing grounds;
- Effects upon general marine traffic/navigation, including fisheries research surveys, and mitigations to avoid research surveys;
- Means by which potentially significant effects may be mitigated through design, scheduling and/or operational procedures; and
- Environmental effects assessment, including cumulative effects.

5.2.11 Fisheries and Other Ocean Users

The EA shall provide only new or updated information, where applicable, to address any changes to the following:

- A description of fishery activities (including traditional, existing and potential commercial, recreational and aboriginal/subsistence and foreign fisheries) in the Study Area;
- Consideration of underutilized species and species under moratoria that may be found in the Study Area as determined by analyses of past DFO research surveys and Industry GEAC survey data, with emphasis on those species being considered for future potential fishers, and species under moratoria;
- Traditional historical fishing activity, including abundance data for certain species in this area, prior to the severe decline of many fish species (e.g., a general overview of survey results and fishing patterns in the survey areas for the last 20 years);
- An analysis of the effects of Project operations and accidental events upon the foregoing. The analysis should include consideration of recent scientific literature on effects of CSEM activity, including identified data gaps;
- Fisheries liaison/interaction policies and procedures;
- Program(s) for compensation of affected parties, including fisheries interests, for accidental damage resulting from project activities;
- Means by which adverse effects upon commercial fisheries may be mitigated through design and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.12 Accidental Events

- Environmental effects of any accidental events arising from accidental releases from the CSEM and support vessels. Cumulative effects in consideration of other oil pollution events (e.g., illegal bilge disposal) should be included.
- Mitigations to reduce or prevent such events from occurring.
- Contingency plans to be implemented in the event of an accidental release.

Environmental Management

5.2.13 The EA shall outline EMGS's environmental management system and its components, including, but not limited to:

- Pollution prevention policies and procedures;
- Fisheries liaison/interaction policies and procedures;
- Program(s) for compensation of affected parties, including fishery interests, for accidental damage resulting from project activities; and
- Emergency response plan(s).

Biological and Follow-up Monitoring

5.2.14 Discuss the need for and requirements of a follow-up program to verify the accuracy of the EA, to verify the effectiveness of any mitigation measures identified in the EA, or both. The discussion should also include any requirement for compensation monitoring (compensation is considered mitigation).

Discuss how the proposed mitigations in the EA Report will be undertaken. Clearly describe the monitoring and reporting aspects on the implementation and effectiveness of the mitigation measures contained in the EA Report and how such monitoring will be accomplished or improved based on a review of best practices.

Details regarding the monitoring and observation procedures, including others identified during the initial review phase of the project description, to be implemented regarding marine mammals, sea turtles and seabirds (observation protocols should be consistent with the C-NLOPB "*Geophysical, Geological, Environmental and Geotechnical Program Guidelines"* (June 2016).

5.3 Significance of Adverse Environmental Effects

The Proponent shall clearly describe the criteria by which it proposes to define the "significance" of any residual adverse environmental effects that are predicted by the EA. This definition should be consistent with the November 2015 CEAA operational policy statement "*Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012*", and be relevant to consideration of each VEC (including components or subsets thereof) that is identified. SARA species shall be assessed independent of non-SARA species. The effects assessment methodology should clearly describe how data gaps are considered in the determination of significance of effects.

5.4 Cumulative Effects

The assessment of cumulative environmental effects should be consistent with the principles described in the December 2014 (Draft) CEAA "*Technical Guidance for*

Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012" and in the March 2015 CEAA operational policy statement "*Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*". It should include a consideration of environmental effects that are likely to result from the proposed project in combination with other projects or activities that have been or will be carried out. These include, but are not limited to: proposed oil and gas activities under EA review (listed on the C-NLOPB Public registry at www.cnlopb.ca); other CSEM activities; fishing activities, including Aboriginal fisheries; other oil and gas activities; and marine transportation. The C-NLOPB website lists all current and active offshore petroleum activity within the Canada-NL offshore area.

6 Projected Timelines for the Environmental Assessment Process

The following are estimated timelines for completing the EA process. The timelines are offered based on experience with recent environmental assessments of similar project activities.

ACTIVITY	TARGET	RESPONSIBILITY
EA review upon receipt from Proponent	6 weeks	C-NLOPB & Expert Departments and Agencies
Compile comments on EA	1 week	C-NLOPB
Review of EA Addendum/Response Document (*if necessary*)	2 weeks	C-NLOPB & Expert Departments and Agencies
Determination of Significance of Project Effects	3 weeks	C-NLOPB
Total	12 weeks	

APPENDIX B
MIGRATORY AND/OR MARINE BIRDS DISTRIBUTION AND COLONY DATA

APPENDIX B.1
SEASONAL DISTRIBUTION OF MARINE BIRDS WITHIN THE RAA

Northern Fulmar

Large colonies of northern fulmar are located in the Arctic and although they do not breed in the Gulf of St. Lawrence in significant numbers (Environment Canada 2012b), they are present in the RAA year round (Figure 1). Northern fulmar numbers vary substantially over the year, with high abundances being particularly associated with summer months. During summer they are amongst the more abundant species in the Gulf and are distributed throughout its extent. Although not as abundant during fall, winter and spring, data indicate that they are present throughout much of the Gulf during these seasons, including in and adjacent to the Project Area.

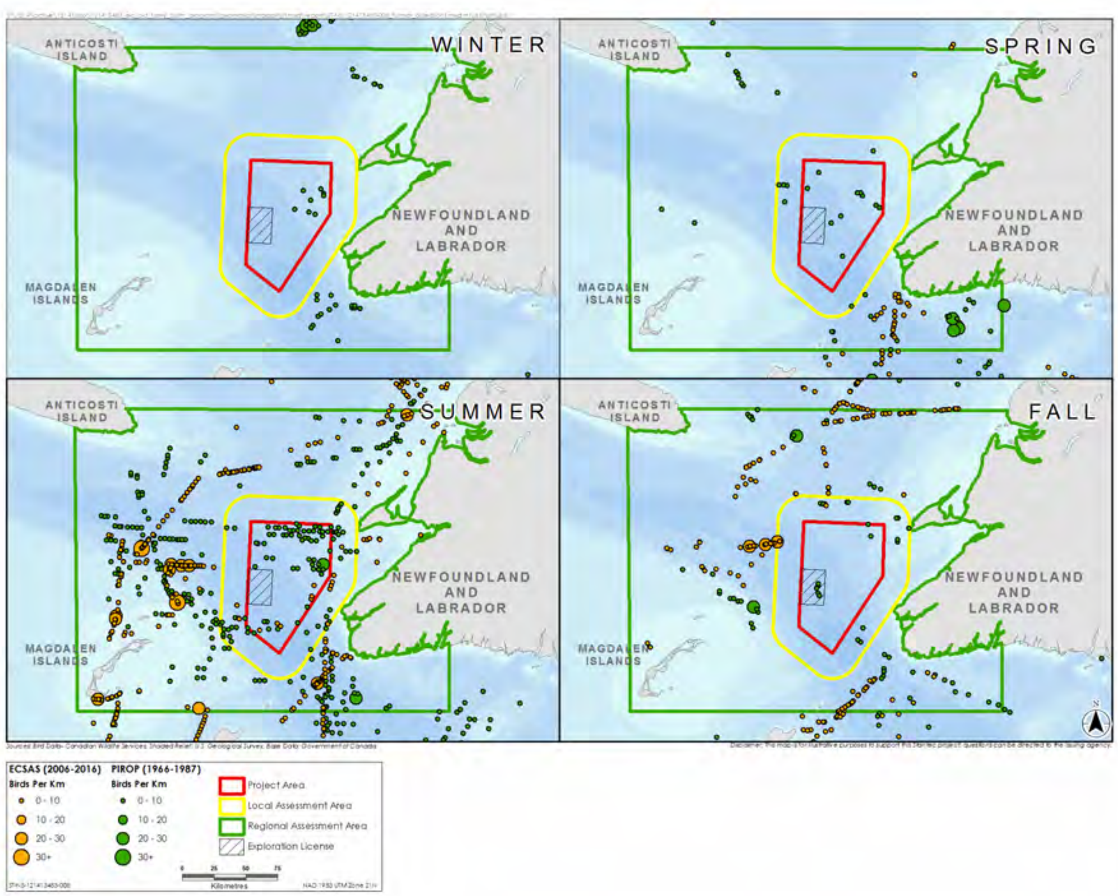


Figure 1 **Seasonal Distribution of Northern Fulmars in the RAA**

Shearwaters

Shearwaters are present in the Gulf during summer and fall, and occur in and around the Project Area during this time (Figure 2). Great shearwater account for the majority of shearwater observations in the PIROP and ECSAS databases, although sooty shearwaters are also regularly encountered. Both of these species spend the winter months in the southern hemisphere where they breed. Manx Shearwater (*Puffinus puffinus*) has also been recorded in the vicinity RAA; this species breeds in the northern hemisphere.

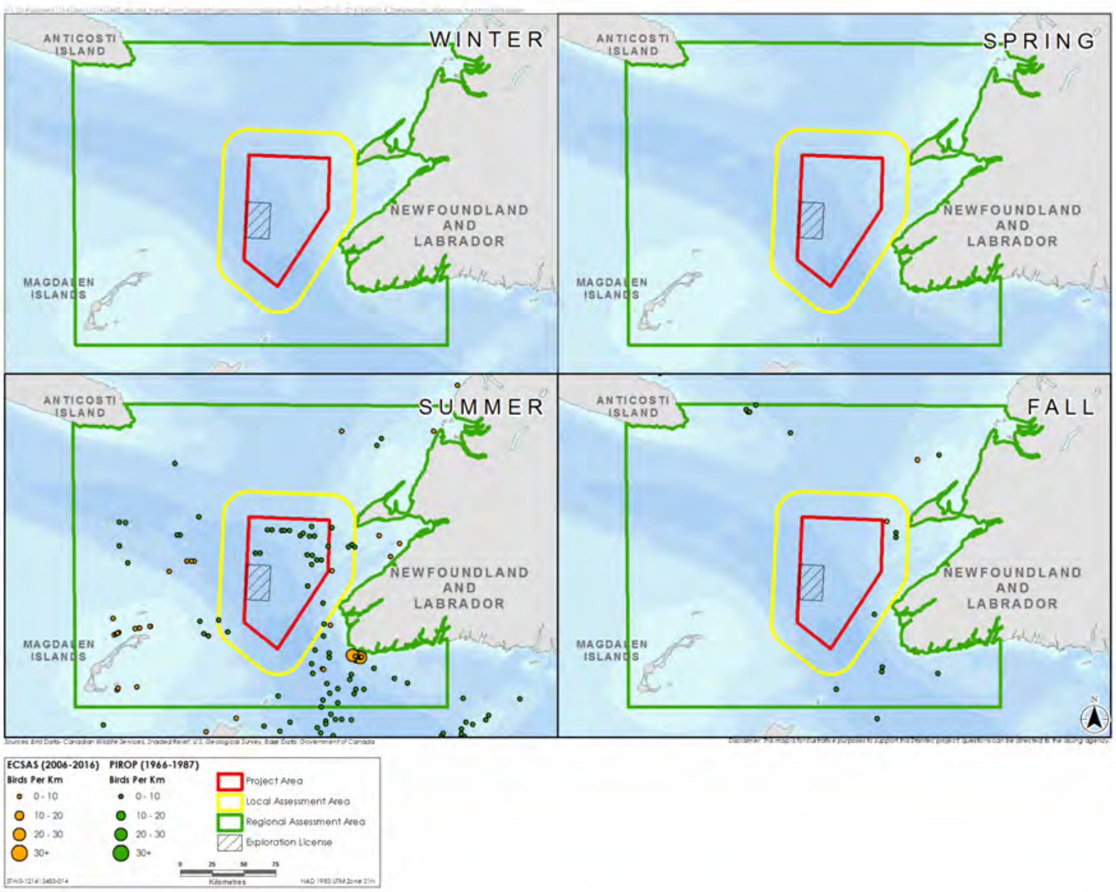


Figure 2 **Seasonal Distribution of Shearwaters in the RAA**

Storm-petrels

Storm-petrels (Leach's storm-petrel and Wilson's storm-petrel) arrive in the Gulf in spring and stay until late fall (Figure 3). Peak densities are reached in summer as a result of the return of Leach's storm-petrels to their breeding colonies and an influx of Wilson's storm-petrels from their breeding grounds in the southern hemisphere to the North Atlantic. ECSAS and PIROP storm-petrel observations were greatest in July and during this time Wilson's storm-petrels were observed to be almost twice as abundant as Leach's storm-petrel. The breeding range of the Leach's storm-petrel in the western North Atlantic is centered on Newfoundland (*e.g.*, world's largest colony reaching 3,360,000 breeding pairs at Baccalieu Island in eastern Newfoundland (Sklepkovych and Montevecchi 1989)), and smaller colnoies are known to occur along southwestern Newfoundland and the Magdalen Islands. ECSAS and PIROP data indicate that storm-petrels are present throughout much of the Gulf during the summer months (Figure 3) and they may be expected to be found foraging in the vicinity of Project Area during the extent of their stay.

