Offshore Seafloor and Seep Sampling Program (2017-2027) Environmental Assessment

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Executive Summary

Fugro GeoSurveys is proposing to conduct seafloor mapping and seep sampling exploration activities in the eastern Newfoundland offshore area (northern Grand Banks / Orphan Basin and southern Flemish Pass) to determine the presence and likely locations of geological structures that might contain hydrocarbon deposits. This environmental assessment, prepared in accordance with the final Scoping Document (C-NLOPB 2017), provides a description of the proposed sampling program and the assessment of the potential environmental effects associated with the proposed program. The following six valued ecosystem components (VECs) were selected to focus this assessment:

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

This assessment includes consideration of the environmental effects of the sampling program on each of the VECs from routine Project activities, potential unplanned (i.e., accidental) events and cumulative environmental effects. Technically and economically feasible mitigation measures, to avoid or reduce potential adverse environmental effects, will be incorporated into the sampling program design and planning.

As described in detail within the assessment, with the implementation of the mitigation measures, adverse residual environmental effects of the proposed sampling program are predicted to be not significant.

Abbreviations

ASP	Atlantic Seafood Producers
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
EA	environmental assessment
FFAW-Unifor	Fish Food & Allied Workers-Unifor
Fugro	Fugro GeoSurveys
HSSE	Health, Safety, Security, and Environment
Hz	Hertz
IBA	Important Bird Area
kHz	kiloHertz
MBES	multi-beam echosounder
MMO	marine mammal observer
NAFO	Northwest Atlantic Fisheries Organization
OCI	Ocean Choice International
SAR	Species at Risk
SARA	*Species at Risk Act*
SBP	sub-bottom profiler
SOCC	Species of Conservation Concern
UXO	unexploded ordnance
VEC	Valued Ecosystem Component

1.0 INTRODUCTION

1.1 OVERVIEW

Fugro GeoSurveys, a division of Fugro Canada Corp. (Fugro), a geophysical survey company, is proposing to conduct seafloor mapping and seep sampling exploration activities (the Project) in the eastern Newfoundland offshore area. The focus of the 2017 survey program is the northern Grand Banks / Orphan Basin area and the southern Flemish Pass area. Focus areas for years 2018 to 2027 will be within the Project Area and more specifically defined each year. Fugro will be the operator of the sampling program and proponent for the purposes of this environmental assessment (EA). The sampling program, used to identify areas of potential natural seabed seeps of hydrocarbons, involves the collection of the data, including:

- multi-beam bathymetry;
- seabed heat flow measurements;
- collection of seabed cores;
- acoustic sub-bottom profiling; and
- sampling of potential natural seabed seeps.

Any combination of the data could be collected in 2017 to 2027.

1.2 PROJECT PROPONENT

Fugro provides geoscience data of various types to oil and gas exploration and production companies worldwide. These include geohazard and engineering datasets for production and development. In recent years Fugro has also conducted considerable seeps investigations to provide data for integration into exploration programs. Multi-client programs, such as the one proposed, are routinely conducted by Fugro throughout the world. Fugro also offers advanced data processing, analysis, and visualization / presentation methods, for integration with client data.

1.3 REGULATORY CONTEXT

The proposed Project will require authorizations pursuant to section 138 (1)(b) of the *Canada-Newfoundland Atlantic Accord Implementation Act* and section 134(1)(b) of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (the Accord Acts). An environmental assessment must be conducted on any proposed technical programs in the Newfoundland and Labrador offshore area according to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2017a). This EA has been prepared to meet the requirements outlined in the final Scoping Document issued by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) on May 26, 2017 (C-NLOPB 2017b).

Project Activities, as described below, are not an undertaking under the *Regulations Designating Physical Activities* under *Canadian Environmental Assessment Act 2012*.

1.4 PROJECT RATIONALE

Natural seeps accounted for 160,000 tonnes of petroleum released into the marine environment in North America from 1990 to 1999 (National Academy of Sciences 2002). These areas are largely underexplored; research using modern technology can help identify new prospective oil and gas basin areas. The location, nature, and composition of hydrocarbon seeps can provide valuable information to optimize oil and gas exploration programs, and reduce the number of exploratory wells drilled.

2.0 PROJECT DESCRIPTION

2.1 OBJECTIVES

Fugro proposes to conduct seafloor mapping and seep sampling exploration activities (the Project) in the eastern Newfoundland offshore area (northern Grand Banks / Orphan Basin and potentially southern Flemish Pass area in 2017). The primary objective of the Project is to determine the presence and likely locations of geological structures that might contain hydrocarbon deposits.

2.2 STUDY AREA

The Project is to be conducted in the Newfoundland and Labrador offshore area to identify those areas that have the potential to contain oil-bearing structures / basins. The proposed Project is a multi-year program (2017 to 2027) to be conducted within the Project Area illustrated in Figure 2-1. The Study Area is the area within which environmental effects are assessed, for activities in 2017 to 2027. Coordinates for the Project Area and Study Area are provided in Appendix A. The 2017 program focuses on the C-NLOPB eastern Newfoundland Land Tenure Region, specifically the southwestern region of the Orphan Basin. An alternate 2017 area has also been defined. The 2017 Primary and Alternate Activity Areas are illustrated in Figure 2-1 and corner coordinates are provided in Table 2.1.

Table 2.1 2017 Activity Area Coordinates

Vertex ID	X_coord	Y_coord
PA1	46° 29' 18.212" W	49° 28' 33.361" N
PA2	46° 30' 21.950" W	47° 59' 26.810" N
PA3	50° 41' 28.138" W	47° 59' 50.666" N
PA4	50° 39' 35.395" W	49° 30' 22.924" N
AA1	46° 30' 53.320" W	47° 18' 53.365" N
AA2	45° 0' 11.687" W	45° 0' 6.554" N
AA3	49° 30' 26.180" W	44° 59' 50.493" N
AA4	48° 22' 38.166" W	47° 19' 12.968" N
PA = Primary Area AA = Alternate Area		

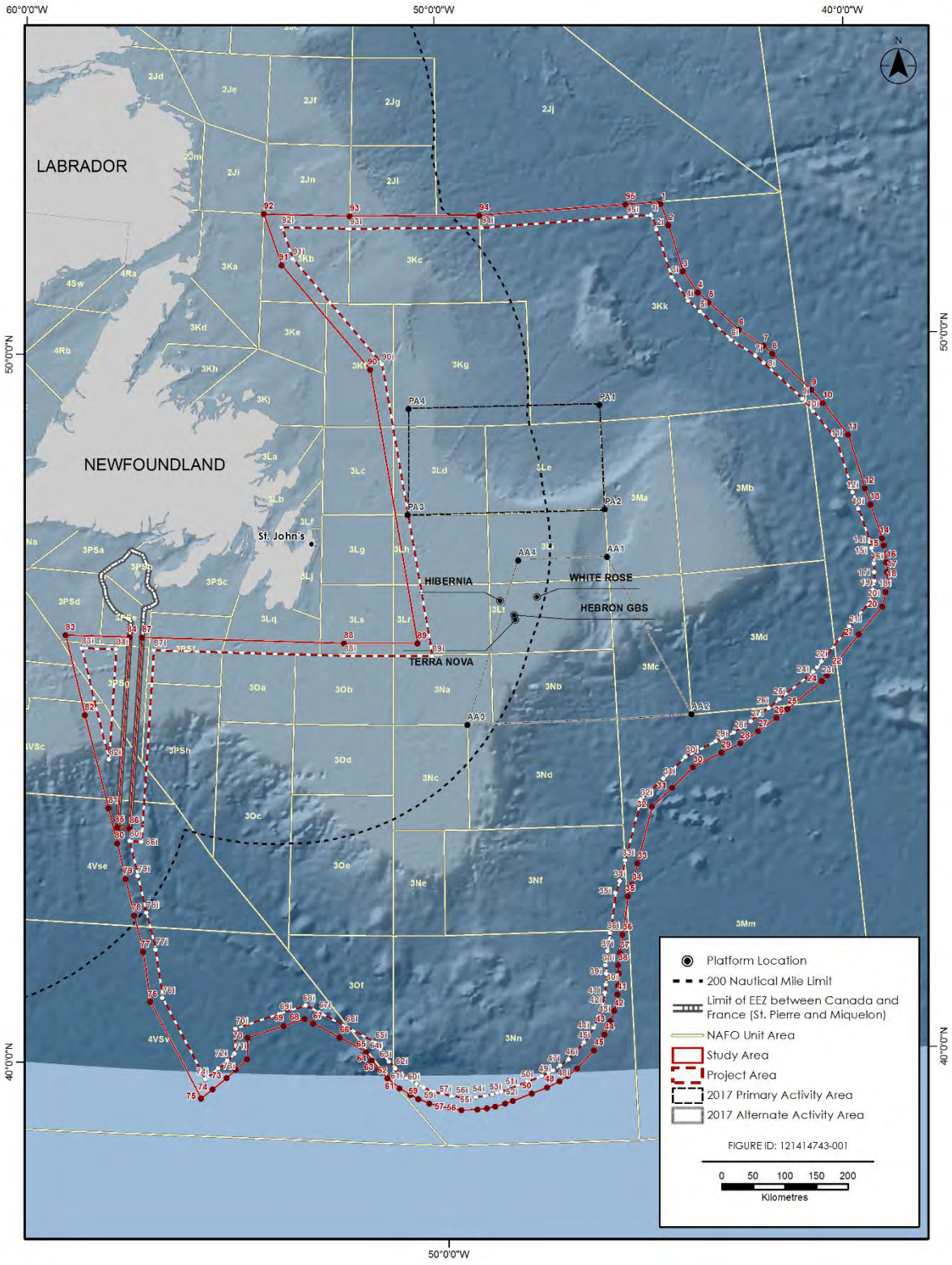

Figure 2-1 Study and Project Areas, including 2017 Activity Areas

2.3 PROJECT SCOPE

Fugro is proposing to conduct seafloor mapping and seep sampling exploration activities, which include:

- acquiring multi-beam sonar data
- acoustic sub-bottom profiling
- conducting seabed heat flow measurements using a thermal probe for shallow seabed core locations;
- collecting seabed cores using a gravity core method;
- sampling potential natural seabed seeps (by collecting water samples).

These Project activities are described in detail in the following subsections. One or two survey vessels may be used, depending on vessel availability.

2.3.1 High-resolution Multibeam Sonar Data

A multi-beam echosounder (MBES) will be used to collect high-resolution sonar data along a swath of the seafloor. The intent is to generate full coverage high-resolution bathymetry and backscatter maps of the seabed throughout the approximately 18,000 km² of the area defined for 2017 work. Additional multibeam data may be acquired over other areas within the Project Area in subsequent years.

The multibeam sonar data will distinguish pockmarks, seabed mounds, acoustic reflection properties, and other possible indicators of natural seep activity. The data are of higher resolution than 3D seismic data. Multibeam bathymetry data can also resolve gas plumes rising from active seep localities by imaging the entire water column.

The survey vessel (see Section 2.4) will have a hull-mounted MBES, able to acquire bathymetry, backscatter, and water column data at normal transit speeds. The survey line spacing and resulting coverage will be varied based on water depth.

2.3.2 Sub-bottom Profiling

Sub-bottom Profiling (SBP) generates high resolution 2D profiles of the seabed, to depths of up to 100 m below seafloor (depending on sediment type). SBP helps identify areas of soft sediment for coring and heat flow work, and can also identify where there may be shallow gas in the shallow sub-seabed.

The SPB will likely be a hull-mounted CHIRP system, rated for full ocean depth. Power levels and frequencies can be modified to suit water depths and seabed conditions in survey areas. The MBES and SBP systems are understood to produce sound pressure levels ranging from 200 to 230 dB at a range of 1m (Hammerstad 2005; National Oceanic and Atmospheric Administration (NOAA) 2010). The systems are designed to measure full ocean depth (11,000 m); since this Project will be operating in depths nominally less than 3,000 m, power levels will be lower than the maximum output.

2.3.3 Heat Flow Measurements

The potential for hydrocarbons beneath the surface can be indicated by the thermal state (temperature profile) of the sub-seabed. Heat flow measurements will be taken using a 3.5 to 6 m length, heat flow probe capable of measuring sediment thermal conductivity *in situ*. This unit is deployed similar to a sediment corer, and is recovered from the seabed after data are acquired.

The locations for heat-flow measurements are selected based on SBP data, to confirm suitable sediment types. Heat flow measurements are anticipated to be collected at up to 20 locations in 2017, with potential for additional sampling in 2017 or subsequent years.

2.3.4 Core Collection

A gravity corer will be used to collect substrate cores up to a depth of 6 m. The gravity corer will be lowered to within a set height (a few tens of metres) above the seabed. Once location is confirmed with acoustic positioning (ultra-short baseline system), the corer will be triggered to release and penetrate the seabed. The barrel and hole are 10 cm in diameter. The corer is fully recovered from the seabed.

Core locations are selected based on the multibeam data, and fine-tuned by using SBP data. Gravity core samples are expected to be collected at up to 200 locations during the 2017 program.

2.3.5 Detection of Natural Seabed Seeps

Specialized sampling kits, using oil-absorbing materials may be used to detect the presence of oil from natural seabed seeps on the ocean surface. The system uses small piece of hydrophobic (water repellant) material that absorbs hydrocarbons. The deployment / retrieval mechanism is composed of a casting device (similar to a fishing rod), fishing line and the individual sampler containers. The containers are deployed for a short period (few minutes) and then recovered for analysis.

2.4 VESSELS

Survey vessels will be able to conduct MBES, SBP, heat flow and piston coring elements. It is anticipated that the vessels will be equipped with dynamic positioning, an A-frame, deep water MBES and SBP. MBES and SBP will first be used to identify target areas in advance of core collection to pinpoint coring stations.

The vessels will have suitable systems on board, and all procedures in place, to complete the work successfully and safely and can work in harsh offshore conditions. Vessels will have equipment, protocols, and procedures for prevention of pollution by oil, sewage, and garbage in accordance with the *Canada Shipping Act* and international standards and certification authorities. The survey vessels will not enter or attempt to conduct survey work in restricted or protected areas (see Section 3.7).

Fugro will consult (in conjunction with One Ocean) with the Fish Food and Allied Workers-Unifor (FFAW-Unifor), Ocean Choice International (OCI), and the Atlantic Seafood Producers (ASP) on the location of their members who fish in the area on an ongoing basis during program activities in a given area.

2.5 PROJECT SCHEDULE

Fugro is proposing to conduct the initial round of data collection between May and November of any year between 2017 and 2027. The 2017 program is scheduled to begin in late August and it is anticipated to require 40 to 50 days to conduct all sample collections; Fugro has scheduled a seven- to eight-week period for the 2017 program, allowing for weather delays. Future programs (2018 to 2027) will also be conducted between May and November.

2.6 HEALTH, SAFETY, AND THE ENVIRONMENT

Fugro's global Health, Safety, Security, and Environment (HSSE) structure is focused on safety leadership with continuous cultural improvement. Safety performance is paramount, and Fugro and their project partners will provide a safe and incident-free project, achieving the stated operational goals in the safest manner possible. Fugro will create a project-specific and achievable HSSE Plan, HSSE Interface Plan, and Emergency Response Plan that demonstrates Fugro's company-wide safety commitment.

The vessels will be fully compliant with local and international pollution prevention protocols, safety, and collision regulations, and will meet C-NLOPB regulatory expectations. Marine and technical crew will meet all local regulatory and corporate safety training requirements.

Fugro is based in St. John's and has been conducting offshore survey operations under C-NLOPB regulatory oversight for nearly 20 years, with an unblemished safety and environmental record. Fugro will once again bring a high quality global safety system, as well as local experience to the Project.

2.7 KEY MITIGATION MEASURES

The scope of work for the proposed Project includes multi-beam bathymetry; seabed heat flow measurements; collection of seabed cores; acoustic sub-bottom profiling; and sampling of potential natural seabed seeps. Interactions with the environment is primarily associated with the operation of the vessel(s) and the collection of sediment samples. The following mitigation measures are proposed for the Project.

- Fugro will contract vessels with equipment, protocols, and procedures for the prevention of pollution by oil, sewage, and associated waste materials in accordance with the *Canadian Shipping Act* and international standards and certification authorities.
- For the 2017 program, seabed samples will not be taken in water depths less than 500 m or greater than 3,000 m.
- A marine mammal observer (MMO) / bird observer will be on board the vessel.

- A Fisheries Liaison Officer (FLO) will be on board the vessel.
- There will be ongoing consultation between Fugro and stakeholders, including One Ocean and the fishers groups (FFAW-Unifor Petroleum Industry Liaison, OCI, and ASP). This will include identifying the location and timing of their members who fish in the area and will avoid areas during times of heavy fixed gear use.
- SIMOPS will be conducted with operators of other exploration activities (e.g., seismic survey proposed for the Orphan Basin in 2017)
- Sampling will occur in a sequence that creates the least disruption to local fishers based on consultation with the fishers groups.
- A minimum distance of 2 km will be maintained from active seabird colonies.
- Survey vessels will not enter or attempt to conduct survey work in restricted or protected areas (Northwest Atlantic Fisheries Organization (NAFO) coral / sponge closure areas, known shipwrecks, and seabird colonies).
- Data collection will occur over a 24-hour period; therefore, lighting is required at night for safety purposes. As there is potential for marine and migratory birds to be attracted to the vessels at night, the vessel crews will conduct routine checks for stranded birds and release of stranded birds per the protocol outlined in Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (Environment Canada 2015) and the Leach's Storm Petrel: General Information and Handling Instructions (Williams and Chardine 1999).
- A Live Seabird Salvage permit will be acquired from the Canadian Wildlife Service (CWS) prior to operations and any stranded birds (or bird mortalities) will be reported to CWS during the program.
- Fisheries and Oceans Canada (DFO) will be contacted prior to start of the Project to determine where DFO research vessels are conducting surveys. The order of sampling locations will be revised, where necessary, to avoid conflict with DFO research vessels.
- The Department of National Defence will be contacted prior to start of the Project to determine where naval exercises are being conducted and the order of sampling locations will be revised, if necessary, to avoid interaction with naval vessels.
- If in the unlikely event of a lost corer, a full risk assessment of the impact would be undertaken with consultation with all relevant parties, and appropriate action then undertaken for recovery, if required.

Potential effects from Project-related activities and Fugro's commitment / mitigation measure to address the potential effect are summarized in Table 2.2.

Table 2.2 Commitment / Mitigation Measures

Potential Effects of Related Activities	Commitment / Mitigation Measure	Status
Disturbance of Marine Mammals / seabirds	The program (collecting cores) is non-intrusive and its duration is short.	Operations to be communicated in Weekly Reports.
Disturbance of Marine Mammals / seabirds	There will be MMO / bird observer on board the vessel.	To be provided by FFAW-Unifor.
Disturbance of Marine Mammals / seabirds	Bird observations will be made in transit (and during coring operations) and marine mammal observations will be made during operations. The bird and marine mammal observations will be made for data collection only.	MMO / bird observer to complete daily and weekly observation reports.
Interference with Fishing Activities	There will be MMO/ bird observer on board the vessel.	To be provided by FFAW-Unifor.
Potential disruption to the Post-Season Trap Survey	the FLOs on board the vessel will establish communications with the industry-DFO Collaborative Post-Season Trap Survey to prevent any potential disruption to the Post-Season Trap Survey.	Communications to be established.
Potential conflict / damage to fixed gear	The vessel will avoid areas during times of heavy fixed gear use.	FLO will provide direction so as to avoid areas of heavy fixed gear use
Potential conflict to other vessels	Fugro will post Notices to Shipping.	Notice to Shippers will be posted immediately prior to start of survey
Potential conflict / damage to fixed gear	Fugro will conduct ongoing consultation with One Ocean and the FFAW-Unifor Petroleum Industry Liaison on the location and timing of their members who fish in the area and will avoid areas during times of heavy fixed gear use.	FLO will provide direction so as to avoid areas of heavy fixed gear use
Interference with Fishing Activities	Fugro will time the sampling of the identified areas in a sequence that creates the least disruption to local fishers.	FLO will provide direction so as to reduce / avoid disruption to local fishers
Disturbance to seabirds	The vessel will maintain a minimum distance of 2 km from active seabird colonies.	Minimum 2-km distance will be maintained from active seabird colonies

Potential Effects of Related Activities	Commitment / Mitigation Measure	Status
Stranding / Injury / Mortality to birds	As there is potential for marine and migratory birds to be attracted to the vessel at night, the vessel crew will conduct routine checks for stranded birds and release of stranded birds per the Best Practices for Stranded Birds Encountered Offshore Atlantic Canada (Environment Canada 2015).	MMO / bird observer to complete daily and weekly observation reports.
Stranding / Injury / Mortality to birds	A Live Seabird Salvage permit will be acquired from the Canadian Wildlife Service prior to operations.	Permit application sent. Expected to receive permit prior to Operation start date.
Potential conflict with DFO Research Vessels	Fugro will contact DFO prior to start of the Project to determine where DFO research vessels are conducting surveys and will revise the sampling location order to avoid conflict with DFO research vessels.	Contact: George Sheppard, DFO
Potential conflict with DND Vessels	Fugro will contact DND prior to start of the Project to determine where naval exercises are being conducted and will revise the sampling location order if necessary to avoid interaction with naval vessels.	Contact: MARLANT (Maritime Forces Atlantic) Headquarters Safety and Environmental Officer for Commander
Potential damage to fishing gear	A compensation program will be made available by Fugro consistent with C-NLOPB guidelines and past practices. This program will cover damage to fishing gear (or vessels) caused by the survey vessel or survey gear, and includes the value of harvest lost as a direct result of an incident. Any and all incidents will be reported to the C-NLOPB.	Fugro will have a compensation program in place consistent with C-NLOPB guidelines and past practices
Potential damage to fishing gear	If in the unlikely event of a corer is lost, then a full risk assessment of the impact would be undertaken with consultation with all relevant parties, and appropriate action then undertaken for recovery if required.	Risk assessment of retrieving / not retrieving a lost core would be conducted with all relevant parties
Potential pollution of the marine environment	Fugro will contract a vessel that has equipment and protocols and procedures in place for prevention of pollution by oil, sewage and associated waste materials in accordance with the *Canadian Shipping Act* and international standards and certification authorities.	

