Seafloor and Seep Sampling Program – Labrador Offshore to Jeanne d'Arc Basin (2014 to 2019)

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Revised Draft Report

April 4, 2014

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Executive Summary

This environmental assessment presents information on the proposed seafloor and seep sampling program, as proposed by TGS-NOPEC Geophysical Company ASA and Multi Klient Invest AS and the results of the environmental assessment. The proposed program would be conducted in a Study / Project / Assessment Area extending from offshore Labrador to the Grand Banks / Orphan Basin / Flemish Pass. A description of the proposed program and the existing physical and biological environments is included. Valued Ecosystem Components (VECs) were identified as per the Scoping Document to focus the environmental effects analysis. The VECs selected for this assessment were:

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

This environmental assessment includes consideration of the environmental effects of the proposed seafloor and seep sampling program on each of the VECs, including the potential effects of each of the planned activities and potential unplanned (i.e. accidental) events. Mitigation measures that are technically and economically feasible have been incorporated into the program design and planning.

The residual environmental effects of the proposed seafloor and seep sampling program are predicted to be not significant.

Abbreviations

Cm	centimetre
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CTD	Conductivity, temperature at depth
dB	decibel
DFO	Fisheries and Oceans Canada
FFAW	Fish, Food and Allied Workers
Hz	hertz
kW	kilowatt
L	litre
m	metre
MBES	Multi-Beam Echosounder
MKI	Multi Klient Invest AS
NAFO	Northwest Atlantic Fisheries Organization
SARA	Species at Risk Act
SBP	Sub-bottom profiler
TGS	TGS-NOPEC Geophysical Company ASA
VEC	Valued Ecosystem Component

1.0 Introduction

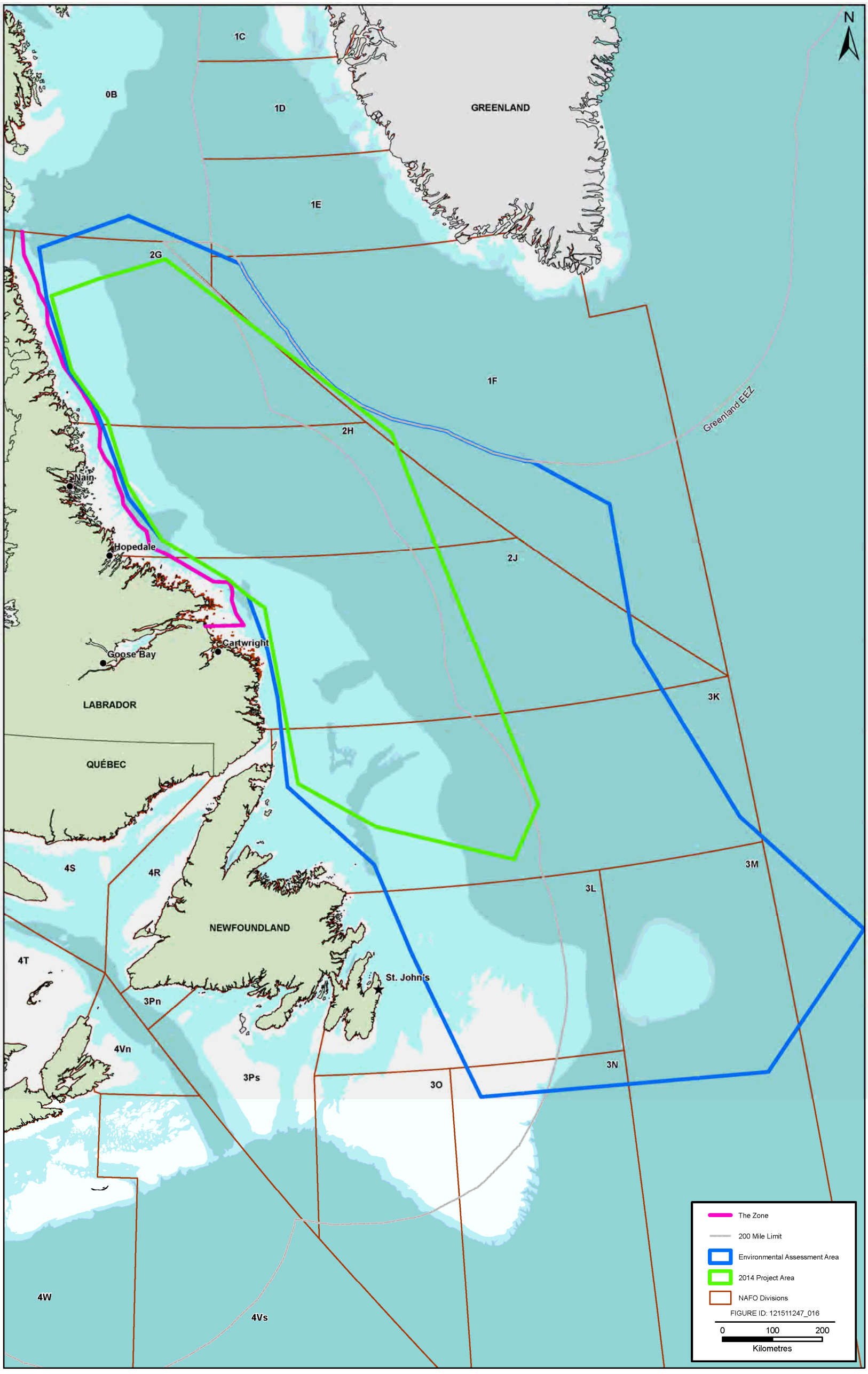
1.1 Background

Exploration activities are to be conducted in the Newfoundland and Labrador offshore area from the tip of northern Labrador to the Orphan Basin to identify those areas that have the potential to contain oil-bearing structures/basins. The proposed Project is a multi-year program (2014 to 2019) to be conducted within the Study / Project / Assessment Area illustrated in Figure 1-1 (coordinates are provided in Table 1.1) and includes the following non-invasive research activities: sampling of natural seafloor seeps, conducting seafloor heat flow measurements, collection of sediment cores, collection of rocks from outcrops, high-resolution bathymetry, sub-bottom profiles and collection of metocean data (specifically, basic conductivity, temperature and depth (CTD) data). There is no seismic (i.e., streamers) involved in this project. Given the restricted nature of the proposed Project (casting and retrieving fishing lines, lowering and raising a core sampler, dragging a rock collector up outcrops and lowering and raising a CTD meter), interactions with the environment and fisheries and other ocean users will be limited.

1.2 Project Proponent

TGS-NOPEC Geophysical Company ASA (TGS) and Multi Klient Invest AS (MKI), a wholly owned subsidiary of Petroleum Geo-Services ASA (PGS), are proposing to conduct seafloor and seep sampling exploration activities offshore Newfoundland and Labrador in the Labrador Sea. TGS will be the operator of the program.

TGS provides multi-client geoscience data to oil and gas exploration and production companies worldwide. In addition to extensive global geophysical and geological data libraries that include multi-client seismic data, magnetic and gravity data, digital well logs, production data and directional surveys, TGS also offers advanced processing and imaging services, interpretation products, permanent reservoir monitoring and data integration solutions. PGS acquires offshore seismic data for oil and gas companies.



Note: "The Zone" refers to the tidal waters of the Labrador Inuit Settlement Area.

Figure 1-1 Multi-year Study / Project / Assessment Area (2014 to 2019)

Table 1.1 Multi-year Study / Project /Assessment Area Coordinates (NAD 83 UTM Zone 21N)

Easting	Northing
587987.14	6649038.40
626589.23	6597249.65
638196.37	6586312.76
646477.50	6569780.67
685001.63	6517916.11
734490.55	6471401.94
788416.85	6435770.28
849378.62	6409272.61
912301.98	6394139.93
960011.56	6384317.85
992109.06	6367548.87
1051448.85	6341478.47
1114450.36	6326050.97
1127330.69	6325196.57
1284159.79	6239991.24
1333329.65	5960216.31
1544419.66	5614755.77
1792294.98	5389834.99
1601333.72	5104857.23
1027070.68	5054885.89
888723.39	5340473.26
813083.06	5519005.21
640134.95	5674253.38
620386.73	5852634.51
600421.00	5947693.91
561015.42	6055933.90
521685.29	6089044.71
388838.96	6168713.20
321921.78	6252298.55
273586.40	6387096.12
250243.07	6444606.48
203592.52	6503310.31
159001.68	6648200.19

Easting	Northing
143673.30	6751680.31
322477.08	6815599.89
546154.16	6719631.03
568313.57	6680908.34

1.3 Regulatory Framework

The activities proposed for this Project can be summarized as sampling of potential natural seafloor seeps, collecting shallow sediment cores, collecting outcrop rocks, conducting seafloor heat flow measurements and collection of metocean data. According to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB 2012)), an environmental assessment must be conducted on any proposed technical programs in the Newfoundland and Labrador Offshore Area. The limited nature of the proposed activities would suggest the requirement for a C-NLOPB review under the Accord legislation only. That is, based on the activities as described, an environmental assessment pursuant to the *Canadian Environmental Assessment Act, 2012* is not required.

1.4 Project Rationale

The onshore and offshore basins of Newfoundland and Labrador are vast and largely underexplored, and modern (primarily non-invasive) technologies now available in onshore and offshore research could help identify new prospective basin areas. The objectives of the sampling survey activities are to identify and characterize petroleum systems, focusing on offshore Labrador. These objectives are met by collecting hydrocarbon seep samples using the gravity coring method, and measuring heat flow in deep water areas. Analyses of seep samples can provide information on the depositional environment, age and maturation of the source, while the measured geothermal gradient will constrain basin models.

The Project covers a large area between 50 to 60N offshore Labrador (Figure 1-1), and includes three sub-areas related to the Saglek, Hopedale and Hawke/Orphan basins. The location of the new sampling targets will be based on the distribution of known direct hydrocarbon indicators (amplitude anomalies identified on TGS/PGS seismic data associated with long-lived oil slicks mapped using satellite data), suggesting active petroleum systems in the areas. Both hydrocarbon macro- and micro-seepage targets will be sampled.

TGS has carried out a number of multi-clients seafloor sampling cruises since 2000 in frontier areas for hydrocarbon exploration. The areas of interest include the Mid-Norwegian Margin, the Jan Mayen Ridge, NE and SW Greenland margins, the Ammassalik Basin, and the Baffin Bay

1.5 Document Organization

The environmental assessment is organized as follows:

- Section 1 introduces the Project, proponent, regulatory context and rationale for the Project.
- Section 2 provides a description of the components of the proposed Project.
- Section 3 describes the existing physical and biological environments
- Section 4 describes the consultation conducted with stakeholders.
- Section 5 describes the valued ecosystem components (VECs), Project-VEC interactions, and the methods used to conduct the environmental effects analyses.
- Section 6 describes the results of the environmental effects assessment.
- Section 7 provides a list of references used in the preparation of the environmental assessment.

2.0 Project Description

2.1 Objectives

The objective of the survey is to collect data for evidence of oil-bearing basins through the collection of sediment cores and outcrop rock samples to develop a lithography of selected sample areas, detection of natural oil seeps and developing a thermal profile of the substrate. The data collected from this program will be input into basin models.

Three types of approaches will be used for sampling seeped hydrocarbons.

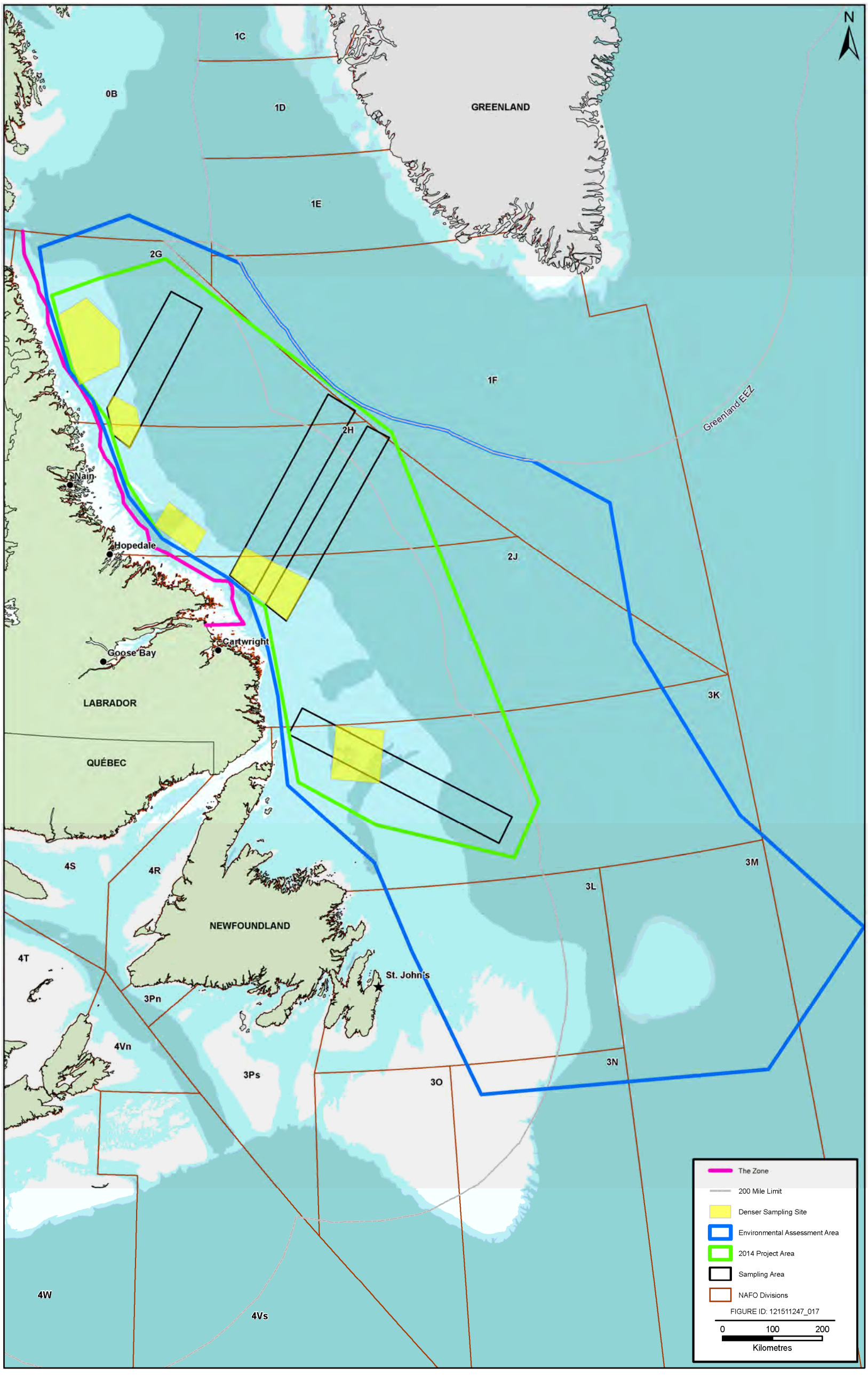
The first approach relies on identifying seismic data terminations of deep-seated faults, shallow amplitude anomalies and depressions on the seafloor associated with oil slicks. These potential macro-seep structures will be sampled by dropping the gravity corer on these specific sites (one to three samples/anomaly). Accurate positioning for macro-seep sampling is important since sub-cropping faults and depressions in the seafloor are small targets. Therefore, the locations of these macro-seep targets will be fine-tuned offshore based on multibeam echosounder (MBE) and sub-bottom profiler (SBP) data acquired prior to the actual sampling. Clay samples will be collected in sealed containers for standard seep studies, amplified geochemical imaging (AGI), and in sterile bags for microbial prospectic technology (MPOG).

The second approach will collect samples following a variable grid above potentially charged structures with or without seabed anomalies. The sampling will be denser above the prospective structure. Micro-seep clay samples will be sealed in containers, and analyzed using the AGI and MPOG. The confidence in identifying the type of fluid phase trapped at depth can be increased by well control, which consists of collecting few calibration samples in the vicinity of wells that are dry, with oil shows, or with gas.

The third approach will consist of sampling slicks on the sea surface. This approach relies on historical satellite data to locate long-lived slicks, and the most recent imagery to locate these slicks that drift depending on currents. The slicks will be sampled using the AGI slick sampling kit.

2.2 2014 Project Area

The Study / Project / Assessment Area for the multi-year geotechnical data acquisition program is illustrated in Figure 1-1. The 2014 Project Area is illustrated in Figure 2-1; coordinates are provided in Table 2.1. The 2014 program focuses on an area that extends from Labrador to the northeast Newfoundland offshore area, specifically the Hopedale Basin, Saglek Basin, St. Anthony Basin and deepwater area of the Labrador Sea. The Project Area for activities in 2015 to 2019 is synonymous with the Study / Project / Assessment Area.



Note: Denser sampling areas (in yellow) are areas of potential seeps.

Figure 2-1 2014 Project Area

Table 2.1 Corner Coordinates for 2014 Project Area (NAD83 UTM Zone 21)

Easting	Northing	ET_ORDER
168320.4	6655502	0
263350.9	6689645	1
395920	6729112	2
848146.6	6381213	3
1141629	5639811	4
1093332	5529032	5
818420.4	5593896	6
661146.8	5680458	7
594825.2	6032113	8
561015.1	6055933	9
521685	6089043	10
388838.7	6168712	11
319098.4	6280983	12
279421.1	6407390	13
208657.3	6505767	14

2.3 Project Scope

TGS is proposing to collect the following data in 2014:

- sampling of potential natural seafloor seeps (by collecting water samples);
- conducting seafloor heat flow measurements using a thermal probe for sediment core locations;
- collection of sediment cores using a gravity core method;
- collection of rocks from outcrops;
- multi-beam bathymetry; and,
- sub-bottom profiling.

No metocean data will be collected in the first year (2014). Any combination of the data could be collected in 2015 to 2019; however, the potential for any future activities will be based on the results of the proposed 2014 program.

2.3.1 Detection of Natural Seafloor Seeps

Natural seeps accounted for 160,000 tonnes of the 260,000 tonnes of petroleum released into the marine environment in North America from 1990 to 1999 (National Academy of Sciences 2002). TGS is proposing to conduct a sampling program to identify areas of potential natural seafloor seeps.