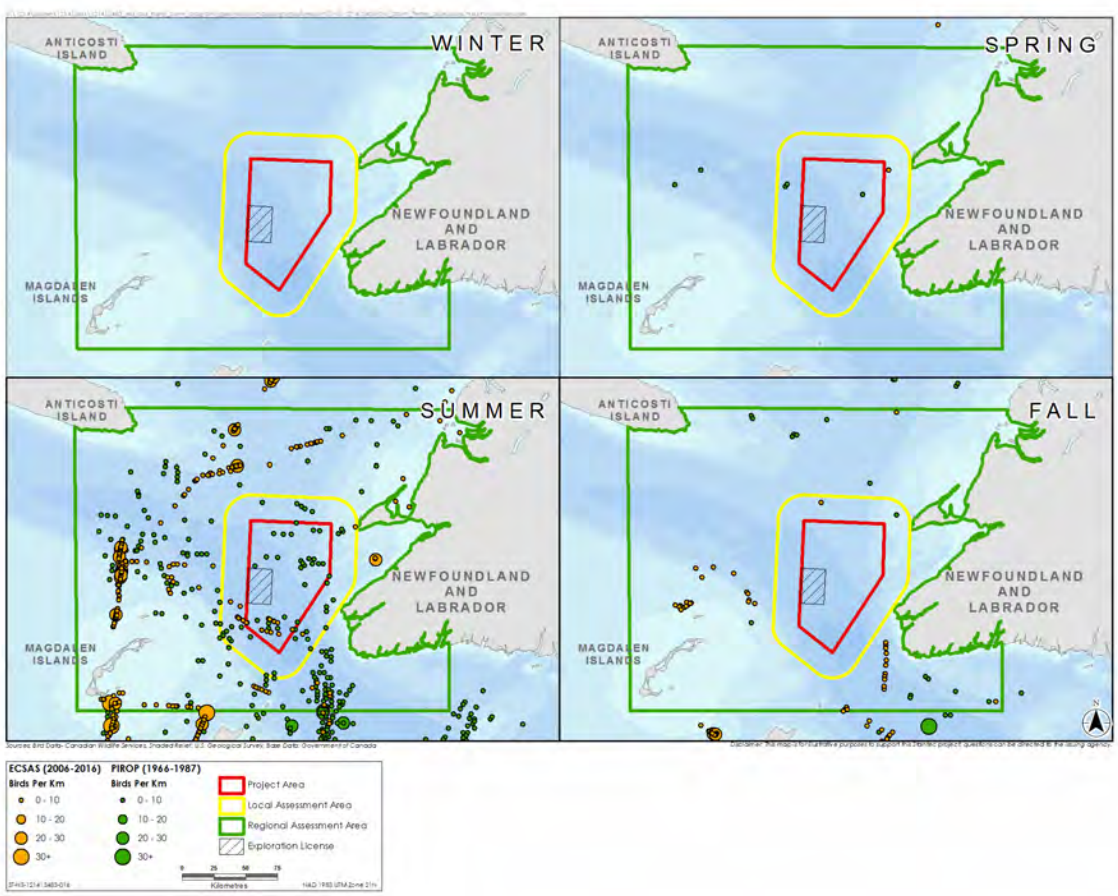


Figure 3 Seasonal Distribution of Storm Petrels in the RAA

Northern Gannets

Northern gannets are generally absent from the Gulf during winter and begin to return to their breeding colonies in April, with peak densities occurring in mid-summer. PIROP and ECSAS survey effort in spring was minimal throughout much of the Gulf but northern gannet activity is expected to be high at this time of the year around the Magdalen Islands were large colonies are located. In particular, a large colony of northern gannets is present at Rocher aux Oiseaux, located in the northern extent of the Magdalen Islands. Individuals from this colony, which has been estimated to contain over 45,000 individuals (CWS 2012), are likely responsible for many of the observations located in the southern Gulf area during the summer and fall months as northern gannets are known to forage several hundred kilometres from their colonies (Hamer *et al.* 2007). Additionally, northern gannets from the Falaise aux Goélands colony, located at the eastern end of Anticosti Island and estimated to support approximately 400 individuals (CWS 2012), also have potential to forage in the vicinity of Project Area. Northern gannets were recorded in relative abundance throughout the southern portion of the Gulf during summer and fall, particularly in the areas surrounding the Magdalen Islands. Aerial photo inventories conducted during the breeding season in 1999 indicated approximately 69 percent of the total North American population of northern gannets were located in the Gulf of St. Lawrence (Chardine 2000). Observations of this species have also been recorded in the more northern portions of the Gulf, but data indicate that such records are less abundant and generally comprised of fewer individuals. Northern gannets migrate to the south during winter but small numbers are recorded during Christmas Bird Counts into December (Environment Canada 2012b).

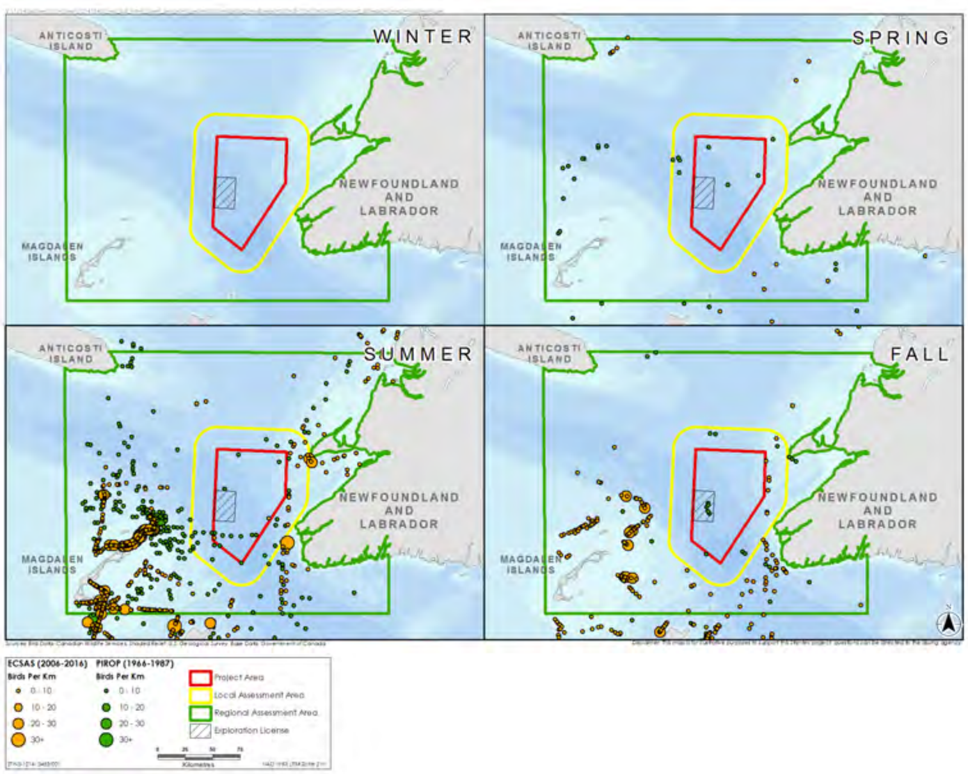


Figure 4 Seasonal Distribution of Northern Gannet in the RAA

Cormorants

Data on the distribution and abundance of cormorants (including double-crested cormorant and great cormorant) within the Gulf indicate that they are typically restricted to coastal environments and have most commonly been recorded in the summer (Figure 5). The majority of the ECSAS and PIROP observations are of double-crested cormorants but the region is known to be important for great cormorants, whose North American population is centered in the eastern part of the Gulf (Lock *et al.* 1994). Although great cormorant do overwinter in the region, many migrate to more southern locations, as does the regional population of double-crested cormorants (Sibley 2000, Tufts 1986). Within the RAA, data indicates that coastal concentrations of cormorants occur in association with the Magdalen Islands during summer months (Figure 5), where multiple colonies that support thousands of breeding pairs are present (Lock *et al.* 1994). Although cormorants have potential to be present in the waters in and adjacent to Project Area throughout much of the year, they are not expected to occur in high concentrations as a result of its distance from the coastline.

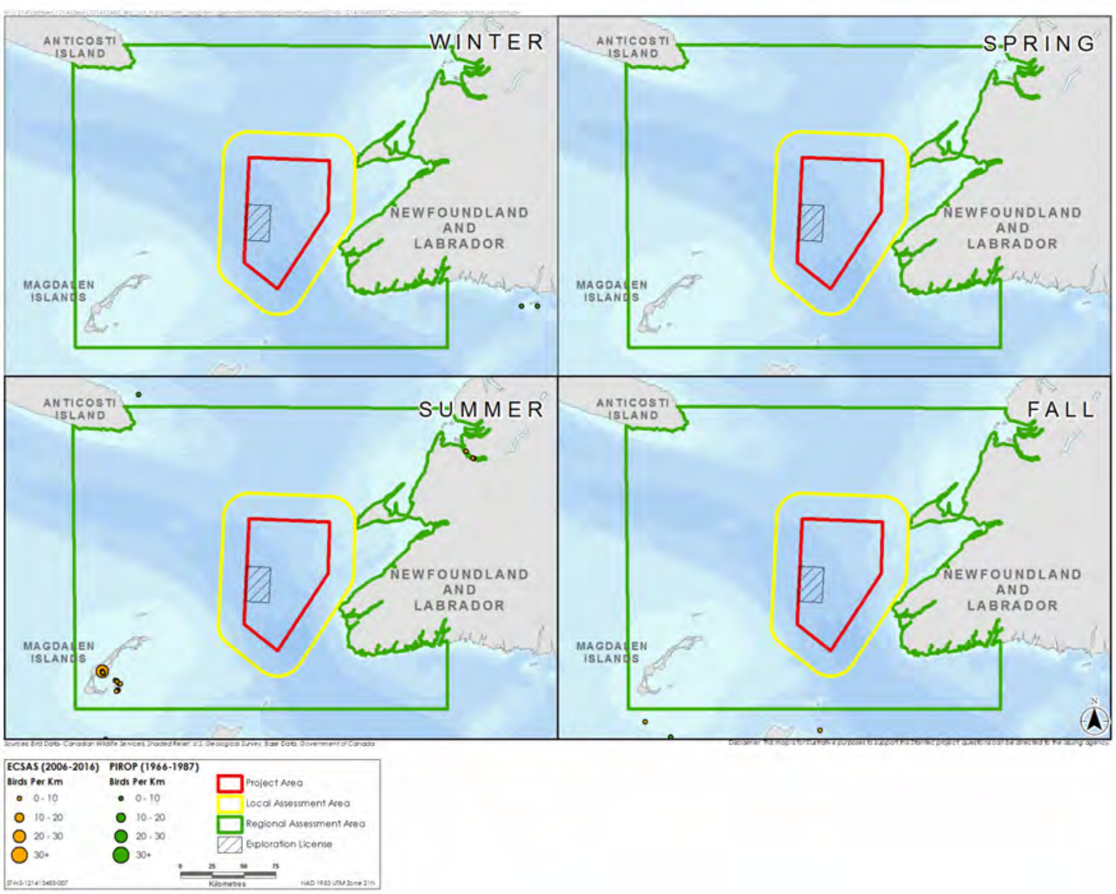


Figure 5 Seasonal Distribution of Cormorants in the RAA

Waterfowl

During spring migration following ice-out in the Gulf, coastal waterfowl (all species) are most highly concentrated along the north shore of Québec between Sept-Îles and Les Îles Ste.-Marie, along the north shore of Anticosti Island and in the inner part of the Bay of Chaleur (Lock *et al.* 1994). For example, numerous scoters have been documented in spring along the North Shore of Quebec between Sept-Îles and Natashquan (Rail and Savard 2003). Other local areas of high concentrations are found in bays and estuaries in New Brunswick, Prince Edward Island and the Gaspé Peninsula (Lock *et al.* 1994).

During the summer, coastal waterfowl are not abundant in the Gulf. Areas of higher concentrations tend to be found along the north shore of Québec between Sept-Îles and the Mingan Archipelago, Anticosti Island, along the shores of the Gaspé Peninsula and at scattered locations along the north shore of New Brunswick and Nova Scotia (Lock *et al.* 1994; EC-CWS, unpublished data, pers. comm. 2012).

Common eiders are the most abundant waterfowl species in coastal waters of the Gulf during the breeding season. At this time, eiders are present throughout most of the coastal waters; however, there are certain areas that support relatively large numbers of breeding birds. The area with the greatest concentration of breeding eiders is the portion of the shore of Québec from the Mingan Archipelago to the Îles Ste.-Marie and along the north shore and eastern tip of Anticosti Island (Lock *et al.* 1994). Large numbers of eider have also been observed moulting along the southern shore of Anticosti Island and the North Shore of Quebec (Rail and Savard 2003; EC-CWS, unpublished data, pers. comm. 2012). Other areas with relatively high concentrations of eider breeding pairs within the Gulf include the eastern tip of the Gaspé Peninsula, the St. Lawrence estuary, the New Brunswick coast, and the portion of the north shore of Quebec extending from the Mingan Archipelago to Sept-Îles (Lock *et al.* 1994; The Joint Working Group on the Management of the Common Eider 2004; EC-CWS, unpublished data, pers. comm. 2012). In western Newfoundland, the islands of St. John bay north of port aux choix support high numbers of nesting eiders. in addition to common Eiders, breeding American black ducks are relatively abundant in coastal waters of the Gulf during the spring and summer months (Lock *et al.* 1994).

During the fall, concentrations of coastal waterfowl (all species) occur in scattered patches in sheltered bays and estuaries throughout the western half of the Gulf. High concentrations are found in Nova Scotia between Amet Sound and Baie Verte, along the south coast of Prince Edward Island, and along the north shore of Quebec at scattered locations between Sept-Îles and the Mingan Archipelago (Lock *et al.* 1994). During fall migration, eiders are most abundant along the north shore of Quebec between Sept-Îles and Les Îles Sainte-Marie and along the shore of Anticosti Island.