2.8 ENVIRONMENTAL MANAGEMENT

In addition to the mitigation measures described in Section 2.7, Fugro will develop a plan to reduce the potential effects to the commercial fisheries, including a description of communications methods (e.g., notifications on the Fisheries Broadcast and Notices to Shipping), and avoidance of areas during times of heavy fixed gear use. The compensation program will be consistent with the C-NLOPB guidelines and past practices and will cover damage to fishing gear and vessels caused by the survey vessel(s) or gear, and includes the value of any harvest lost as a direct result of the incident. Procedures for responding to a claim, similar to those outlined in the One Ocean Protocol document, will be implemented in the event of an incident. Incidents will be reported to the C-NLOPB, through their 24-hour answering service at 709-682-4426 (709-778-1400 during working hours) and the reports on contacts with fishing gear will include the exact time and location of initial contact, loss of contact, and a description of any identifying markings on the gear.

3.0 EXISTING ENVIRONMENT

This section provides an overview of the existing environment within which the Project is located. This information is used to help identify key components that may interact with the Project. The spatial boundaries for the Study Area are shown in Figure 2-1. Few Project-environment interactions are anticipated given the generally non-intrusive nature and offshore location of the proposed Project. Environmental features are therefore limited to the marine environment and are described in the following sections.

The C-NLOPB has published Strategic Environmental Assessments (SEAs) for Eastern Newfoundland and Labrador Offshore Area (Amec 2014) and Southern Newfoundland and Labrador Offshore Area (LGL 2010). These documents provide information on the Newfoundland offshore physical and biological environment, including marine birds, fish and fish habitat, marine mammals and sea turtles, species at risk, sensitive areas, and human activities. This information, particularly species life history and commercial fisheries descriptions, is not repeated below. The following subsections provide details specific to the Study Area and relevant information that has become available since the preparation of the SEAs.

3.1 PHYSICAL ENVIRONMENT

The Study Area encompasses the eastern and southern Newfoundland and Labrador offshore areas. The Study Area extends from the Newfoundland-Labrador Shelf, over the Grand Bank, into the Flemish Pass and Cap and oceanic waters beyond the continental shelf break, and the Tail of the Grand Banks and Laurentian sub-basin / eastern Scotian Shelf area. The 2017 survey will be conducted in the eastern Newfoundland offshore area, in the waters of the northern / Orphan Basin area (with the potential for sampling to be conducted in the alternate southern Flemish Pass and Eastern Canyons area).

Water depths in the Grand Banks average 75 m, with the Flemish Pass reaching depths of 1,300 m rising to 130 m at the Flemish Cap (Amec 2014). There are several canyons in the region with ocean depths between 2,000 to 4,000 m (Amec 2014).

3.1.1 Metocean Conditions

Sea surface temperatures in the region are warmest in August-September and coldest in January to March. In the Orphan Basin region, mean sea surface temperatures range from 0.4ºC in February to 11.3ºC in August (Amec 2014). Mean sea surface temperature in the Flemish Cap ranges from 3.8ºC in February to 13.7ºC in August and September and the Grand Banks range from 0.0ºC in February to 14.0ºC in August (Amec 2014). Sea surface temperatures in the southern Grand Banks range from 3.96°C in February and March to 18.05°C in August (LGL 2010).

Air temperatures are warmest in August and coldest in February. In the Flemish Cap region, the mean temperature (based on historical data from 1950 to 2012) ranges from 2.6ºC in February to 14.2ºC in August (Amec 2014). The Orphan Basin region mean temperatures range from -2.9ºC in

February to 11.7ºC in August (Amec 2014). The mean temperature in the Grand Banks region ranges from -0.1ºC in February to 14.6ºC in August (Amec 2014). Air temperatures in the southern Grand Banks range from 2.36°C in February to 18.78°C in August (LGL 2010). The average number of foggy days is highest in spring and summer. In the region, most of the observed precipitation events are in the form of rain, or in the winter, snow, with mixed rain and freezing rain occurring less frequently (LGL 2010; Amec 2014). There is year-round potential for thunderstorms with the highest frequency of occurrence in the months from June to August (LGL 2010; Amec 2014).

Seasonal sea or pack ice can occur from January to April in the Orphan Basin and Grand Bank areas, with the maximum southern extent occurring from February to the middle of March (Amec 2014). The Flemish Pass and Tail of the Grand Banks areas rarely experience sea ice (typically one or two weeks in mid-March when it is present) (LGL 2010; Amec 2014). Icebergs can occur in the Orphan Basin, Grand Bank, and Flemish Pass areas from February to July, especially in the region nearest the Grand Banks (Amec 2014). While icebergs have been recorded in the Tail of the Grand Banks area, large icebergs are rarely seen (LGL 2010).

3.1.2 Submarine Landslide

As described in the Eastern Newfoundland SEA (Amec 2014), analysis from Natural Resources Canada indicates that in the offshore area of Eastern Canada there is a risk of a major landslide every 20,000 years and a minor landslide every few thousand years. Within the Orphan Basin, there has been evidence of past instability including thick, stacked mass-transport deposits on the basin floor and seabed failure scars on the continental slope (Campbell 2005 in Amec 2014). The youngest widespread slope failure to occur on the Orphan Basin was approximately seven thousand years ago (Tripsanas et al. 2008 in Amec 2014). Landslides have also been identified in the Flemish Pass area, occurring 27 thousand and 20.5 thousand years ago and believed to be a result of earthquake activity (Cameron et al. 2014 in Amec 2014). The steep slopes, abundant shallow gas and possibly greater seismicity in the northern Flemish Pass and southern Orphan Basin makes large landslides more frequent, approximately on an interval of ten thousand years (Cameron et al. 2014, in Amec 2014). The Tail of the Grand Banks area has few identified seismic hazards (Natural Resources Canada 23006, in LGL 2010). Less is known about geohazards in the Grand Banks; however, it is suspected that landslides are less common than around the Flemish Pass and southern Orphan Basin (Amec 2014).

3.1.3 Acoustic Environment

Anthropogenic sound sources in the ocean environment include sound from shipping, seismic surveying, sonars, explosions, industrial activity, and other miscellaneous sources (National Research Council 2003). One of the primary contributors to the acoustic environment in the ocean is vessels (both offshore supply vessels and other vessel traffic). The different types of vessels generate different sound levels; however, the primary sound sources are propeller cavitation and various systems on the vessel (Husky Energy 2010). Shipping traffic noise dominates the ambient noise in the 20 to 300 hertz (Hz) frequency range and distant fishing vessels typically peak at 300 Hz (Richardson et al. 1995, in Husky Energy 2010). Wind and precipitation also contribute to ambient

noise, with wind, large surface waves and precipitation generating noise in the range of approximately 100 Hz to 50 kilohertz (kHz), 1 to 20 Hz, and above 500 Hz (Wenz 1962, in Husky Energy 2010). Marine mammal species also contribute to the acoustic environment due to acoustic communication and echolocation techniques (used for navigation and hunting), producing noise in the range of 0.01 kHz from blue and fin whales to 150 kHz from the harbor porpoise (Husky Energy 2010).

3.2 SPECIES AT RISK

Species at risk (SAR) have a status on Schedule 1 under *Species at Risk Act* (SARA). Species of conservation concern (SOCC) are species designated under Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which have the potential of being listed in the future under SARA. Several SAR and SOCC have potential to occur throughout the proposed Study Area (see Figure 2-1), either as occasional visitors or regular inhabitants. As of June 2017, Table 3.1 summarizes the SARA-listed species that may be found within the Study Area; Table 2 lists the COSEWIC-assessed species.

Table 3.1 SARA-listed Species at Risk with Potential to Occur within the Study Area

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation
Marine Fish			
Atlantic wolffish [A]	*Anarhichas lupus*	Special Concern	Special Concern
Northern wolffish [B,C]	*Anarhichas denticulatus*	Threatened	Threatened
Spotted wolffish [B,C]	*Anarhichas minor*	Threatened	Threatened
White shark (Atlantic population) [D]	*Carcharodon carcharias*	Endangered	Endangered
Marine Mammals			
Blue whale (Atlantic population) [B,C]	*Balaenoptera musculus*	Endangered	Endangered
Fin whale (Atlantic Population) [B,E]	*Balaenoptera physalus*	Special Concern	Special Concern
North Atlantic right whale [B,C]	*Eubalaena glacialis*	Endangered	Endangered
Northern bottlenose whale (Scotian Shelf population) [B,E]	*Hyperoodon ampullatus*	Endangered	Endangered
Sowerby's beaked whale [B,C]	*Mesoplodon bidens*	Special Concern	Special Concern
Sea Turtles			
Leatherback sea turtle (Atlantic population) [B,C]	*Dermochelys coriacea*	Endangered	Endangered
Birds			
Ivory Gull [B]	*Pagophila eburnea*	Endangered	Endangered

Common Name	Scientific Name	SARA Schedule 1 Status	COSEWIC Designation
Piping Plover (*melodus* subspecies)	*Charadrius melodus melodus*	Endangered	Endangered
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Endangered	Endangered
Roseate Tern	*Sterna dougallii*	Endangered	Endangered
Harlequin Duck	*Histrionicus histrionicus*	Special Concern	Special Concern
Barrows Goldeneye	*Bucephala islandica*	Special Concern	Special Concern
A = Management Plan B = Recovery Strategy C = Action Plan anticipated in 2017 D = Recovery Strategy anticipated in 2017 E = Management Plan anticipated in 2017			

Table 3.2 COSEWIC-assessed Species of Conservation Concern with Potential to Occur within the Study Area

Common Name	Scientific Name	COSEWIC Designation
Marine Fish		
Acadian redfish (Atlantic population)	*Sebastes fasciatus*	Threatened
American eel	*Anguilla rostrata*	Threatened
American plaice (Newfoundland and Labrador population)	*Hippoglossoides platessoides*	Threatened
Atlantic bluefin tuna (Grand Banks of Newfoundland only)	*Thunnus thynnus*	Endangered
Atlantic cod (Newfoundland and Labrador population)	*Gadus morhua*	Endangered
Atlantic salmon (various populations)	*Salmo salar*	Endangered, Threatened, Special Concern
Basking shark (Atlantic population)	*Cetorhinus maximus*	Special Concern
Blue shark (Atlantic population)	*Prionace glauca*	Special Concern
Cusk	*Brosme brosme*	Endangered
Deepwater redfish (Northern population)	*Sebastes mentella*	Threatened
Porbeagle shark	*Lamna nasus*	Endangered
Roughhead grenadier	*Macrourus berglax*	Special Concern
Roundnose grenadier	*Coryphaenoides rupestris*	Endangered
Shortfin mako shark (Atlantic population)	*Isurus oxyrinchus*	Threatened

Common Name	Scientific Name	COSEWIC Designation
Smooth skate (Laurentian-Scotian population)	*Malacoraja senta*	Special Concern
Smooth skate (Funk Island Deep population) [A]	*Malacoraja senta*	Endangered
Spiny dogfish (Atlantic population)	*Squalus acanthias*	Special Concern
Thorny skate	*Amblyraja radiata*	Special Concern
White hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*	Threatened
Winter skate (Eastern Scotian Shelf – Newfoundland population)	*Leucoraja ocellata*	Endangered
Marine Mammals		
Beluga whale (various populations)	*Delphinapterus leucas*	Endangered, Threatened, Special Concern
Bowhead whale (Eastern Canada – west Greenland population)	*Balaena mysticetus*	Special Concern
Harbour porpoise (Northwest Atlantic population)	*Phocoena phocoena*	Special Concern
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	Special Concern
Northern bottlenose whale (Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*	Special Concern
Sea Turtles		
Loggerhead Sea Turtle	*Caretta caretta*	Endangered
Birds		
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern

A = Note: Nose of the Grand Banks population has been assessed by COSEWIC as Data Deficient; there is also a Flemish Cap population that is outside Canadian jurisdiction, but within the 2017 to 2027 Study Area).

B = Recovery Strategy

C = Action Plan anticipated in 2017

D = Management Plan anticipated in 2017

3.3 MARINE FISH AND SHELLFISH

3.3.1 Fish Habitat

The Grand Banks has an average depth of approximately 75 m and extends approximately to the 200-m depth contour (Husky Energy 2012). The Flemish Pass reaches to depths of almost 1,300 m. The circulation over the Newfoundland Shelf and its northeast slope is dominated by flows toward the equator associated with the inshore and offshore Labrador current with a substantial seasonal cycle in the current regime, with strong flows during the fall / winter and weak flows in spring / summer (Han and Wang 2006; Husky Energy 2012). Given the strong currents, there is little sediment deposition in the Flemish Pass (Morin and Pereira 1987, in JWEL 2002a), as suspended particles are

swept by near-bottom current velocities of 18 cm/s from the deep slope component of the Labrador current (Kennard et al. 1990, in JWEL 2002a). Sediments on the Flemish Pass floor are predominantly sandy mud (20% to 80% sand) (Amec 2014). Past interpretations from seafloor photographs suggest that the seafloor is stable, with relatively little sediment transport occurring in the region (McElhanney 1982 in Husky Energy 2012). This conclusion is supported by the results of site surveys (FJGI 1999a, 1999b, 2000a, 2000b), which clearly display anchor marks from old drilling programs, preserved in sand after 15 to 20 years.

The Study Area supports a variety of infaunal and epifaunal benthic species including sand dollars, anemones, clams, sea cucumbers, bryozoans, corals, ascidians, urchins, hydroids, polychaete worms, and several crab species (Husky Energy 2012). Photographic / video drift surveys along the Flemish Pass and slope and identified epibenthic megafauna totaling 570 taxa with the most abundant groups being sponges / demosponges, cnidaria, ophiuroids, shrimp and echinoderms (Beazley et al. 2013).

On the Grand Banks, spatial variability in benthic invertebrate communities occurs over small scales (within metres) (Schneider and Haedrich 1991, in Husky Energy 2012), largely driven by the differences in microhabitat (e.g., water depth, substrate grain size composition, water mass properties), as well as disturbance and the temporal variability in abundance of some macrofaunal species (Kenchington et al. 2001, in Husky Energy 2012). When disturbance events, such as storms and fishing gear, alter the seafloor, epifaunal and infaunal organisms are exposed and vulnerable to predation by larger organisms (e.g., snow crab). After a disturbance event, the community will undergo a process of ecological succession as it rebuilds and stabilizes (Husky Energy 2012).

Corals and sponges, marine benthic invertebrates, attach themselves to the bottom substrates, feeding on suspended food in the water column. Offshore Newfoundland, there are two types of cold-water corals, hard / stony corals (*Scleractinia*) and octocorals or soft corals. Within the Study Area, deep-water corals include stony corals, black wire and gorgonian corals, soft corals, sea pens, and sponges. At depths of 500 to 900 m, the various coral species that exists on the slopes of the Grand Banks and Flemish Cap, descending into the Flemish Pass, includes black coral (*Stauropathes arctica*), cup coral (*Flabellum alabastrum*), sea pen (*Funiculina quadrangularis*), soft coral (*Heteropolypus sol*), and small gorgonian coral (*Acanella arbuscular*) (Murillo et al. 2015). In the 800 and 1,200 m depth, species include sea urchin (*Phormosoma placenta*), sea stars (*Bathybiaster vexillifer*), and the sea pens (*Funiculina quadrangularis*, *Anthoptilum grandiflorum, Halipteris finmarchica*, and *Pennatula aculeate*) (Murillo et al. 2015). The highest average coral biomass occurred between 600 and 900 m depth along the northeastern slope of the Grand Banks, in the Flemish Pass, and around the Flemish Cap.

Critical habitat has not yet been defined for any listed marine fish species known to occur in the Study Area, though draft critical habitat does exist for wolffish (DFO 2015a, 2015b). There are two fish Schedule 1 species at risk with a high potential to be present year-round on the Grand Banks and Flemish Cap: northern and spotted wolffish. A draft recovery strategy completed in 2015 for

both species (DFO 2015a, 2015b) identifies potential critical habitat on the Newfoundland shelf (Figure 3-1).

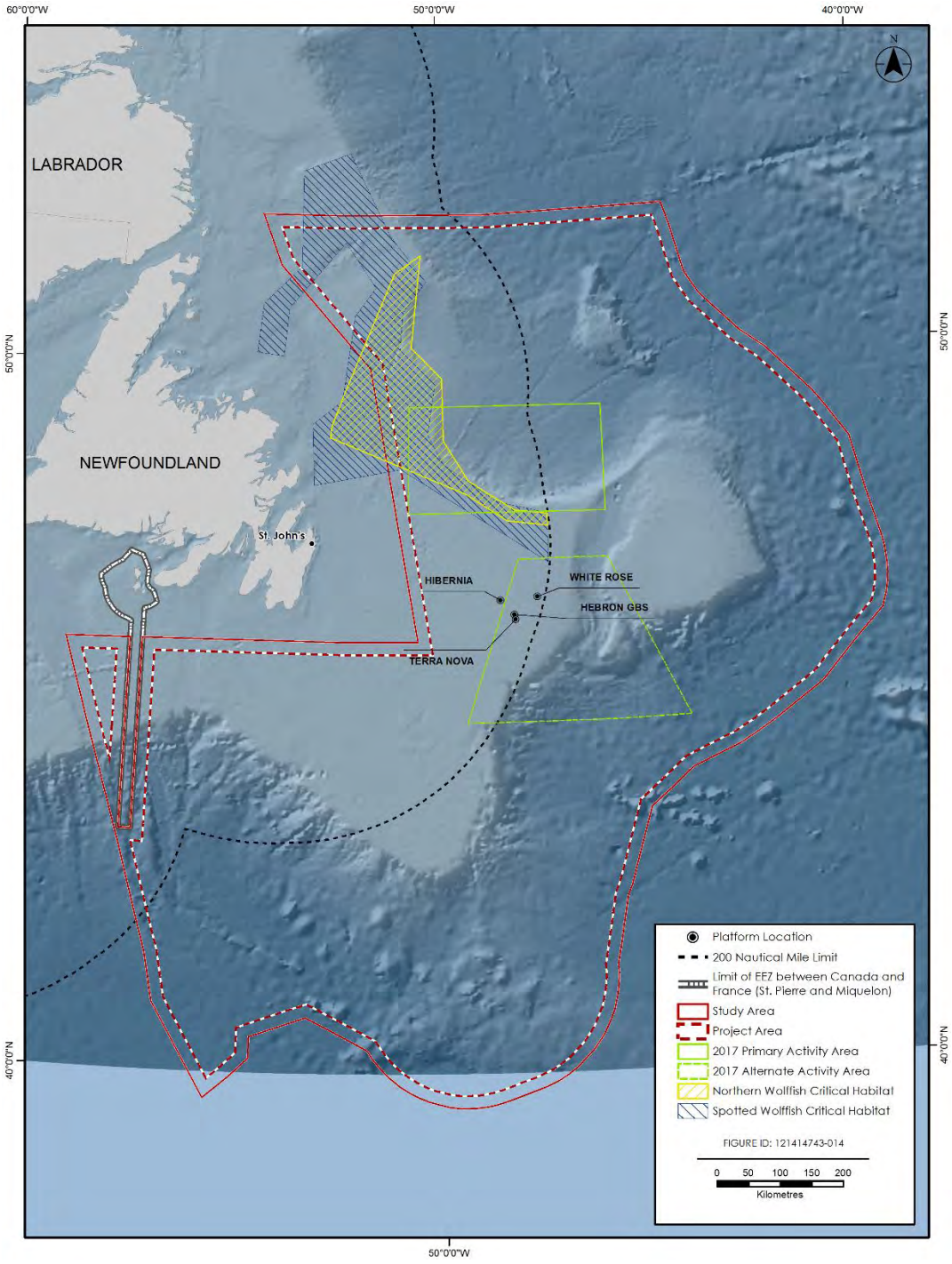

Figure 3-1 Draft Potential Critical Habitat under SARA for Northern and Spotted Wolffish

3.3.2 Fish and Shellfish

Fish and shellfish species common to the Study Area include both pelagic and demersal finfishes, as well as commercially important macroinvertebrates such as shrimp and crab.

There are approximately 188 species of marine fish known to occur offshore Newfoundland and Labrador (Templeman 2010, in Amec 2014). Fish in the Study Area include:

Groundfish Species:

- American plaice
- Atlantic cod
- Atlantic halibut
- Atlantic wolffish
- barndoor skate
- black dogfish
- blue hake
- cusk
- Greenland halibut
- haddock
- longnose eel
- longfin hake
- marlin-spike
- monkfish
- northern wolffish
- pollock
- redfish
- roughhead grenadier
- roundnose grenadier
- spotted wolffish
- sculpin
- smooth skate
- spiny dogfish
- spinytail skate
- thorny skate
- Vahl's eelpout
- white hake
- winter skate
- witch flounder
- yellowtail flounder

Pelagic Species:

- alewife
- American eel
- Atlantic herring
- Atlantic mackerel
- Atlantic salmon
- Atlantic saury
- basking shark
- Blue shark
- Bluefin tuna
- capelin
- Greenland shark
- lanternfish
- porbeage shark
- shortfin mako shark
- spiny eel
- swordfish
- white shark

There are more than 30 species of shrimp found offshore Newfoundland (Templeman 2010, in Amec 2010), with the Northern shrimp being the most abundant and commercially important, followed by striped pink fish (Amec 2014). Northern shrimp are concentrated along the edge of the continental shelf and in the Flemish pass (Amec 2014). Like the northern shrimp, striped pink fish are concentrated along the edge of the continental shelf but are also found in greater abundance in coastal areas and on the Grand Banks (Amec 2014).

Snow crab are also an important component of the fishery and are widely distributed with concentrations in the colder waters of the northern slopes of the Grand Banks and Flemish Pass and portion of the northern Newfoundland Shelf (Amec 2014).

3.4 FISHERIES AND OTHER USERS

3.4.1 Fisheries

The commercial fishery in Newfoundland and Labrador has been an important activity since the colonization of the island. Prior to 1992, most of the harvesting in the offshore areas of the eastern Grand Banks was for groundfish, including: Atlantic cod, redfish, American plaice, and several other species. However, in 1992, with the acknowledgement of the collapse of several of these groundfish stocks, a harvesting moratorium was declared. Currently, northern shrimp and snow crab are the principal catches by most fishers in the Study Area, although some areas have since been placed under a moratorium due to declining stocks.