Samples to detect the presence of oil from natural seafloor seeps will be collected with an AGI (GORE) or similar sampling kit. The sampler is hydrophobic (i.e., repels water) and can collect hydrocarbons from very thin oil layers in the water. The deployment / retrieval mechanism is similar to a fishing rod (folding casting device, weighted bobbers and fishing line and hardware); the sampling containers are deployed by casting them out (Figure 2-2) from the vessel. Laboratory analysis (by thermal desorption / gas chromatography/mass spectrometry) can detect approximately 100 compounds from C_6 to C_{35}, including key biomarkers (AGI 2013).

As TGS is proposing to collect samples along a pre-identified sampling design, rather than from a known oil seep, it is proposed that the sampler will be cast from the bow of the vessel, allowing the sampler to ride the bow wave of the vessel for five minutes as the vessel maintains a speed of 3.7 to 5.6 km/h (2 to 3 knots).

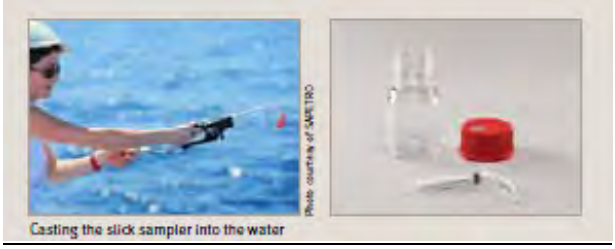


Figure 2-2 Example of GORE Sampling

2.3.2 Heat Flow Measurements

The temperature of the substrate can give an indication of the potential for hydrocarbons beneath the surface. Heat flow measurements will be taken using a thermal probe mounted to the exterior of a gravity core barrel. The thermistors are placed along the length of the core barrel on an outrigger made of stainless steel double bands. This arrangement can indicate through temperature measurements whether a thermal gradient occurs within the substrate. Heat flow measurements are anticipated to be collected at up to 300 locations in 2014, with potential for additional sampling in subsequent years (if the program is conducted beyond 2014).

Accurate positioning for macro-seep sampling is important since sub-cropping faults and depressions in the seafloor are the main targets. Fine, soft sediments (e.g., clays and silts) are required to achieve good penetration by the heat-flow probes. Prior to releasing the gravity corer to sample the substrate, high-resolution bathymetry will be acquired to refine the sampling locations and a sub-bottom profiler (SBP) will be used to determine if any subsurface hazards are present in the sampling area.

2.3.3 High-resolution Bathymetry

A MBE will be used to collect data to provide high-resolution bathymetry along a narrow strip. These types of data allow differentiation between pockmarks and iceberg plough marks on the seafloor. In addition, the resolution of the MBE data permits the identification of additional smaller pockmarks that cannot be resolved with existing seismic data. The MBE has also previously been used to image gas plumes rising from an active seep locality. The MBE will be mounted to the hull of the research vessel and it is anticipated it will operate at 30 kHz (the source level is less than 228.8 dB measured 1 m from the energy source stated in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012)).

2.3.4 Sub-bottom Profiling

Data collected by a SBP can image between 5 to 40 m of sediments below the seafloor, with a typical 15 cm resolution between reflections. SBPs are used to identify surficial geology, boulder till, channel fill, slumping, faulting, gas-charged sediments, iceberg scours, morphology of depositional units, shipwrecks, sea floor obstructions, bedforms indicative of sea floor, or sediment dynamics. The SBP is a crucial instrument for identifying shallow gas anomalies (acoustic blanking), and any other anomalies in the layering of the reflections close to the seafloor. Subsurface hazards, which can damage the sampling equipment, can also be identified on the SBP data with their characteristic hyperbolic reflections above the seafloor.

The SBP is typically mounted on the hull of the vessel or side-mounted on a retractable post and consists of an array of transducers driven by a SES-2000 medium-100 top-end system with up to 50 kW combined on all channels. The SBP is designed for offshore applications down to 2,000 m water depth, with primary high frequency bandwidth of 90 to 115k Hz and a secondary low frequency bandwidth of 2 to 22 kHz; this is within the threshold (less than 228.8 dB measured 1 m from the energy source) stated in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012).

2.3.5 Seafloor Sample Collection

2.3.5.1 Sediment Sampling

Once the sample location has been selected and is confirmed clear of subsurface hazards, sediment cores will be collected up to a depth of 3 m using a gravity corer (Figure 2-3). The gravity corer will be lowered to within 50 m of the substrate. Once positioned (and thermal probe acclimation is completed), the corer will be triggered to release and penetrate into the substrate, collecting a sediment sample. Once the core is retrieved, temperature will be recorded at set depths within the core. These temperature measurements supplement the data obtained from the external thermistors. Gravity core samples are anticipated to be collected at up to 300 locations.

Figure 2-3 Example of a Gravity Corer

The gravity corer comprises a core barrel, liner and cutting shoe. On top of the core barrel is a series of adjustable weights totalling 0.8 ton. The core barrel is 3 m. A plastic liner is inserted in the core barrel, with a core catcher inserted at the end of the plastic liner, and a cutting shoe (bit) screwed to secure the liner in the barrel. The gravity corer has a non-return valve at the top of the tube to avoid water ingress and sample wash-out when retrieving the corer. The gravity

corer is deployed on a single steel lifting cable from the trawl winch, and penetration is achieved by allowing the unit to free fall the last 5 m to the seabed. Penetration is gravity driven, and not assisted by a piston. For core recovery length less than 3 m (i.e., liner length), penetration length will be assumed to correspond to the recovery length. For full recovery (i.e., 3 m), the penetration of the gravity corer into the sediments can be estimated by recording the line between a clean and muddy gravity corer. If the gravity corer is recovered covered in mud, the penetration depth can only be estimated to be greater than 4 m (i.e., core barrel + weight length).

The assembled gravity corer is typically attached to a swivel and wire-rope with shackles. The gravity corer will be deployed using a winch that has freefall capabilities and a cable counter. Optionally, the gravity corer can be deployed in such a manner that it can be tracked on the fish-finder in order to determine the right depth for freefall release on the winch. After penetration of the gravity corer into the seafloor, the equipment is brought back slowly to avoid any suction effect and loss of sampling material. After recovery the corer is secured and the core liner is extracted.

2.3.5.2 Outcrop Sampling

A towed dredge will be used to collect rock samples from outcrops on the seafloor (not loose sediments). The chain-bag attached to the end of the tow bridle forms a net, with wide spacing between the chain-links close to the sampler to allow soft pelagic clay to be washed out and closer spacing at the end for capturing rock fragments.

The tow wire is attached with a swivel to the mid-point tow-ring of the sampler tow bridle (Figure 2-4). The dredge is lowered to the water depth. The tow wire is deployed with a minimum length equal to the double of the water-depth to position the sampler opening parallel to the seafloor as possible. Once in position, the dredge is lowered onto the seafloor (cable length is 1.5 times the water depth) and the vessel will follow the sampling profile (i.e., TGS seismic line) at 3.7 km/h (2 knots). The cable length is regularly adjusted to maintain a cable length of 1.5 times the water depth. A dredge profile along an escarpment is generally carried out into two steps with at least 500 m overlap. In order to recover brittle / soft rocks, the chain bag is fitted with a nylon net-bag that has a smaller mesh size. This will allow for the capture of finer pieces of rock fragments, and still allow soft clay to be washed away. The dredge contents are emptied out onto the deck (see Figure 2-5), and the soft clay is washed with a high-pressure hose. Up to 30 to 35 rock outcrops will be sampled.

Note: Typical dimensions are 90 x 40 x 30 cm + 120 cm chain bag

Figure 2-4 Typical Rock Sampler

Figure 2-5 Example of Contents of Rock Sampler

2.4 Vessel

As the geochemical data acquisition program is designed to collect information to be used in a basin model, accurate positioning data are key. The data will be collected using a research vessel with dynamic positioning capabilities. The vessel will also be required to be able to deploy and retrieve the various sampling equipment proposed as part of the geochemical data acquisition program. And given the Study / Project / Assessment Area (see Figure 1-1), the vessel will also be required to work in the harsh conditions of the Labrador offshore area and the northern Grand Banks / Orphan Basin / Flemish Pass / Cap areas.

TGS will contract a certified vessel that is capable of working in Labrador Sea conditions. The selected vessel will be required to have equipment and protocols and procedures in place for prevention of pollution by oil, sewage and garbage in accordance with the *Canadian Shipping Act* and international standards and certification authorities. At no time will a survey vessel enter or attempt to conduct any survey work in restricted or protected areas. TGS is in the process of selecting a vessel to conduct this research survey and will update the C-NLOPB with the vessel's specifications once selected.

TGS will consult with the Fish, Food and Allied Workers (FFAW) on the location of their members who fish in the area and contact the local FFAW representative to provide information on the vessel movements during the survey program.

2.5 Schedule

TGS are proposing to conduct the natural seafloor seep sample collection, heat probe, gravity core and outcrop rock sample collection components of the research program in the open water / ice-free season of 2014. The start date is anticipated to be July 1, 2014. The program is anticipated to require 30 to 45 days to conduct all sample collection; TGS have scheduled an eight-week period to conclude the program, allowing for weather delays. Future programs (2015 to 2019, if any are conducted) will be conducted in open / ice-free waters.

2.6 Health, Safety and Environmental Management

TGS is committed to leading the industry in minimizing the effects of its activities on the environment. This commitment is achieved by assessing their effects on those environments, planning operations to minimize those environmental effects, monitoring their performance against those plans, complying with applicable laws, regulations and guidance, monitoring the environmental performance of their contractors, and seeking means for continuous improvement.

TGS will contract a vessel that has equipment and protocols and procedures in place for prevention of pollution by oil, sewage and garbage in accordance with the *Canadian Shipping Act* and international standards and certification authorities. Solid wastes, recyclables, hazardous materials and non-biodegradable materials will be stored and returned to shore for

proper handling and disposal. At no time will a survey vessel enter or attempt to conduct any survey work in restricted or protected areas. Transport Canada will conduct a Safety Inspection of the vessel in accordance with requirements of the C-NLOPB. TGS will have a representative on board the vessel to accompany Transport Canada during their survey.

TGS is committed to providing a safe and healthy workplace for its employees, contractors and clients while protecting the environment in which they work. TGS is dedicated to the continuous improvement of health, safety and security standards for its people and insists on the same policy from its contractors.

The company has defined safe operating procedures in the Health, Safety and Environment Management System that are designed to meet or exceed all appropriate legal requirements and, in the absence of any defined standards, to meet or better generally-accepted, industry-wide "best operating practices". The company will actively participate with all client / contractor associations and relevant authorities in developing standards and promoting the image of the industry.

A high level of safety awareness shall be maintained by means of safety meetings, internal auditing, review meetings and general communications. All employees are actively encouraged to participate in the conduct and management of safety by means of achieving defined objectives and standards, which are regularly reviewed and appraised.

TGS requires all employees and contractors to be accountable for and committed to their own health and safety as well as for those with whom they work. Line management has the responsibility for the communication and implementation of TGS health and safety policies. Line management will also require that employees have the appropriate training to enable compliance with health and safety requirements.

2.7 Key Mitigation Measures

The scope of work is limited and entails deploying and retrieving a seep sampling kit, lowering and raising a core sampler (and a CTD meter) and collecting rock samples from outcrops. The primary interaction with the environment will be the operation of the vessel and the collection of sediment / rock samples. The following mitigation measures will be applied to this Project:

- TGS 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.
- At no time will a survey vessel enter or attempt to conduct any survey work in restricted or protected areas, including the Nunatsiavut Zone ('The Zone'), established under the *Labrador Inuit Land Claims Agreement* (2005)
- TGS proposes to place a Fisheries Liaison Officer on board the research vessel.

- TGS will continue to consult with the FFAW 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.
- TGS, in consultation with the FFAW Petroleum Industry Liaison, will time the sampling of the identified areas in a sequence that creates the least disruption to local fishers.
- As the data collection will occur over a 24-hour period, lighting is required at night for safety purposes; 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 protocol of Williams and Chardine (1999). A Live Seabird Salvage permit may be required.
- The research vessel will avoid seabird colonies.
- TGS will contact Department of National Defence prior to start of the Project to determine where naval exercises are being conducted; TGS will revise sampling area order if necessary to avoid interaction with naval vessels.
- TGS will contact DFO prior to start of the Project to determine where DFO research vessels are conducting surveys; TGS will revise sampling area order to avoid conflict with DFO research vessels.

3.0 Existing Environment

Given the generally non-intrusive nature of the proposed Project (using a science research vessel to deploy natural seafloor seep samplers into the ocean surface using fishing line, collect heat gradients and cores using a gravity corer with thermal probes and collect rocks from outcrops), Project-environment interactions are anticipated to be few. If Project-environment interactions occur, the components of the environment most likely to be potentially affected by the proposed Project are fish habitat (sediment and rocks) and fisheries and other ocean users (vessel conflict).

3.1 Physical Environment

The 2014 survey will be conducted both along the Labrador Shelf and in deeper waters in the Labrador Sea, with the 2014 to 2019 Study / Project / Assessment Area extending to the Orphan Basin, northern Grand Banks and Flemish Cap. Water depths range from less than 70 m within 2 km of the Labrador coast (into which the Project does not extend) to 3,500 m in the offshore portion of the Study / Project / Assessment Area. Sea temperatures in the Labrador Shelf and offshore range from -2°C to 0°C, with warmer temperatures in the southern extent of the Study / Project / Assessment Area (0°C to 15°C). Air temperatures range from -15°C to 12°C. Pack ice can occur from November to July in the Labrador portion of the Study / Project / Assessment Area, extending down to the southern portion of the Study / Project / Assessment Area in February. Sea ice and icebergs are also present, with icebergs occurring from July to October in the Labrador Shelf Area and the majority along the east coast occurring from March to June or July. Wind speeds are highest in the fall and winter and decline in spring and fall. Waves are also at their highest in the fall and winter. The average number of foggy days is highest from May to August (C-NLOPB 2010, 2011a, 2011b).

Oceanic water is an excellent medium for conducting sound. The National Research Council (2003) groups anthropogenic sound sources into six categories: shipping; seismic surveying; sonars; explosions; industrial activity; and miscellaneous). Ambient sound is highly variable on oceanic continental shelves and can be comprised of wind, thermal sound, precipitation, vessel traffic and biological sources. There is a lack of noise measurement and modelling in the Labrador shelf and offshore area. Vessel traffic is a major contributor to ambient noise and dominates in the 20 to 300 Hz frequency range, with distant fishing vessels peaking at 300 Hz (Richardson et al. 1995, in Husky Energy 2010; Section 3.3.3). Wind, large surface waves and precipitation produce noise is in the range of approximately 100 Hz to 50 kHz, 1 to 20 Hz and above 500 Hz, respectively (Wentz 1962, in Husky Energy 2010, Section 3.3.3). Marine mammals also contribute to the ambient noise, producing noise in the range of 0.01 (blue and fin whales) to 150 (harbour porpoise) kHz (Husky Energy 2010; Section 3.3.3; Table 3-1).

3.2 Species at Risk

A number of species at risk (as listed under the *Species at Risk Act* (SARA) or assessed as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) have the potential to occur throughout the proposed Study / Project / Assessment Area (Figure 1.1), either as sporadic visitors or regular inhabitants. Species and their critical habitat (if identified) listed under SARA Schedule 1 are legally protected in Canadian waters. These include the following species listed on SARA Schedule 1:

- marine fish - white shark (Endangered), northern wolffish (Threatened), spotted wolffish (Threatened) and Atlantic wolffish (Special Concern);
- marine mammals - blue whale (Endangered), North Atlantic right whale (Endangered), fin whale - Atlantic population (Special Concern), Sowerby's beaked whale (Special Concern) and polar bear (Special Concern);
- marine reptiles - leatherback sea turtle (Endangered); and
- marine and/or migratory birds - Ivory Gull (Endangered). Barrow's Goldeneye (Special Concern) and Harlequin Duck (Special Concern) are two primarily coastal species that could occur in the Study / Project / Assessment Area. Eskimo Curlew (Endangered) is thought to be extinct.

Species assessed as at-risk by COSEWIC (but are not listed on SARA Schedule 1) that could occur in the Study / Project / Assessment Area include:

- marine fish - Atlantic cod - Newfoundland and Labrador population (Endangered), porbeagle shark (Endangered), roundnose grenadier (Endangered), American eel (Endangered), smooth skate - Funk Island population (Endangered) (note Hopedale Channel and Nose of the Grand Banks populations have been assessed by COSEWIC as Data Deficient; there is also a Flemish Cap population that is outside Canadian jurisdiction, but within the multi-year Study / Project / Assessment Area), Atlantic salmon (various populations) (Endangered, Threatened, Special Concern), American plaice - Newfoundland and Labrador population (Threatened), cusk (Threatened), shortfin mako shark (Threatened), Acadian redfish (Threatened), deepwater redfish (Threatened), white hake (Atlantic and Northern Gulf of St. Lawrence population (Threatened), blue shark - Atlantic population (Special Concern), basking shark - Atlantic population (Special Concern), roughhead grenadier (Special Concern), spiny dogfish (Special Concern), thorny skate (Special Concern) and Atlantic bluefin tuna (Grand Banks of Newfoundland only) (Special Concern).
- marine mammals - harbour porpoise (Special Concern), killer whale (Special Concern), loggerhead sea turtle (Endangered), beluga whale (various populations) (Endangered, Threatened, Special Concern), bowhead whale (Eastern Canada – West Greenland population) (Special Concern) and northern bottlenose whale (Davis Strait-Baffin Bay-Labrador Sea population) (Special Concern).

There is no designated critical habitat, as defined under SARA, in the Study / Project / Assessment Area.