Because ice cover in the Gulf is highly variable during winter, the distribution of coastal waterfowl can vary substantially from year to year. In general, during the winter months, large concentrations of coastal waterfowl can occur along the north shore of Québec between Sept-Îles and the Mingan Archipelago, along the shores of Anticosti Island and along the eastern tip of the Gaspé Peninsula (Lock *et al.* 1994). Additionally, large numbers of eiders have been observed wintering offshore of the Magdalen Islands (EC-CWS, unpublished data, pers. comm. 2012).

Coastal waterfowl use nearshore habitats and are not expected to be present on a regular basis in offshore areas, such as in the immediate vicinity of Project Area. Migrating waterfowl would pass through the area and may on rare occasions rest on the water in this area.

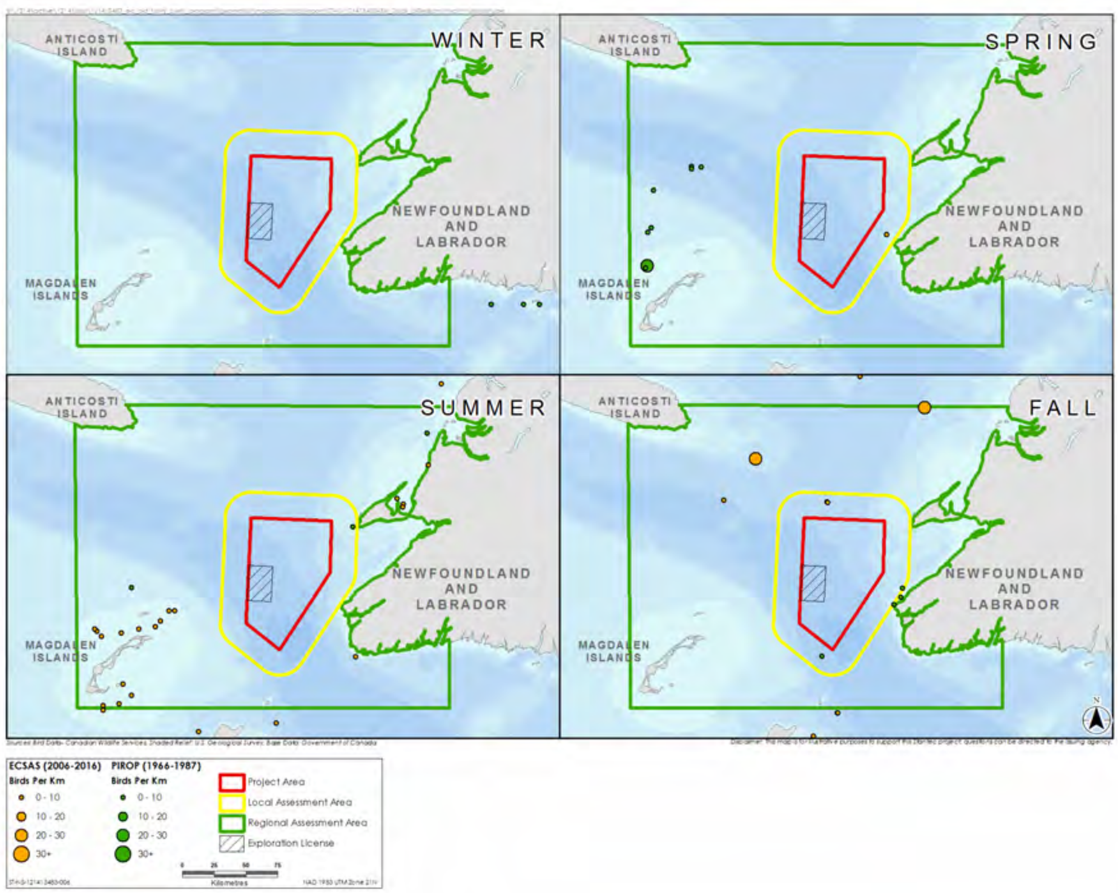


Figure 6 Seasonal Distribution of Waterfowl in the RAA

Phalaropes

Phalaropes typically forage on the surface of the sea in areas where upwelling brings plankton to the surface. Although they are not known to breed in the Gulf, they do pass through during migration between their arctic nesting grounds and more southerly wintering areas. PIROP and ECSAS data indicate that phalaropes have been recorded within the Gulf during spring, summer, and fall (Figure 7). Relatively high concentrations of these species have been recorded near the Magdalen Islands during summer months (Figure 7). Although phalaropes are generally not abundant they may be encountered throughout much of the Gulf and are likely to be intermittently present in the waters of Project Area and the surrounding area.

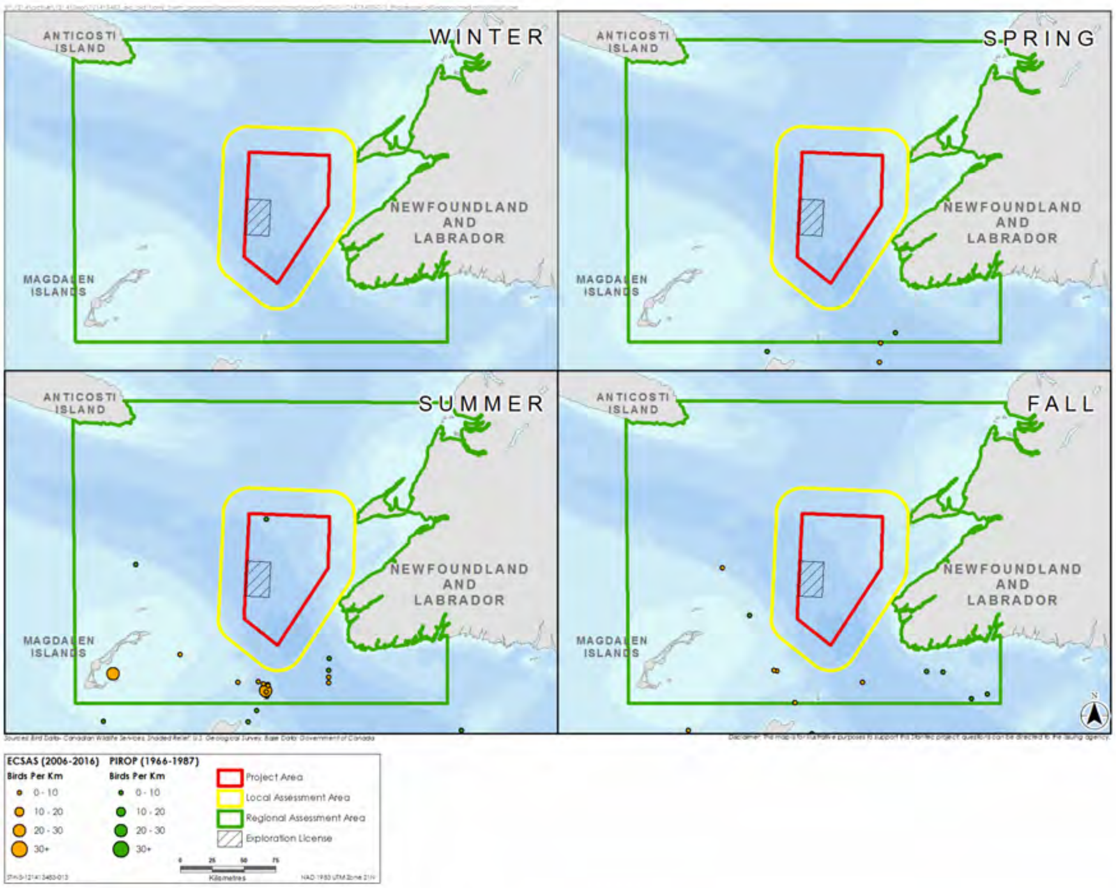


Figure 7 **Seasonal Distribution of Phalaropes in the RAA**

Jaegers

Jaegers (including long-tailed, parasitic, and pomarine jaeger) do not breed in the Gulf but are present in offshore waters of the region during migration. ECSAS and PIROP data indicate that they are infrequently encountered during surveys, but that they may be found throughout much of the RAA (Figure 8). They may be expected to occur in low numbers in the vicinity of the Project Area, except during winter when they are found in much more southern localities. Abundances are expected to be highest in spring and fall when they are travelling between wintering and breeding grounds.

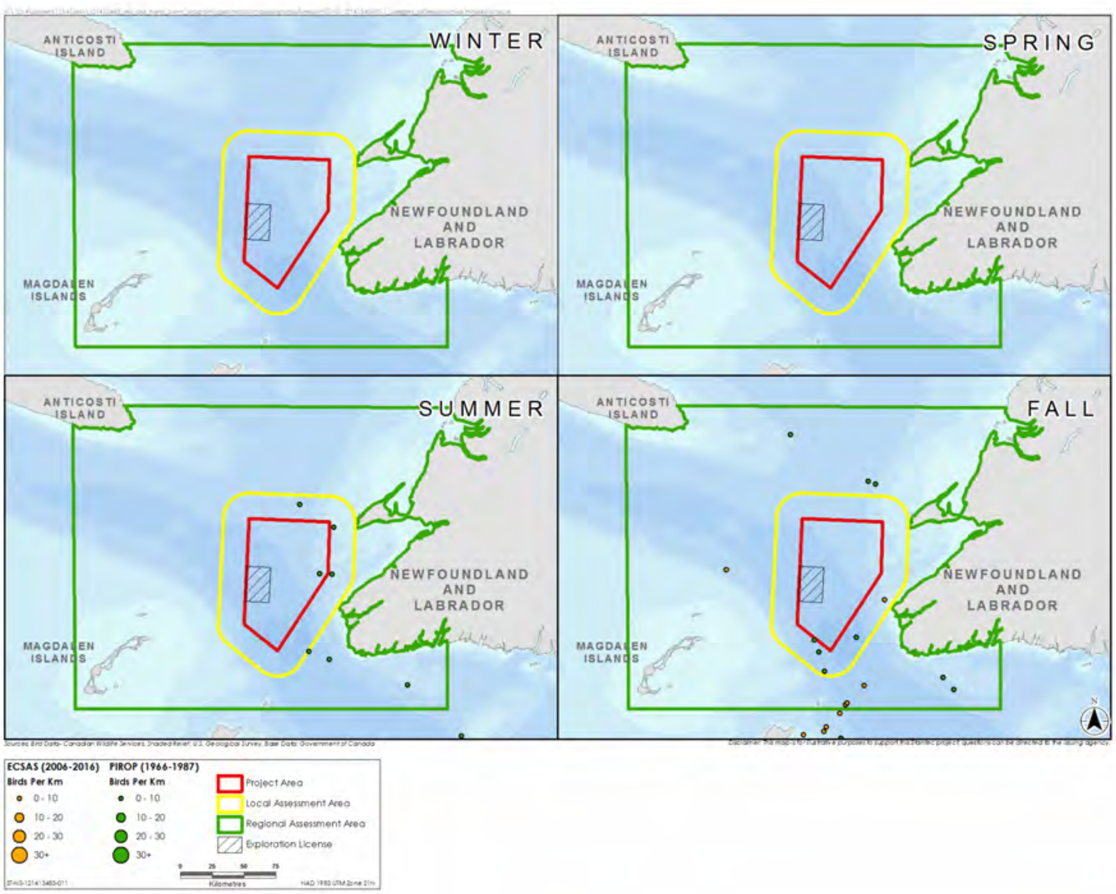


Figure 8 **Seasonal Distribution of Jaegers in the RAA**

Skua

Great skua are considered to be present in offshore waters of the North Atlantic during winter (Sibley 2000) and may be encountered in the Gulf of St. Lawrence during that time. Additionally, PIROP and ECSAS data indicate that this species is occasionally observed in the Gulf at other times of the year, particularly summer and fall (Figure 9). Although South Polar Skua is also known to occur in the offshore of the North Atlantic (Sibley 2000), available data do not include any records for this species in the Gulf. Although great skua has potential to be encountered in and around the waters of Project Area throughout much of the year, any encounters are expected to be infrequent and of few individuals.