The Study Area encompasses NAFO Unit Areas 3KLMNO and 4V. Commercially important species in these NAFO Unit Areas include snow crab, northern shrimp, Greenland halibut, Atlantic halibut, cod, yellowtail flounder, redfish, white hake, skates, monkfish, pollock, hagfish, swordfish, and molluscs (e.g., whelks).

Commercial fishing activity in NAFO Unit Areas 3KLMN is described in the Eastern Newfoundland SEA. As described in the SEA, the 2008 to 2012 commercial fish harvest in these areas totaled approximately 363,000 tonnes with landing value over $815.6 million (Amec 2014). Within this period, northern shrimp comprised 54% of the total landings by weigh, followed by queen / snow crab at 32% and turbot at 5% (Amec 2014). Based on landed value, the queen / snow crab accounted for over half of the landings, followed by northern shrimp at 36% and turbot at 7% (Amec 2014). Harvest locations for all species in all months from 2011 to 2015 are illustrated in Figure 3-2. Figures illustrating harvest locations of snow crab, shrimp, groundfish, and pelagic fish are provided in Appendix B.

Timing of fishing activity varies by the location and the species, and can be determined by factors such as weather and ice conditions, availability of resources, fisheries licencing, and fishery management considerations (Amec 2014). During the period of 2008 to 2012, as described in the SEA, the summer period between May and August has the highest landings by weight and accounted for 75% of the total value of fish harvest (Amec 2014).

There are various types of gear used to harvest fish and shellfish, including shrimp trawl, pot, bottom otter trawl, gillnet as well as others. Shrimp trawls accounted for 54% of the total fish landings by weight, followed by pot at 32% and bottom otter trawls at 10% (Amec 2014). Fixed and mobile gear use is indicated in Figures 3-3 and 3-4, respectively.

The Study Area extends beyond the 200 nm limit (Economic Exclusion Zone (EEZ)). NAFO member organizations (including Canada) fish in the NAFO fishing footprint (Figure 3-5).

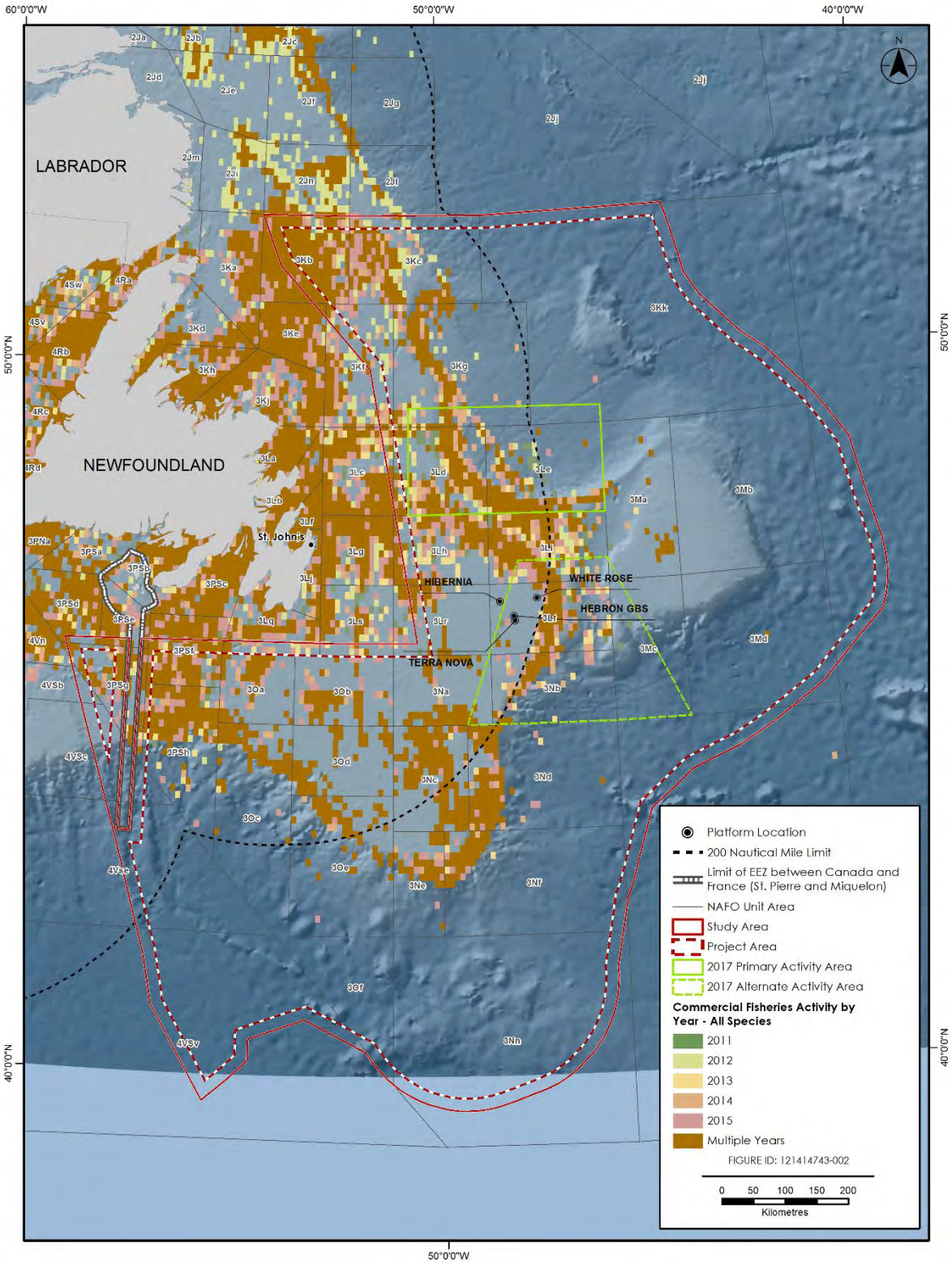

Figure 3-2 Commercial Fishing Activity, All Species, All Months, 2011 to 2015

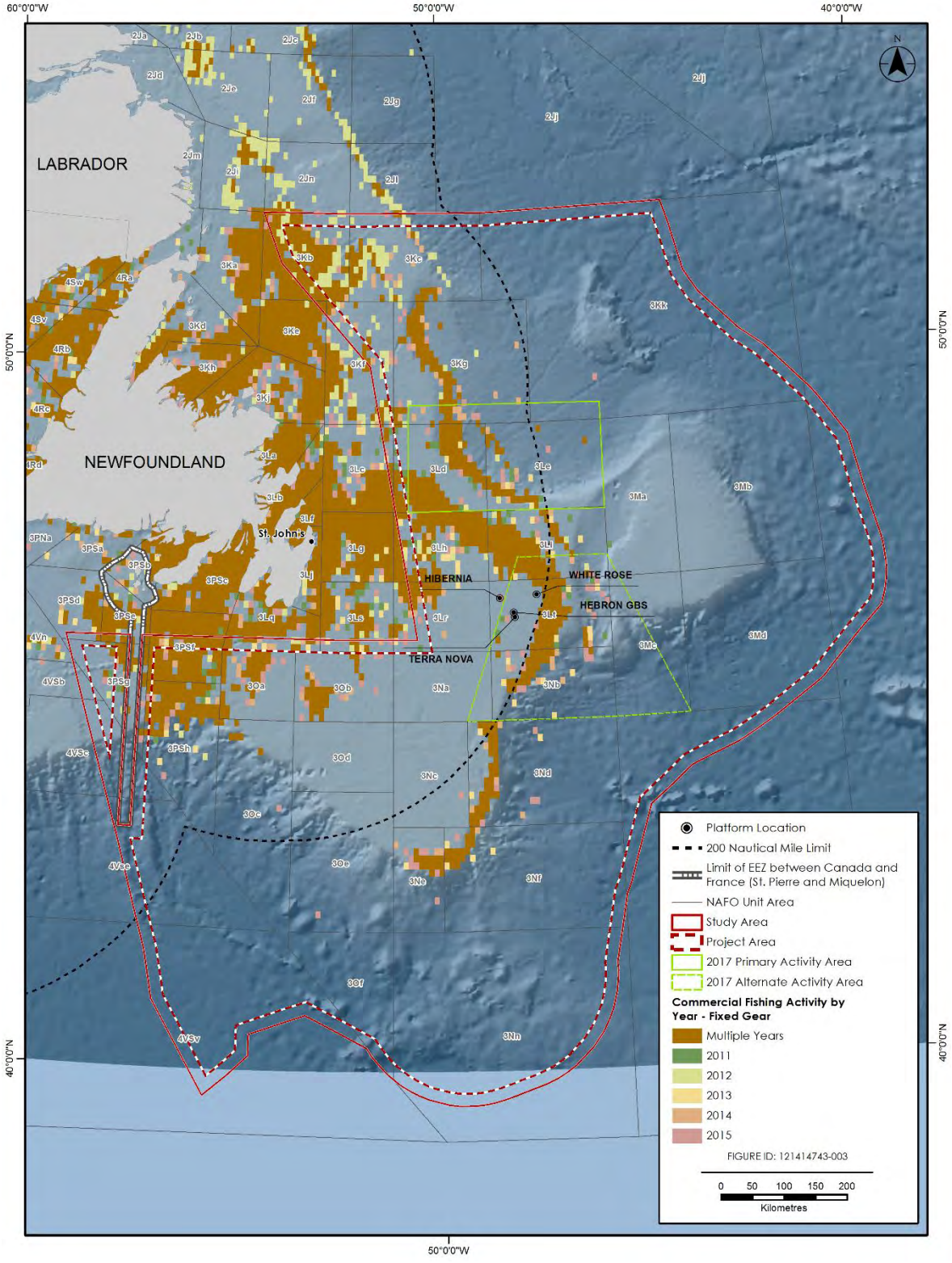

Figure 3-3 Fixed Gear Locations

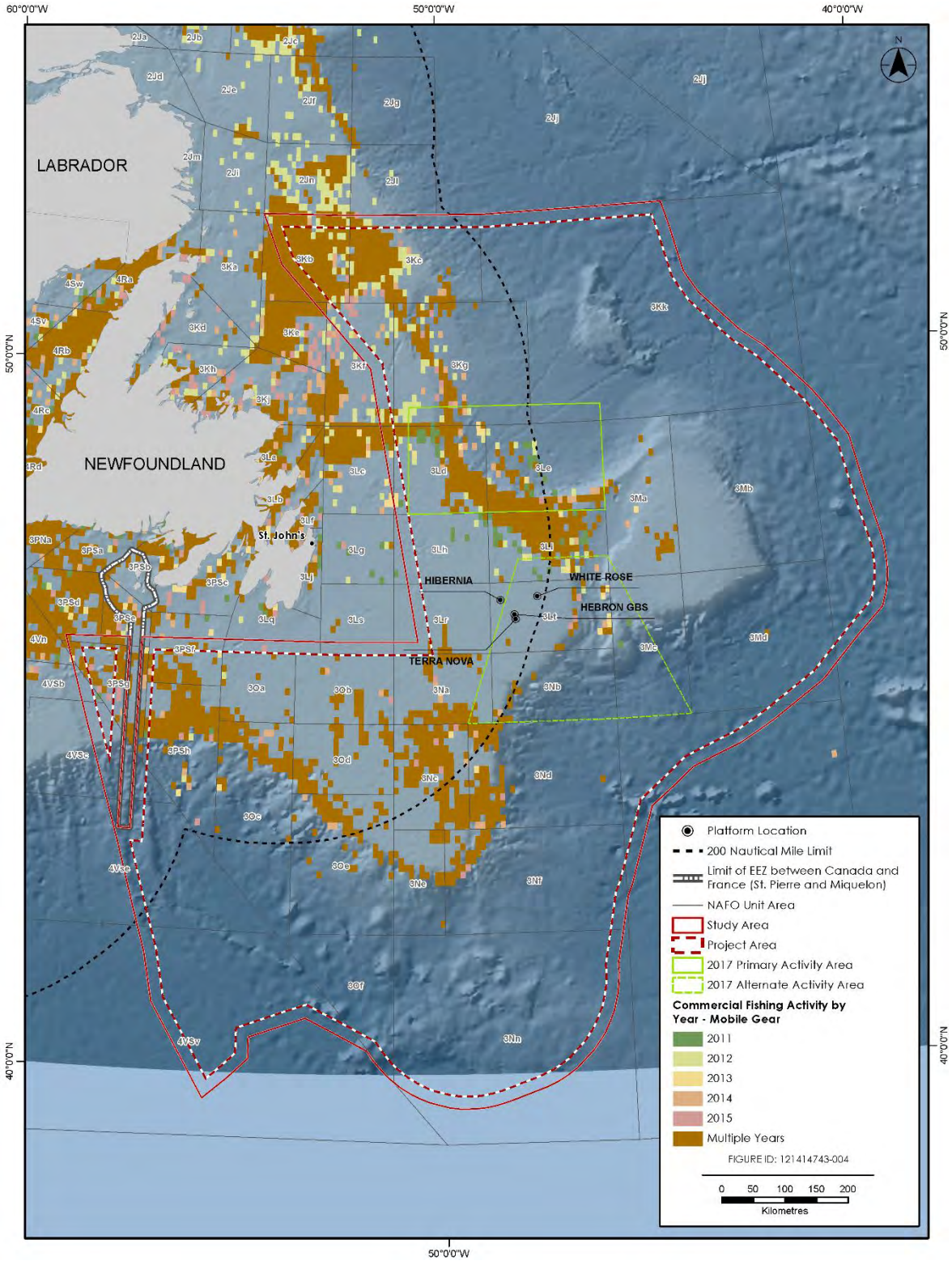

Figure 3-4 Mobile Gear Locations

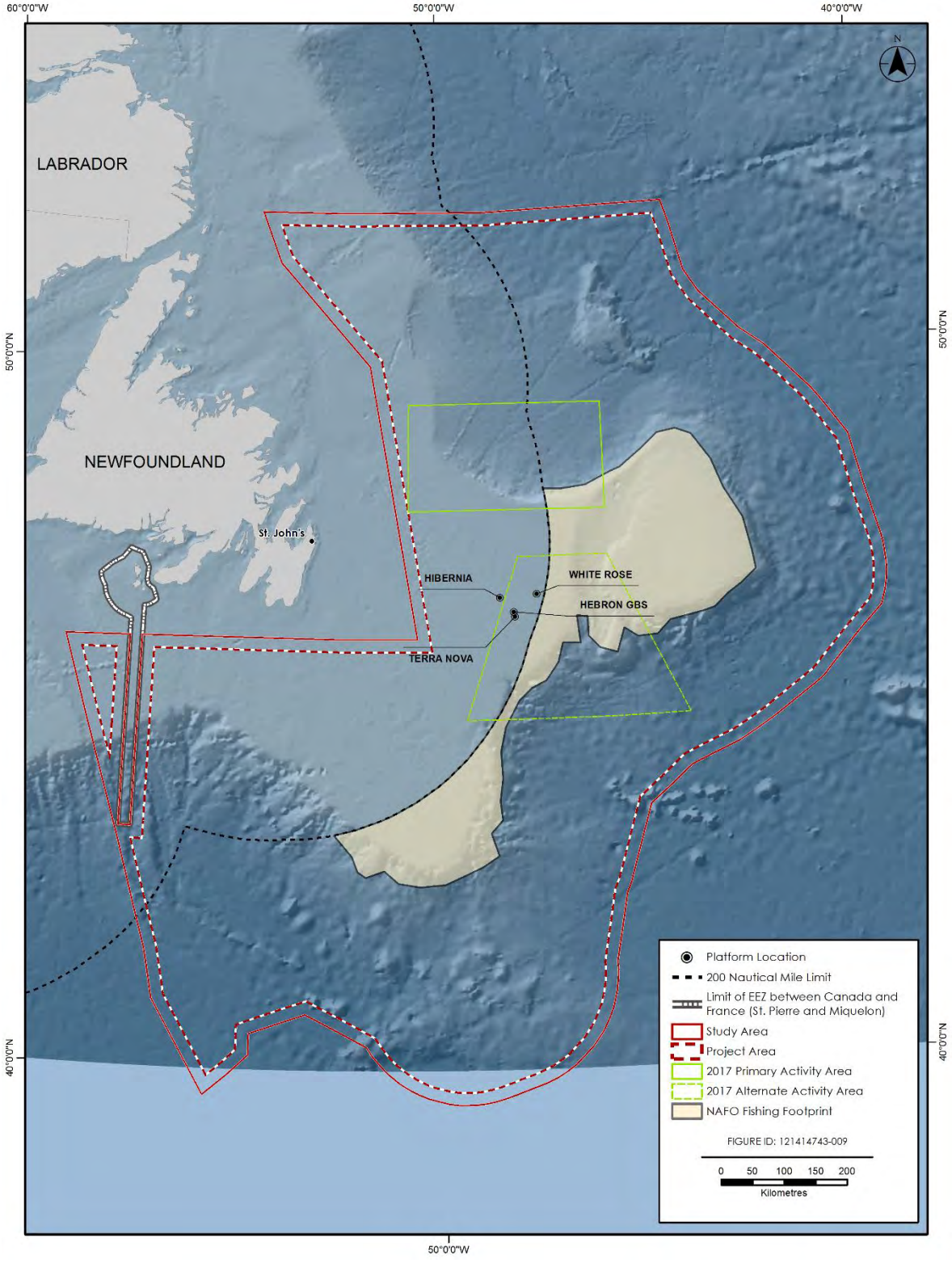

Figure 3-5 NAFO Fishing Footprint

3.4.2 Other Users

Marine Research

Annual research studies are conducted by DFO and includes the Atlantic Zone Monitoring Program and the RAPID Climate Change Program Study throughout NAFO divisions within Canada's 200 nm EEZ. These programs include bottom trawl surveys to collect information for managing and monitoring marine resources in the offshore Newfoundland and Labrador region. In 2017, the *RV Needler* will be conducting its Fall Survey from mid-September to early November in 3KLNO, while the *RV Teleost* will be conducting its Fall Survey from late October to end of November in 3KL(Deep). The DFO-Industry Collaborative Post-season snow crab survey is conducted annually and typically starts in September of each year. The stations illustrated in Figure 3-6 is based on 2017 locations and could change annually. An Industry-DFO halibut longline survey in 3NOPs4VWX began in 1998. To date the survey has focused on the traditional fishing grounds for halibut. An expanded stratified random survey, which will include more stations in 3NOP (Figure 3-7), was initiated in 2017. The survey begins in late May and continues until the end of July.

Marine Shipping

Within the eastern region of Newfoundland there are approximately 17 ports used for both domestic and international shipping activities: nine of these accommodate both domestic and international shipping; four are used exclusively for international shipping; and four are used for domestic shipping (Amec 2014).

Offshore Oil and Gas

Offshore oil and gas production activities have been occurring off the coast of Newfoundland and Labrador for approximately 20 years, and exploration has occurred for decades. There are three production platforms (Hibernia, Terra Nova, and White Rose), with Hebron scheduled to begin drilling in 2017.