3.3 Marine Fish and Shellfish

3.3.1 Fish Habitat

The Labrador Sea is a highly productive ecosystem, with a spring phytoplankton bloom that starts in March and peaks in the spring, followed by a zooplankton bloom; there is another phytoplankton bloom that peaks in the fall (C-NLOPB 2010). Benthic polychaete assemblages are influenced by topographical features on the ocean floor, while bivalve assemblages are distributed at approximately 5 to 25 m water depth; other types of assemblages, such as barnacles, sea urchins and suspension feeders, also have distinct substrate requirements (C-NLOPB 2010).

3.3.2 Fish and Shellfish

Northern shrimp, snow crab and Greenland halibut are the most important commercial fish species occurring within the Study / Project / Assessment Area (accounting for up to 95 percent of the annual harvest in recent years). Other fish and shellfish species include redfish (species at risk), Atlantic salmon (species at risk), Arctic char, sand lance, capelin, herring, Arctic cod, rock cod, Atlantic cod (species at risk), witch flounder, winter flounder, yellowtail flounder, American plaice (species at risk), lumpfish, Atlantic mackerel, white hake (species at risk), angler fish, haddock, cusk (species at risk), grenadier (species at risk), American eel (species at risk), thorny skate (species at risk), smooth skate (Funk Island population species at risk), wolffish(species at risk), spiny dogfish (species at risk), black dogfish and porbeagle shark (species at risk) (Husky Energy 2010; LGL 2011; RSP 2011).

Northern or pink shrimp occur from the Gulf of Maine in the south to the Davis Strait in the north. Females typically produce 2,400 eggs on average (Haynes and Wigley 1969, in Husky Energy 2010; Section 5.2.4.3), with eggs in summer and attached to the female until the female migrates to shallow coastal waters to spawn the following spring (Ollerhead et al. 2004, in Husky Energy 2010; Section 5.2.4.3). Northern shrimp grow by moulting their shells. Shrimp undergo a vertical migration during the day from the bottom into the water column to feed on small pelagic crustaceans. Predators of northern shrimp include Greenland halibut, cod (Fisheries and Oceans Canada (DFO) 2006, in Husky Energy 2010; Section 5.2.4.3), Atlantic halibut, skate, wolffish and harp seal (DFO 2000, in Husky Energy 2010; Section 5.2.4.3).

Snow crab occur over a broad range of depths from the Gulf of Maine to Greenland. Females lay between 20,000 to 150,000 eggs and carry the eggs for approximately two years. The eggs then remain in the water column for up to eight months before settling to the seafloor (DFO 2002, in Husky Energy 2010; Section 5.2.4.2; Fisheries Resources Conservation Council 2005, in Husky Energy 2010; Section 5.2.4.2), where they undergo a series of moults as they increase in size. Commercial-size crabs commonly occur at depths of 70 to 280 m (Elner 1985, in Husky Energy

2010; Section 5.2.4.2). Snow crab feed on fish, clams, benthic worms, brittle stars, shrimps and crustaceans, including smaller snow crabs. Predators include various groundfish and seals (DFO 2002, in Husky Energy 2010; Section 5.2.4.2).

Greenland halibut (turbot) is a deep-water flatfish that extends from the Scotian Shelf to Greenland over a wide range of depths (90 to 1,600 m), with larger individuals occurring in deeper waters. The spawning grounds of Greenland halibut are believed to be located southwest of Iceland and extend to south of the Flemish Pass off Newfoundland (Junquera and Zamarro 1994, in Husky Energy 2010; Section 5.2.5.2). While maturing, Greenland halibut are thought to move to deep water and migrate north to the spawning area, suggesting a continuous stock throughout the range (Bowering 1982, in Husky Energy 2010; Section 5.2.5.2). Greenland halibut in the Northwest Atlantic are thought to be a relatively homogenous genetic stock; however, there is some evidence that genetic mixing does occur.

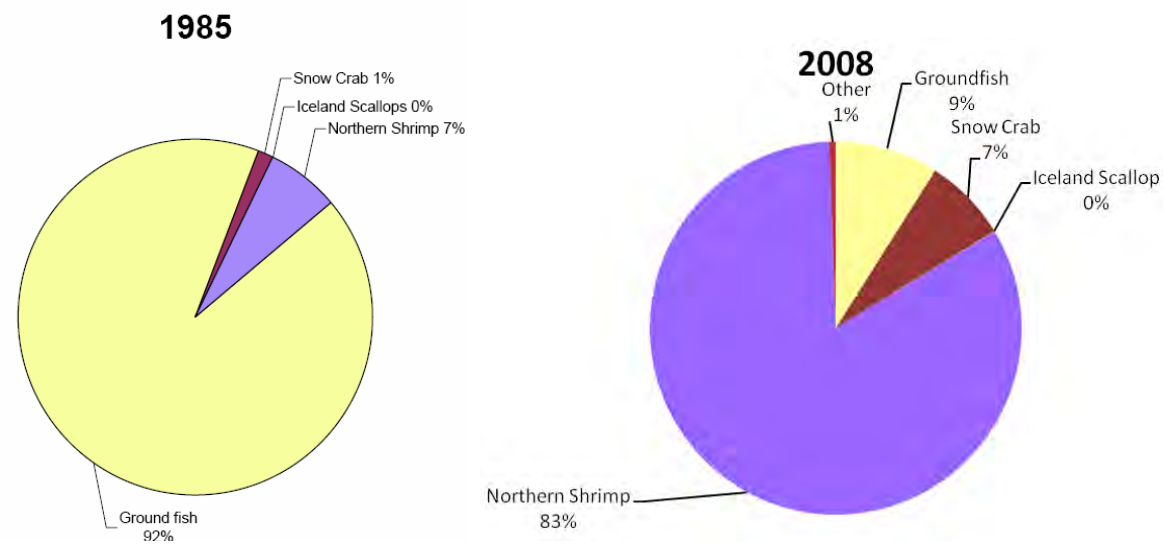
3.4 Fisheries and Other Ocean Users

3.4.1 Fisheries

Groundfish catches in Northwest Atlantic Fisheries Organization (NAFO) Area 2 (refer to Figure 2-1) were large in the 1970s and 1980s; however, the fishery was considerably curtailed at the time of the moratorium in the early 1990s (Figure 3-1). In 1985, groundfish landings dominated the NAFO Area 2 harvest, comprising 92 percent of the fishery. Since then, the groundfish fishery in NAFO Area 2 has been considerably reduced while the crustacean (particularly northern shrimp) fisheries have increased in their importance (Husky Energy (2010); Section 5.5.2) (Figure 3-2). The same was seen in NAFO Areas 3KLM, with groundfish harvest between 1990 to 2009 reflecting the onset of the moratorium, and the shrimp and snow crab harvest increasing in catch and value importance (LGL (2011); Section 4.3.2, Figures 4.4 and 4.5). There have been minimal foreign fisheries in NAFO Area 2GHJ since the onset of the moratorium (see Figure 3-1). There is minimal foreign fishery in 3K, approximately half the catch in 3L is foreign and almost all of the catch in 3M is foreign (LGL (2011); Section 4.3.1.3, Table 4-5).

Source: Husky (2010); Section 5.5.2

Figure 3-1 Northwest Atlantic Fisheries Organization 2GHJ Harvest, 1985 to 2004, Foreign and Domestic

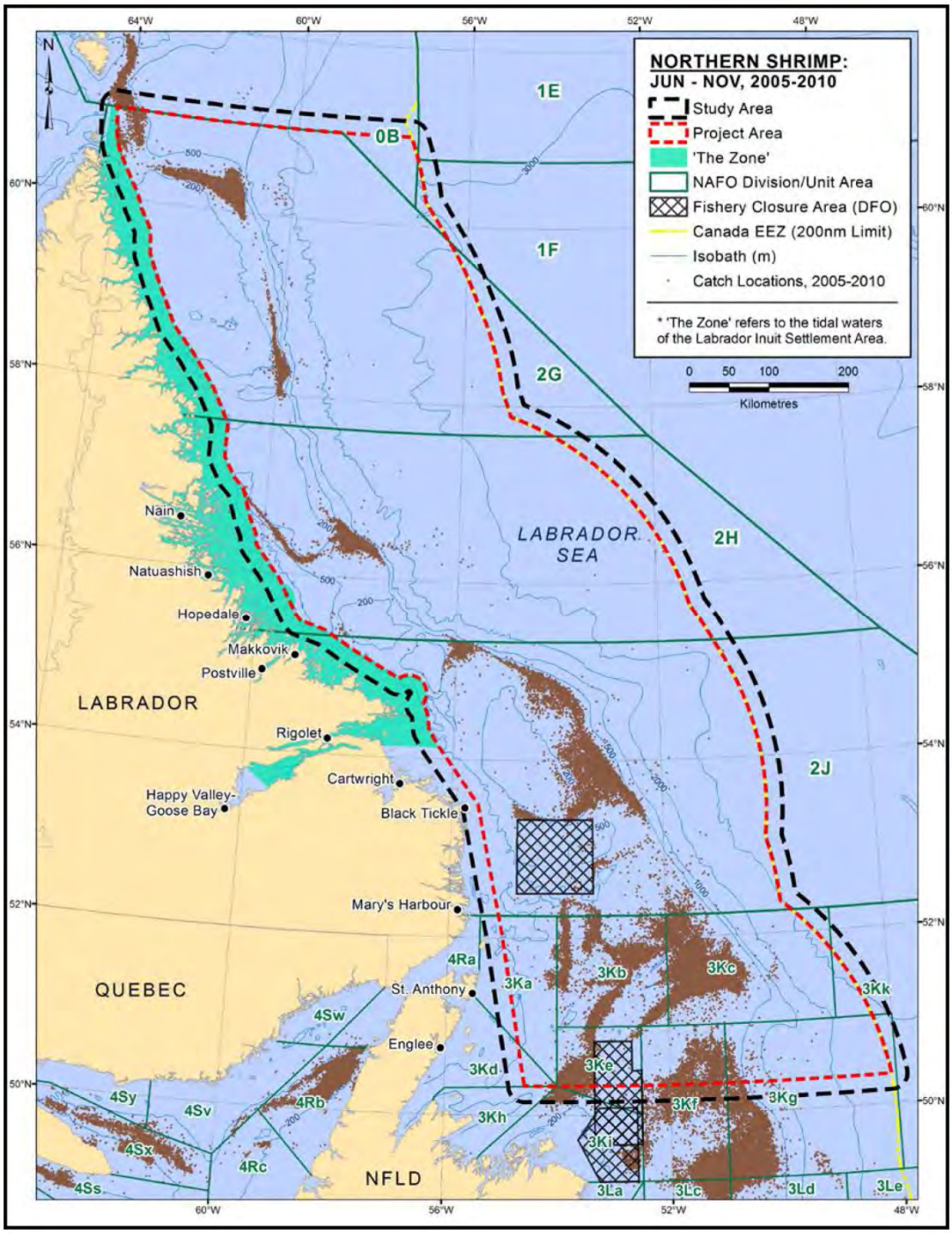


Source: Husky (2010) Section 5.5.2

Figure 3-2 Northwest Atlantic Fisheries Organization Area 2 Composition of Harvest, 1985 and 2008

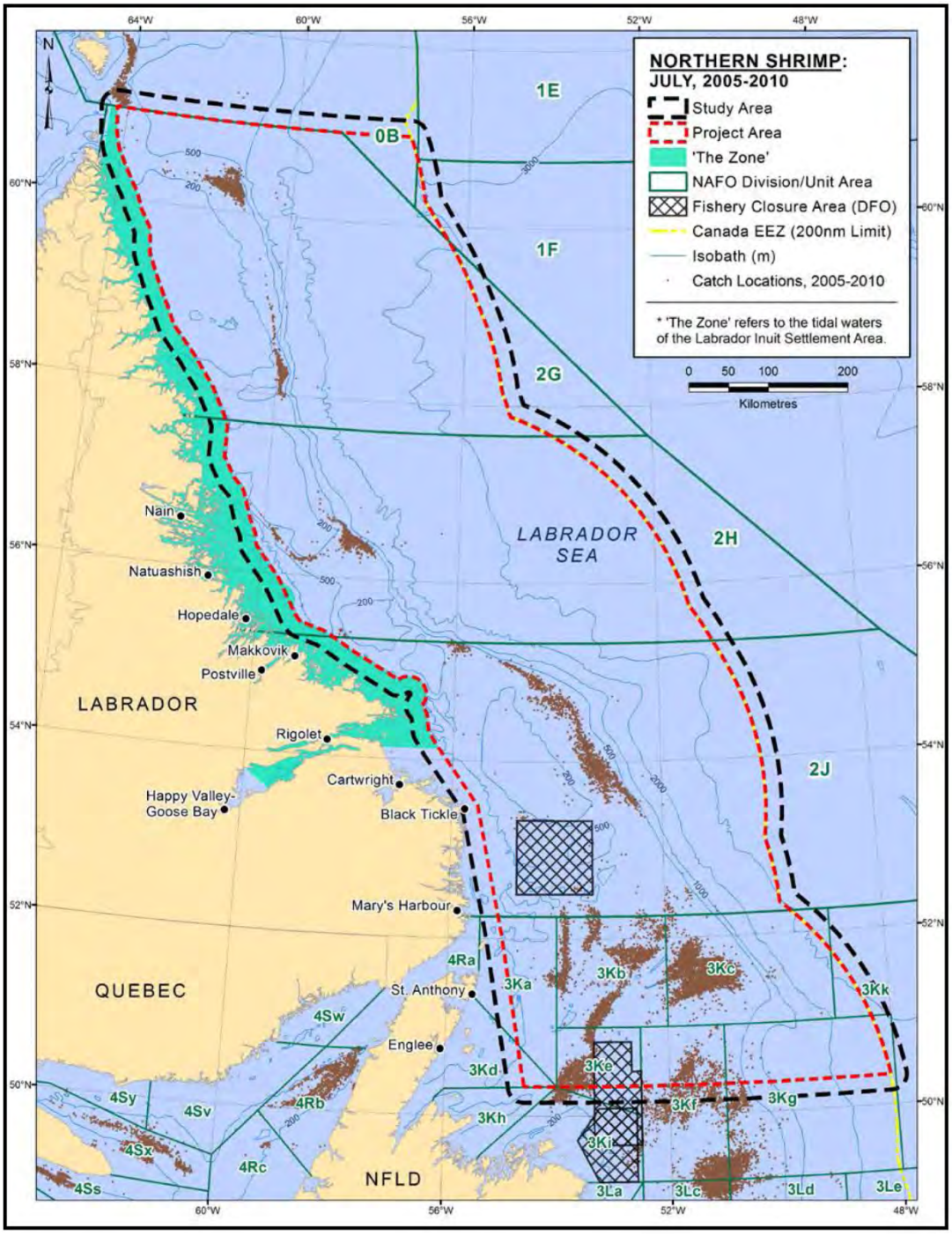
Fisheries in the Study / Project / Assessment Area are focused primarily on northern shrimp, which accounts for approximately 85 percent of the harvest in NAFO 2GHJ (Husky Energy 2010), and approximately 60 percent of the harvest in 3KLMN and 2J (RPS Energy 2012). Shrimp spawn in the late summer and fall and are harvested using mobile gear (trawl). Snow crab mate in late winter and spring and are an important component in 3KLMN and 2J; they are harvested using fixed gear (crab pots). Greenland halibut is the other species most often harvested in the Study / Project / Assessment Area and spawn during December to April; they are harvested using both fixed gear (gillnets and longlines) and mobile gear (otter trawls). These three species account for approximately 95 percent of the harvested fish in the Study / Project / Assessment Area (C-NLOPB 2010, 2011; Husky Energy 2010).

The domestic harvesting locations offshore Labrador (LGL Limited and GX Technology Canada Ltd. 2013; Section 4.3.2.2)) for shrimp (2005 to 2010 combined) from June to November and in July (proposed survey period for this sampling program) are illustrated in Figures 3-3 and 3-4, respectively. The domestic harvesting locations for snow crab (2005 to 2010 combined) from June to November are illustrated in Figure 3-5. The domestic harvesting locations for Greenland halibut (2005 to 2010 combined) for June to November are illustrated in Figure 3-6.