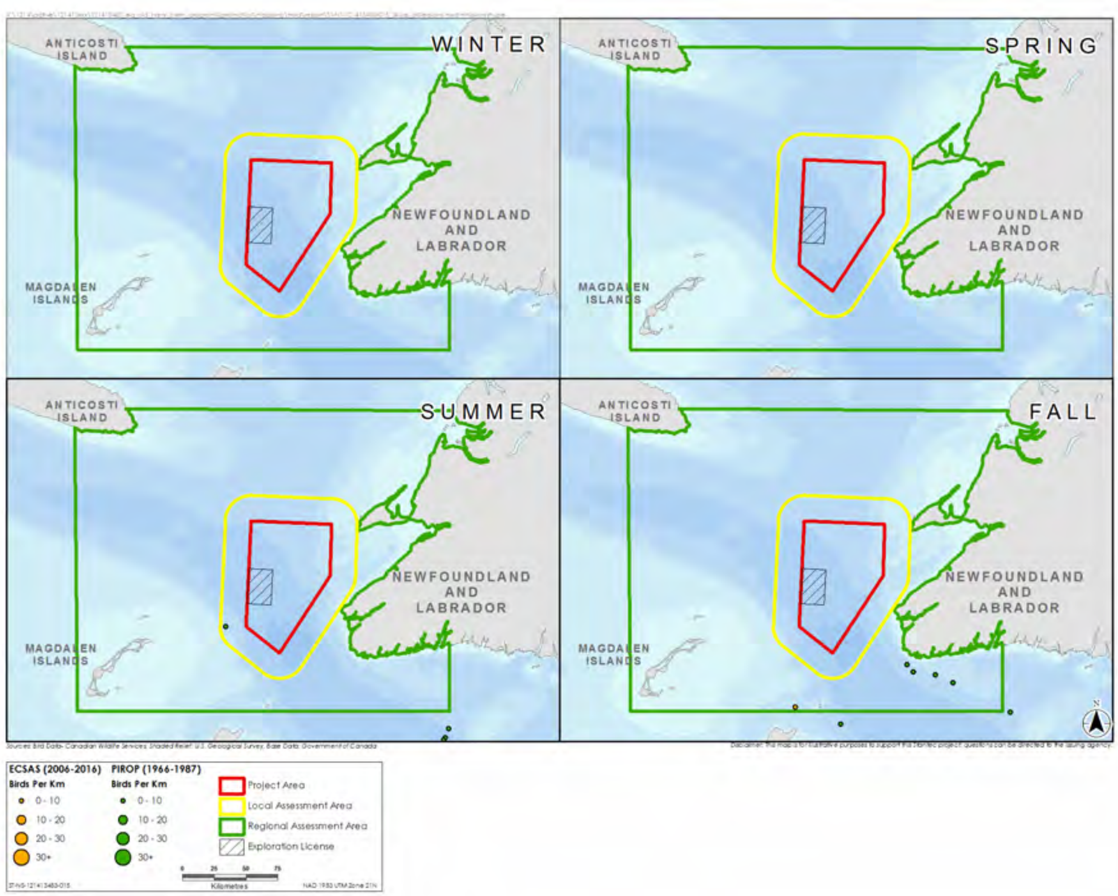


Figure 9 **Seasonal Distribution of Greater Skua in the RAA**

Gulls

As a guild, gulls are amongst the most abundant seabirds present within the Gulf, and data indicate that they are present throughout the region at all times of the year (Figure 10). Both large and small gulls are included in this group (with the exception of black-legged kittiwakes which have been examined separately), with the most abundant species recorded during ECSAS and PIROP surveys in the RAA being herring gull and great black-backed gull, both of which breed throughout the Gulf region and may be found nesting alone or in colonies along most parts of the coast. Large numbers of Iceland gull were also observed during winter months, but this species is general absent during the summer when it travels to more northern latitudes for breeding purposes. Although seasonal patterns vary depending on the particular species, gulls (in general) are abundant in the Gulf at all times of the year, and may be expected to occur in the vicinity of Project Area during spring, summer, fall, and winter.

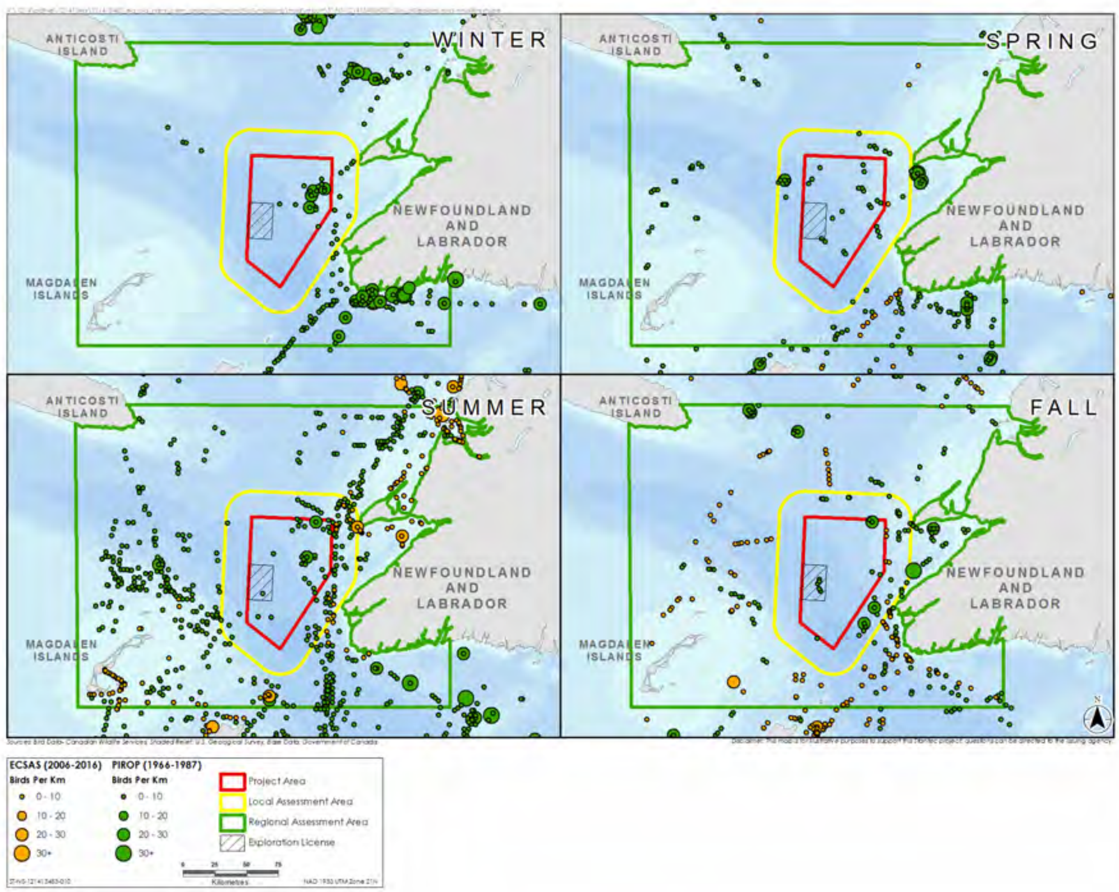


Figure 10 **Seasonal Distribution of Gulls in the RAA**

Black-legged Kittiwakes

Black-legged kittiwakes are pelagic gulls that spend the majority of their time on offshore waters, except during the breeding season when they come onshore to nest. They are present year round in the Gulf and are one of the most abundant pelagic seabirds encountered during ECSAS and PIROP surveys. This species nests in colonies during spring and summer months and may be encountered foraging in the vicinity of these colonies or far offshore during this time (Figure 11). For example, data show large numbers of black-legged kittiwakes surrounding the waters of the Magdalen Islands, which host the Rocher aux Oiseaux and Île Brion colonies, both of which are comprised of thousands of individuals (CWS 2012, Lock et al, 1994). Additionally, the relatively large concentrations of this species near the Port au Port Peninsula along the western shore of Newfoundland are in close proximity to a recently documented colony on a cliff to the north of Cape St. George (EC-CWS 2013b). Although only small abundances of black-legged kittiwakes have been recorded near the eastern point of Anticosti Island (Figure 11), the paucity of data in this area may reflect a lack of survey effort as this area is known to support the large Falaise aux Goélands colony, which has been recently estimated to contain over 30,000 individuals (CWS 2012). Although surveys have been minimal during winter, black-legged kittiwakes do overwinter in the Gulf and PIROP surveys indicate that they are abundant during this season off the west coast of Newfoundland and in the vicinity of Project Area.

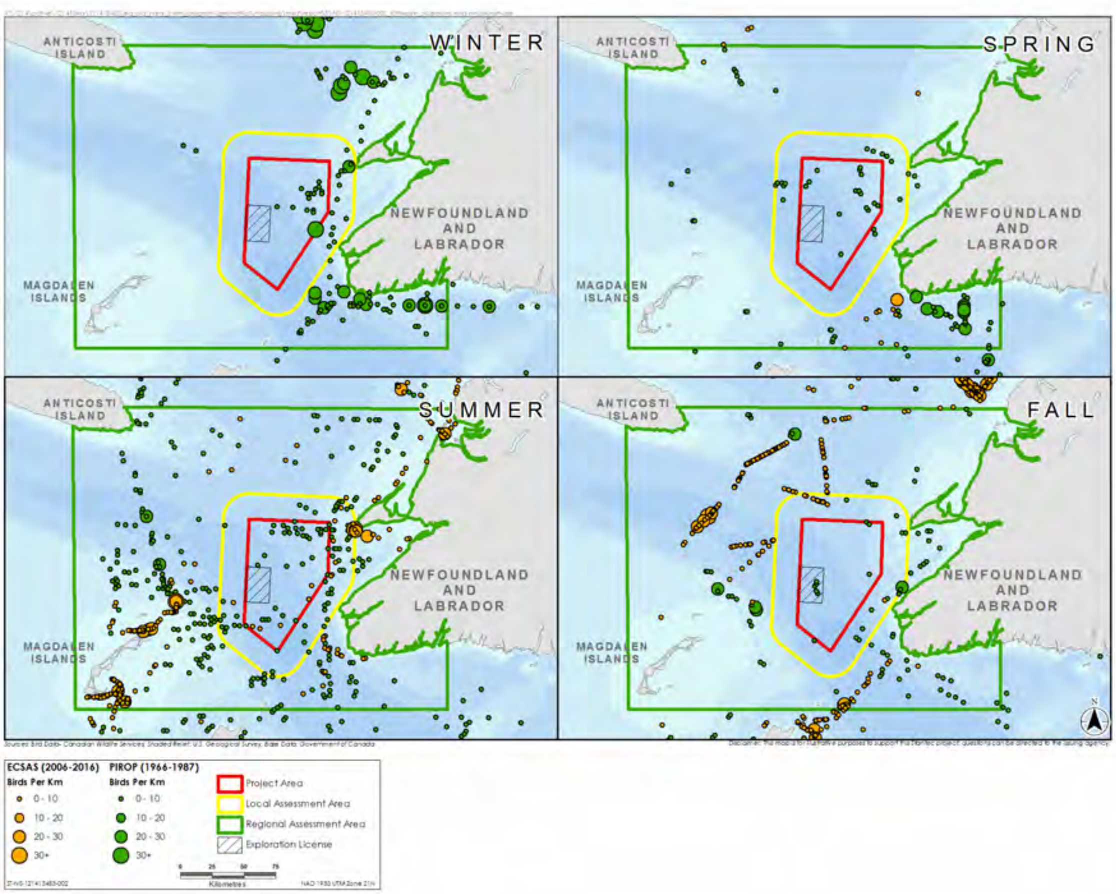


Figure 11 Seasonal Distribution of Black-legged Kittiwakes in the RAA

Terns

Most terns would arrive in the Gulf during May from their more southern wintering grounds and are most abundant in the summer months, particularly in the vicinity of breeding colonies. All ECSAS and PIROP tern records within the RAA are of common and Arctic terns, although roseate and Caspian terns are known to occur in association with the Magdalen Islands (Bird Studies Canada and Nature Canada 2017). Migration for common terns occurs during August and September (Tufts 1986) and for Arctic terns it has been described as beginning in mid-July and to be largely completed by mid-September (Tufts 1986). Data indicate that terns may be encountered throughout the RAA during their stay (Figure 12), and would be relatively abundant in proximity to coastal features. Although Arctic terns forage offshore at all seasons, common terns do not feed as far out to sea, being largely restricted to coastal areas (Erskine 1992).

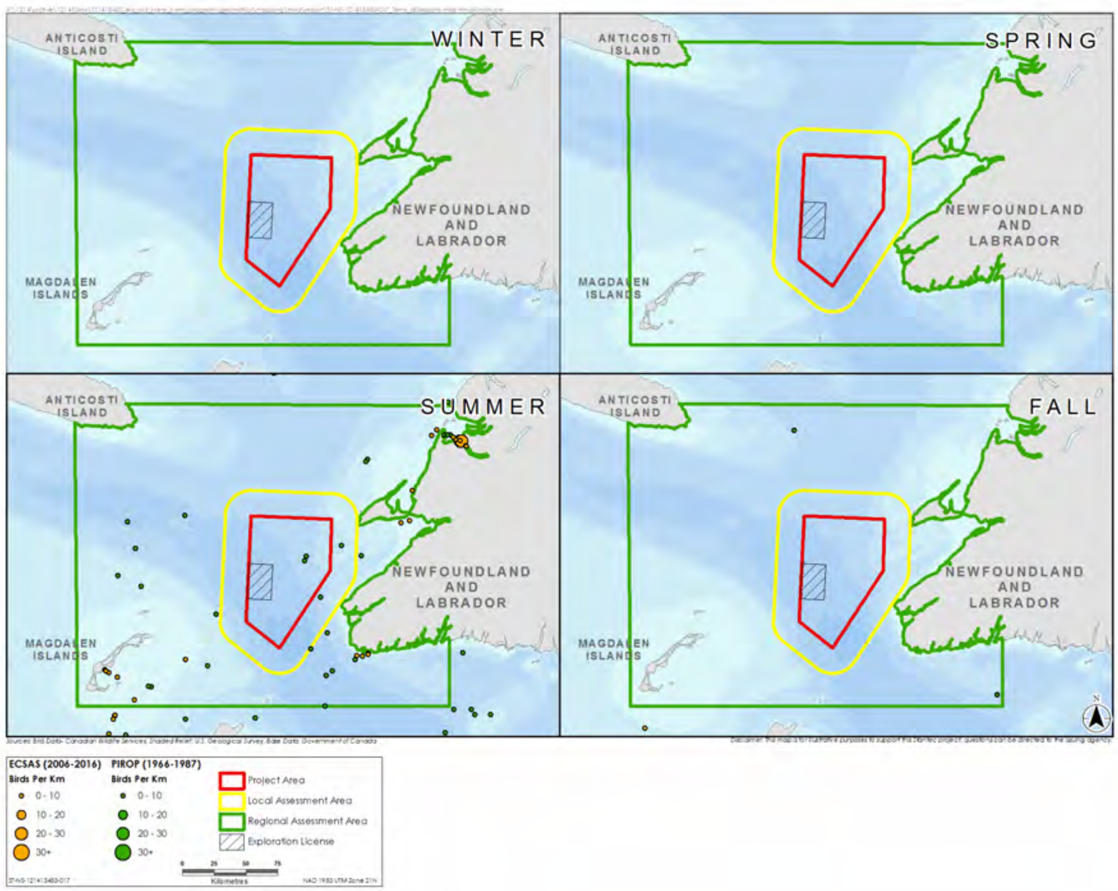


Figure 12 Seasonal Distribution of Terns in the RAA

Dovekie

Dovekies nest in the high Arctic and do not breed in Canada in significant numbers. However, data indicate that they occur in low numbers in the Gulf during most months of the year but reach their peak densities in late fall / early winter. During fall, data indicate that they are concentrated in areas of deeper water, such as in association with the Laurentian Channel, (Figure 13). During the spring and summer, most dovekies are present near their northern breeding colonies, and low densities of this species would be encountered in the Gulf at that time. Although information is lacking for the area in the immediate vicinity of Project Area during winter, data indicate that dovekies have been recorded in relatively high concentrations within the Laurentian Channel during winter months and late fall (*i.e.*, November), and they may be expected to be in high abundance in and around Project Area during that time.