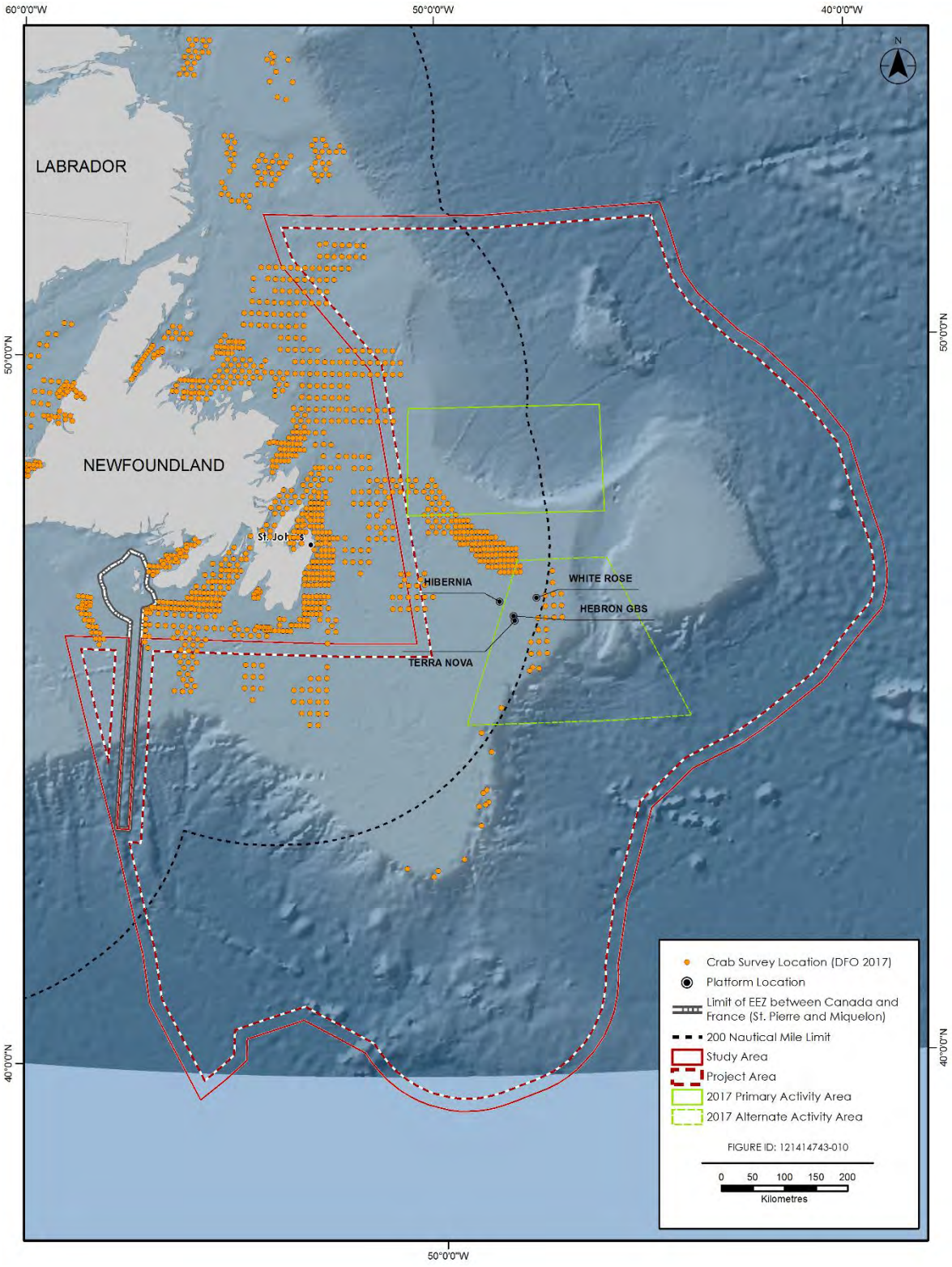

Figure 3-6 Industry-DFO Collaborative Post-season Snow Crab Survey Stations

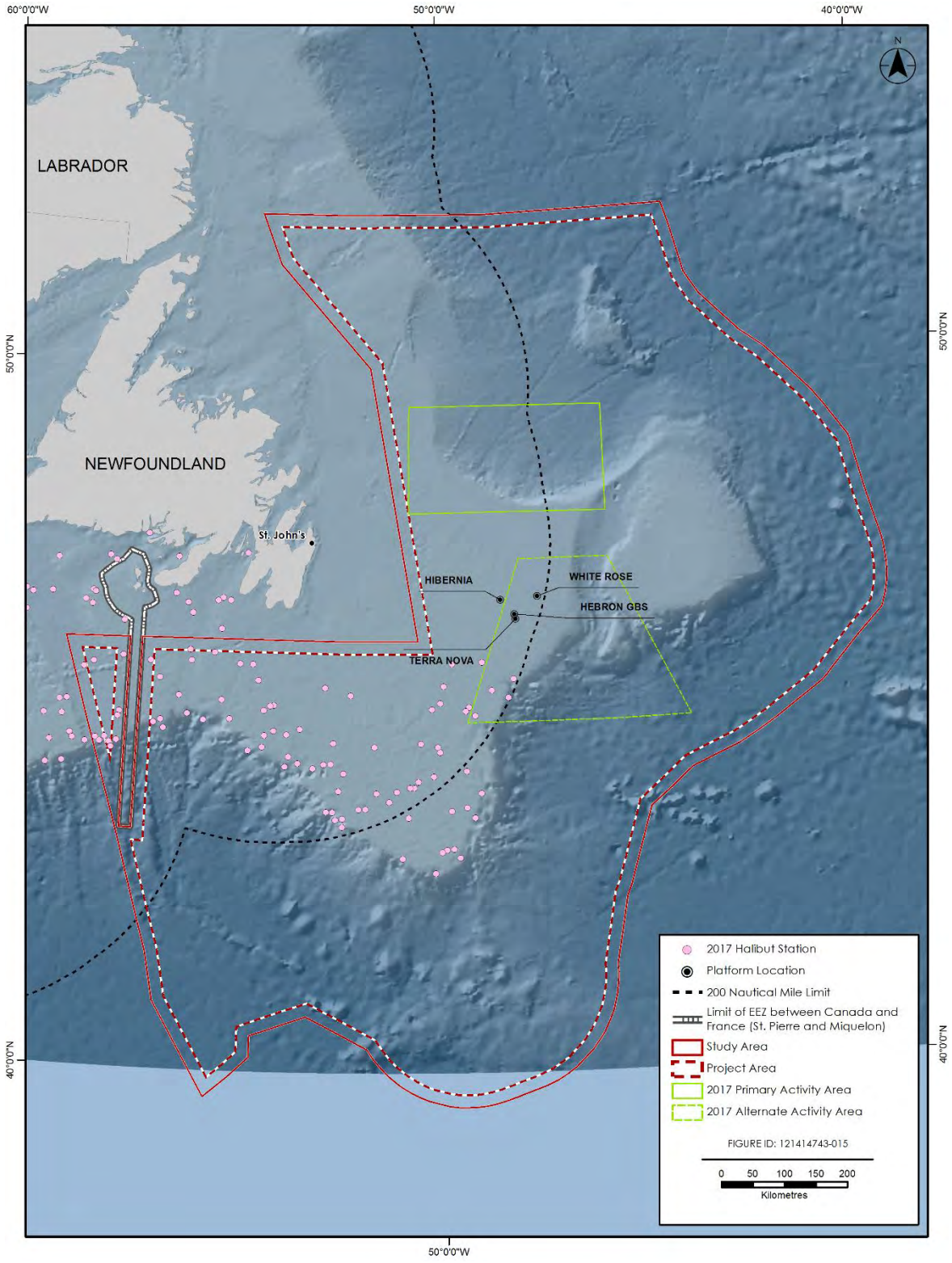

Figure 3-7 Industry-DFO Collaborative Post-season Halibut Survey Stations

Department of National Defence Operations

The Royal Canadian Navy and Air Force conduct routine surveillance operations throughout Atlantic Canadian waters. Military vessels also sometimes support DFO with research operations or conducting fishery patrols (Amec 2014). In the past, many sites across Canada have been used for military training and weapons testing by the Department of National Defence and therefore legacy sites exist across Canada's coastline where unexploded ordnance (UXO) may remain. There are 1,100 known UXO sites that exist off Canada's east coast (Amec 2014). The location of known shipwrecks and legacy sites is illustrated in Figure 3-8.

Ocean Infrastructure

Active and inactive marine subsea cables exist within the Study Area, laid across the seabed between two land-based substations to carry telecommunications between geographic regions (Amec 2014). These cables generally span the Atlantic Ocean, connecting North America to the United Kingdom and Europe. The location of known submarine cables is illustrated in Figure 3-9.

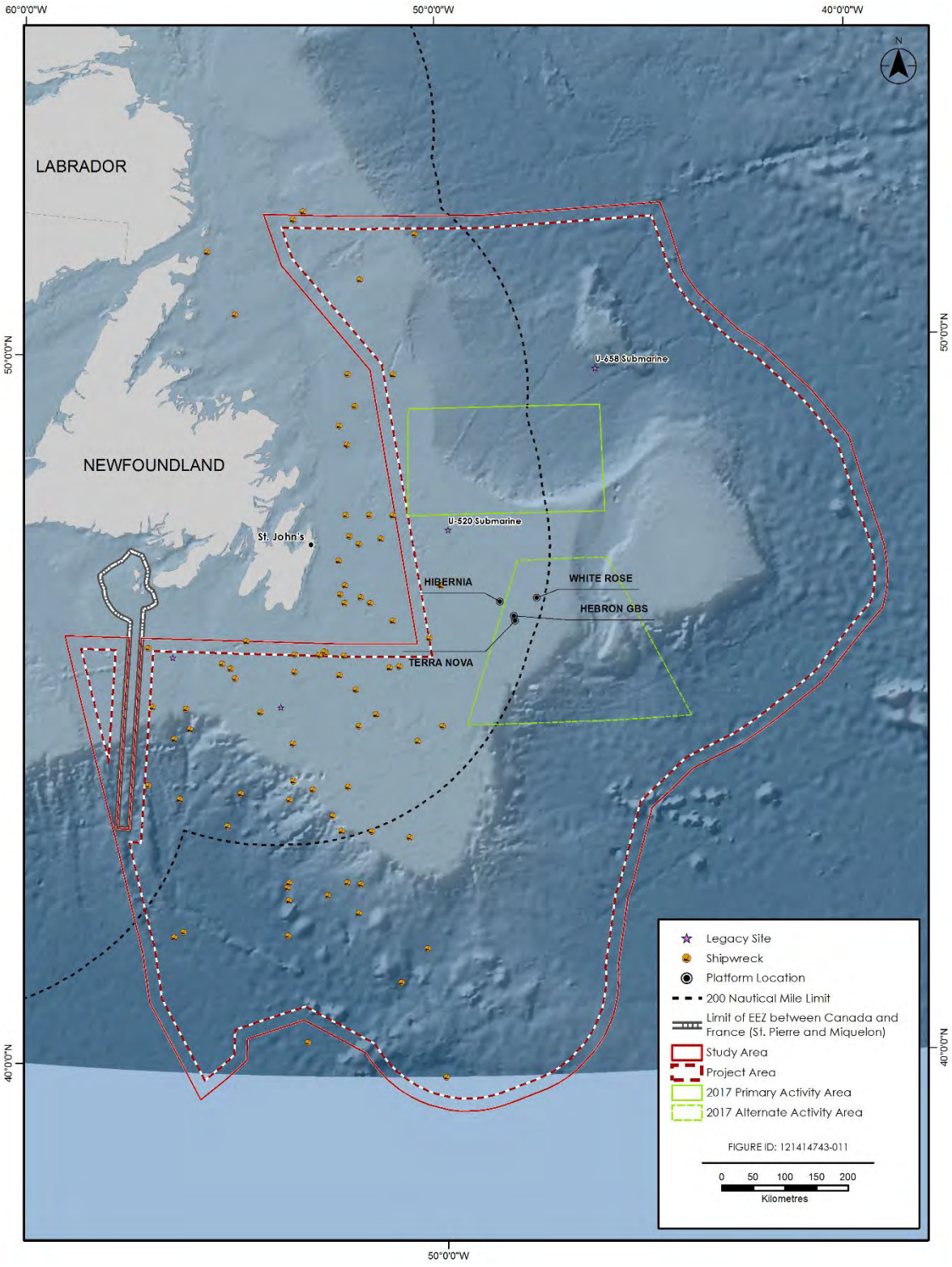

Figure 3-8 Shipwreck and Legacy Sites

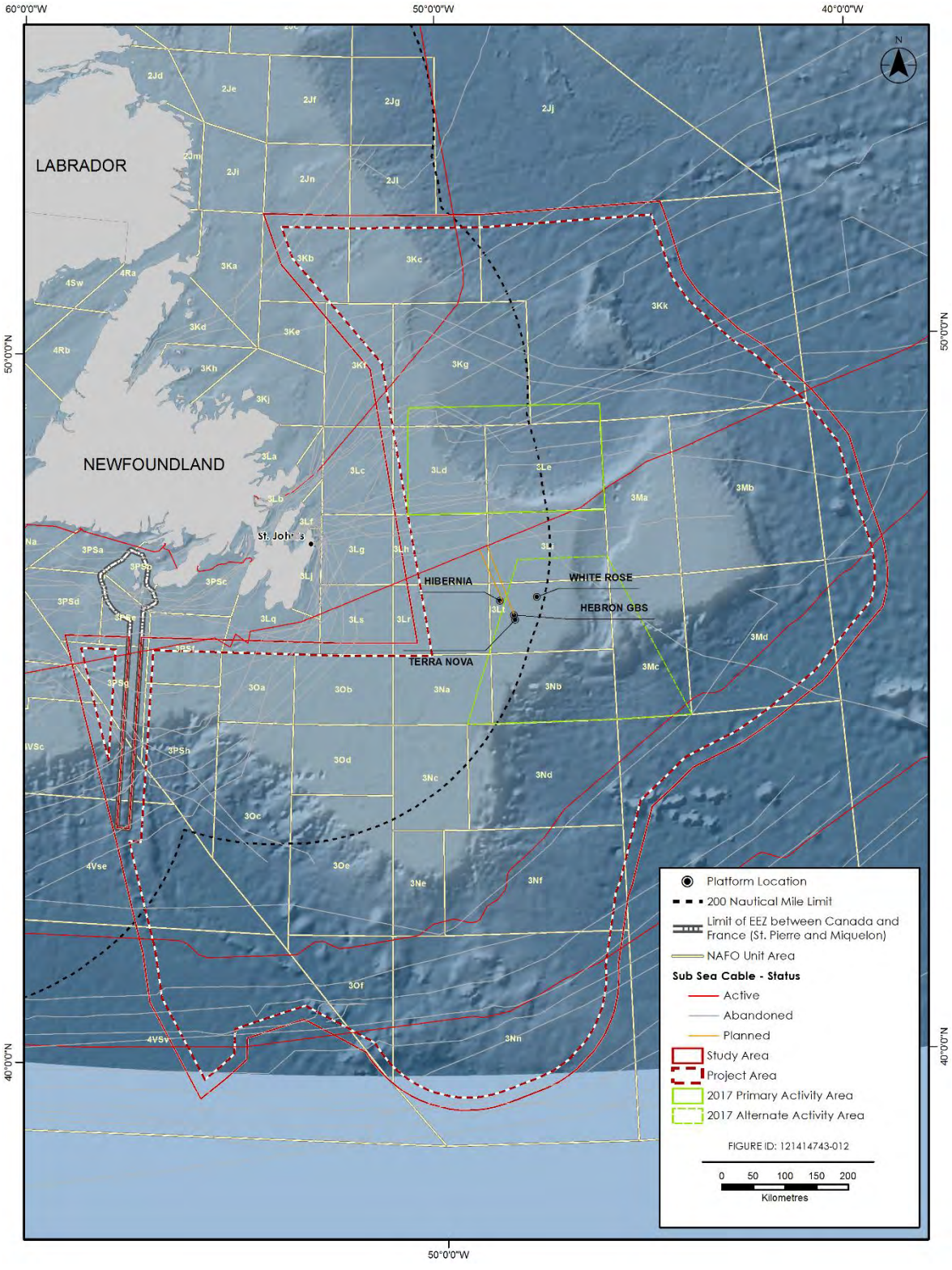

Figure 3-9 Subsea Cables

3.5 MARINE MAMMALS AND SEA TURTLES

There are three groups of marine mammals that can be found within the Study Area: the mysticetes (toothless / baleen whales), odontocetes (toothed whales), and phocids (seals). These include:

- Mysticetes (baleen whales):
  - North Atlantic right whale
  - blue whale
  - fin whale
  - humpback whale
  - sei whale
  - minke whale
- Odontocetes (toothed whales):
  - sperm whale
  - northern bottlenose whale
  - killer whale
  - long-finned pilot whale
  - Sowerby's beaked whale,
  - harbour porpoise
  - common bottlenose dolphin
  - short-beaked common dolphin
  - Atlantic white-sided dolphin
  - white beaked dolphin
  - striped dolphin
  - Risso's dolphin
- Seals:
  - Harp seal
  - Hooded seal
  - Grey seal

All the species of baleen whales occurring in eastern Newfoundland presumably migrate to lower latitudes during winter months, although a small number of animals appear to remain in Newfoundland waters year-round. They generally arrive in the nearshore waters in late spring or early summer and remain until September or October. As they feed primarily on capelin, they follow the migration of capelin and are common around inshore Newfoundland during the summer. By late October most whales have moved offshore and have begun to migrate south (Lien 1985, in Husky Energy 2012).

Species of toothed whales are expected to occur within the Study Area year-round, with abundances generally higher during summer months, June to October (Amec 2014).

In late fall, harp and hooded seals generally migrate from Arctic waters to the Grand Banks area before moving to more inshore / coastal icepack to pup and breed in March. In the early sprint

they, migrate back to Arctic waters. Grey seals generally overwinter inshore, migrating offshore in late winter. Harbour seals are most commonly observed along the coast of Newfoundland (Amec 2014)).

Sea turtles present in the Study Area include the leatherback, loggerhead, and Kemp's ridley. The leatherback and loggerhead sea turtles are both seen with some regularity off Newfoundland in summer and fall (Goff and Lien 1988, in Husky Energy 2012; Witzell 1999, in Husky Energy 2012; Ledwell and Huntington 2009, in Husky Energy 2012). Less is known about the distribution of Kemp's ridley sea turtle in eastern Canada; however, it is considered rare.

Marine mammal and sea turtle SAR and SOCC are identified in Section 3.2.

3.6 MARINE AND MIGRATORY BIRDS

A variety of birds either feed or migrate through the Study Area, including:

- seabirds (cormorants, gannets, phalaropes, gulls, terns, alcids, jaegers and skuas, fulmars and shearwaters, and storm-petrels);
- coastal waterfowl (including loons and grebes); and
- shorebirds.

The waters off eastern Newfoundland support a diverse seabird assemblage, including cormorants, gannets, phalaropes, gulls, terns, alcids (auks), jaegers, skuas, fulmars, petrels, and shearwaters, concentrated at shelf edges and areas where currents mix which create productive environments (Husky Energy 2012) (Appendix C). The food resources of the Grand Banks support many locally breeding birds that nest along the coast of southeastern Newfoundland and forage in more offshore waters during and after the nesting season.

Waterfowl can be generally categorized as dabbling ducks (primarily inland breeders) and diving ducks (most of which are considered "sea ducks" as they spend much of the non-breeding season at sea). Waterfowl generally nest near fresh water, apart from eiders which nest on coastal islands where fresh water is available and raise their broods in coastal waters. Seaducks are typically found in coastal waters outside of the breeding season, over reefs and banks where benthic prey is accessible.

Many shorebirds nest in wetland or upland habitats and use coastal stopover sites for feeding and resting during migration except for species such as willet and piping plover which raise their young in coastal environments. Unlike other shorebirds with coastal associations, phalaropes typically forage offshore in areas where upwelling brings plankton to the surface.

3.7 SENSITIVE AREAS

The Study Area contains a number of sensitive and special areas, including Ecologically and Biologically Significant Areas, Vulnerable Marine Ecosystems, NAFO identified coral and sponge closure areas, seamounts, Bonavista Cod Box, Marine Protected Areas and Areas of Interest, and preliminary Representative Marine Areas (Figure 3-10). The 2.09 km² Eastport Marine Protected Areas on the Bonavista Peninsula, insular Newfoundland, was established in October 2005 and an Area of Interest at Leading Tickles, also on the Island of Newfoundland. Both of these areas are outside the Study Area.

Important Bird Areas (IBAs) are discrete areas that support nationally or globally important groups of birds. Although IBAs are not legally protected, they are often found within areas that have been designated as protected areas by federal or provincial authorities. There is a total of 17 IBA sites associated with eastern Newfoundland.

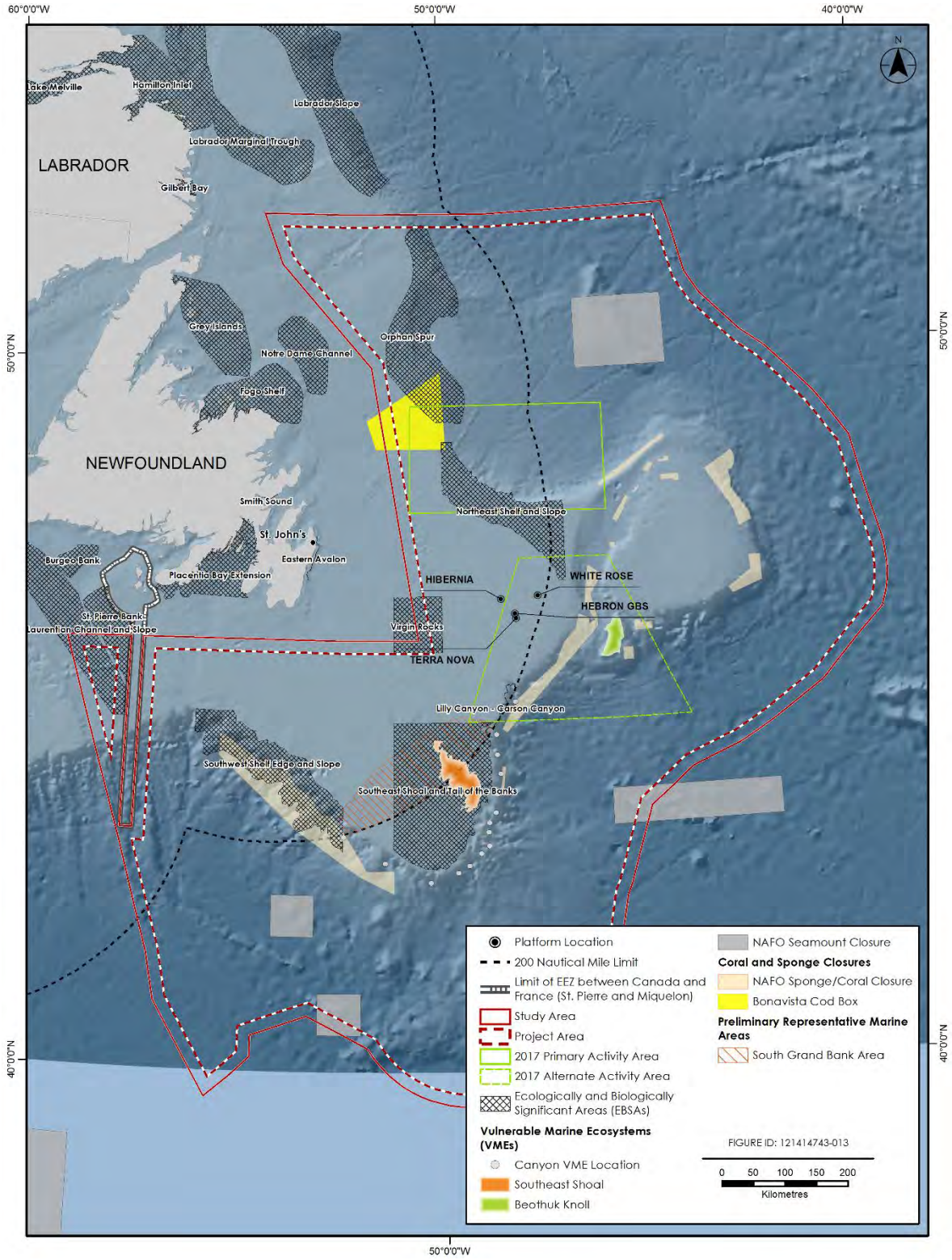

Figure 3-10 Special Areas

4.0 STAKEHOLDER CONSULTATION

Fugro has and will continue to consult with the C-NLOPB during the preparation of the EA and throughout the life of the Project. The official start of the consultation process is initiated with the submission of the Project Description on April 25, 2017.

Fugro has met with the FFAW-Unifor, OCI, and the ASP prior to the submission of the EA to provide details on the proposed Project to the commercial fishing community. A liaison / representative from One Ocean also attended the meeting with OCI.

Fugro met with APS on May 17, 2017, to introduce the company to ASP and provide them with an overview of the Project. ASP provided information on timing of various fisheries in relation to the proposed survey time (approximately 45 days starting mid to late August) and indicated the crab fishery would be over and the shrimp fishery (with its reduced quota) would be mostly finished and predominately outside the 2017 Primary Activity Area.

Fugro met with FFAW-Unifor on May 25, 2017, to provide them with an overview of the Project. FFAW-Unifor indicated that the Industry-DFO post-season crab survey stations could change (on an annual basis); this is noted in the EA. In addition, the Industry-DFO post-season halibut survey was expanding stations within the Study Area (in NAFO 3NOP); this is also noted in the EA. FFAW-Unifor is able to provide Fisheries Liaison Officers (FLOs).