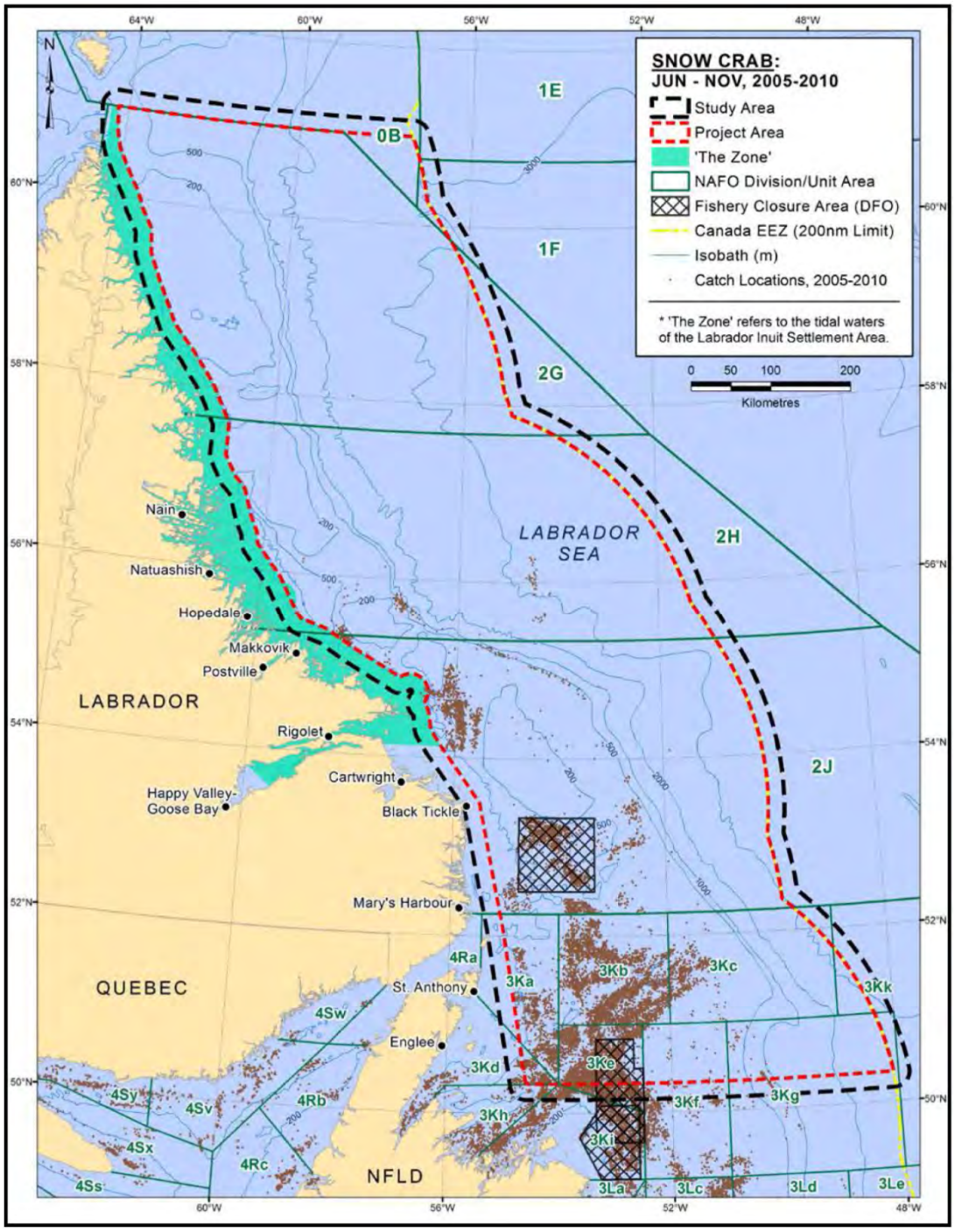
Source: LGL Limited and GX Technology Canada Ltd. 2013 (Figure 4-24, page 77)

Figure 3-3 Domestic Harvesting Locations for Northern Shrimp (2005 to 2010 combined) from June to November



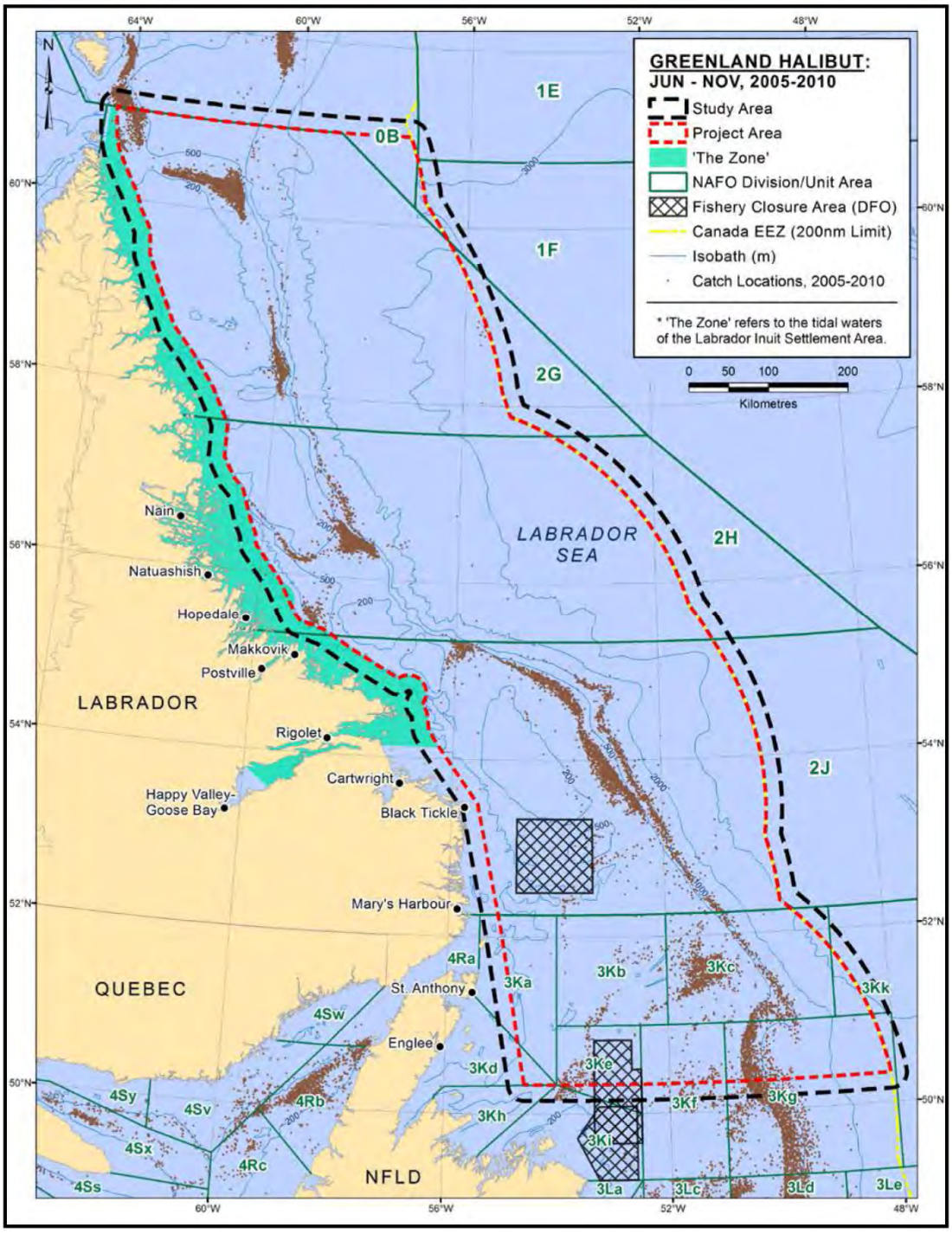
Source: LGL Limited and GX Technology Canada Ltd. 2013 (Figure 4-28, page 80)

Figure 3-4 Domestic Harvesting Locations for Northern Shrimp (2005 to 2010 combined) in July



Source: LGL Limited and GX Technology Canada Ltd. 2013 (Figure 4-34, page 86)

Figure 3-5 Domestic Harvesting Locations for Snow Crab (2005 to 2010 combined) from June to November



Source: LGL Limited and GX Technology Canada Ltd. 2013 (Figure 4.37, page 88)

Figure 3-6 Domestic Harvesting Locations for Greenland Halibut (2005 to 2010 combined) from June to November

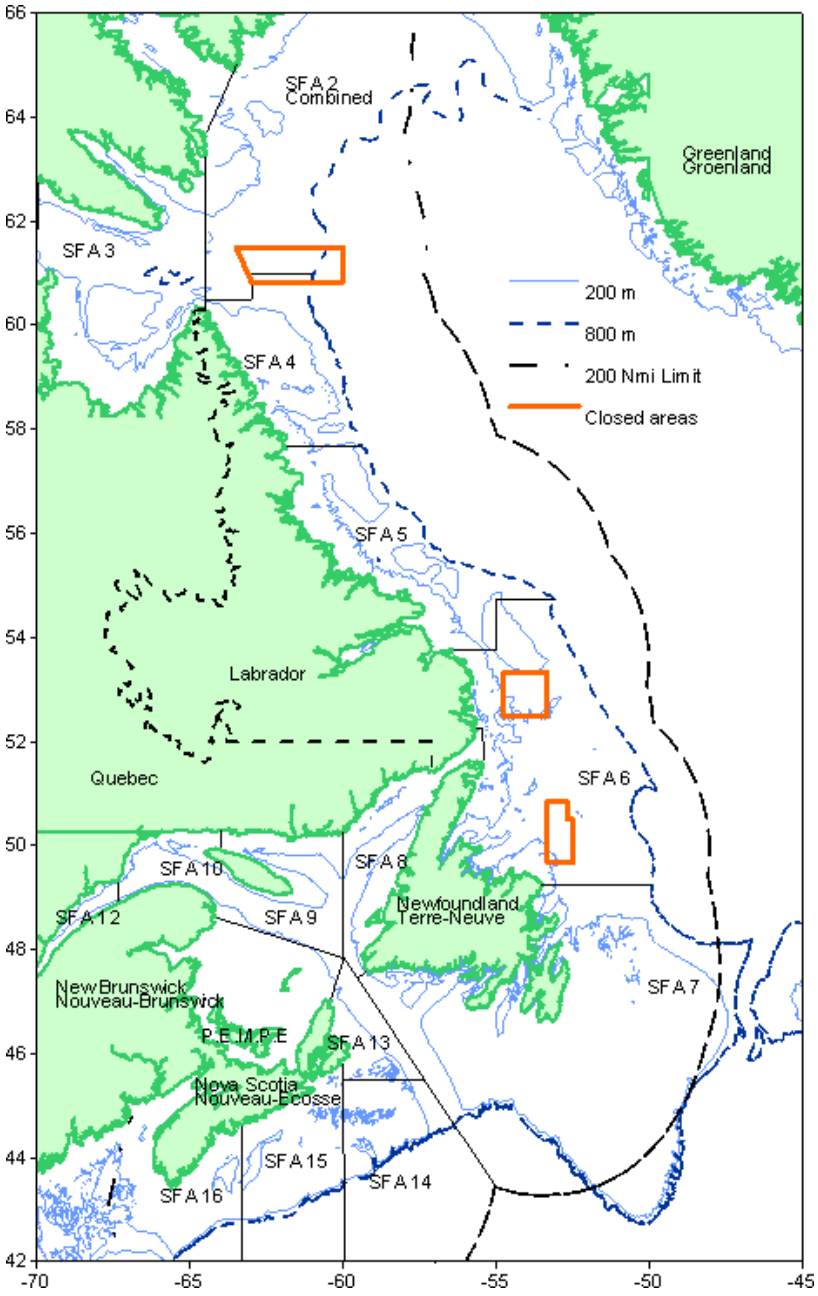
Figures illustrating the percent weight and percent value of these three species in 2011 and 2012 are provided in Appendix A (Figures A-1 to A-12). DFO Ottawa Statistical Division has a policy that prohibits the wholesale release of fisheries data in order to maintain privacy of individuals that could potentially be identified through detailed microdata. Spatial data are released at an aggregated 1/10th degree cell level only. No absolute values of weight and value are provided; the actual weight and value of a catch within each box are provided as a range. Therefore, the figures illustrate an average percentage of the weight / value percentage data provided by DFO. The weight / value percent for a specific cell has been summed and divided by the number of months that specific cell was fished (i.e., when the cell was fished, x% of species A was caught in the boundaries).

3.4.2 Other Ocean Users and Presence of Marine Survey Vessels

The southern portion of the Study / Project / Assessment Area includes the Orphan Basin, Flemish Pass/Cap and the northern Grand Banks. Ongoing oil and gas activities in these areas include seismic surveys, exploration drilling and production platforms.

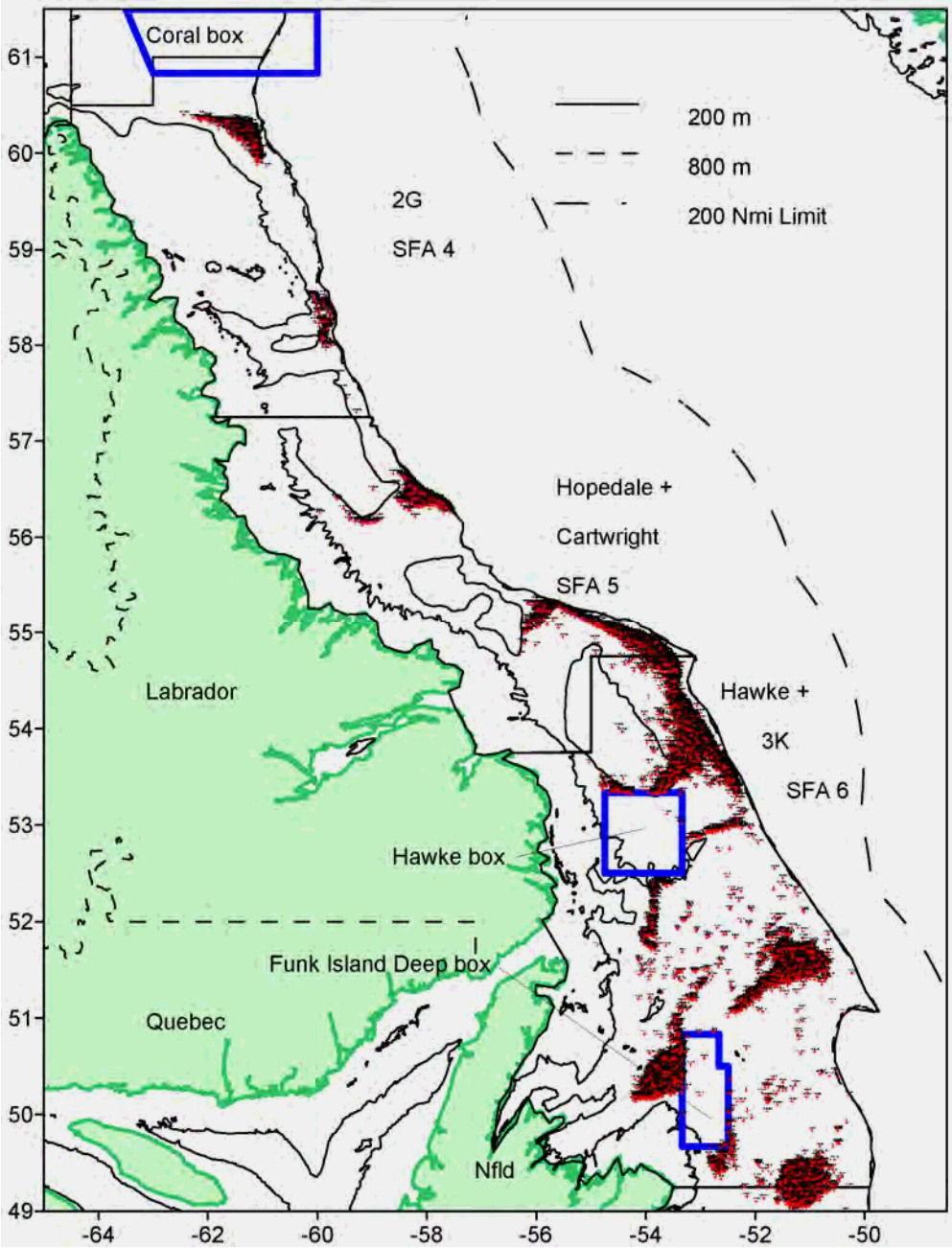
"The Zone" (refer to Figure 1-1) encompasses 48,690 km² of ocean established under the *Labrador Inuit Land Claims Agreement* (2005). Labrador Inuit have the right to harvest fish and marine mammals for Inuit food, social and ceremonial purposes within "The Zone" (Husky (2010); Section 5.5.9). Food that is used by traditional harvesting is important to the health and social well-being of families, as well as the economy (Alton Mackey and Orr 1987, in Husky 2010; Section 5.5.9). Traditional fish species include Atlantic cod, Arctic char, rock cod, salmon and other fish species such as herring, capelin, smelt, flounder, turbot, halibut, whitefish, redfish and sculpin (Alton Mackey and Orr 1987 and Brice-Bennett 1977, in Husky 2010; Section 5.5.9). Other species collected in the coastal waters of The Zone include migratory birds, seals, polar bear, harbour porpoise and white-sided dolphins (LGL Limited and GX Technology Canada Ltd. 2013; Section 4.3.4). The sampling program proposed by TGS will not enter The Zone. Recreational fishing for Atlantic salmon and Arctic char is restricted to coastal marine waters or in fresh water.

Shrimp Fishing Areas (SFAs) are illustrated in Figure 3-7. The Northern Shrimp Research Foundation, in conjunction with DFO, conducts an annual summer survey collecting shrimp from water depths between 100 to 750 m, typically from July 15 to the first week of October, in SFA 4 (NAFO Division 2G) (Orr et al. 2011) (Figure 3-8). As of March 2010, analysis of data collected from SFA 4, as well as data acquired during the DFO multispecies surveys in SFA 5 (Hopedale and Cartwright Channels) and 6 (NAFO Division 3K + Hawke Channel) indicated that northern shrimp appear to be increasing in the northern part of the survey area (SFAs 4 and 5) and decreasing in the south (SFA 6) (Orr et al. 2011).



Source: DFO 2013
NOTE: The orange boxes indicate closed areas (Coral – voluntary for large vessels; Hawke Channel, mandatory for large and small vessels; Funk Island Deep mandatory for small vessels and voluntary for large vessels).

Figure 3-7 Shrimp Fishing Areas



Source: Orr et al. 2011
NOTE: The red crosses indicate large and small vessel fishing positions during the 2009/2010 management year. The Blue boxes indicate closed areas (Coral – voluntary for large vessels; Hawke Channel, mandatory for large and small vessels; Funk Island Deep mandatory for small vessels and voluntary for large vessels).