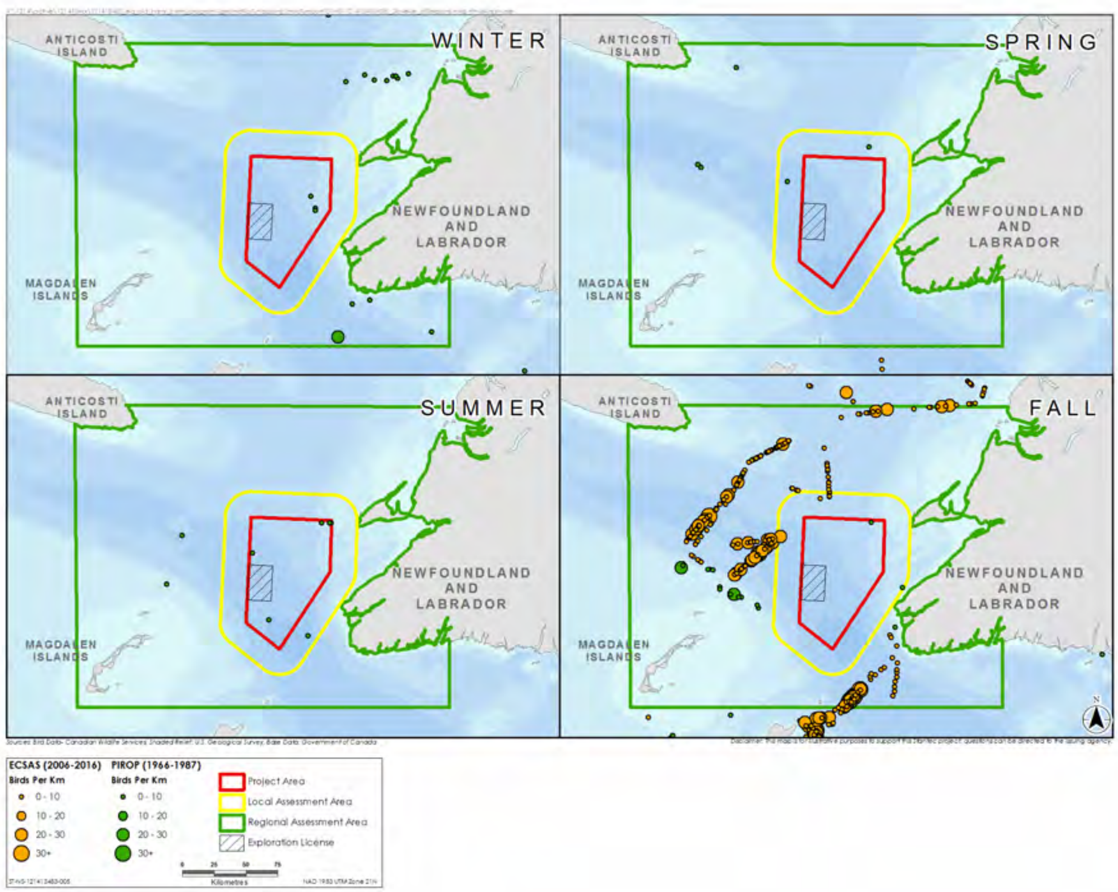


Figure 13 **Seasonal Distribution of Dovekies in the RAA**

Large Alcids

Large auks and other alcides are amongst the most common groups of birds in the Gulf. As a group, they are distributed throughout the region with large concentrations being recorded both in association with coastal features and in more offshore waters(Figure 14). Common murres were the most abundant species encountered during ECSAS and PIROP data collection, being particularly abundant in spring and summer. Razorbills, Atlantic puffins, and thick-billed murres were also recorded in the RAA during ECSAS and PIROP surveys. Common murre and razorbill colonies are found throughout the Gulf and the high concentrations of auks present in Figure 14 are often in close proximity to the nesting sites for these species, such as the Magdalen Islands (Lock *et al.* 1994). Thick-billed murre colonies are comparatively few in the Gulf, but this species has been recorded to breed at several locations in the region, including at Rocher aux Oiseaux in the Magdalen Islands (Lock *et al.* 1994). Atlantic puffin are colonial nesters during late spring and summer but were most encountered during the ship-based surveys after young have fledged in fall. Although many common murres, thick-billed murres, and razorbills are known to overwinter in the Gulf (Sibley 2000), most Atlantic puffins in the region migrate to more southern localities for the winter months (Sibley 2000, Tufts 1986). Large auks would be present in the vicinity of Project Area during all times of the year.

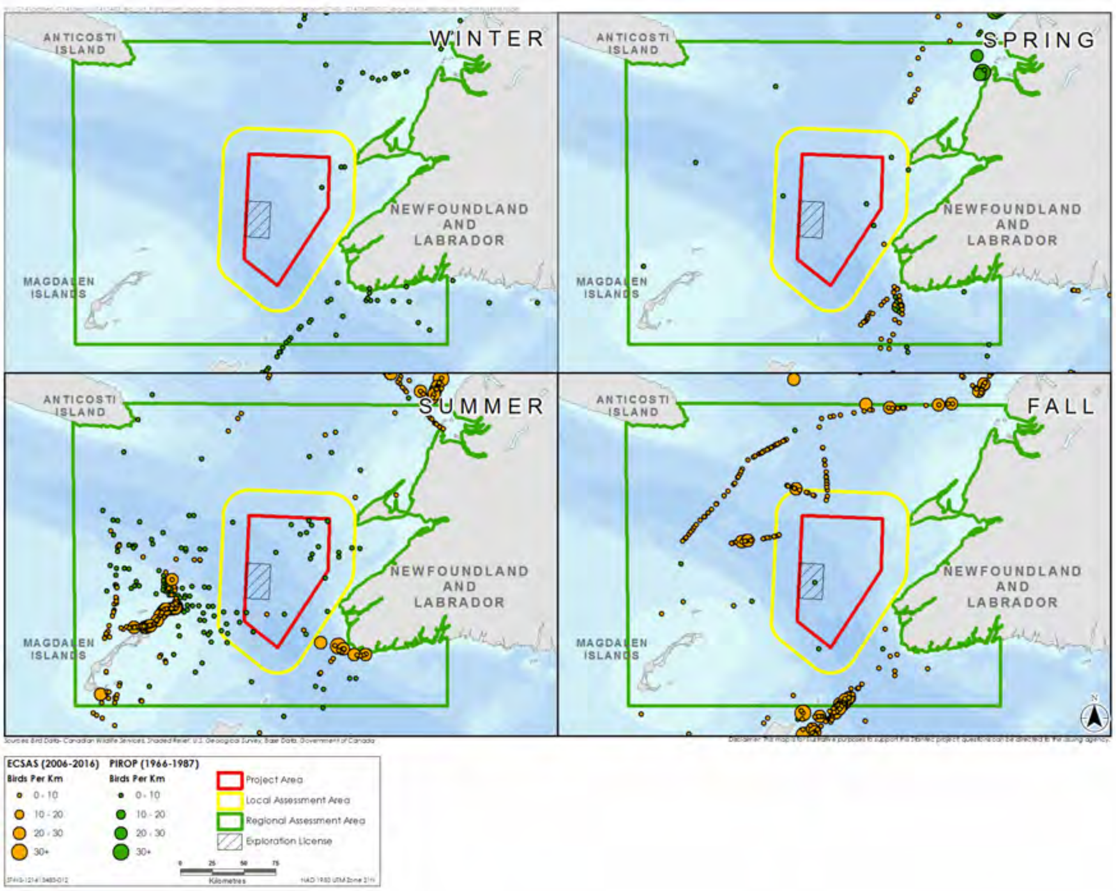
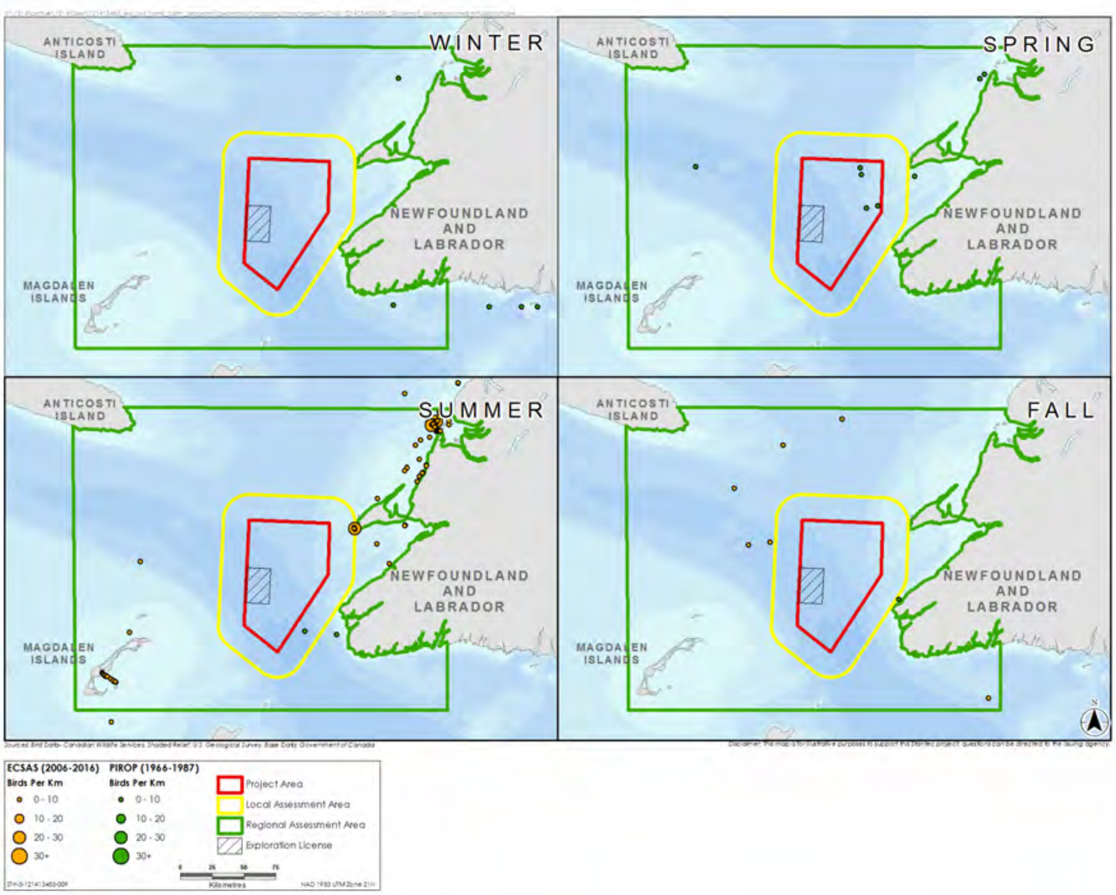


Figure 14 Seasonal Distribution of Large Auks and other Alcids in the RAA

Black Guillemots

Black guillemots are present in the Gulf year round. ECSAS and PIROP data indicate that the highest concentrations of this species are generally encountered in association with the coastline, but they also frequent deeper sections of the Gulf such as the Laurentian Channel (Figure 15). Relatively high abundances of this species may be expected to near known colony sites during the breeding season. However, other concentrations of ECSAS Black Guillemot observations, such as those associated with the Port au Port Peninsula in western Newfoundland, are not associated with any known colony sites (CWS survey data, Lock *et al.* 1994). Black guillemots may be present within the vicinity of Project Area at all times of the year, although available data do not indicate that they are particularly abundant at any time due to the distance from the coastline.