Fugro met with OCI and One Ocean on May 30, 2017, to provide them with an overview of the Project. OCI was interested in timing (mid- to late August start) and water depth (focus greater than 500 m, but there will be shallower stations) as they harvest redfish year-round on the area at the 300 to 500 m depth. OCI was also interested in mitigation measures in place if a core is lost (see Section 2.7).

5.0 ENVIRONMENTAL ASSESSMENT METHODS

5.1 VALUED ECOSYSTEM COMPONENTS

Based on the final Scoping Document (C-NLOPB 2017b), Table 5.1 describes the valued ecosystem components (VECs) that have been identified as requiring assessment of potential environmental effects resulting from Project activities and the rationale for their selection.

Table 5.1 VECs and Rationale for Selection

VEC Name	Rationale for Selection
Species at Risk (either listed on Schedule 1 of SARA or assessed as at risk by COSEWIC)	• Several SAR and SOCC are known to occur near the Study Area, including fish, marine mammals, sea turtles, and marine birds, and have potential to be affected by routine Project activities as well as accidental events associated with the Project.
Marine Fish and Shellfish	• Several species of fish and corals are known to occur near the Study Area and have potential to be affected (including effects on fish habitat) by Project activities (sensory disturbance, localized disturbance to benthic environment) as well as accidental events (injury, mortality, and/or reduced health to marine fish and shellfish) associated with the Project.
Fisheries and Other Users	• Commercial fishing of several species occurs within the Study Area and has potential to be affected by Project activities and components as well as accidental events associated with the Project.
Marine Mammals and Sea Turtles	• Several species of marine mammals and sea turtles are known to occur in the Study Area and have potential to be affected by Project activities (sensory disturbance, potential injury, or mortality from vessel collisions) as well as accidental events (injury, mortality, and/or reduced health to marine mammals and sea turtles) associated with the Project.
Marine and Migratory Birds	• Several species of marine birds are known to occur near the Study Area and have potential to be affected by Project activities (attraction of marine birds to the lighting and mortality and strandings) as well as accidental events (injury, mortality, and/or reduced health to marine birds) associated with the Project.
Sensitive Areas	• Several sensitive areas (i.e., areas designated as being of special interest due to their ecological and/or conservation sensitivities such as EBSAs VMEs and NAFO closure areas, including those protected under federal legislation) are known to occur near the Study Area and have potential to be affected by Project activities as well as accidental events associated with the Project.

Routine Project activities and accidental events (i.e., unplanned hydrocarbon release) associated with the Project are discussed in Section 6 of this EA. Section 6 of this assessment also provides an analysis of cumulative environmental effects.

5.2 BOUNDARIES

Environmental effects are evaluated within spatial and temporal boundaries that are used to help focus the scope of the EA. The spatial boundaries reflect the geographic range over which the Project's potential environmental effects may occur. The temporal boundaries identify when an environmental effect may occur. As per the final Scoping Document (C-NLOPB 2017b), spatial and temporal boundaries were selected based on:

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

5.2.1 Spatial Boundaries

Project Area: The spatial boundary for the 2017 to 2027 program is shown in Figure 2-1. This is the area in which proposed activities will to occur. Focus areas for years 2018 to 2027 will be within the Project Area and more specifically defined each year.

Study Area: The spatial boundary for the 2017 to 2027 program is shown in Figure 2-1. This is the area that could potentially be affected by Project activities beyond the Project Area and provides the ultimate spatial boundary for this EA.

Regional Area: Given the extent of the 2017 to 2027 Study Area, the Regional Area is equivalent to the Study Area.

2017 Program Area(s): The 2017 Primary and Alternate Activity Areas are illustrated in Figure 2-1. This is the spatial area within which Project activities will occur in 2017. Focus areas for years 2018 to 2027 will be within the Project Area and more specifically defined each year.

5.2.2 Temporal Boundaries

The temporal scope of the 2017 to 2027 program is May to November in any given year. The 2017 program is planned to start in late August, with a 40- to 50-day duration.

5.3 PROJECT INTERACTIONS

Fugro is proposing to conduct a seafloor and seep sampling program that includes the following activities: sampling of natural seabed seeps; conducting seabed heat flow measurements; collecting shallow seabed cores; collecting high-resolution bathymetry and backscatter via MBES and SBP. Potential Project-VEC interactions are identified in Table 5.2. The primary interactions from routine Project activities with the VECs comprises the collection of substrate cores and operation of the vessels.

Table 5.2 Project-VEC Interaction

Activity	Species at Risk	Fisheries and Other Ocean Users	Marine and Migratory Birds	Marine Mammals and Sea Turtles	Marine Fish and Shellfish (fish habitat)	Sensitive Areas
Operations						
Use of MBES and SBP	X	X	-	X	-	-
Collection of Heat Flow Measurements and Core Samples	-	X	-	-	X	-
Collection of Surface Samples	-	X	-	-	-	-
Operation of Vessels	-	X	X	X	-	-
Accidental Event						
Loss of Diesel Fuel Due to Damage / Sinking of the Vessels	X	X	X	X	X	X
Collision with Vessels	X	X	-	X	-	-

Notes:
'X' means potential interaction
'-' means interaction not likely

5.4 SIGNIFICANCE CRITERIA

Significant environmental effects are those adverse residual effects that, even with mitigation applied, will cause a change that will alter the status or integrity of a VEC beyond an acceptable level. Where pre-established standards or thresholds do not exist, significance criteria have been defined qualitatively and justifications for the criteria provided. For this EA, significance criteria for each VEC is provided in Table 5.3.

Table 5.3 Residual Environmental Effects Significance Criteria for by VEC

VEC	Criteria
Species at Risk	A significant adverse residual environmental effect on all species listed in Schedule 1 of SARA as "Extirpated", "Endangered" or "Threatened" is one that results in a non-permitted contravention of any of the prohibitions stated in sections 32 to 36 of SARA.
Marine Fish and Shellfish Marine Mammals and Sea Turtles Marine and Migratory Birds	A significant adverse residual environmental effect is defined as one that affects VEC populations and/or habitat, 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.
Fisheries and Other Users	A significant adverse residual environmental effect is one where the Project results in a net loss of commercial fisheries that is not compensated consistent with C-NLOPB guidelines and past practices and as outlined in the One Ocean Protocol document.
Sensitive Areas	A significant adverse residual environmental effect is one that alters the valued habitat of the identified Sensitive Area physically, chemically, or biologically, in quality or extent, to such a degree there is a decline in abundance of key species or species at risk or a change in community structure, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population or community to its former level within several generations.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 PROJECT ACTIVITIES

6.1.1 Use of MBES and SBP

As indicated in Table 5.2, the use of MEBS and SBP have the potential to interact with Fisheries and Other Ocean Users and Marine Mammals and Sea Turtles (including SAR). An MBES will be used to collect high-resolution sonar data along a swath of the seafloor. A SBP generates high-resolution 2D profiles of the seabed, to depths of up to 100 m below seafloor (depending on sediment type).

Underwater sound levels may increase due to the operation of the MBES and SBP. As Marine mammals rely heavily on the use of underwater sounds to communicate and to gain information about their surroundings, an increase in underwater sound may result in a potential effect to Marine Mammals and Sea Turtles (including SAR) close to the sound source. The MBES will operate at 30 or 12 kHz and SBP has a bandwidth of 2 to 16 kHz. The MBES and SBP systems are understood to produce sound pressure levels ranging from 200 to 230 dB at a range of 1m (Hammerstad 2005; NOAA 2010). The systems are designed to measure full ocean depth (11,000 m); since this Project will be operating in depths nominally less than 3,000 m, power levels will be lower than the maximum output.

MBES frequencies may overlap with those used predominantly by baleen whales (approximately 7 Hz to 22 kHz) and pinnipeds (75 Hz to 75 kHz). Some MBES pulses may be audible to toothed whales, but unlikely to mask communication signals because they are short and have narrow beam widths (Husky Energy 2010; Section 7.1.3.2). SBP frequencies can overlap with those used by baleen whales and pinnipeds; however, masking of communication would be limited given to the discontinuous, short duration of these pulses. The low frequency spectrum of sound produced by the SBP will not overlap with the high frequency echolocation of belugas, dolphins, or pilot whales, for example. SBP pulses are intermittent and predominantly low frequency and are unlikely to mask the echolocation / communication of toothed whales. An MMO will be on board the vessels to monitor and report on marine mammal and sea turtle sightings during vessel operation to avoid marine mammals or sea turtles (including SAR), where possible.

The use of MBES and SBP also have the potential to interact with Fisheries and Other Ocean Users through the presence of the vessel required for the operation of the MBES and SBP. Potential effects of the operation of the vessel are discussed in Section 6.1.4. Any incident that involves a dead or distressed SARA-listed species will be recorded and reported to the local DFO office immediately.

Given the limited interaction of the Project activities with the VECs, the environmental effects of the use of the MBES and SBP on Species at Risk, Commercial Fisheries and Other Users, and Marine Mammals and Sea Turtles, are predicted to be not significant (see criteria for significance of residual effects in Table 5.3).

6.1.2 Collection of Heat Flow Measurements and Core Samples

A gravity (or piston) corer will be used to collect substrate cores up to a depth of 6 m. Heat flow measurements will be taken using a 3.5 to 6 m length heat flow probe that is deployed in a similar manner to a sediment corer.

As indicated in Table 5.2, the collection of heat flow measurements and core samples have the potential to interact with Fisheries and Other Ocean Users including an interruption to harvesting activities such as having grounds closed to fishing, impediments to or from fishing grounds, lost or damaged fishing gear, or lost or reduced catch. The collection locations will be selected to avoid areas of commercial fishing activity (especially any areas of fixed gear) as identified through consultation with the FFAW-Unifor's Petroleum Industry Liaison.

The deployment of the corer and probe have the potential to interact with and Marine Fish and Shellfish, particularly the benthic environment including coral and sponge areas. Data collection sites will be selected to avoid coral/sponge closure areas and other identified sensitive areas.

The frequency of occurrence is once (i.e., one sample is collected at distinct separate locations), with a short program duration (i.e., typically two weeks). Seabed disturbance from cores will be extremely localized (10-cm footprint) and is expected to be virtually indistinguishable from the surrounding area. Any disturbance will become restored through natural recruitment of benthic species within one or two seasons. Given the short duration and limited interaction of the Project activities with the VECs, the environmental effects of the collection of heat flow measurements and core samples on Commercial Fisheries and Other Users and Marine Fish and Shellfish are predicted to be not significant (see criteria for significance of residual effects in Table 5.3).

6.1.3 Collection of Surface Samples

Specialized sampling kits, using oil-absorbing materials may be used to detect the presence of oil from natural seabed seeps on the ocean surface. The system uses small piece of hydrophobic material that absorbs hydrocarbons and is deployed using a casting device similar to a fishing rod. The containers are deployed for a short period (few minutes) and then recovered.

As indicated in Tables 5.2, the collection of surface samples has the potential to interact with Fisheries and other Ocean Users causing an interruption to harvesting activities due to the presence of Project vessels (see Section 6.14). The collection locations will be selected on an opportunity basis (i.e., the presence of a surface sheen, which might indicate the presence of a potential seep). The FLO will consult with the FFAW-Unifor's Petroleum Industry Liaison to identify areas of commercial fishing activity (especially any areas of fixed gear).

Given the limited interaction of the Project activities with the VECs, the environmental effects of the collection of surface samples on Commercial Fisheries and Other Users are predicted to be not significant (see criteria for significance of residual effects in Table 5.3).

6.1.4 Operation of Vessels

As indicated in Table 5.2, the operation of the vessels has the potential to interact with Fisheries and Other Ocean Users, Marine and Migratory Birds, Marine Mammals and Sea Turtles and Species at Risk.

The operation of the vessels has the potential to interact with Fisheries and other Ocean Users causing an interruption to harvesting activities, impediments to or from fishing grounds, lost or damaged fishing gear, or lost or reduced catch. To the extent possible, coring locations will be selected to avoid areas of commercial fishing activity (especially any areas of fixed gear) as identified through consultation with the FFAW-Unifor's Petroleum Industry Liaison. Vessels will also adhere to standard at sea protocol and procedures, thereby reducing potential conflicts with commercial fisheries. Sampling will also occur in a sequence that creates the least disruption to local fishers based on consultation with the FFAW-Unifor Petroleum Industry Liaison.

The proposed Project will require the operation of vessels over a 24-hour period and therefore, there is potential for marine and migratory birds to be attracted to the vessels at night, potentially resulting in strandings, collisions, increased opportunities for predation, and exposure to other vessel-based threats. As many marine and migratory birds navigate by sight, artificial lights in the offshore environment has the potential to attract nocturnally-active migratory birds. For example, procellariform seabirds (e.g., shearwaters and storm-petrels) feed on bioluminescent prey and therefore are naturally attracted to light (Imber 1975). The presence of an approaching vessel may alert birds and flush some species from the area. Adverse effects from the operation of the vessels is anticipated to be minimal compared to the ongoing shipping activity occurring in the region. A minimum distance of 2 km will be maintained from active seabird colonies. As discussed in Section 2.7, routine checks for stranded birds on the vessels will be implemented throughout the Project and the release stranded birds will be conducted as per the protocol of Williams and Chardine (1999). Dead birds are occasionally found on ships. If more than 10 birds are found dead in the same event, they will be collected as per the Environment Canada (2012) Protocol for Collecting Dead Birds from Platforms (for birds not associated with a pollution event). Necessary permits will be obtained prior to operations.

As discussed in the Eastern Newfoundland SEA, vessel traffic is likely the main source of anthropogenic sound in the marine environment (Wright et al. 2007 in Amec 2014) and have the potential to affect marine mammals through masking. Sound produced by vessels may cause marine mammals to exhibit avoidance, approach, or indifference (Richardson et al. 1995, in Amec 2014). Sound levels from vessel operation associated with the Project are not expected to be high enough to cause physical or physiological effects on marine mammals or sea turtles (Richardson et al. 1995 in Husky 2012). Marine mammals may also be susceptible to mortality or injury from vessel collisions (Williams and O'Hara 2010 in Amec 2014). Vessel speed during the program will typically range from stationary (for coring) to survey speeds of up to 18.5 km/h (10 knots). Serious (or lethal) vessel strikes to whales are infrequent at vessel speeds less than 26 km/h (14 knots) and are rare at vessel speeds less than 18.5 km/h (10 knots) (Laist et al. 2001); therefore, the potential for the research vessel to strike a marine mammal is minimal. An MMO will

be on board the vessels to monitor and report on marine mammal and sea turtle sightings during vessel operation to avoid marine mammals or sea turtles (including SAR), where possible.

Given the limited interaction of the Project activities with the VECs, the environmental effects of the operation of the vessels on Commercial Fisheries and Other Users, Marine and Migratory Birds and Marine Mammals and Sea Turtles are predicted to be not significant (see criteria for significance of residual effects in Table 5.3).

6.2 ACCIDENTAL EVENTS

In the event of damage or sinking of the vessels, most spill fluids will consist of light fuel (diesel) which evaporates from the water surface relatively quickly. Diesel typically disperses naturally within a day or less, even in cold water (NOAA 2006). Diesel has a low viscosity and is readily dispersed within the water column when winds reach approximately 9 to 13 km/h (5 to 7 knots) or with breaking waves. It is possible for diesel to be dispersed by wave action and may form droplets that are kept in suspension and move with currents and is unlikely to reach the seabed.

As indicated in Table 5.2, a diesel spill may interact with Species at Risk, Fisheries and Other Ocean Users and Marine and Migratory Birds. Species at risk and other species would be able to avoid any film that might form. Potential effects on marine birds would include oiling feathers and the resultant hypothermia or ingestion of oil due to cleaning of feathers. Potential effects on fisheries resources might occur if a spill prevented or impeded a harvester's ability to access fishing grounds (because of areas temporarily excluded during the spill or spill clean-up), caused damage to fishing gear (through oiling), or resulted in a negative effect on the marketability of fish products (because of market perception resulting in lower prices). However, the vessels will have limited amounts of marine fuel on board that could potentially be spilled to the ocean thereby limiting effects on the marine environment and fisheries. The Project vessels will have spill response equipment on board and an Emergency Response Plan, including an Oil Spill Response Plan, in the unlikely event of vessel distress. The vessels' Safety, Health and Environment Management Systems include spill response.

Given the on-board spill response plan and equipment and the fact that a spill (resulting from a collision) is unlikely to affect a substantial portion of any population, the adverse residual environmental effect of an accidental spill on Species at Risk, Commercial Fisheries and Other Users, and Marine and Migratory Birds is predicted to be not significant (see criteria for significance of residual effects in Table 5.3).

6.3 CUMULATIVE ENVIRONMENTAL EFFECTS

The incremental amount of Project-related vessel traffic will be negligible compared to existing vessel traffic in the region. Overlapping environmental effects between the Project activities and similar effects from other oil and gas exploratory programs or development projects are not anticipated as the Project activities are transitory, with low magnitude, and limited in spatial extent. SIMOPS and ongoing communications will be conducted with the active geophysical

programs in the general vicinity of the Primary Activity Zone to reduce the potential for cumulative environmental effects on the VECs. DFO and Department of National Defence will be contacted in advance of the survey to provide notification of sampling locations so that cumulative environmental effects can be avoided. In general, Project mitigation measures proposed in Section 2.7 will also reduce overall potential for cumulative effects. Therefore, the adverse residual cumulative environmental effect on Species at Risk, Commercial Fisheries and Other Users, Marine and Migratory Birds, Marine Mammals and Sea Turtles, Marine Fish and Shellfish and Sensitive Areas is predicted to be not significant.

6.4 CONCLUSION

Fugro is proposing to conduct a seafloor and seep sampling program in one or more years within 2017 and 2027 timeframe in the eastern and southern portion of Newfoundland and Labrador offshore area to determine the presence and likely locations of geological structures that might contain hydrocarbon deposits. The program includes the following activities: sampling of natural seabed seeps, conducting seabed heat flow measurements, collection of shallow seabed cores, high-resolution bathymetry and backscatter via MBES, and SBP. As discussed above, interaction with the environment will be limited and environmental effects negligible; therefore, follow-up monitoring is not required for this Project. With the implementation of mitigation measures described in Section 2.7, residual adverse environmental effects from routine Project activities, accidental events and cumulative effects are predicted to be not significant.

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APPENDIX A
STUDY AREA COORDINATES

Appendix A STUDY AREA AND PROJECT AREA COORDINATES

Table A.1 Study Area Coordinates

Label	X_coord	Y_coord
1	44° 47' 9.679" W	52° 15' 50.655" N
2	44° 39' 3.010" W	51° 57' 0.917" N
3	44° 24' 50.478" W	51° 16' 50.179" N
4	44° 7' 28.376" W	50° 57' 49.443" N
5	43° 54' 8.367" W	50° 48' 41.919" N
6	43° 17' 35.922" W	50° 22' 46.715" N
7	42° 47' 25.623" W	50° 7' 2.215" N
8	42° 36' 52.983" W	49° 59' 28.677" N
9	41° 51' 27.908" W	49° 25' 9.222" N
10	41° 38' 44.908" W	49° 12' 42.530" N
11	41° 11' 33.547" W	48° 43' 29.976" N
12	40° 59' 27.434" W	47° 56' 22.941" N
13	40° 55' 4.612" W	47° 42' 12.070" N
14	40° 45' 58.751" W	47° 12' 38.809" N
15	40° 44' 52.127" W	47° 6' 15.611" N
16	40° 44' 16.290" W	46° 51' 46.229" N
17	40° 45' 18.334" W	46° 43' 35.652" N
18	40° 47' 4.510" W	46° 35' 17.313" N
19	40° 50' 21.073" W	46° 26' 47.866" N
20	40° 56' 27.154" W	46° 15' 2.579" N
21	41° 29' 1.378" W	45° 53' 59.824" N
22	42° 6' 35.426" W	45° 27' 33.768" N
23	42° 13' 0.662" W	45° 22' 36.924" N
24	42° 19' 51.230" W	45° 18' 20.114" N
25	43° 4' 45.614" W	44° 57' 42.215" N
26	43° 18' 42.130" W	44° 50' 53.189" N
27	43° 42' 8.148" W	44° 40' 56.430" N
28	44° 4' 24.949" W	44° 32' 7.904" N
29	44° 27' 57.736" W	44° 25' 33.004" N
30	45° 3' 1.556" W	44° 14' 54.786" N

Label	X_coord	Y_coord
31	45° 29' 24.668" W	43° 58' 44.718" N
32	45° 54' 39.213" W	43° 43' 46.146" N
33	46° 15' 21.755" W	42° 56' 8.684" N
34	46° 22' 59.866" W	42° 37' 59.903" N
35	46° 28' 32.652" W	42° 28' 32.497" N
36	46° 36' 52.265" W	41° 55' 58.997" N
37	46° 40' 54.916" W	41° 40' 33.616" N
38	46° 43' 40.109" W	41° 29' 57.492" N
39	46° 43' 22.590" W	41° 23' 4.037" N
40	46° 44' 32.081" W	41° 12' 48.629" N
41	46° 46' 11.886" W	41° 5' 7.245" N
42	46° 50' 43.900" W	40° 51' 18.302" N
43	46° 55' 35.541" W	40° 42' 40.294" N
44	47° 2' 52.837" W	40° 31' 32.260" N
45	47° 15' 7.077" W	40° 18' 28.911" N
46	47° 34' 56.236" W	40° 3' 24.929" N
47	47° 45' 52.753" W	39° 57' 29.270" N
48	47° 54' 57.567" W	39° 53' 10.575" N
49	48° 9' 4.481" W	39° 48' 5.494" N
50	48° 26' 8.213" W	39° 43' 18.152" N
51	48° 47' 21.527" W	39° 37' 36.114" N
52	48° 55' 50.284" W	39° 35' 17.205" N
53	49° 6' 50.141" W	39° 33' 3.470" N
54	49° 16' 6.156" W	39° 31' 39.052" N
55	49° 26' 49.690" W	39° 30' 39.493" N
56	49° 44' 26.726" W	39° 30' 32.082" N
57	49° 57' 46.238" W	39° 31' 50.271" N
58	50° 19' 49.780" W	39° 36' 14.970" N
59	50° 31' 58.345" W	39° 40' 18.240" N
60	50° 40' 49.941" W	39° 43' 46.756" N
61	50° 52' 36.138" W	39° 49' 27.125" N
62	51° 6' 22.676" W	39° 58' 8.112" N
63	51° 15' 43.207" W	40° 5' 37.853" N
64	51° 23' 46.958" W	40° 13' 20.356" N
65	51° 30' 5.654" W	40° 20' 27.971" N
66	52° 0' 4.745" W	40° 32' 40.375" N