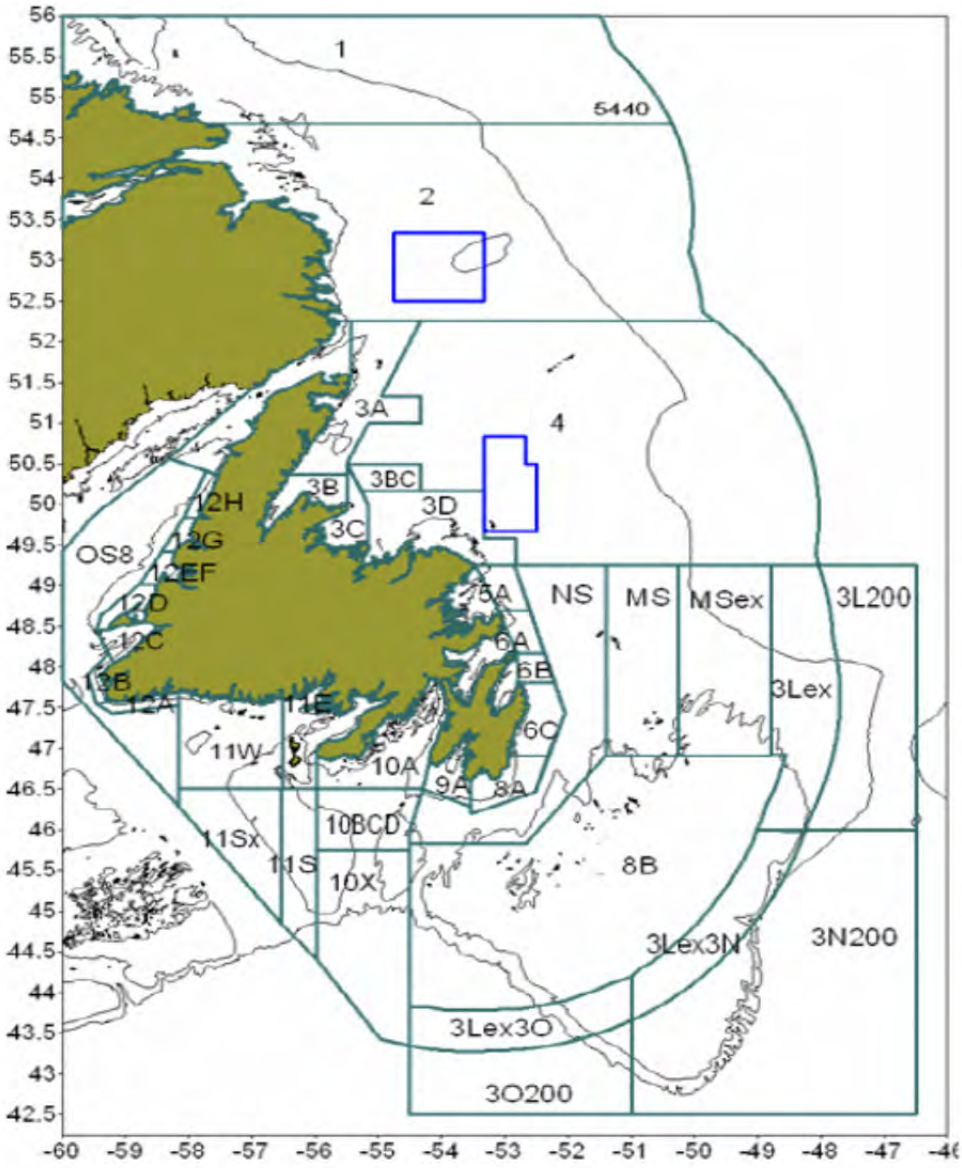
Figure 3-8 Northern Shrimp Research Foundation 2009/2010 Fishing Locations

Crab Management Areas are illustrated in Figure 3-9. The DFO-Industry Post-Season Crab Survey is conducted annually (usually starting in September) and extends from 3O north to 2J (Figure 3-10; the 2013 survey locations are illustrated in Appendix B). The 2012 post-season crab survey ran from August 29 to November 17. The 2013 post-season crab survey collected samples from the same locations as the 2012 survey and the locations and timelines for the 2014 survey will be exactly the same as they were last year (D. Power, pers. comm.). Analysis of data collected from 2004 to 2012 indicated that there is no one pattern applicable to Divisions 2J or 3KLO (Stansbury et al. 2012) (Figures 3-11 and 3-12). Inshore catch rates of old-shelled legal-size crab is at a new high in Divisions 3K and 3L; however, offshore 3K (and 2J, until 2009) has shown a decrease in legal-size crab, whereas offshore 3L (and 2J, since 2009) has shown an increase in legal-size crab (Stansbury et al. 2013). Offshore catch rates of sub-legal-size crab remain steady in Divisions 2J and 3K and 3O, and increased in Division 3L until 2010, when they have since declined (Stansbury et al. 2013).

DFO Research Vessel surveys are conducted throughout the Study / Project / Assessment Area (2012 surveys are illustrated in Appendix B, Figure B-1). A DFO Research Vessel is currently scheduled to conduct the summer Atlantic Zone Monitoring Program (refer to Figure 3-13 for a map of the 7 stations and 14 sections included in the program) from July 9 to 28, 2014, departing from St. Anthony, NL (G. Sheppard, pers. comm.). Three other Research Vessel surveys are scheduled to be conducted in the Study / Project / Assessment Area from mid-April to the end of May, 2014. TGS will contact the Canadian Coast Guard Regional Operations Centre Atlantic (who will have the specific locations of the DFO Research Vessels on any given day) prior to the start of their research program to determine if there are any DFO Research Vessels in the area.

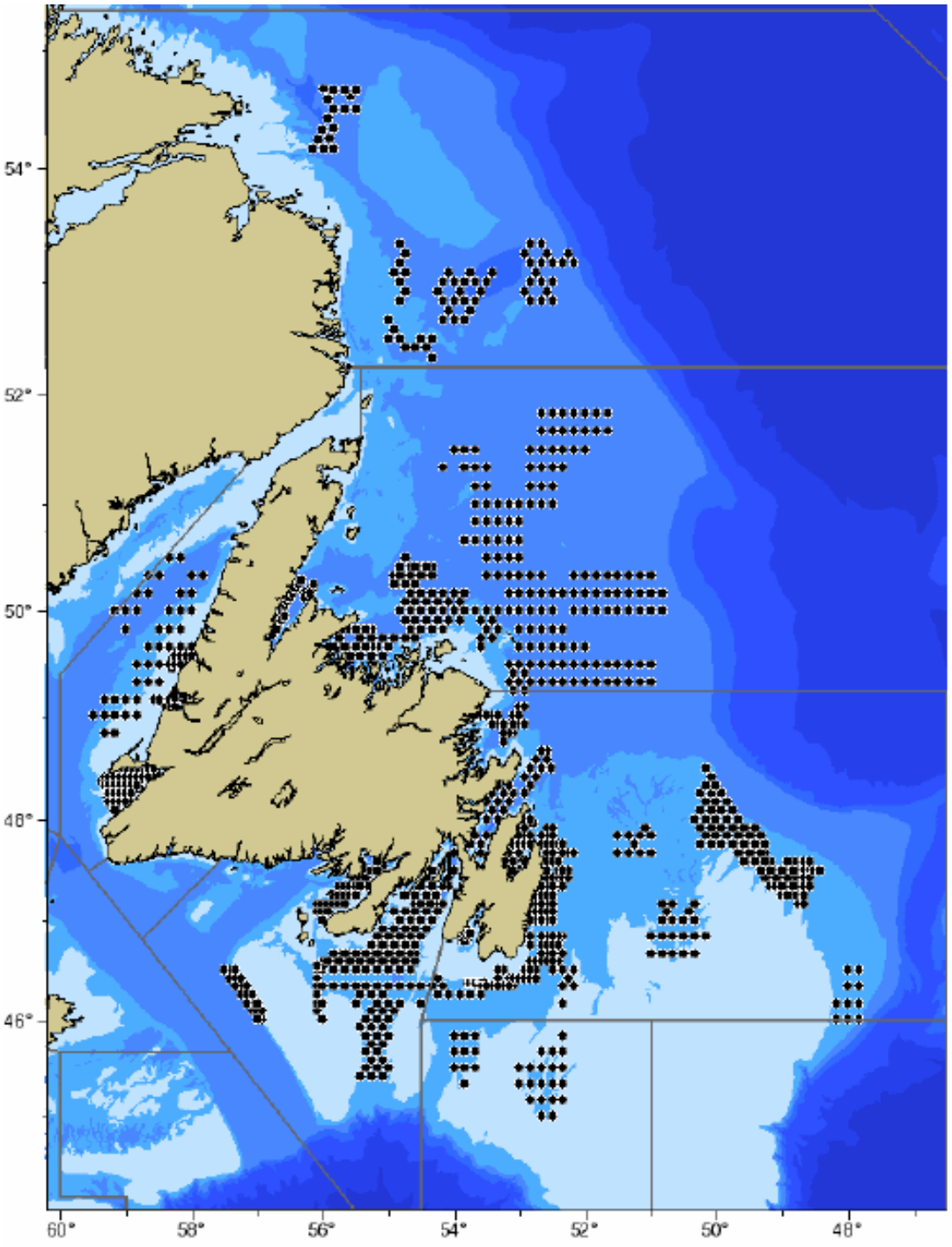
Other potential marine vessels in the Study / Project / Assessment Area are cruise ships, oil tankers and the Department of National Defence. Cruise ships run primarily south to north and return (C-NLOPB 2011a). Oil tankers operated by several companies transit the Study / Project / Assessment Area regularly during the shipping season to deliver fuel to ports along the Labrador coast (C-NLOPB 2008).

The Department of National Defence has advised that they will likely be operating in the vicinity of the Study / Project / Assessment Area in a non-interference manner during the proposed project timeframe; therefore, there is the potential for interaction with naval operations (C. Griffin, pers. comm.). TGS will contact the Department of National Defence prior to the start of the proposed research program to determine if there are any naval exercises scheduled during the proposed research program. The Department of National Defence has also identified two wrecks with potential unexploded ordnance in the Study / Project / Assessment Area (these are outside the 2014 Project Area). TGS will mark and immediately report any unidentified unexploded ordnance to the Canadian Coast Guard if any is found during the proposed survey.



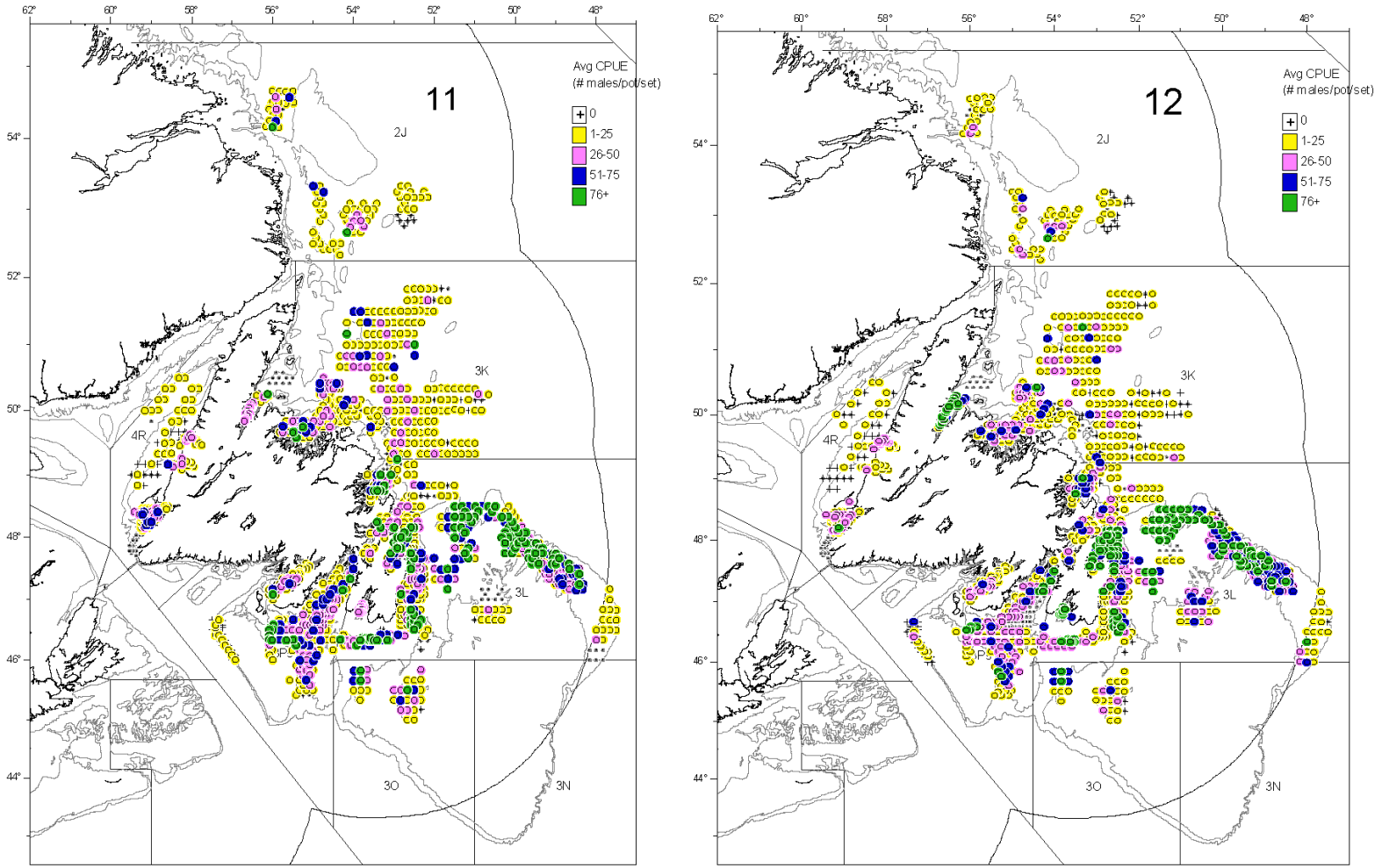
Source: Stansbury et al. 2013
NOTE; The Blue boxes indicate closed areas (Hawke Channel, mandatory for large and small vessels; Funk Island Deep mandatory for small vessels and voluntary for large vessels).

Figure 3-9 Crab Management Areas



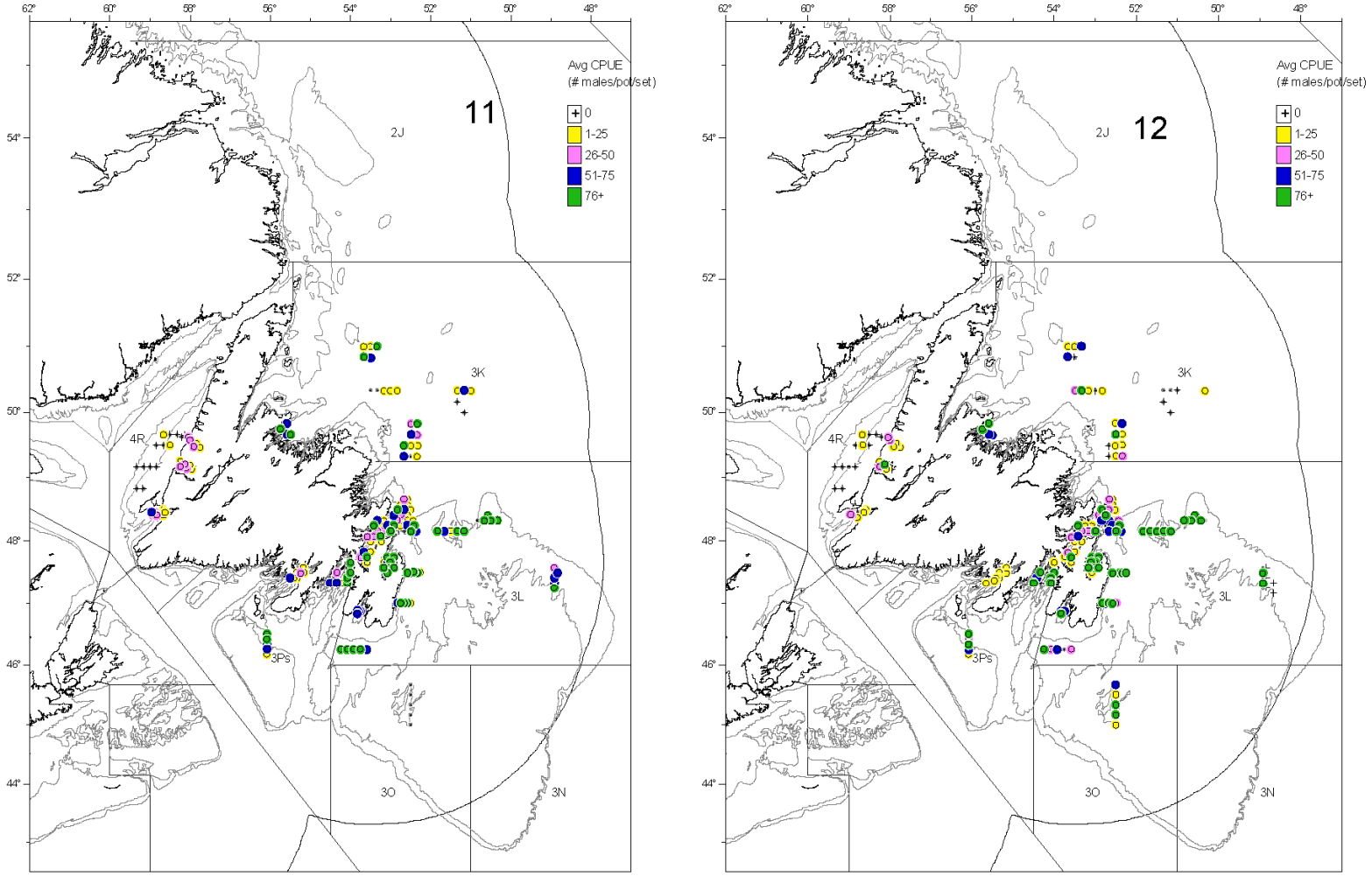
Source: Stansbury et al. 2013

Figure 3-10 Stations for DFO-Industry Post-Season Crab Survey



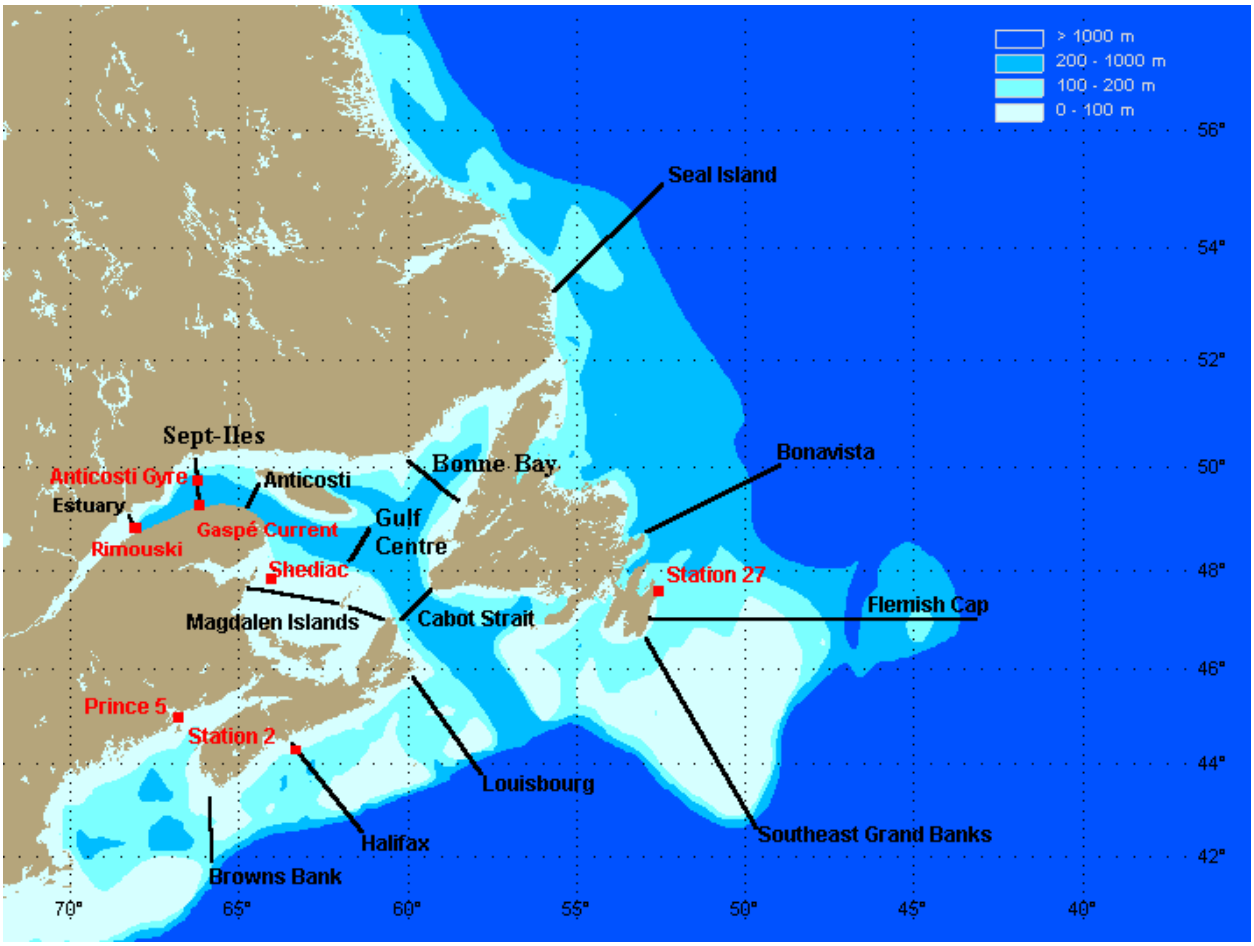
Source: Stansbury et al. 2013

Figure 3-11 Catch Distribution (mean numbers/trap) for 2011-2012 for Large Mesh Traps