Figure 15 Seasonal Distribution of Black Guillemot in the RAA



APPENDIX B.2
SEABIRD COLONY DATA

Table 1 Number of Seabirds Recorded within Colonies in the Vicinity of the RAA, including the Magdalen Islands, Western Newfoundland, Southern Newfoundland, Cape Breton Island, and the Southern Portion of Anticosti Island1

Colony #	Name	Colony Size Units	Species[2]																				Total
			GRCO	DCCO	COSP	COEI	BLKI	TBMU	COMU	RAZO	BLGU	ATPU	GBHE	NOGA	LESP	HERG	GBBG	BHGU	RBGU	COTE	ARTE	ROTE	
Magdalen Islands																							
1	Île d'Entrée	Individual	280				4,614		4	334	450					8	2						5,692
2	Cap du Sud-Ouest	Individual	32				1,022			38	48					16	4						1,160
3	Cap Noir	Individual	114				22				232					6							374
4	Corps Mort	Individual	138	14			6		6	68	84					24	14						354
5	Havre-aux-Basques Lagoon Islets	Individual		1,122												42	204			1,276	22		2,666
a	Baie du Portage Islets	Individual		1,122												42	200						1,364
b	Colonie de la Planche à Voile Islet	Individual																					0
c	Pointe des Canot Islets	Individual															4			164			168
d	Îles de Travers	Individual																		2			2
e	Colonie du Nord-Ouest Islets	Individual																		836	22		858
f	Etang de la Martinique Islets	Individual																		274			274
g	Goulet du Nord Islet	Individual																					0
6	Île aux Goélands	Individual	434	908		2	334			48	34					16	6						1,782
7	Île du Cap-aux-Meules	Individual									330					8							338
8	Île aux Cochons	Individual														0	0			0			0
9	Îlets des Étroits	Individual														0	0			92			92
10	Île Shag	Individual	240	1,500			710		2	30	24					8	28						2,542
11	Îlot B of the Grande-Entrée Lagoon	Individual		1,666													18						1,684
12	Île du Chenal (Grande-Entrée Lagoon)	Individual														392	1,098			1,566	+	1	3,057
13	Île aux Loups Marins	Individual		0												0	0						0
14	Île Rouge (Grande-Entrée Lagoon)	Individual		0							0					0	0						0
15	Pointe de l'Est	Individual														0	4	34		702	+	1	741
16	Île Brion	Individual	104	164			3,780		2,266	598	806	156			8	0	2						7,884
17	Rochers aux Oiseaux	Individual					3,778	794	6,982	1,900		2		46,922		0	4						60,382
18	Cap du Dauphin	Individual								2	30												32
19	Île Rouge (Havre-aux-Maisons Lagoon)	Individual		0												0	0						0
20	Île de Grande-Entrée	Individual									94												94

Table 1 Number of Seabirds Recorded within Colonies in the Vicinity of the RAA, including the Magdalen Islands, Western Newfoundland, Southern Newfoundland, Cape Breton Island, and the Southern Portion of Anticosti Island1

Colony #	Name	Colony Size Units	Species[2]																				Total
			GRCO	DCCO	COSP	COEI	BLKI	TBMU	COMU	RAZO	BLGU	ATPU	GBHE	NOGA	LESP	HERG	GBBG	BHGU	RBGU	COTE	ARTE	ROTE	
21	Île du Havre-aux-Maisons	Individual									190					236	90						516
22	Cap du Sud	Individual					84				182					24	4						294
23	Île aux Loups	Individual									42					4							46
24	Fatima (Île du Cap-aux-Meules)	Individual											112										112
25	Mont Moore (Grosse-Île)	Individual											0										0
26	Pointe des Canots (Île du Havre-Aubert)	Individual											0										0
27	Cap-aux-Meules Marina	Individual														198	74						272
28	Île du Bassin	Individual															4			1,330			1,334
29	Étang-du-Nord Wreck	Individual									4					108	2						114
30	Pointe Rockhill (Grosse-Île)	Individual											2										2
Anticosti Island																							
32	Pointe Dauphiné	Individual	2	122																			124
33	Lac de la Croix	Individual															1						1
34	Baie du Naufrage	Individual														0	0						0
35	Pointe de l'Est	Individual								6		1											7
36	Falaise aux Goélands	Individual		100			18,802			54				400									19,356
37	Cap Sandtop	Individual	0	0			0				51												51
38	Pointe Merrimack	Individual		0																			0
39	Baie Innommée	Individual	0	0			0			0	75	0				0							75
40	Baie du Renard	Individual															20						20
41	Pointe du Renard	Individual					608			32													640
42	Cap de la Table	Individual	0				0			0	359	0				0							359
Newfoundland (Southwest Coast)																							
43	Black Rock, NF	Pair			101-500																		101-500
44	Smoky Island, NF	Pair																	101-500	14			115-500
45	Gull Island, NF	Pair																		10			10
46	Flat Island, NF	Pair			101-500																		101-500
47	Three Islands, south, NF	Pair															11-100						11-100

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			GRCO	DCCO	COSP	COEI	BLKI	TBMU	COMU	RAZO	BLGU	ATPU	GBHE	NOGA	LESP	HERG	GBBG	BHGU	RBGU	COTE	ARTE	ROTE	
48	Three Islands, middle, NF	Pair														11-100	11-100						22-200
49	Jacques Island, NF	Pair														11-100							11-100
50	Ireland Island, NF	Pair															9						9
51	Tinker Island, Little La Poile Bay, NF	Pair																		27			27
52	Wreck Island, Garia Bay, NF	Pair													100	11-100	11-100						122-300
53	Duck Island, Rose Blanche, NF	Pair															11-100	11-100					22-200
54	Shag Rocks, NF	Pair															11-100						11-100
55	Three Islands, north, NF	Pair																		155			155
56	Pigeon Island, NF	Pair															9						9
57	Grandy Sound, uni in, NF	Pair															9						9
58	Salmon Island, NF	Pair															1			29			30
59	Isle aux Morts, NF	Pair															9						9
60	Round Rock, NF	Pair															2			15			17
61	Garden Islands, SW, NF	Pair															11-100	11-100					22-200
62	Money Island, NF	Pair															1			98			99
63	Vardys Island, NF	Pair														11-100	9						20-100
64	Mouse Island, NF	Pair															9						9
Newfoundland (West Coast)																							
65	Green Island	Pair															1-100						1-100
66	Bard Island	Pair															101-500						101-500
67	Duck Island	Pair															101-500						101-500
68	Durands Island	Pair														101-500	101-500		101-500				303-1500
69	Shag Island	Pair			101-500												1-100						102-600
70	Bay behind Shaol Point	Pair															1-100						1-100
71	Codroy Island	Pair														1-100	1-100			2			2-200
72	Grebes Head	Pair			1-100																		1-100
73	Wreck Cove	Pair			1-100																		1-100

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Colony #	Name	Colony Size Units	Species[2]																				Total
			GRCO	DCCO	COSP	COEI	BLKI	TBMU	COMU	RAZO	BLGU	ATPU	GBHE	NOGA	LESP	HERG	GBBG	BHGU	RBGU	COTE	ARTE	ROTE	
74	Ship Cove, Uni in	Pair			1-100																		1-100
75	Crabbe River estuarty, Uni 2 in	Pair															101-500	101-500					202-1000
76	Crabbe River estuarty, uni 1 in	Pair																		50			50
77	Cliff N of Cape St. George	Pair					501-1000																501-1000
78	Cliff S. edge of Big Cove	Pair					>1000																>1000
79	St. Georges River, uni in	Pair																	101-500	183			284-500
80	Sandbar in St. Georges River	Pair																		35			35
81	Ship Island	Pair															101-500						101-500
82	Cape Cormorant	Pair			101-500																		101-500
83	Gravels Pond Island	Pair																		240			240
84	Red Island	Pair														101-500	101-500						202-1000
85	Point Au Mal	Pair																		80			80
86	Fox Island River	Pair														1-100							1-100
87	Fox Island	Pair														1-100							1-100
88	Shag Island	Pair			101-500		1-100									101-500	1-100						204-1200
89	rock inside of White Rocks	Pair															1-100						1-100
90	Seal Island	Pair														101-500	1-100						102-600
Cape Breton																							
91	Chimney Corner	Individual	78																				78
92	Cap Le Moine	Individual	2																				2
93	The Capes	Individual	257																				257
94	Cheticamp Island	Pair									10												10
95	Cheticamp Island, Causeway	Pair														338	129						467
96	Cheticamp Harbour, uni in	Pair															27			31			58
97	Cheticamp Harbour, uni in	Individual														680	129						809

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Colony #	Name	Colony Size Units	Species[2]																				Total
			GRCO	DCCO	COSP	COEI	BLKI	TBMU	COMU	RAZO	BLGU	ATPU	GBHE	NOGA	LESP	HERG	GBBG	BHGU	RBGU	COTE	ARTE	ROTE	
98	Gros. Cap. Cheticamp Island	Individual															170						170
99	Gros. Cap. Cheticamp Island	Pair															170						170
100	Lowland Cove	Individual	15																				15
101	Lead Island	Pair		391												128	240						759
102	Money Point	Pair	36																				36
103	South Harbour, small uni Island	Pair																		154			154
104	Yellow Head	Pair														20	8						28
105	Ingonish	Pair															35						35
106	Ingonish Island	Pair	251													504	1,188						1,943
107	Middle Head	Pair															103						103

[1]Adopted from Stantec (2013); data for the Madgalen Islands from Rail (2009); Anticosti island from EC-CWS (2013a), and Newfoundland and Cape Breton from EC-CWS (2013b)

[2]Species Codes: GRCO=Great Cormorant; DCCO= Double-crested Cormorant; COSP= Cormorant species; BLKI=Black-legged Kittiwake; TBMU=Thick-billed Murre; COMU=Common Mure; RAZO=Razorbill; BLGU=Black Guillemot; ATPU=Atlantic Puffin; GBHE= Great Blue Herron; NOGA= Northern Gannet; LESP= Leach's Storm-Petrel; HERG=Herring Gull; GBBG= Great Black-backed Gull; BHGU=Black-headed Gull; RBGU=Ring-billed Gull; COTE= Common Tern; ARTE= Arctic Tern; ROTE= Roseate Tern