Label	X_coord	Y_coord
67	52° 30' 8.229" W	40° 44' 19.606" N
68	52° 39' 45.956" W	40° 48' 2.606" N
69	53° 3' 13.652" W	40° 41' 55.406" N
70	53° 43' 1.010" W	40° 30' 50.325" N
71	53° 43' 10.841" W	40° 12' 30.558" N
72	53° 55' 16.261" W	40° 3' 11.368" N
73	54° 5' 9.945" W	39° 55' 58.474" N
74	54° 20' 4.005" W	39° 45' 50.877" N
75	54° 32' 40.816" W	39° 37' 40.241" N
76	55° 34' 18.263" W	40° 58' 4.960" N
77	55° 45' 24.990" W	41° 40' 21.239" N
78	55° 58' 4.356" W	42° 10' 56.500" N
79	56° 10' 30.138" W	42° 41' 39.077" N
80	56° 22' 49.174" W	43° 11' 39.175" N
81	56° 35' 49.658" W	43° 40' 58.949" N
82	57° 11' 42.021" W	44° 58' 35.303" N
83	57° 42' 46.293" W	46° 5' 15.553" N
84	56° 24' 13.645" W	46° 7' 50.566" N
85	56° 23' 52.900" W	43° 25' 4.500" N
86	56° 9' 26.000" W	43° 24' 58.000" N
87	56° 9' 5.072" W	46° 8' 13.637" N
88	52° 0' 33.791" W	46° 9' 54.491" N
89	50° 30' 10.708" W	46° 9' 57.849" N
90	51° 30' 33.511" W	50° 3' 58.008" N
91	53° 32' 44.854" W	51° 31' 29.616" N
92	54° 0' 2.614" W	52° 14' 51.680" N
93	52° 0' 16.358" W	52° 14' 51.680" N
94	49° 0' 2.430" W	52° 14' 51.680" N
95	45° 35' 56.516" W	52° 17' 50.807" N

Table A.2 Project Area Coordinates

Vertex_ID	X_coord	Y_coord
1i	45° 1' 29.702" W	52° 7' 2.421" N
2i	44° 55' 57.831" W	51° 54' 26.708" N
3i	44° 41' 0.833" W	51° 12' 52.987" N
4i	44° 21' 15.704" W	50° 51' 23.763" N
5i	44° 6' 38.877" W	50° 41' 25.955" N
6i	43° 29' 12.524" W	50° 14' 57.539" N
7i	42° 58' 58.120" W	49° 59' 13.724" N
8i	42° 49' 21.513" W	49° 52' 21.688" N
9i	42° 4' 35.100" W	49° 18' 39.229" N
10i	41° 52' 31.014" W	49° 6' 54.004" N
11i	41° 26' 59.783" W	48° 39' 38.822" N
12i	41° 15' 7.910" W	47° 54' 22.050" N
13i	41° 10' 37.053" W	47° 39' 59.632" N
14i	41° 1' 30.804" W	47° 10' 54.062" N
15i	41° 0' 32.396" W	47° 5' 27.538" N
16i	40° 59' 55.293" W	46° 52' 3.990" N
17i	41° 0' 48.173" W	46° 44' 49.201" N
18i	41° 2' 20.467" W	46° 37' 26.244" N
19i	41° 5' 11.015" W	46° 29' 58.961" N
20i	41° 9' 44.630" W	46° 21' 7.827" N
21i	41° 39' 43.135" W	46° 1' 42.733" N
22i	42° 17' 40.480" W	45° 34' 57.335" N
23i	42° 23' 44.659" W	45° 30' 16.185" N
24i	42° 29' 5.887" W	45° 26' 54.995" N
25i	43° 13' 13.081" W	45° 6' 37.687" N
26i	43° 26' 52.702" W	44° 59' 56.708" N
27i	43° 49' 40.111" W	44° 50' 16.071" N
28i	44° 10' 50.471" W	44° 41' 53.785" N
29i	44° 33' 37.607" W	44° 35' 31.602" N
30i	45° 11' 0.259" W	44° 24' 10.906" N
31i	45° 39' 0.125" W	44° 7' 0.764" N
32i	46° 7' 30.335" W	43° 50' 3.769" N
33i	46° 29' 23.191" W	42° 59' 21.061" N
34i	46° 36' 44.030" W	42° 41' 44.256" N
35i	46° 42' 34.200" W	42° 31' 43.352" N

Vertex_ID	X_coord	Y_coord
36i	46° 51' 4.162" W	41° 58' 0.754" N
37i	46° 55' 3.026" W	41° 42' 36.992" N
38i	46° 58' 4.324" W	41° 30' 48.783" N
39i	46° 57' 43.672" W	41° 23' 20.409" N
40i	46° 58' 44.085" W	41° 14' 7.611" N
41i	47° 0' 11.423" W	41° 7' 17.137" N
42i	47° 4' 15.864" W	40° 54' 44.433" N
43i	47° 8' 29.178" W	40° 47' 11.882" N
44i	47° 14' 23.379" W	40° 37' 49.631" N
45i	47° 25' 54.484" W	40° 25' 30.389" N
46i	47° 44' 1.142" W	40° 11' 42.976" N
47i	47° 53' 37.812" W	40° 6' 30.265" N
48i	48° 1' 38.574" W	40° 2' 41.872" N
49i	48° 14' 27.304" W	39° 58' 4.884" N
50i	48° 30' 50.049" W	39° 53' 29.009" N
51i	48° 51' 59.883" W	39° 47' 47.902" N
52i	48° 59' 56.862" W	39° 45' 37.693" N
53i	49° 9' 57.556" W	39° 43' 35.963" N
54i	49° 18' 16.858" W	39° 42' 20.183" N
55i	49° 27' 43.167" W	39° 41' 27.812" N
56i	49° 43' 37.855" W	39° 41' 21.175" N
57i	49° 55' 7.569" W	39° 42' 28.651" N
58i	50° 15' 16.645" W	39° 46' 30.545" N
59i	50° 26' 0.806" W	39° 50' 5.698" N
60i	50° 33' 55.316" W	39° 53' 11.946" N
61i	50° 44' 23.718" W	39° 58' 15.100" N
62i	50° 57' 28.480" W	40° 6' 30.327" N
63i	51° 4' 42.974" W	40° 12' 22.957" N
64i	51° 12' 24.647" W	40° 19' 45.529" N
65i	51° 20' 20.194" W	40° 28' 43.815" N
66i	51° 53' 31.055" W	40° 42' 15.439" N
67i	52° 23' 41.704" W	40° 53' 57.810" N
68i	52° 38' 40.737" W	40° 59' 44.456" N
69i	53° 7' 58.254" W	40° 52' 6.638" N
70i	53° 57' 7.922" W	40° 38' 21.971" N
71i	53° 57' 14.825" W	40° 16' 59.649" N
72i	54° 5' 6.580" W	40° 10' 54.859" N

Vertex_ID	X_coord	Y_coord
73i	54° 14' 39.141" W	40° 3' 56.580" N
74i	54° 28' 55.097" W	39° 54' 13.911" N
76i	55° 20' 47.864" W	41° 1' 59.151" N
77i	55° 31' 26.315" W	41° 42' 59.268" N
78i	55° 44' 11.219" W	42° 14' 4.135" N
79i	55° 56' 29.459" W	42° 44' 44.562" N
80i	56° 8' 27.762" W	43° 14' 10.505" N
86i	55° 54' 43.889" W	43° 14' 2.365" N
87i	55° 53' 37.700" W	45° 57' 48.479" N
88i	52° 0' 36.594" W	45° 59' 6.468" N
89i	50° 11' 52.374" W	45° 59' 1.790" N
90i	51° 14' 50.307" W	50° 8' 45.337" N
91i	53° 17' 46.466" W	51° 37' 15.720" N
92i	53° 34' 29.593" W	52° 3' 52.869" N
93i	52° 0' 9.041" W	52° 4' 4.334" N
94i	48° 57' 20.471" W	52° 4' 7.101" N
95i	45° 35' 54.209" W	52° 7' 4.563" N
82i	56° 38' 56.666" W	44° 22' 27.484" N
83i	57° 21' 46.578" W	45° 55' 15.375" N
84i	56° 39' 37.556" W	45° 56' 37.387" N