Source: Stansbury et al. 2013

Figure 3-12 Catch Distribution (mean numbers/trap) for 2011-2012 for Small Mesh Traps



Source: DFO 2014

Figure 3-13 Map of the Atlantic Zone Monitoring Program Stations and Sections

3.5 Marine and Migratory Birds

The coast of Labrador is used by many marine birds for breeding, overwintering, migration or moulting stopover, including sea ducks, shorebirds and seabirds. The Study / Project / Assessment Area is used by approximately 30 bird species. The Hawke Channel, edge of the Labrador Shelf and Funk Island have high densities during the breeding season, with many birds sharing breeding space. In the southern portion of the Study / Project / Assessment Area, the Flemish Pass, Orphan Basin and Sackville Spur have been identified as important areas to different bird species/groups. Various species nest along the Labrador coast, including the various coastal islands (e.g., Atlantic Puffin, Common and Thick-billed Murre, Guillemot and Razorbill). A number of species overwinter in the Labrador Sea (e.g., Common and Thick-billed Murre). Other species breed in one location (such as the Study / Project / Assessment Area) and overwinter in other locations (e.g., Leach's Storm-Petrel). Species also use the Study / Project / Assessment Area as a migration route between southern wintering areas and northern breeding grounds (e.g.,

jaegers). The southern portion of the Study / Project / Assessment Area is important to Black-legged Kittiwake, Northern Fulmar, Leach's Storm-Petrel, shearwaters and gulls (C-NLOPB 2010, 2011a, 2011b).

3.6 Marine Mammals and Sea Turtles

Marine mammals (including baleen and toothed whales and seals) are common in the Study / Project / Assessment Area, especially in the summer, and polar bear are found in the northern portion of the Study / Project / Assessment Area. A number of these species (including polar bear) are considered to be at risk species by either SARA and/or COSEWIC. Not at-risk species include the sei whale, humpback whale, minke whale, sperm whale, long-finned pilot whale, Atlantic white-sided dolphin, white beaked dolphin, striped dolphin, common bottlenose dolphin, short-beaked common dolphin, harp seal, ringed seal, bearded seal, harbour seal, grey seal and hooded seal. The Kemp ridley's sea turtle is the only not at-risk sea turtle in the Study / Project / Assessment Area, although it is not common (C-NLOPB 2010, 2011a, 2011b).

3.7 Sensitive Areas

Sensitive areas (Appendix C, Figure C-1) include a Marine Protected Area at Torngat Mountains National Park, Gilbert Bay, Gannett Islands Ecological Reserve, Important Bird Areas (none of which are inside the Study / Project / Assessment Area), the Bonavista Cod Box and the Placentia Bay-Grand Banks Large Ocean Management Area (and potential Ecological and Biological Sensitive Areas).

The northern portion of the Study / Project / Assessment Area has the Coral Protection and Conservation Areas (areas of corals (found in deeper waters (>200 m)), with aggregations found between Makkovik Bank and Belle Island Bank, Saglek Bank and Hatton Basin). The southern portion of the Study / Project / Assessment Area has 11 areas of important coral and sponge concentrations (note that the 2014 program will not be conducted in these areas) (C-NLOPB 2010, 2011a, 2011b).

4.0 Stakeholder Consultation

TGS provided an overview description of the proposed Project to determine the level of environmental assessment required by the C-NLOPB. The C-NLOPB developed a draft Scoping Document and invited regulator and public comment on the draft Scoping Document. Based on comments received, the C-NLOPB issued a final Scoping Document on March 4, 2014, to guide the preparation of this environmental assessment. The official start of the consultation process was initiated with the formal submission of the Project Description.

TGS met with FFAW/One Ocean in St. John's on February 5, 2014. TGS provided details on the activities and discussions centred around timing and the flexibility of the Project to accommodate crab fishing seasons, especially in NAFO Division 3K. TGS also made a commitment to use a Fisheries Liaison Officer during the survey. The intent of the Project was also discussed (that is, if this research project does not provide favourable information, it is unlikely that TGS will conduct additional sampling).

TGS met with the C-NLOPB on February 5, 2014, to discuss in more detail the project description submitted to the C-NLOPB. The C-NLOPB offered comments on the submitted project description and direction on suggested content of the environmental assessment. The C-NLOPB also discussed other permitting requirements in addition to the environmental assessment that TGS have to satisfy prior to receiving release from the C-NOPB's regulatory process.

TGS initiated contact with the Nunatsiavut Government on January 19, 2014, to set a time for a meeting to provide details on the activities of the proposed Project, as the multi-year Study / Project / Assessment Area parallels the Nunatsiavut Zone (note that the Project will not include any sampling within The Zone). TGS will meet with the Nunatsiavut Government on May 7, 2014 to provide information on the proposed Project. While in Nain, TGS will also hold a public information session on the project for the residents of Nain. The issues raised during the meeting with the Nunatsiavut Government will be included in the Amendment to the environmental assessment that will be prepared to address reviewer comments.

Issues raised by the FFAW / One Ocean / C-NLOPB included the following:

- inclusion of Project components and the NAFO Divisions on the fisheries maps (refer to Appendix A).
- use of daily VMS (vessel movement system) data for identifying fishing vessel positions.
- flexibility in the description of activities to ensure all aspects are assessed. The C-NLOPB did indicate that an amendment to the environmental assessment would not be an impediment and as long as activities took place within the area assessed (the Study / Project / Assessment Area illustrated in Figure 1-1), then modification of specific sampling areas proposed for 2014 (see Figure 2-1) would not be an issue and would not require an amendment to the environmental assessment.

- if TGS do plan to continue sampling in future years (which is contingent upon the findings of the proposed 2014 sampling program), then an annual update to the environmental assessment (focusing primarily on fisheries data and species at risk) would be required prior to initiating that year's activities.

5.0 ENVIRONMENTAL ASSESSMENT METHODS

5.1 Valued Environmental Components

The final Scoping Document (C-NLOPB 2014) has defined the following as valued environmental components (VEC) that require assessment of potential environmental effects resulting from the Project:

- Species at Risk (either listed on Schedule 1 of SARA or assessed as at risk by COSEWIC);
- Marine Fish and Shellfish;
- Fisheries and Other Ocean Users;
- Marine and/or Migratory Birds;
- Marine Mammals and Sea Turtles; and
- Sensitive Areas.

Planned activities and accidental events (i.e., unplanned hydrocarbon release) associated with Project activities are assessed in this environmental assessment. In addition, this environmental assessment includes an analysis of cumulative environmental effects.

5.2 Boundaries

Boundaries help focus the scope of the environmental assessment and allow a meaningful analysis of potential environmental effects associated with the Project. The environmental assessment considers the potential effects of the proposed Project 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 VEC.

The spatial boundary for the 2014 to 2019 program is illustrated in Figure 1-1. Given the extent of the Study / Project / Assessment Area, the regional area is equivalent to the Study / Project / Assessment Area. The proposed 2014 survey program is illustrated in Figure 2-1. The temporal scope of the 2014 to 2019 program is the ice-free season.

5.3 Project Interactions

The Project consists of:

- sampling of potential natural seafloor seeps (casting and retrieving a fishing line with a GORE sampler attached);
- collection of sediment cores using a gravity core (selected areas will be scanned with MBES and SBP prior to collecting the sample);
- collection of rock samples from outcrops;

- conducting seafloor heat flow measurements using a thermal probe; and
- collection of metocean data.

Note as this is a seafloor sampling survey, conventional seismic survey methods and equipment, such as a seismic source airgun array(s) and streamer(s), are not proposed and will not be used. The primary interactions of Project operations with the environment are the collection of sediment cores and operation of the vessel (Table 5.1). An accidental release of diesel fuel due to damage / sinking of the research vessel would also result in an interaction with the environment (see Table 5.1).

Table 5.1 Project-Valued Environmental Component Interaction

Activity	Species at Risk	Marine Fish and Shellfish (fish habitat)	Fisheries and Other Ocean Users	Marine and/or Migratory Birds	Marine Mammals and Sea Turtles	Sensitive Areas
Operations						
Collection of Surface Oil Samples	-	-	-	-	-	-
Use of MBE and SBP	X	-	-	-	X	-
Collection of Sediment Cores	-	X	X	-	-	-
Collection of Rock Samples from Outcrops	-	X	X	X	-	-
Collection of CTD Data	-	-	-	-	-	-
Operation of Research Vessel	-	X	-	X	X	-
Accidental Event						
Loss of Diesel Fuel Due to Damage / Sinking of the Research Vessel	X	X	X	X	-	X
Collision with Vessel	-	-	X	-	-	-
Other Projects and Activities						
Fishing Activities	X	X	-	X	X	-
Marine Traffic	X	-	X	X	X	-
Seismic Surveys	X	X	X	X	X	-

5.4 Significance Criteria

Evaluating the significance of predicted residual environmental effects is one of the critical stages in an environmental assessment. Significant environmental effects are those adverse effects that will cause a change that will alter the status or integrity of a VEC beyond an acceptable level. In this environmental assessment, environmental effects are evaluated as significant or not significant based on definitions of significance that have been developed and used for each VEC (Table 5.2).

Table 5.2 Residual Environmental Effects Significance Criteria by Valued Environmental Component

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 and/or Migratory Birds/ Marine Mammals and Sea Turtles /	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 several 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 Ocean Users	A significant effect is one where the Project results in an unmitigated net loss for Fisheries and Other Ocean Users.
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 that 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.

5.5 Environmental Management

Plans will be developed to avoid or lessen potential effects on the commercial fishery. These plans will include elements such as communications (e.g., Fisheries Broadcast and Okalakatiget Society notifications and Notices to Shipping), avoidance of areas during times of heavy fixed gear use and a fishing gear damage compensation program (as per C-NLOPB and Canada-Nova Scotia Offshore Petroleum Board 2002), in the event of an oil spill. Other proposed mitigation measures are described in Section 2.6.

6.0 ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Project Activities

The proposed program will collect GORE samples from the surface of the water using a standard fishing rod and line, shallow (penetrating to 3 m in the substrate) sediment cores from the seafloor using a gravity corer with mounted thermal probes, rocks from outcrops and continuous CTD logs through the water column, to just above the seafloor

The MBES and SBP are part of the research vessel's infrastructure. The MBES will operate at 30 kHz, and a SBP has a primary high frequency bandwidth of 90 to 115 kHz and a secondary low frequency bandwidth of 2 to 22 kHz; these are is within the threshold (less than 228.8 dB measured 1 m from the energy source) stated in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012). The MBES will be used to provide detailed bathymetry and the SBP will be used to refine the sediment core collection areas. MBES frequencies do not overlap with those used predominantly by baleen whales and pinnipeds. SBP frequencies can overlap with those used by baleen whales and pinnipeds, but masking of communication would be limited due to the discontinuous, short duration of these pulses, which avoids significant masking. The low frequency spectrum of industrial noise will not overlap with the high frequency echolocation of belugas, dolphins, or pilot whales, for example. Because seismic and SBP pulses are intermittent and predominantly low frequency and are unlikely to mask the echolocation / communication of toothed whales. Some MBES pulses may be audible to toothed whales, but unlikely to mask communication signals due to the fact that they are short and have narrow beam widths (Husky Energy 2010; Section 7.1.3.2).

Sediment cores (3-m deep) will be collected in up to 300 discrete locations. It is anticipated that up to 30 to 35 rock samples will be collected from outcrops. The collection locations will avoid areas of commercial fishing activity (especially any areas of fixed gear) as identified through consultation with the FFAW's Petroleum Industry Liaison. Samples will not be collected within The Zone, nor will the vessel enter The Zone to turn. Data collection will avoid coral closure areas and other identified sensitive areas.

Vessel speed during seep sample collection will typically be 3.7 to 5.6 km/h (2 to 3 knots), and as evidence suggests that 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), the potential for the research vessel to strike a marine mammal is minimized.

As the data collection will occur over a 24-hour period, there is potential for marine and migratory birds to be attracted to the vessel at night, potentially resulting in stranding on the vessel. TGS will implement a program to conduct a routine check for stranded birds on the research vessel and will release stranded birds 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 that are not associated with a pollution event).

The magnitude of environmental effects resulting from Project activities is negligible. The frequency of occurrence is one sample collected at distinct separate locations within a short duration (i.e., three to four weeks). Given the limited interaction of the Project activities with the VECs, the environmental effects of the proposed Project on Species at Risk, Fisheries and Other Ocean Users, Marine Fish and Shellfish, Marine and/or Migratory Birds, Marine Mammals and Sea Turtles and Sensitive Areas are predicted to be not significant.

6.2 Accidental Events

In the event of an accidental release of hydrocarbons, most spill fluids will consist of light fuel (diesel). The nature of diesel fuel is such that it evaporates from the surface relatively quickly and does not persist in the environment for any length of time (dispersing naturally within a day or less, even in cold water) (National Oceanic and Atmospheric Administration 2006). Small diesel spills will usually evaporate and disperse naturally within a day or less. This is particularly true for typical spills from a fishing vessel (1,900 to 19,000 L (500 to 5,000 gallons), even in cold water.

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. It is unlikely that the diesel would reach the seafloor. Species at risk and other not at risk species would be able to avoid any film that might form. The research vessel will have limited amounts of marine fuel on board that could potentially be spilled to the ocean. The research vessel will have spill response equipment on board. The vessel's Safety, Health and Environment management system includes spill response (Appendix D). The Canadian Wildlife Service Response Plan Guidance (2012) will be followed in the event of an oil spill.

Data collection will occur in the ice-free season and therefore, in the case of an accidental event, no spilled fuel will become trapped in ice. Given the on-board spill response plan and equipment, the residual environmental effect of an accidental spill on Species at Risk, Fisheries and Other Ocean Users, Marine Fish and Shellfish, Marine and/or Migratory Birds, Marine Mammals and Sea Turtles and Sensitive Areas is predicted to be not significant. The likelihood of a spill is unlikely.

6.3 Cumulative Environmental Effects

The program will be conducted from a single research vessel, with sampling gear limited to the immediate vicinity of the research vessel (i.e., no streamers), and can therefore be considered as essentially another vessel traversing the Study / Project / Assessment Area. Compared to existing vessel traffic in the area, the incremental amount of vessel traffic as a result of this Project will be negligible. The Project activities are transitory with limited spatial and temporal overlap with other projects and activities; overlap with other oil and gas exploratory programs or

development projects is not anticipated (the research vessel would not be allowed into any of the exclusion zones established around existing production platforms or exploration vessels). Therefore, the residual cumulative environmental effect on Species at Risk, Fisheries and Other Ocean Users, Marine Fish and Shellfish, Marine and/or Migratory Birds, Marine Mammals and Sea Turtles and Sensitive Areas is predicted to be not significant.

6.4 Conclusion

Given that the Project consists of deploying and retrieving fishing lines to collect oil samples on the water surface, use of MBES and SBP to refine sampling locations, lowering and raising a sample corer (with thermal probes) to collect sediment cores, collecting rocks from outcrops and lowering and raising a CTD meter to collect metocean data from a research vessel, interaction with the environment will be limited and environmental effects will be negligible. The adverse residual environmental effects of this Project are assessed as not significant. Given the limited interaction with the environment, biological and follow-up monitoring is not required for this Project.