APPENDIX C
COMMERCIAL FISHING LOCATIONS BY SPECIES

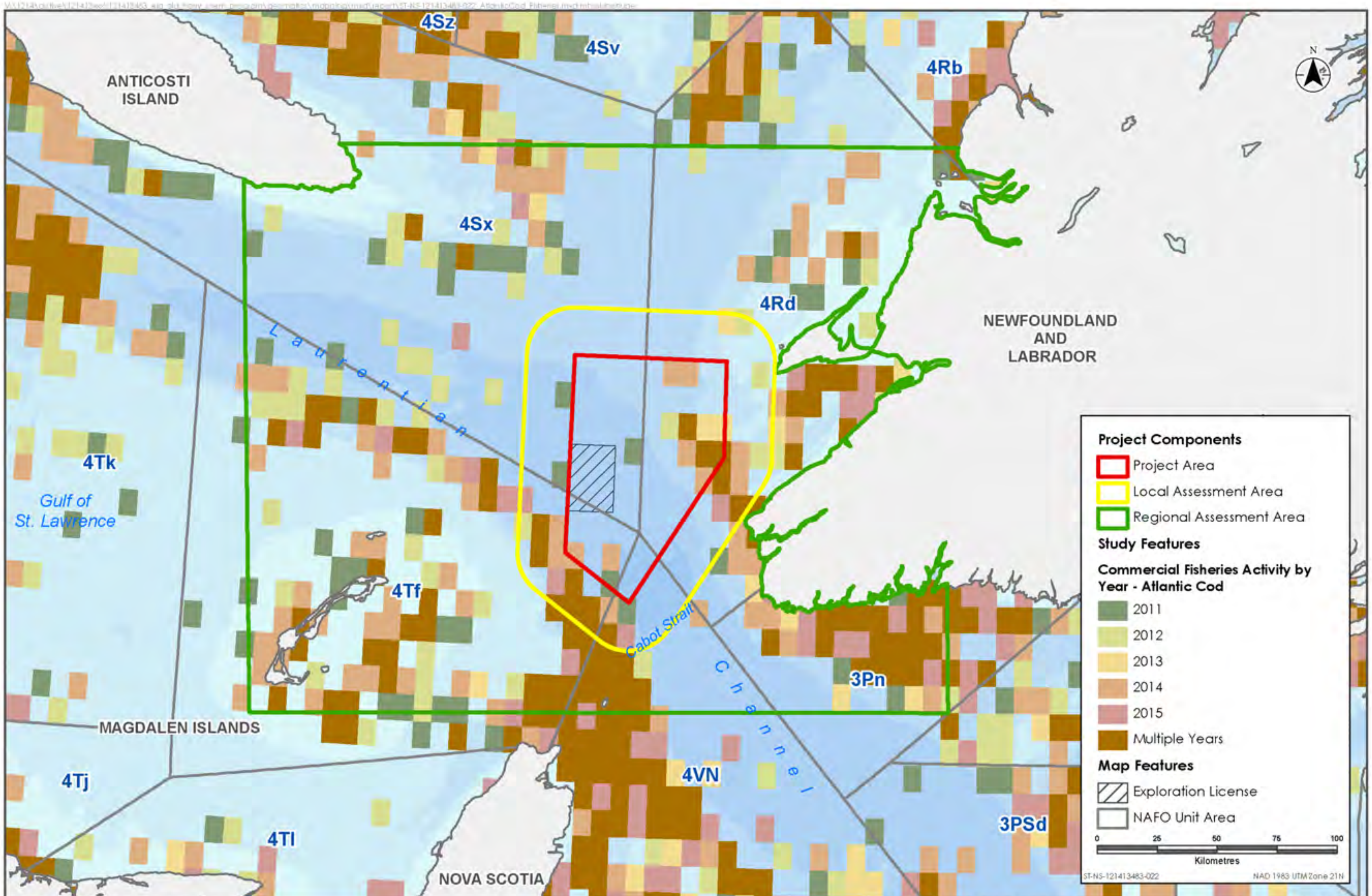

Figure 1 **Commercial Fisheries Activity by Year – Atlantic Cod**

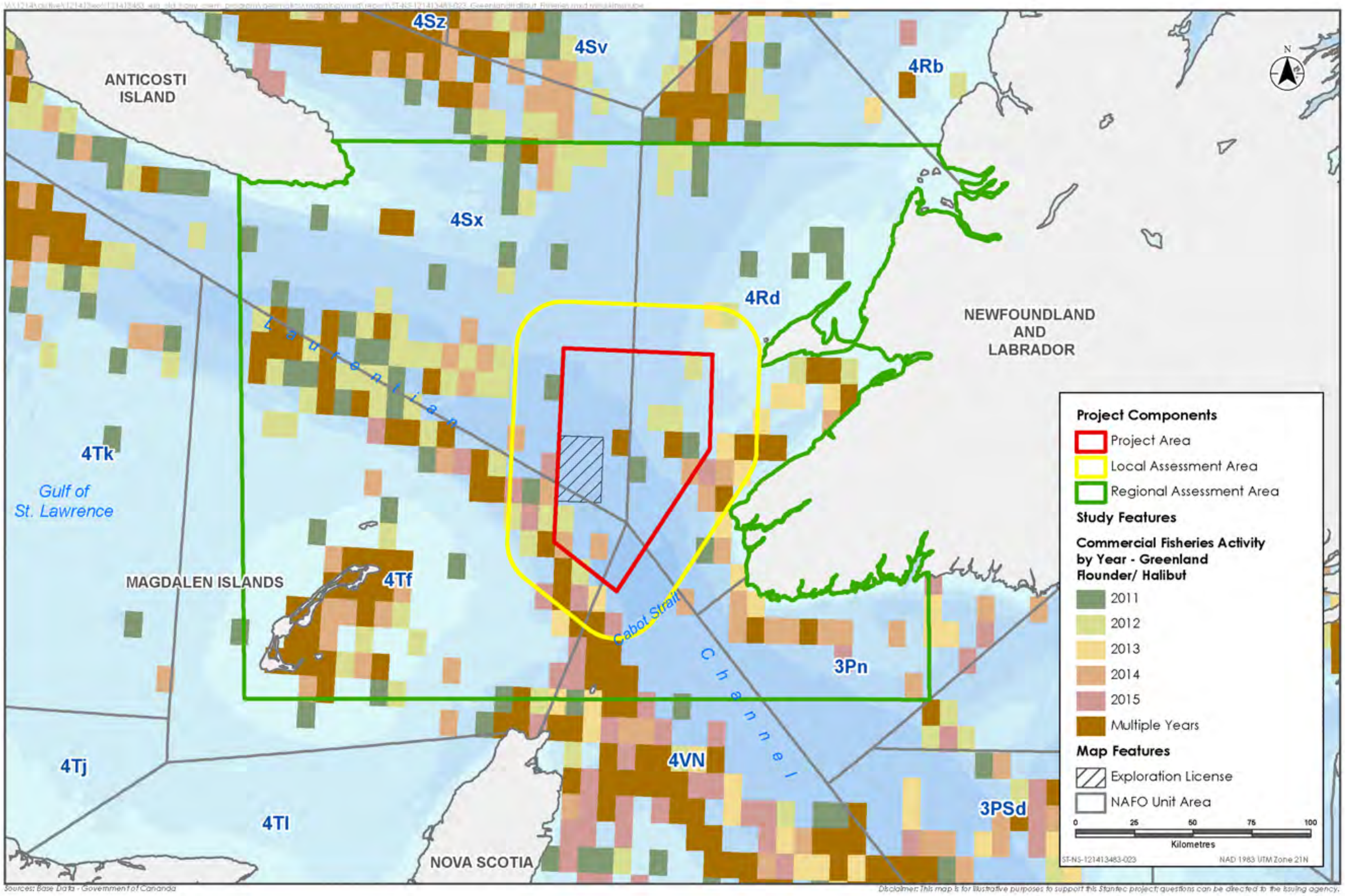

Figure 2 Commercial Fisheries Activity by Year – Greenland Flounder/Halibut

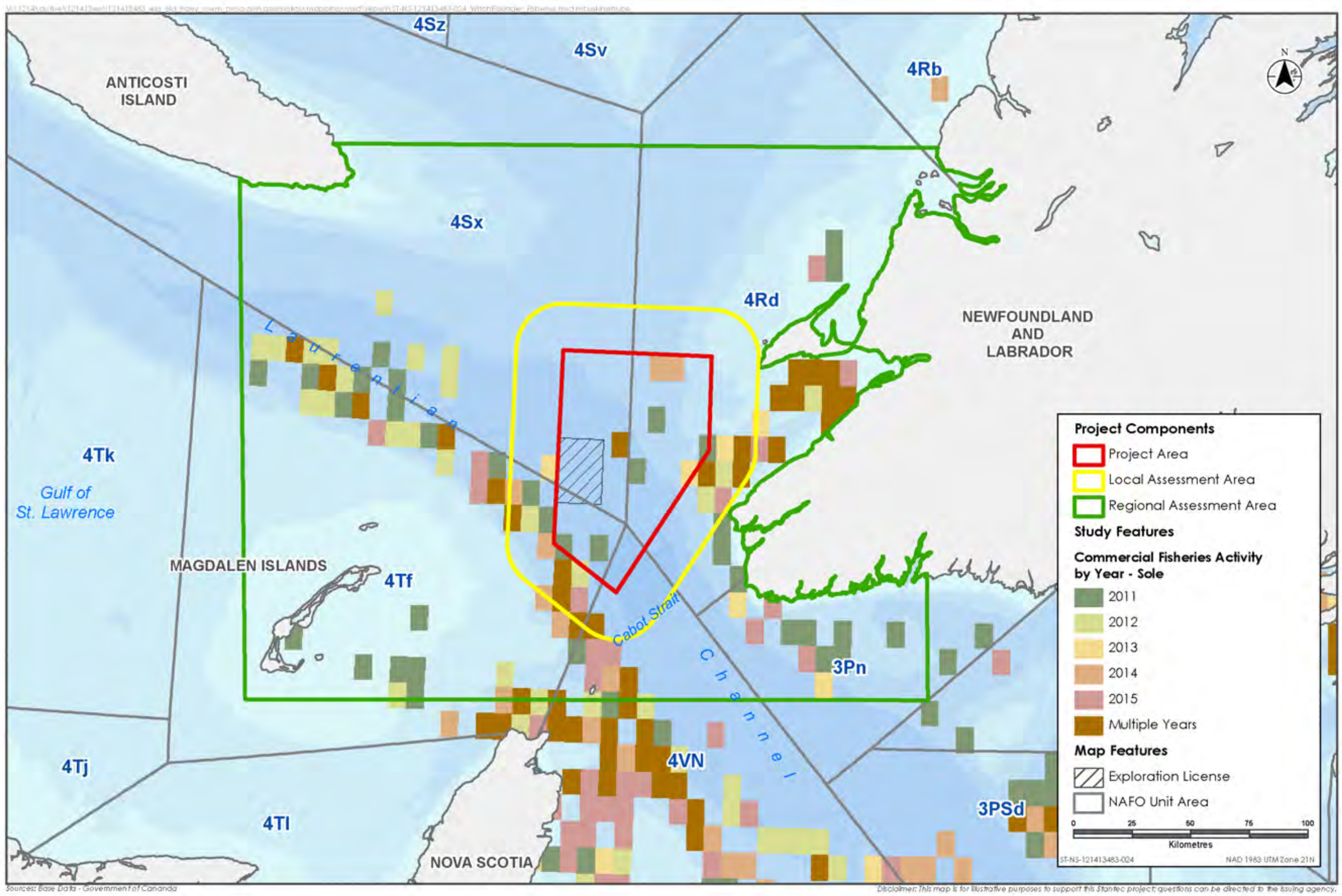

Figure 3 Commercial Fisheries Activity by Year – Grey Sole

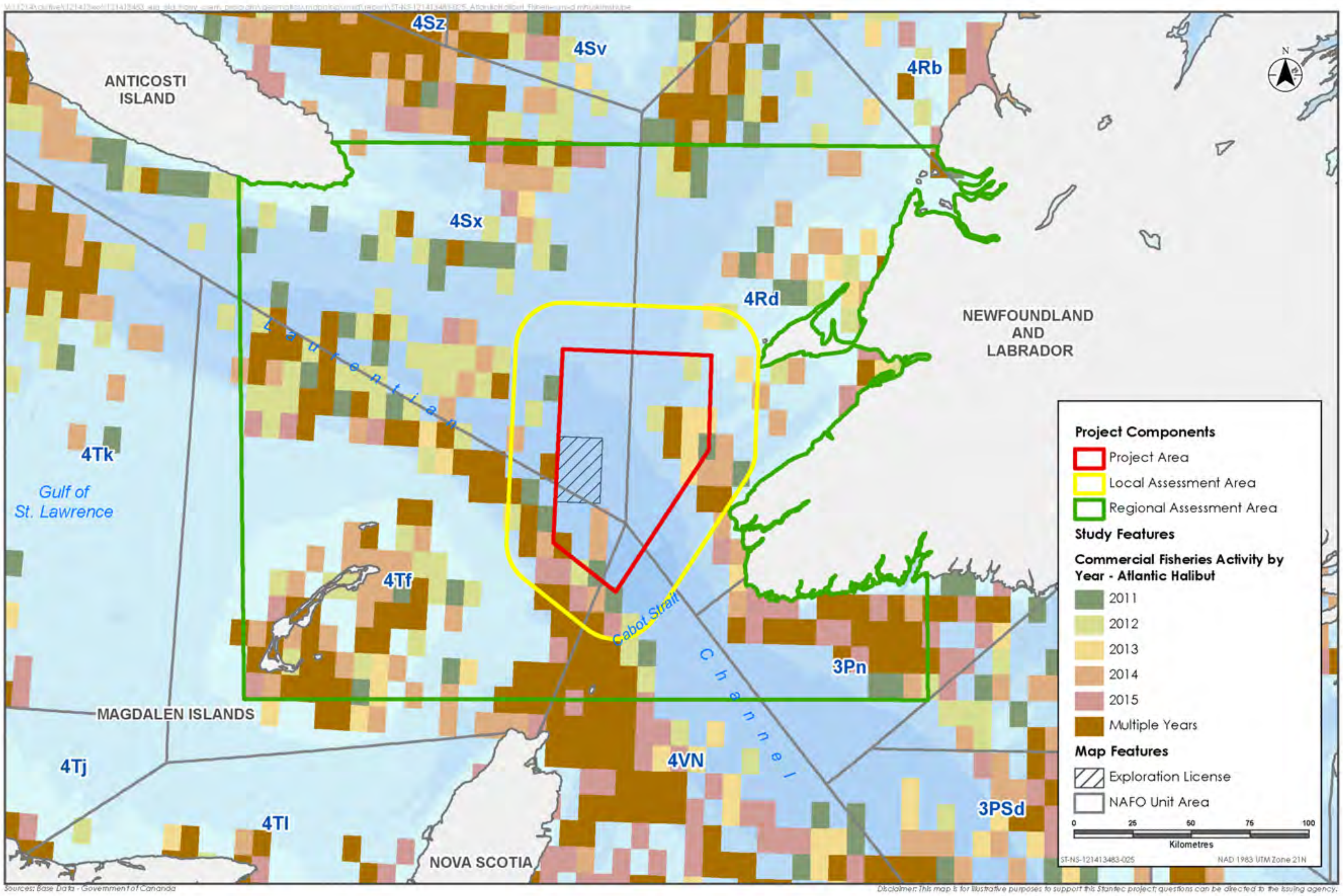