APPENDIX B
COMMERCIAL FISHING ACTIVITY, 2011 TO 2015

Appendix B COMMERCIAL FISHING ACTIVITY, 2011 TO 2015

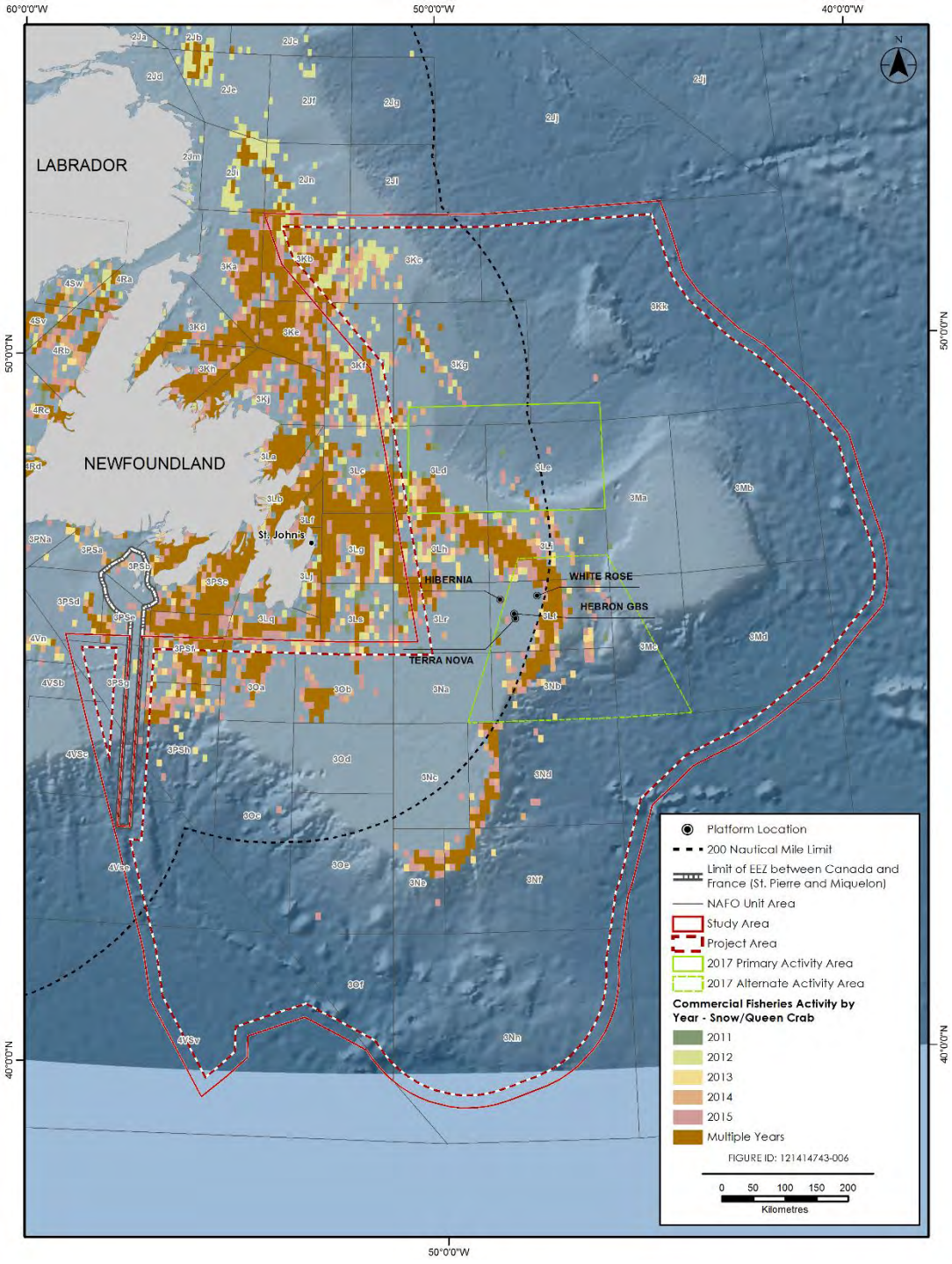

Figure B.1 Snow Crab Fishing Activity, All Seasons, 2011 to 2015

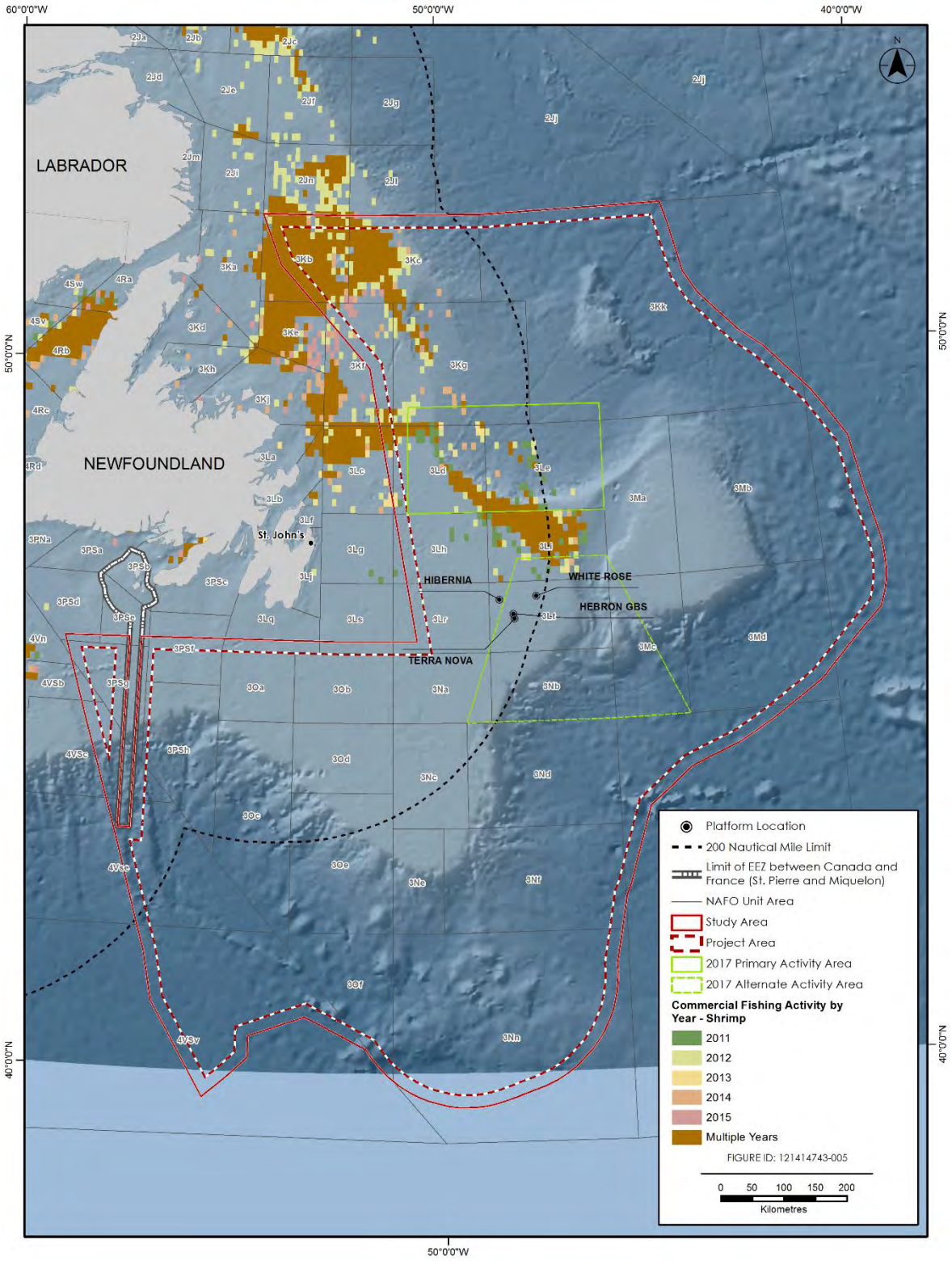

Figure B.2 Shrimp Fishing Activity, All Seasons, 2011 to 2015

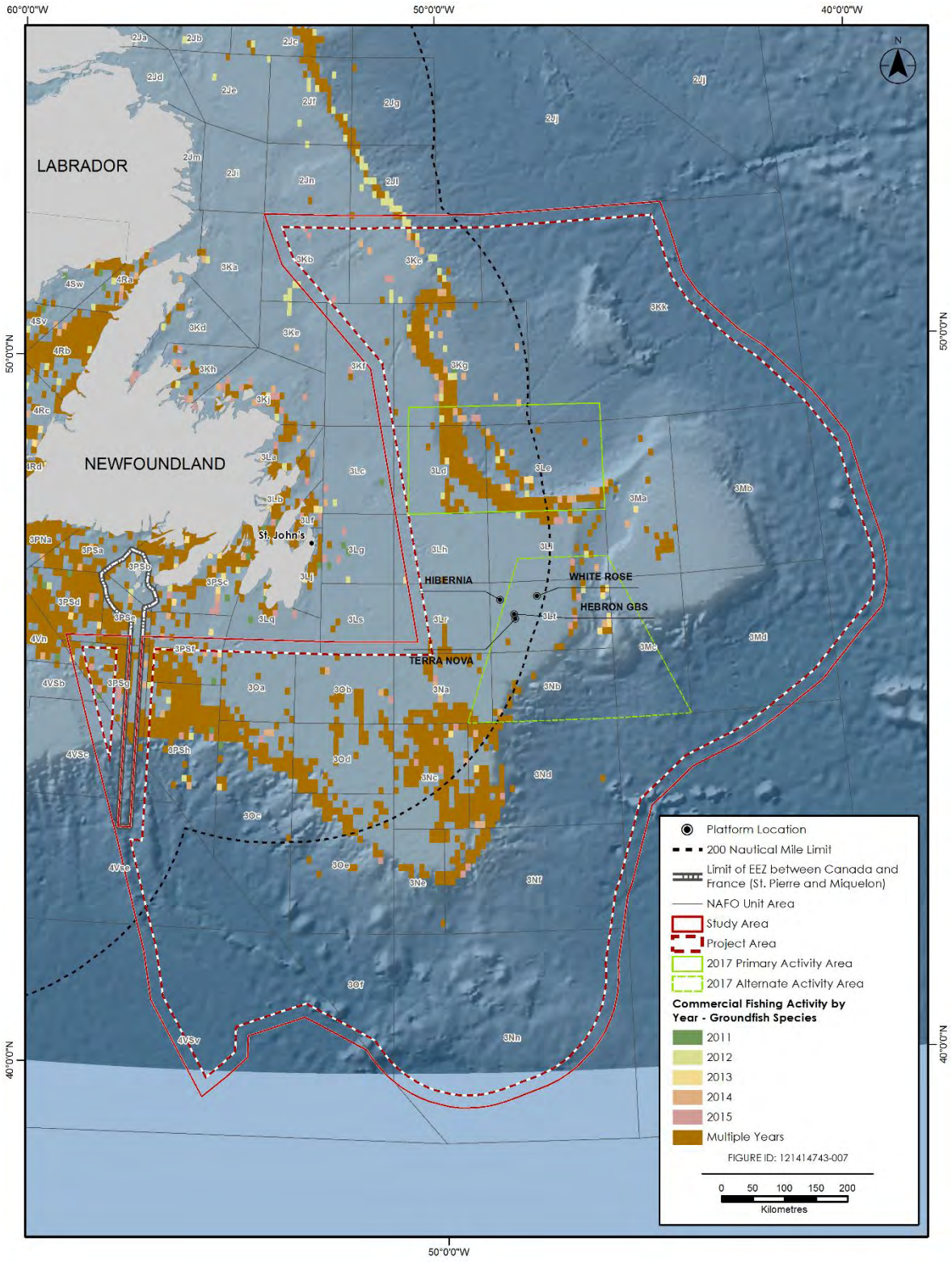

Figure B.3 Groundfish Species Fishing Activity, All Seasons, 2011 to 2015

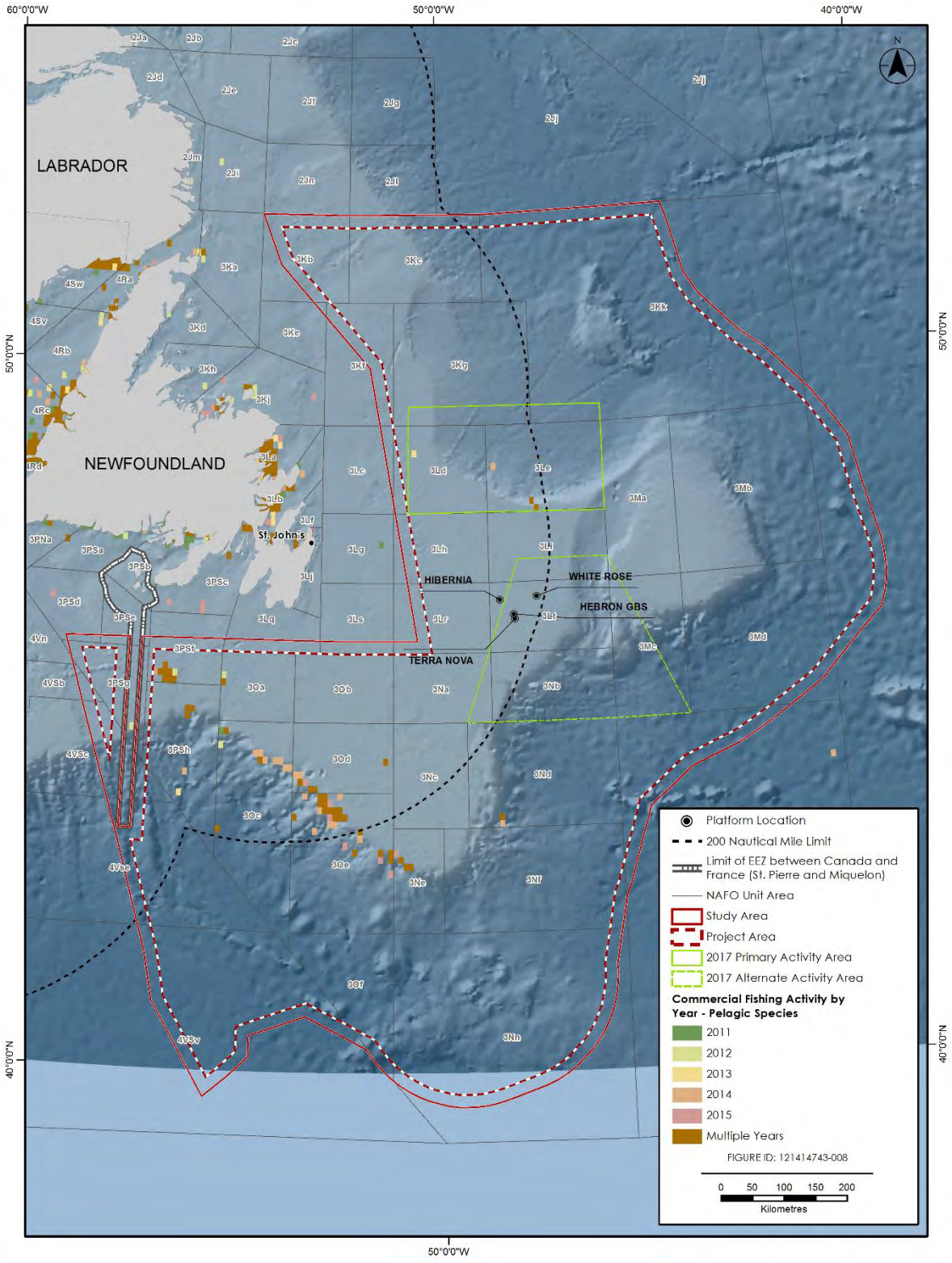

Figure B.4 Pelagic Species Fishing Activity, All Seasons, 2011 to 2015

APPENDIX C
MARINE BIRDS

Appendix C MARINE BIRDS

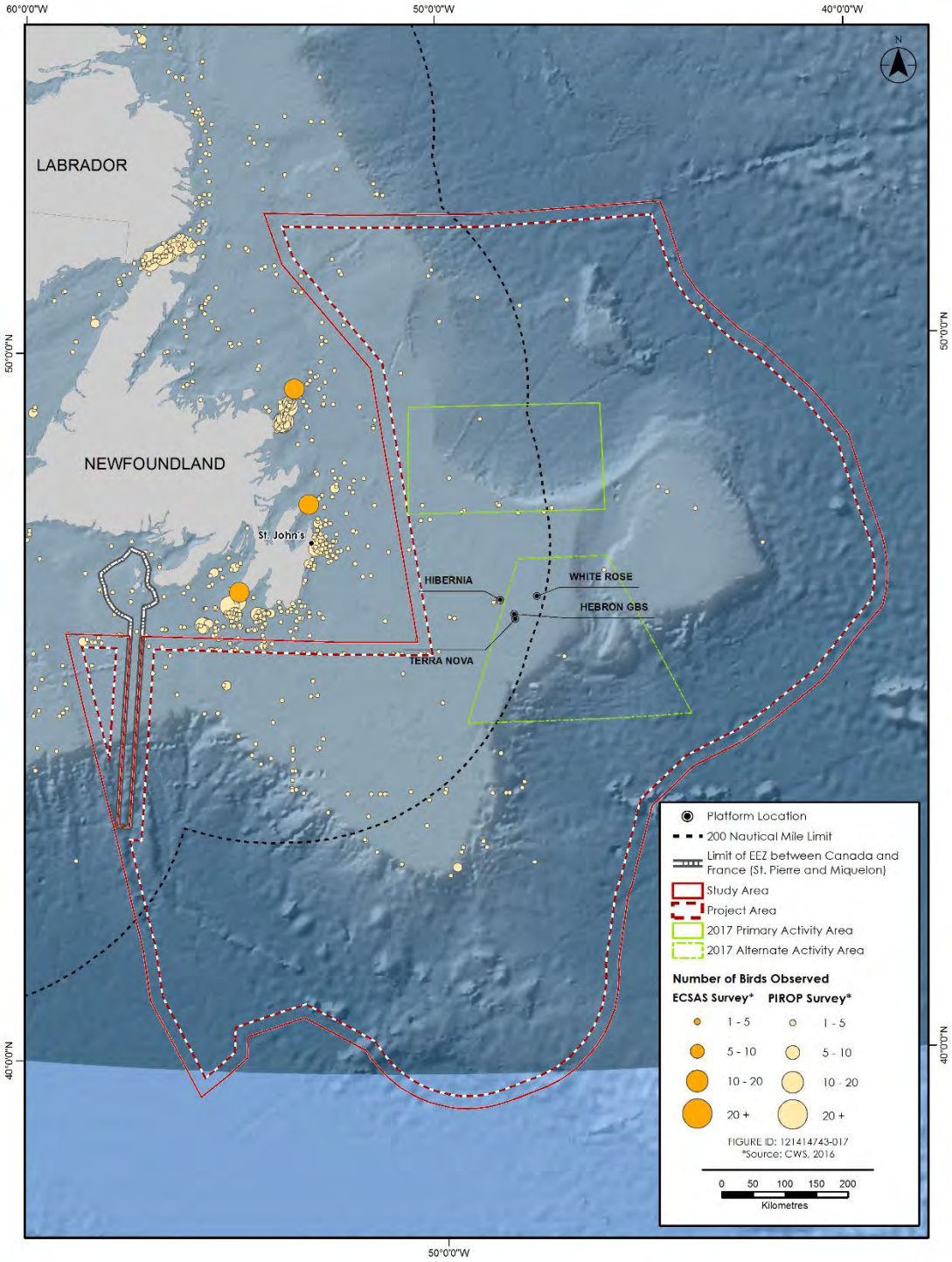

Figure C.1 Gannet Observations

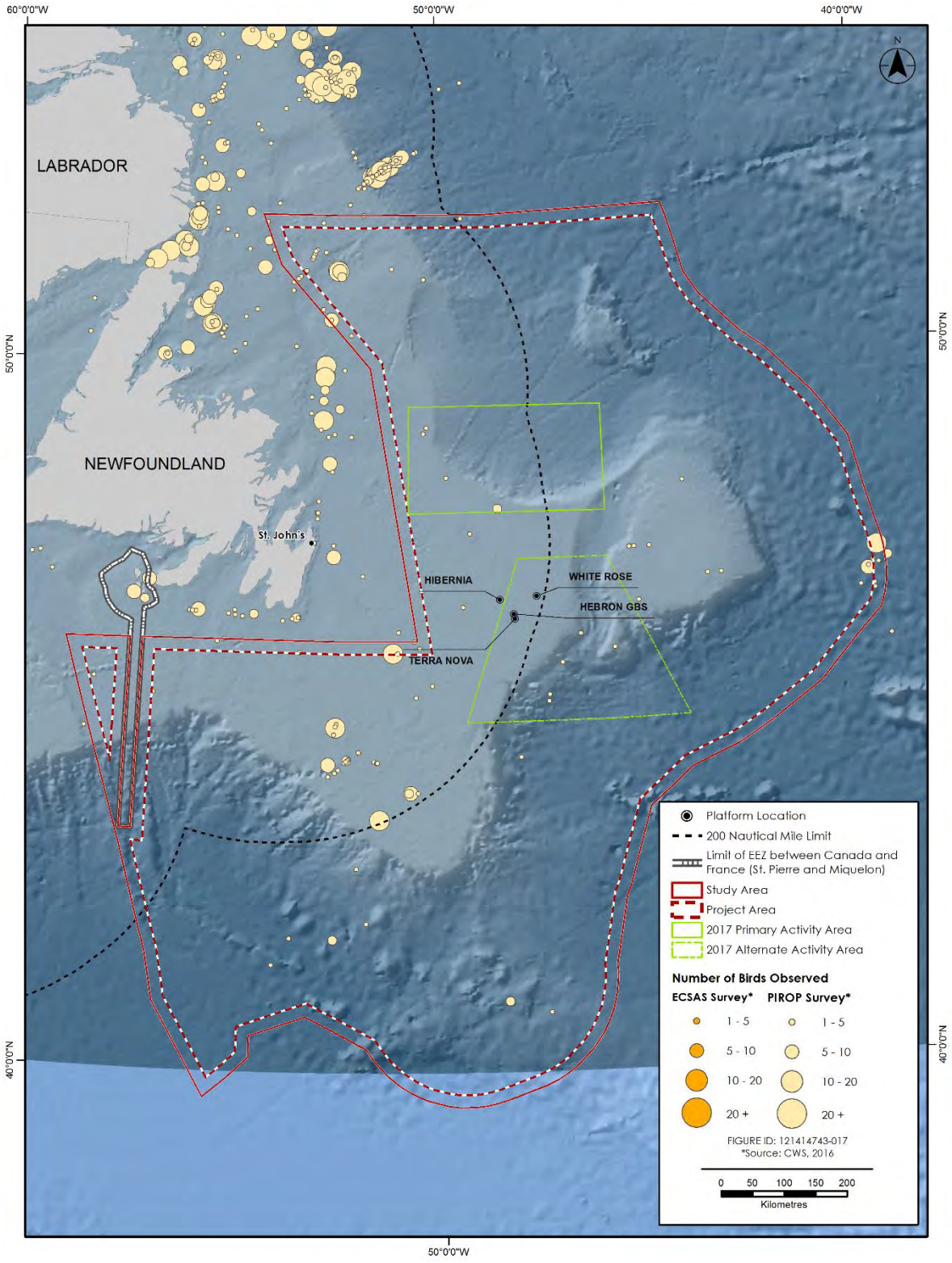