7.0 References

AGI (Amplified Geochemical Imaging, LLC). 2013. *Offshore Petroleum Slick Sampling*. Available at: https://www.agisurveys.net/Offshore_Slick_Sampling.html

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2008. *Strategic Environmental Assessment - Labrador Shelf Offshore Area*. Prepared by Sikumiut Environmental management and Jacques Whitford Limited, St. John's, NL. xxv + 519 pp. + Appendices.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2010. *Husky Energy Labrador Shelf Seismic Program 2010-2017 Screening Report*. Prepared by the Canada-Newfoundland Offshore Petroleum Board, St. John's, NL. 18 pp.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2011a. *Multi Klient Invest AS – Labrador Sea and Davis Strait 2D Seismic Program, 2011-2013 Screening Report*. Prepared by the Canada-Newfoundland Offshore Petroleum Board, St. John's, NL. 25 pp.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2011b. *Chevron Canada Limited North Grand Banks Seismic Program 2011-2017 Screening Report*. Prepared by the Canada-Newfoundland Offshore Petroleum Board, St. John's, NL. 22 pp.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2012. Geophysical, Geological, Environmental and Geotechnical Program Guidelines. 38 pp + Appendices.

C-NLOPB (Canada-Newfoundland and Labrador Offshore Petroleum Board). 2014. *TGS-NOPEC Geophysical Company ASA Offshore Labrador Seafloor and Seep Sampling Program (2014 to 2019): Scoping Document*. Prepared by the Canada-Newfoundland Offshore Petroleum Board, St. John's, NL. 11 pp.

C-NLOPB and Canada-Nova Scotia Offshore Petroleum Board. 2002. *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity*. Prepared by the Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL, and Canada-Nova Scotia Offshore Petroleum Board, Halifax, NS.

DFO (Fisheries and Oceans Canada). 2013. *Facts on Canadian Fisheries: Shrimp*. Available at: http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/shrimp-crevette-eng.htm

DFO (Fisheries and Oceans Canada). 2014. *AZMP Map of the 7 Stations and 14 Sections*. Available at: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/map-carte-eng.html Date Modified:2014-02-12

Environment Canada. 2012. *Protocol for Collecting Dead Birds from Platforms*.

Griffin, C.L. MARLANT Safety and Environmental Officer. Department of National Defence, Maritime Forces Atlantic, Halifax, NS. Personal communication (email to C-NLOPB's Request for Identification of Expertise and Comments on Project from Government).

Husky Energy. 2010. *Labrador Shelf Seismic Survey Environmental Assessment*. Prepared by Jacques Whitford Environment Limited for Husky Energy, St. John's, NL. xv + 251 pp. + Appendices.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet and M. Podesta. 2001. Collisions between ships and whales. *Marine Mammal Science*, 17(1):35-75.

LGL Limited. 2011. *Environmental Assessment of Chevron's North Grand Banks Regional Seismic Program 2011-2017*. LGL Report SA1119. Report by LGL Limited in association with Canning & Pitt Associates, Inc., St. John's, NL, and Oceans Ltd., St. John's, NL, for Chevron Canada Limited, Calgary, AB. 226 pp. + Appendices.

LGL Limited and GX Technology Canada Ltd. 2013. *Environmental assessment of GXT's LabradorSPAN 2-D Seismic, Gravity and Magnetic Survey, 2013-2015*. LGL Rep. SA1199. Rep. by LGL Limited, St. John's, NL, and GX Technology, Calgary, AB. 286 pp. + App.

National Academy of Sciences. 2002. *Oil in the Sea: Inputs, Fates and Effects*. National Academy Press, Washington, DC.

National Oceans and Atmospheric Administration. 2006. *Small Diesel Spills (500-5,000 gallons)*. Available at: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html

National Research Council. 2003. *Marine Mammals and Low-frequency Sound Progress Since 1994*. National Academy Press, Washington DC. 158 pp.

Orr, D.C., P.J. Veitch, D.J. Sullivan and K. Skanes. 2011. The status of the Northern shrimp (*Pandalus borealis*) resource off Labrador and northeastern Newfoundland as of March 2010. *Canadian Science Advisory Secretariat Research Document*, 2011/004: vi + 175 pp.

Power, D., Project Manager/Programmer, DFO, St. John's, NL. Personal Communication.

RPS Energy. 2011. *Environmental Impact Assessment for Marine 2D Seismic Reflection Survey, Labrador Sea and Davis Strait, Offshore Labrador by Multi Klient Invest AS (MKI)*. Prepared by RPS Energy, Halifax, NS.

Sheppard, G., Technician, Program Services and Planning DFO, St. John's, NL. Personal Communication (schedules *for R/V Teleost* and *R/V Needler*).

Stansbury, D.E., D. Fiander and D. Maddock Parsons. 2013. *Summary of the Industry-DFO Collaborative Post-season Trap Surveys for Snow Crab in Div. 2J3KLOPs4R*.

Williams, U. and J. Chardine. 1999. *Leach's Storm-petrel (Oceanodroma leucorhoa): A Handbook on Release Techniques Prepared for Workers on the Terra Nova Oil Field*. 4 pp.

APPENDIX A

Percent Weight and Percent Value (2011 and 2012) for Northern Shrimp, Snow Crab and Greenland Halibut

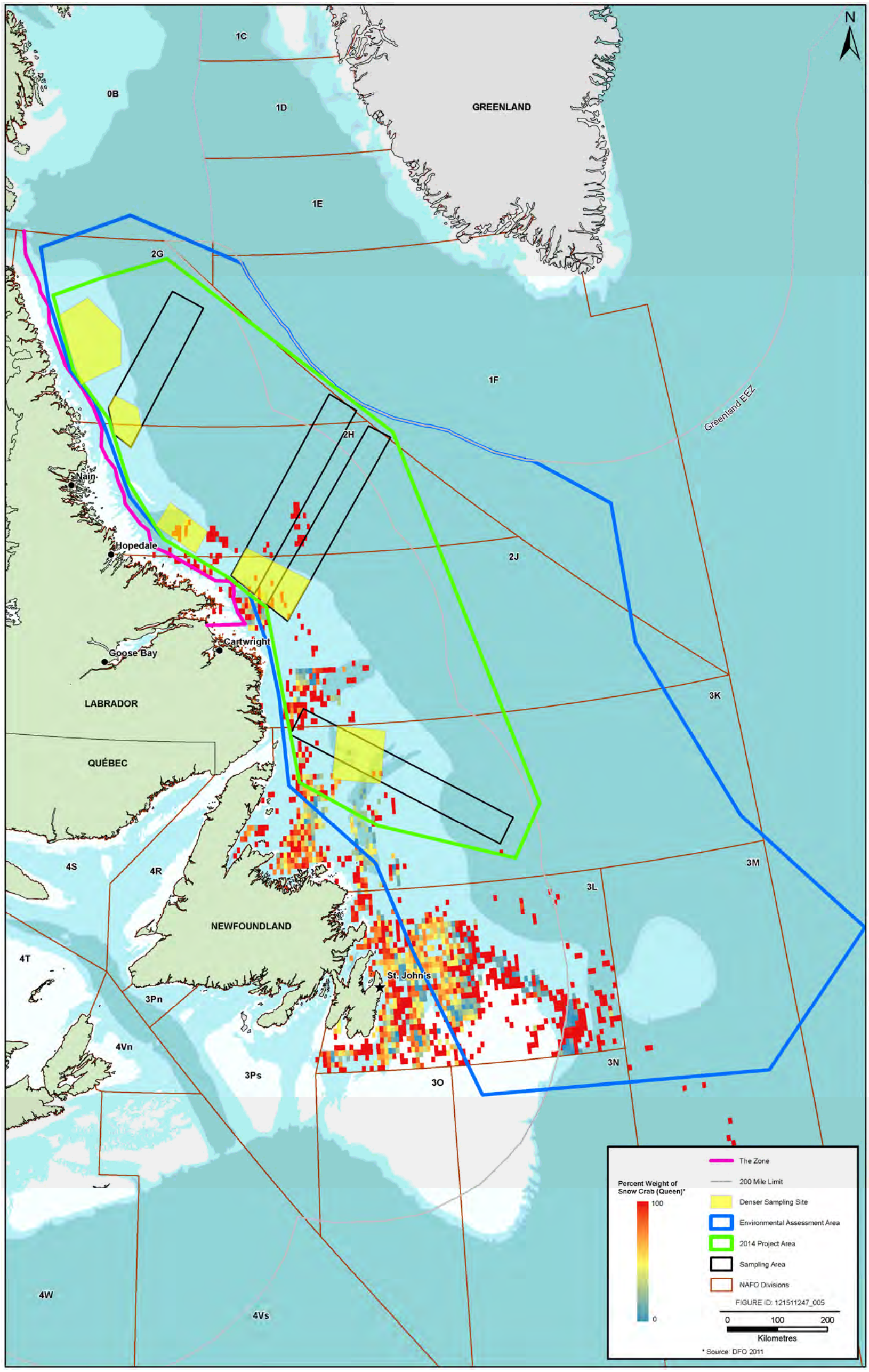


Figure A-1 Percent Weight of Snow Crab Harvested in the Study / Project / Assessment Area in 2011

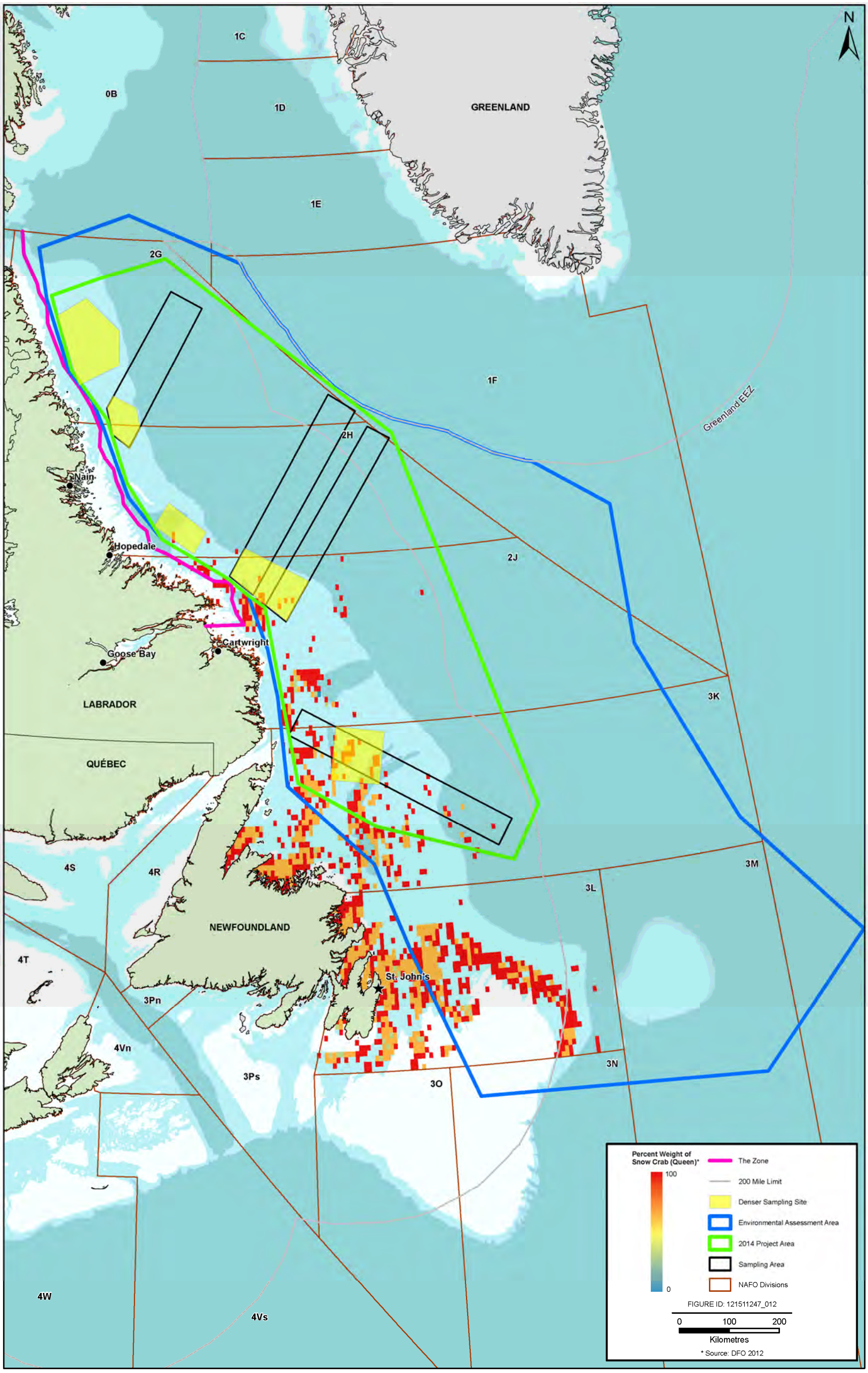


Figure A-2 Percent Weight of Snow Crab Harvested in the Study / Project / Assessment Area in 2012

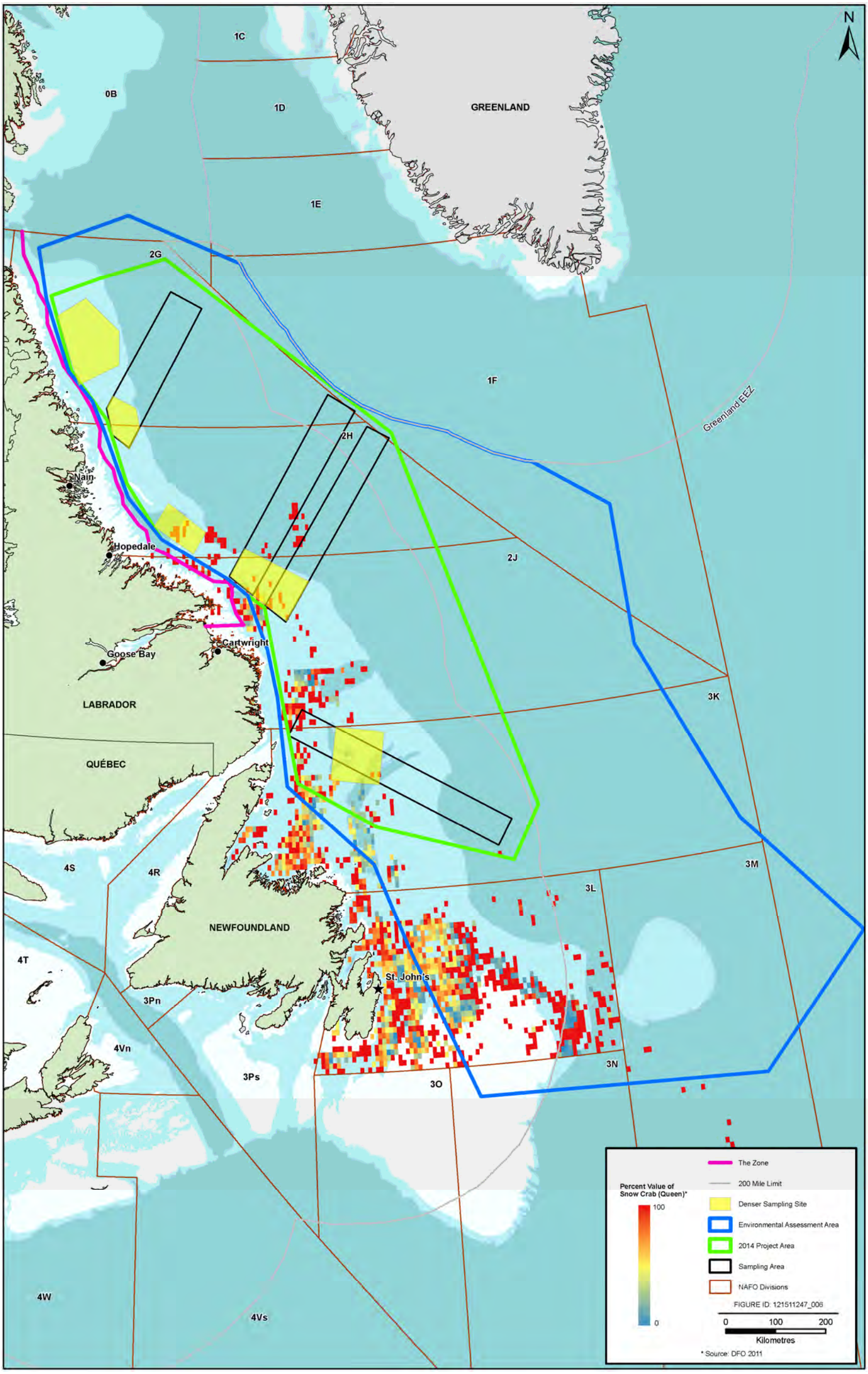


Figure A-3 Percent Value of Snow Crab Harvested in the Study / Project / Assessment Area in 2011