Figure 4 Commercial Fisheries Activity by Year – Atlantic Halibut

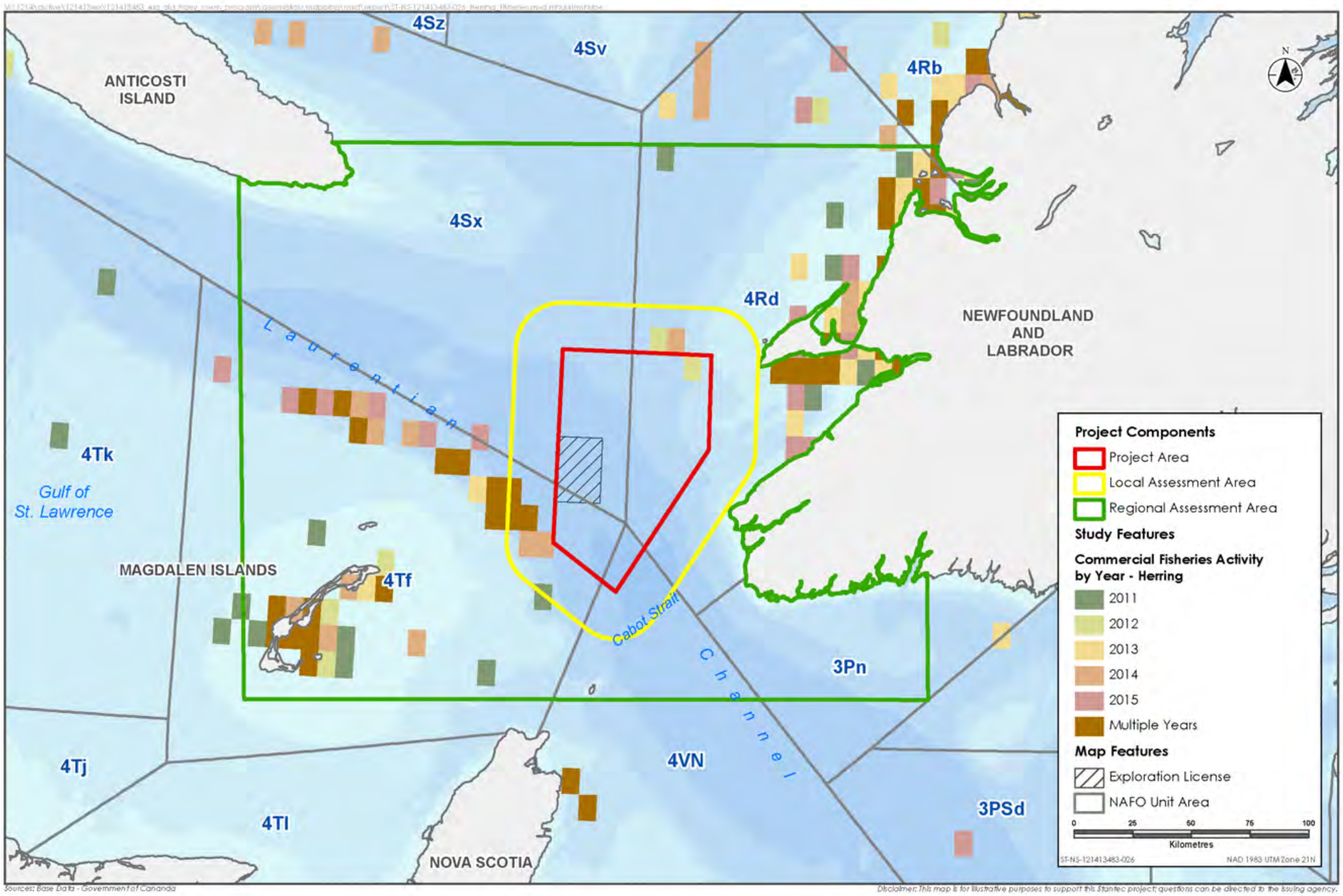

Figure 5 Commercial Fisheries Activity by Year – Herring

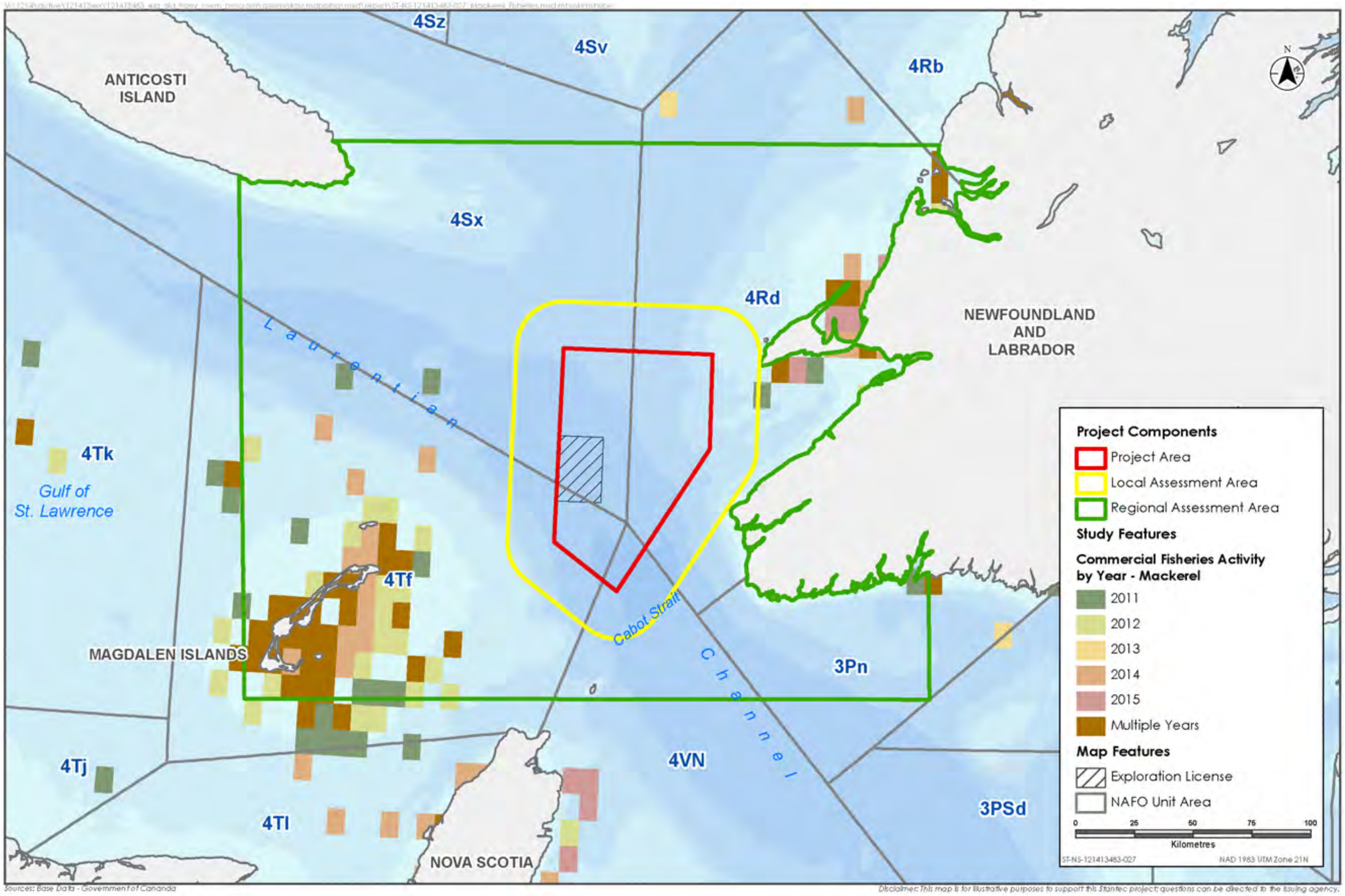

Figure 6 Commercial Fisheries Activity by Year – Mackerel

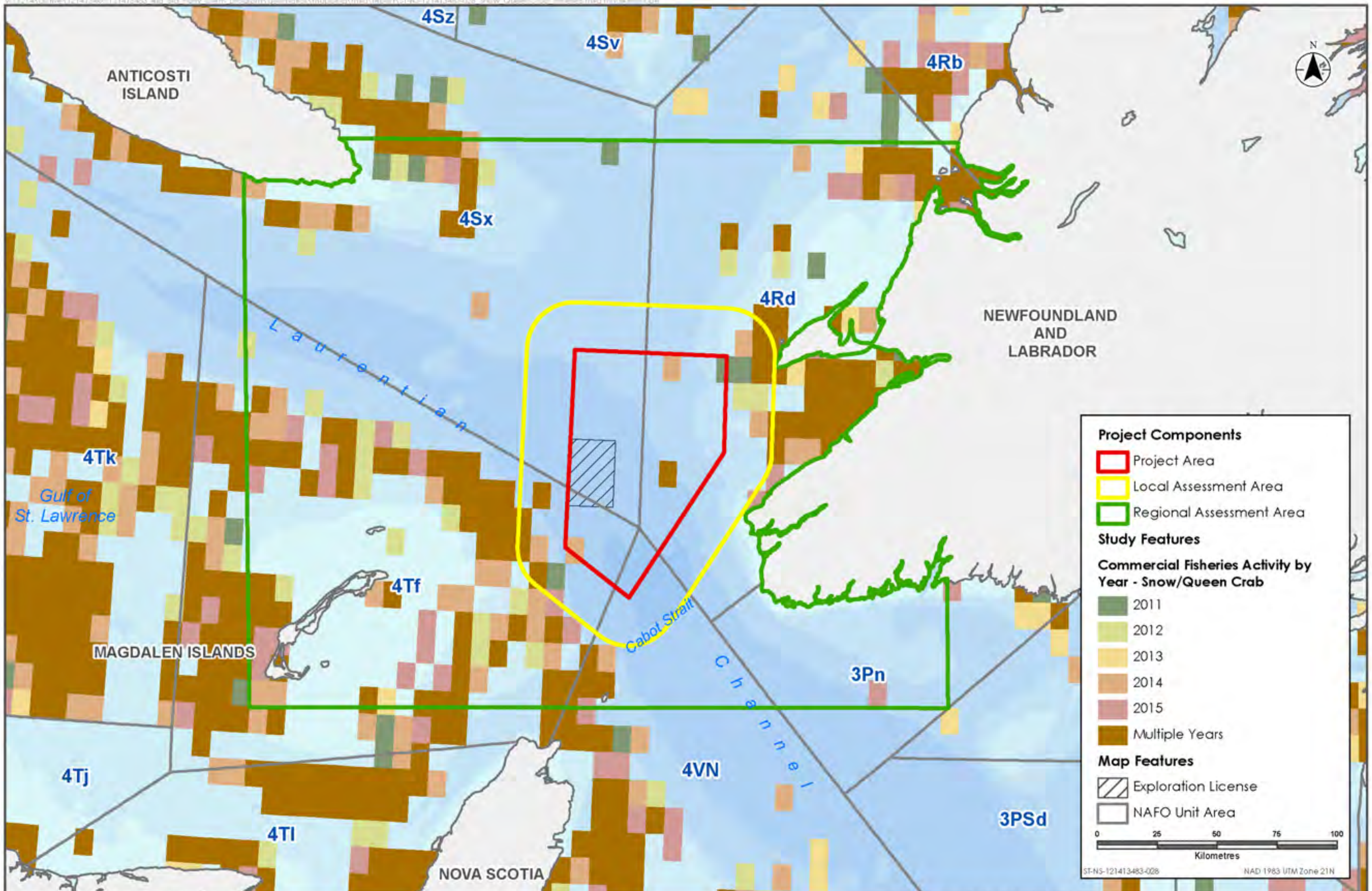

Figure 7 Commercial Fisheries Activity by Year – Snow/Queen Crab

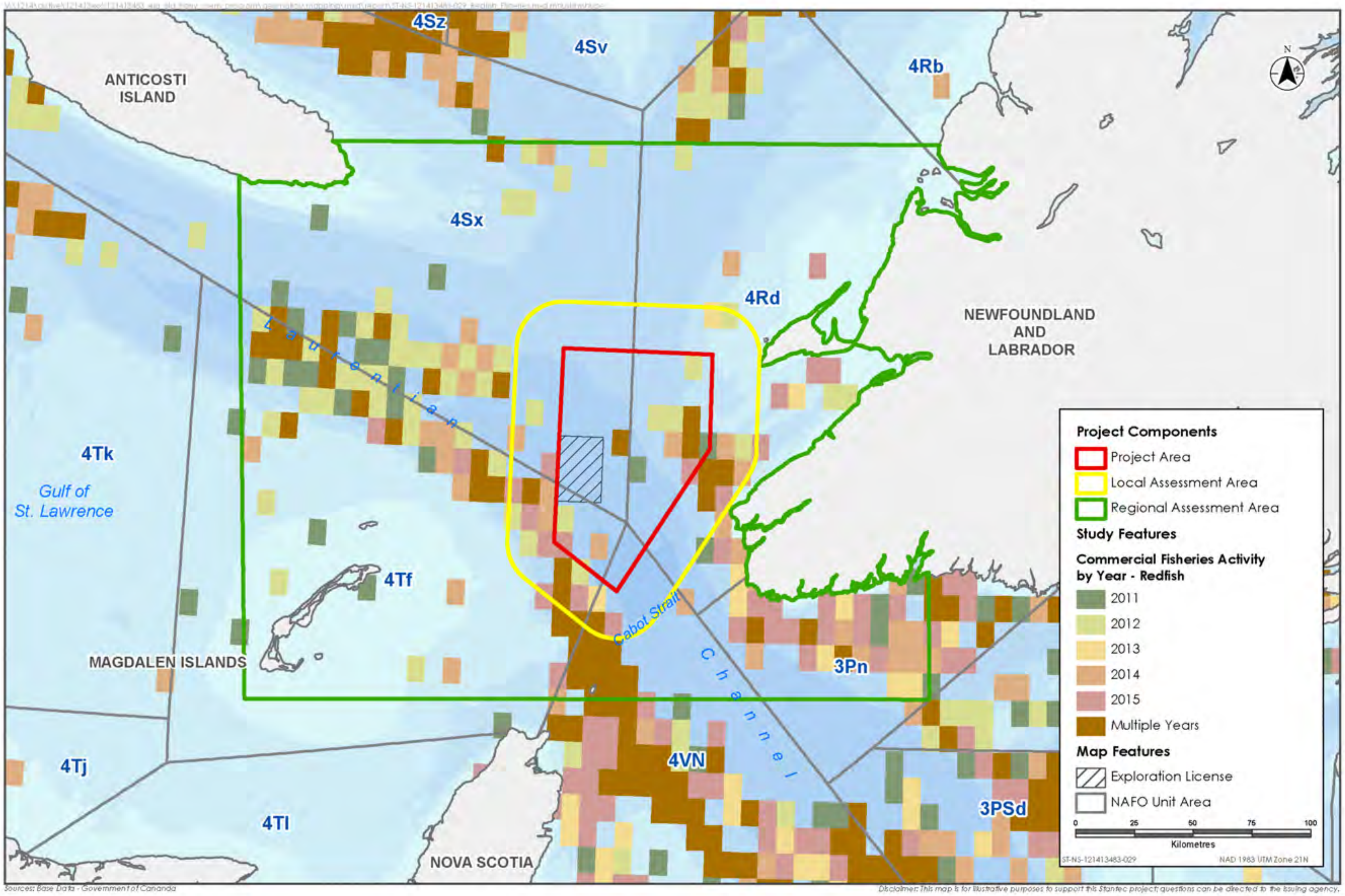

Figure 8 Commercial Fisheries Activity by Year – Redfish