Figure C.2 Phalarope Observations

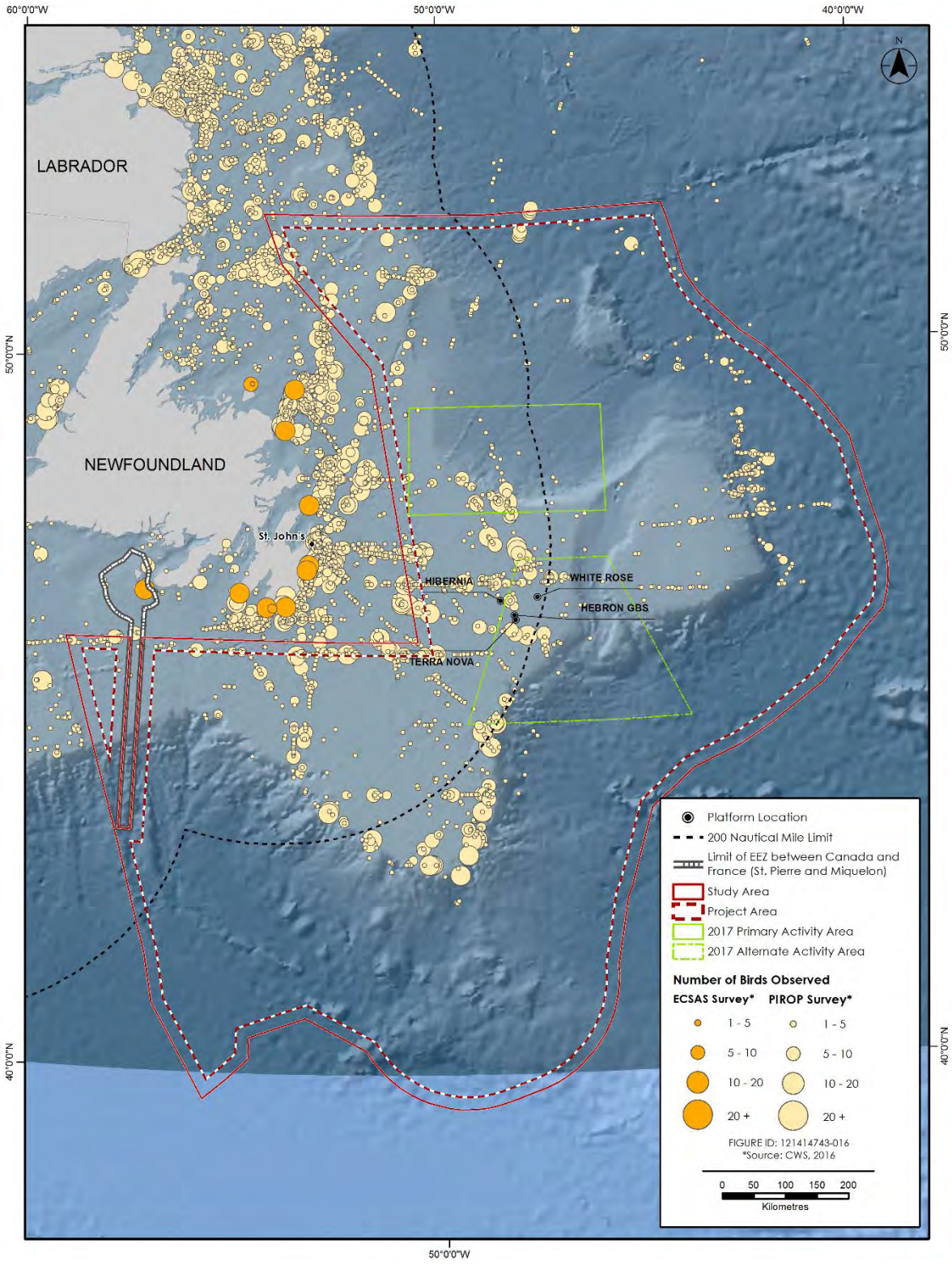

Figure C.3 Murre Observations

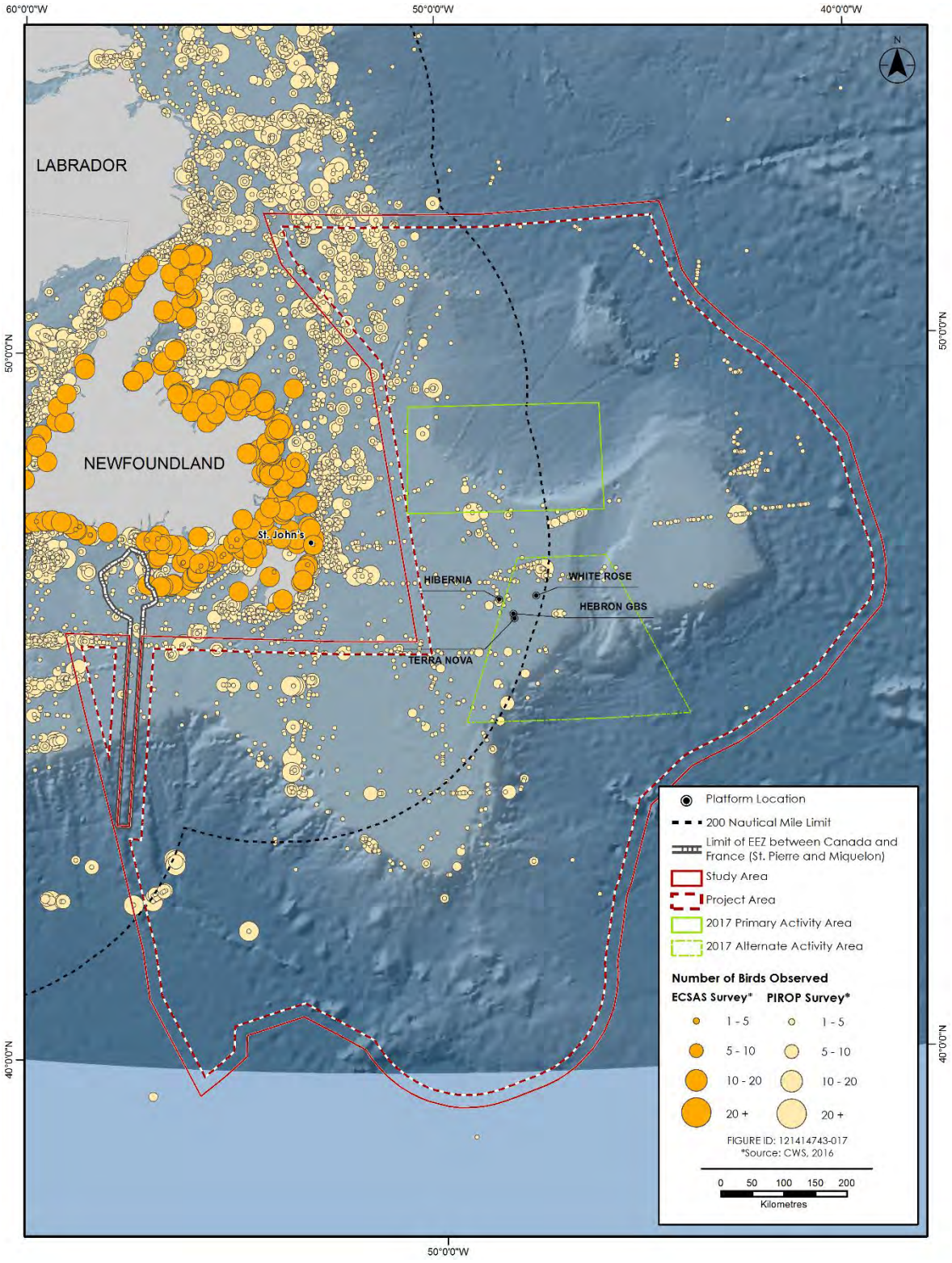

Figure C.4 Gull Observations

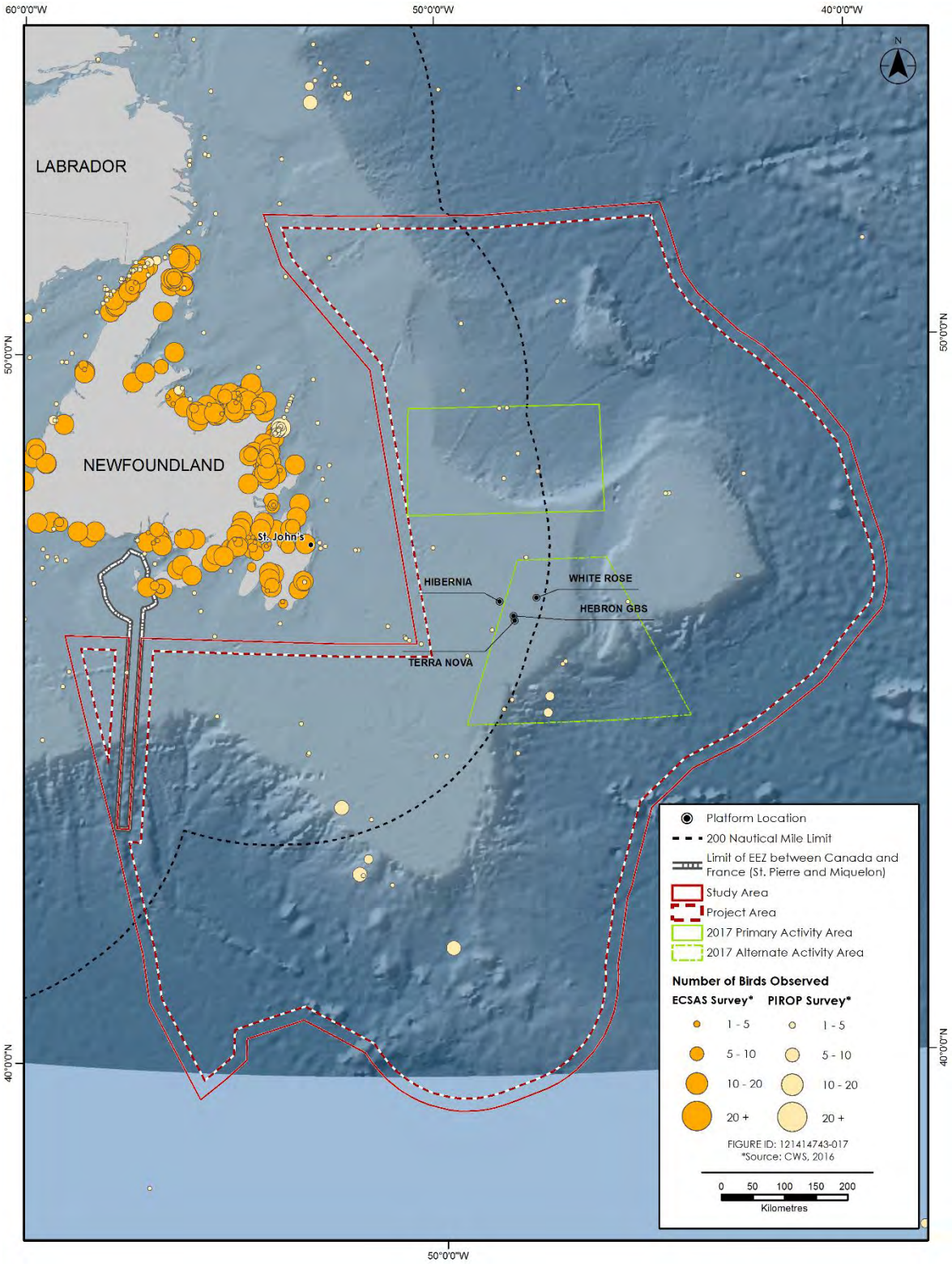

Figure C.5 Tern Observations

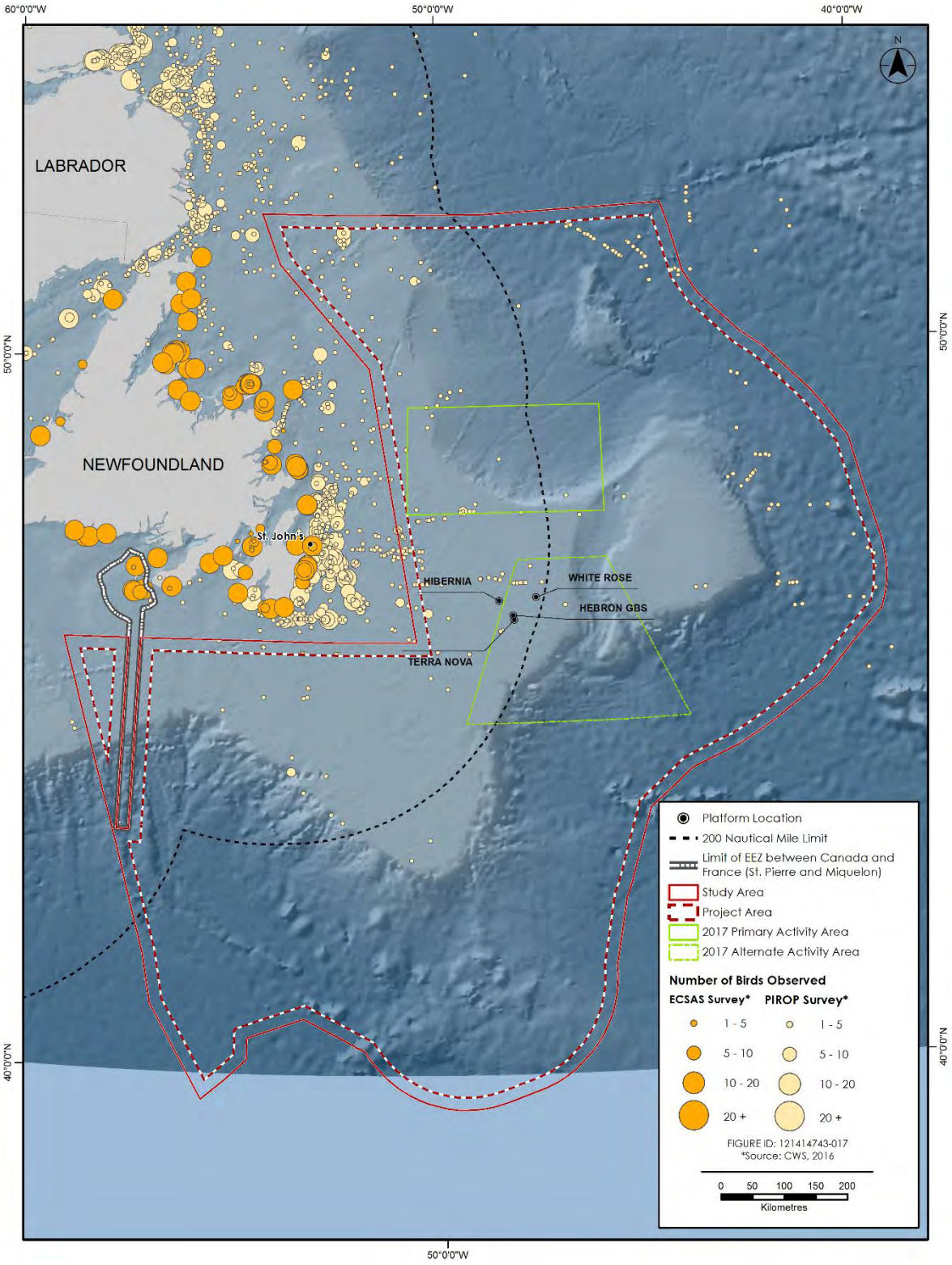

Figure C.6 Alcid Observations

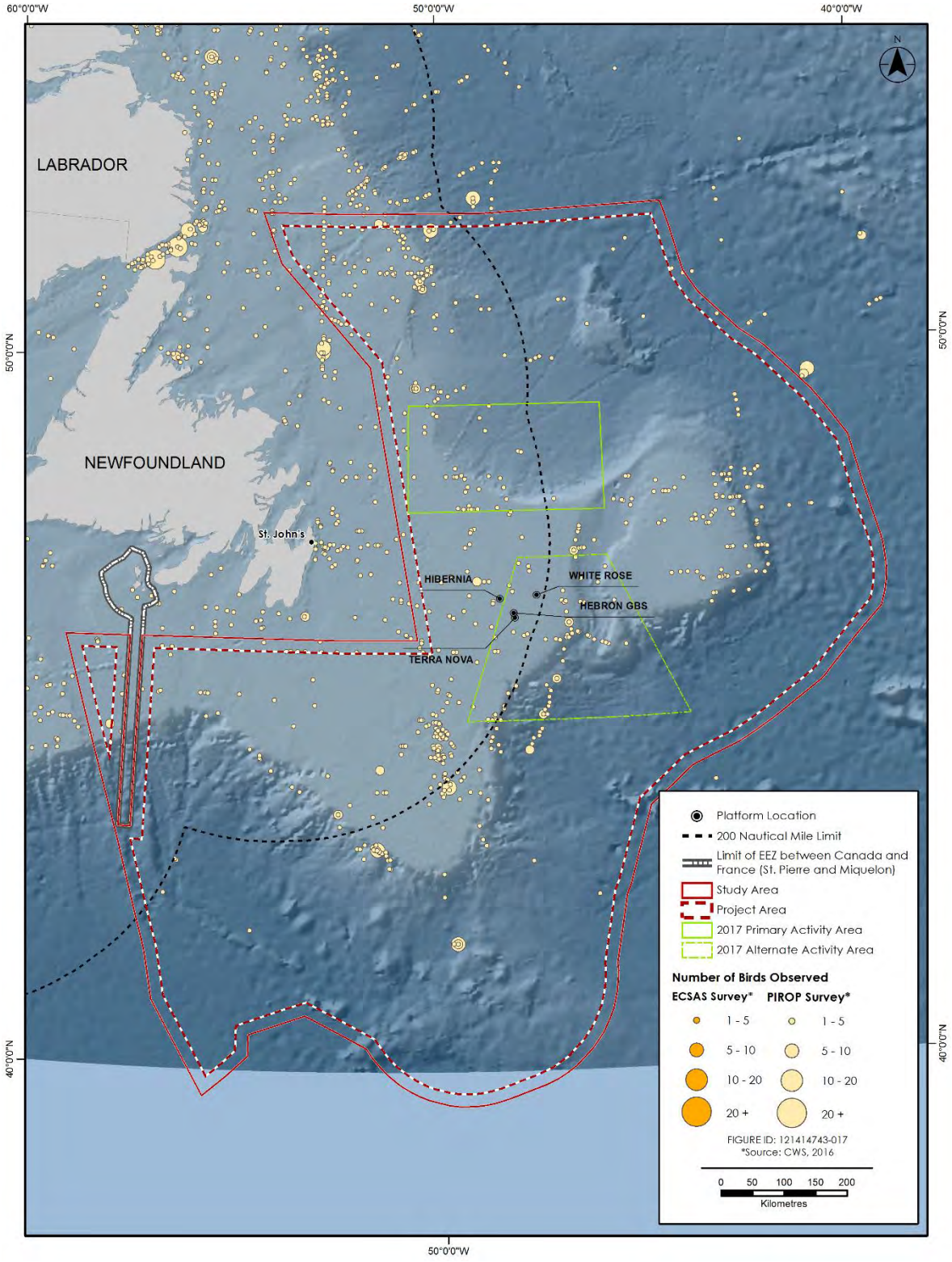

Figure C.7 Skua and Jaeger Observations

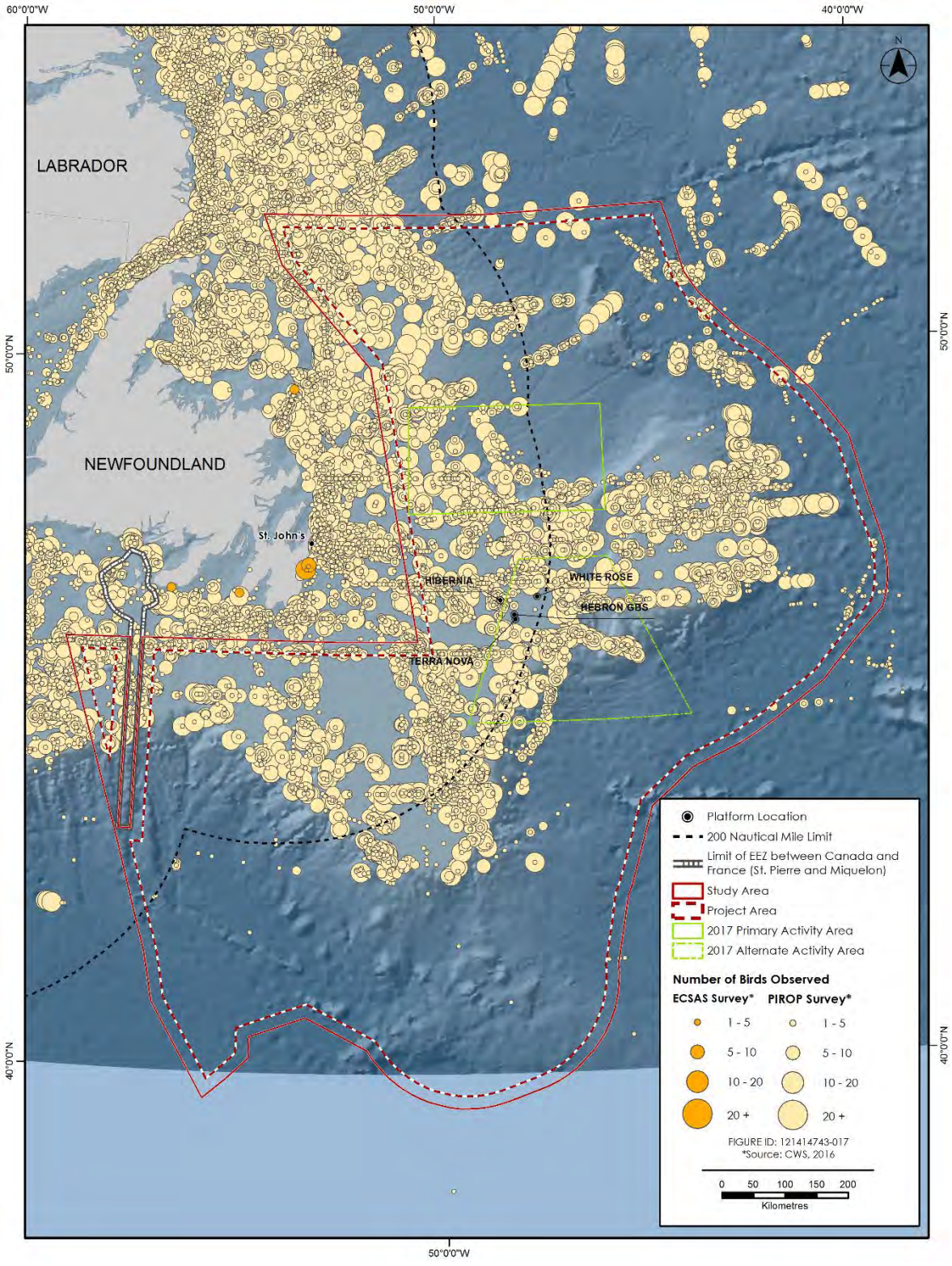

Figure C.8 Fulmar and Shearwater Observations

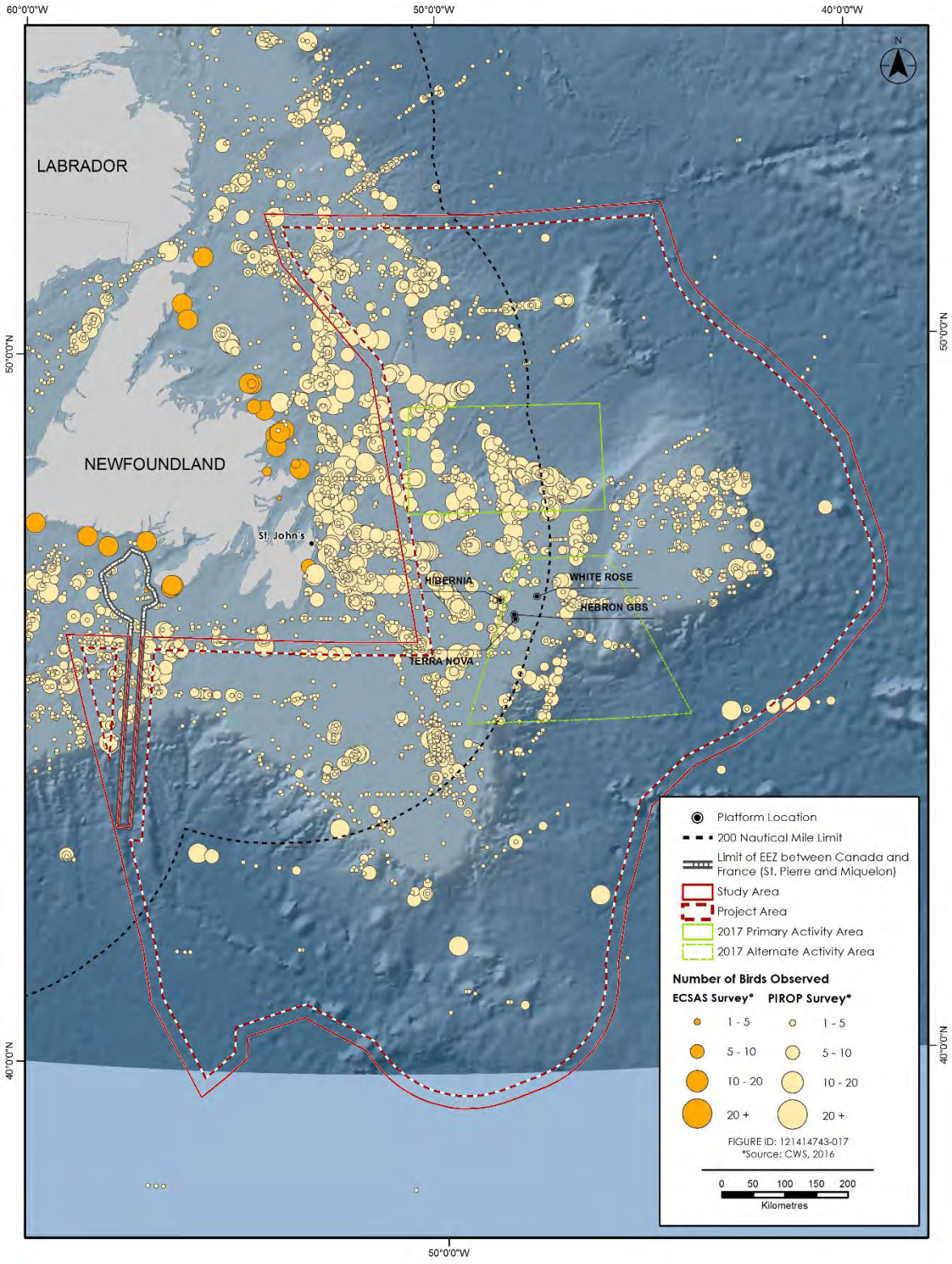

Figure C.9 Storm-petrel Observations

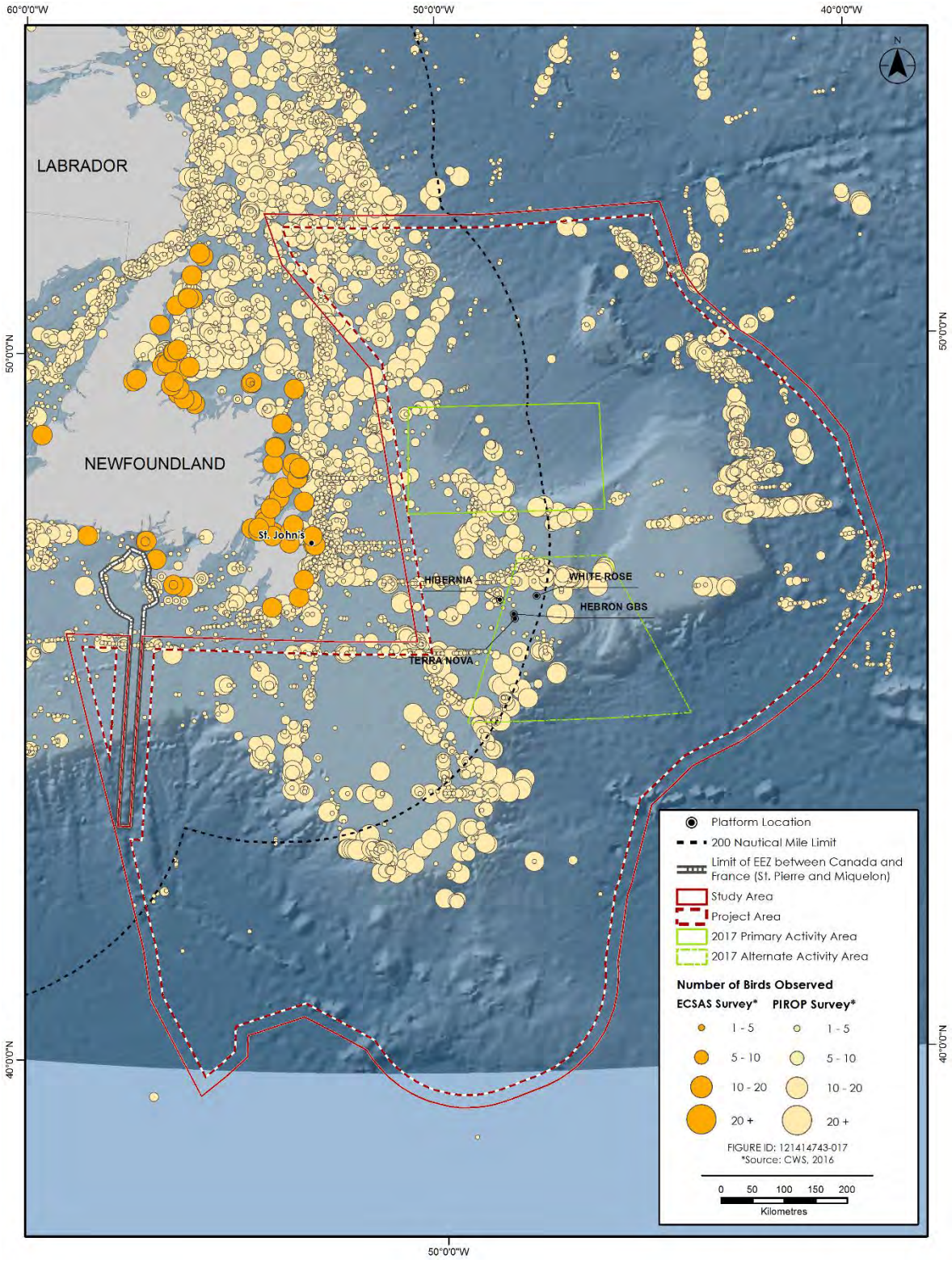

Figure C.10 Kittiwake Observations

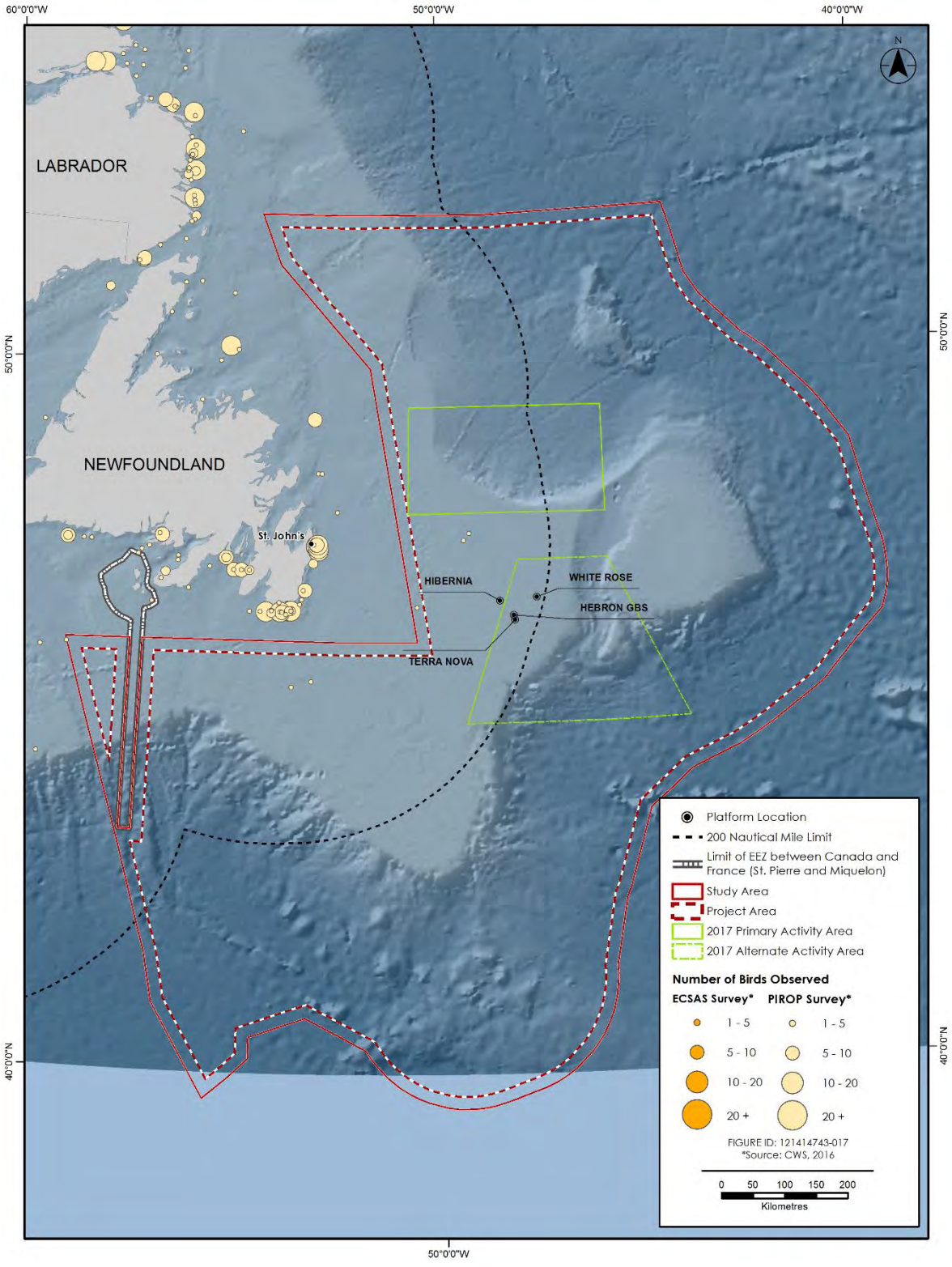

Figure C.11 Coastal Waterfowl Observations