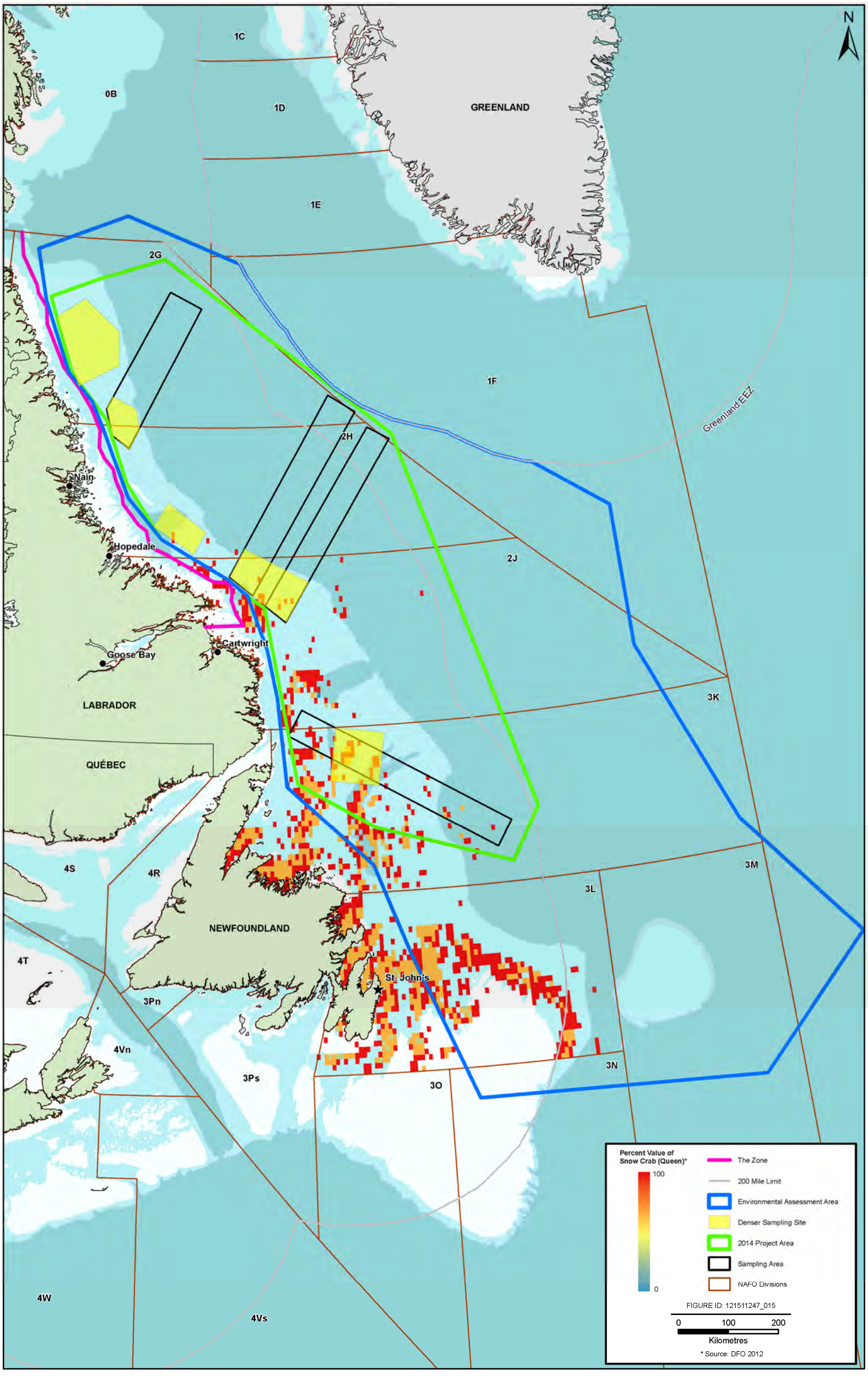


Figure A-4 Percent Value of Snow Crab Harvested in the Study / Project / Assessment Area in 2012

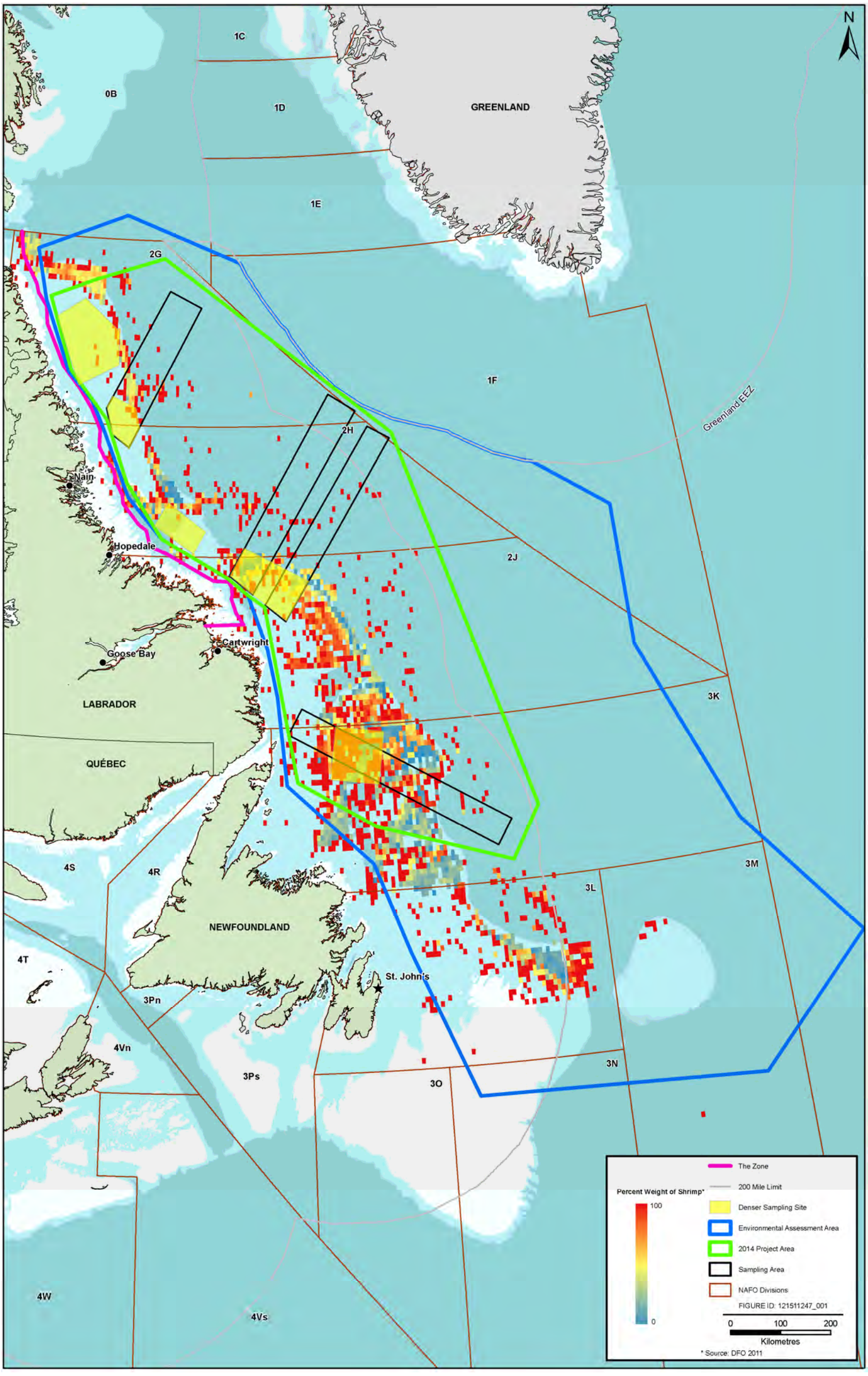


Figure A-5 Percent Weight of Shrimp Harvested in the Study / Project / Assessment Area in 2011

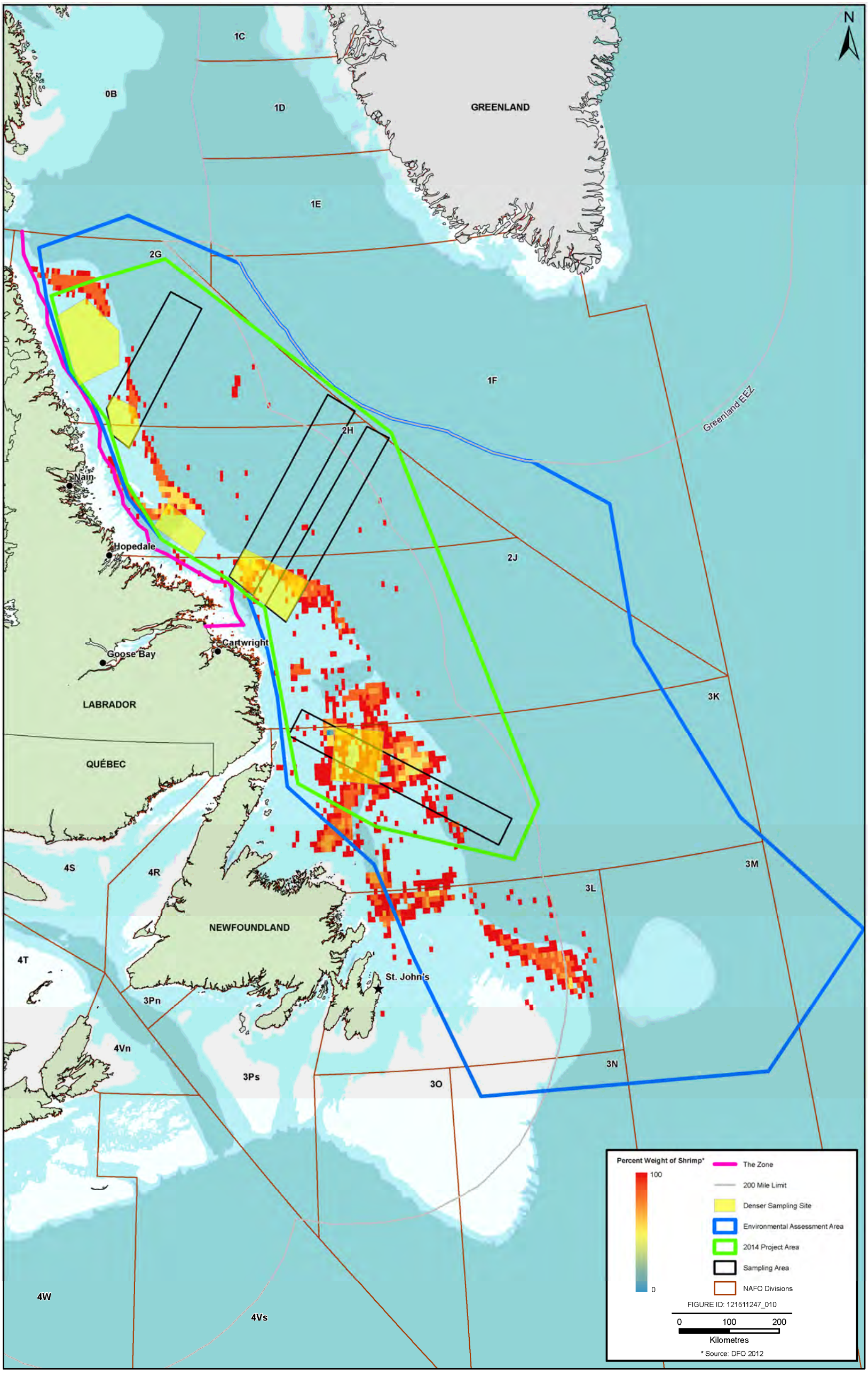


Figure A-6 Percent Weight of Shrimp Harvested in the Study / Project / Assessment Area in 2012

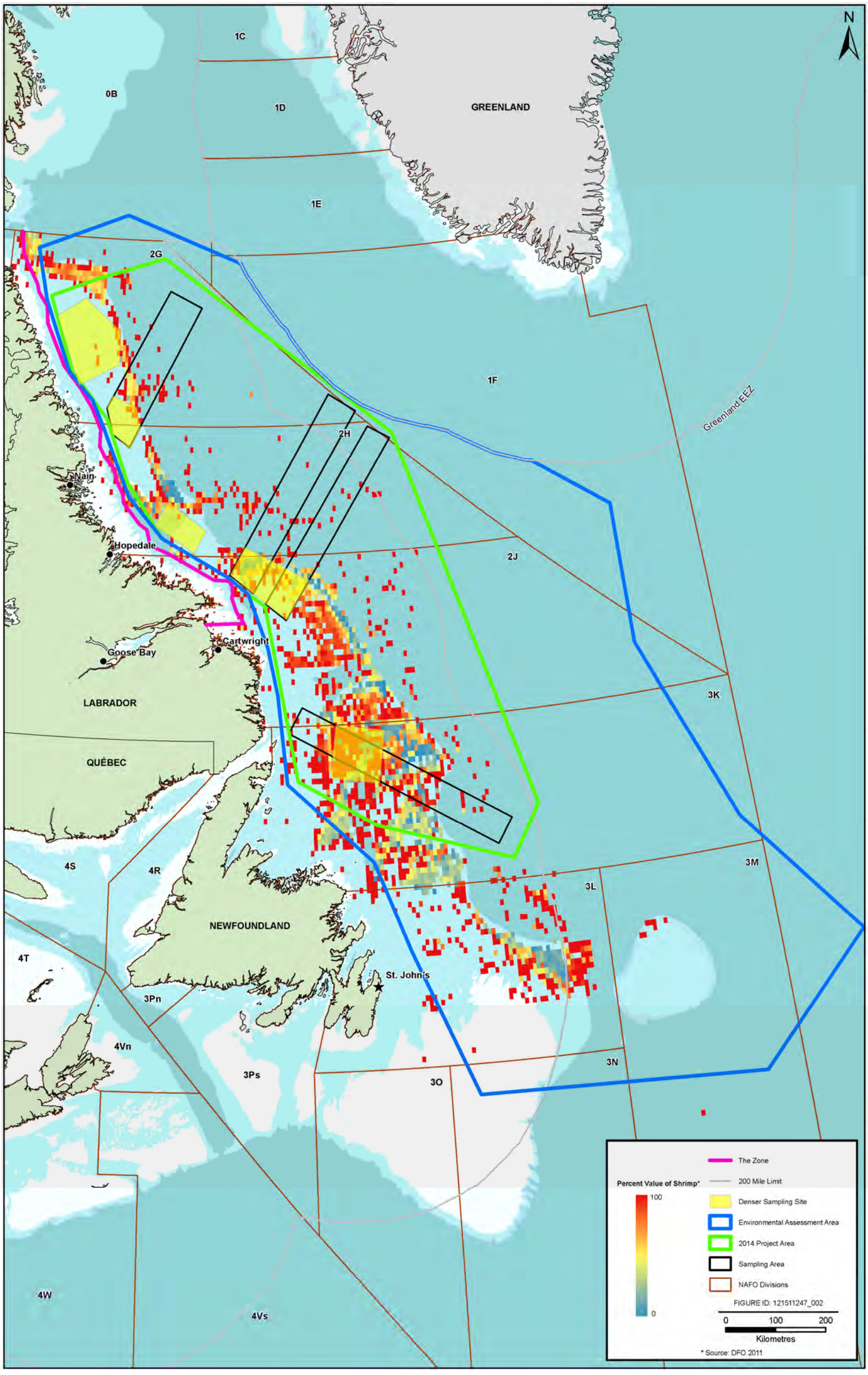


Figure A-7 Percent Value of Shrimp Harvested in the Study / Project / Assessment Area in 2011

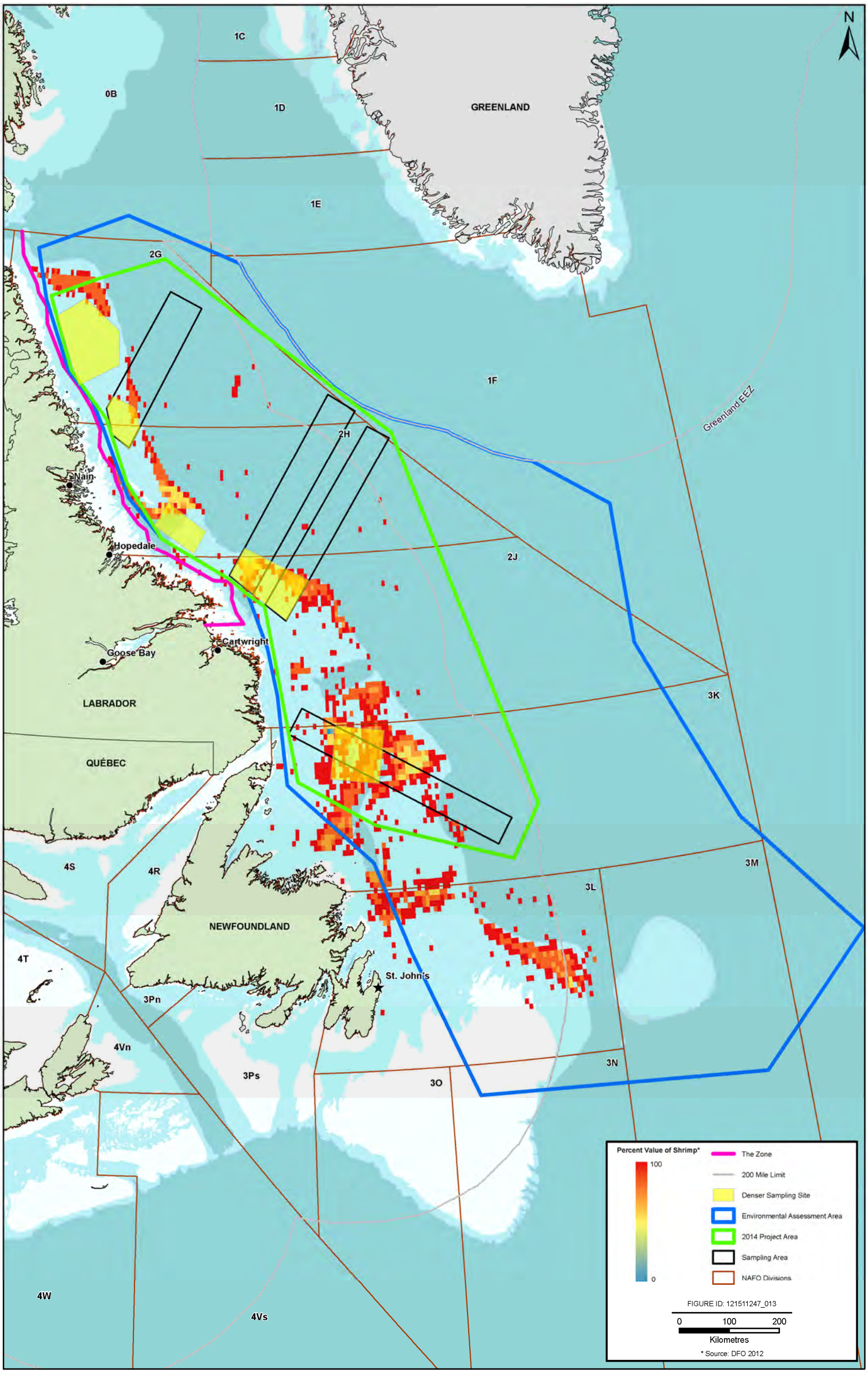


Figure A-8 Percent Value of Shrimp Harvested in the Study / Project / Assessment Area in 2012

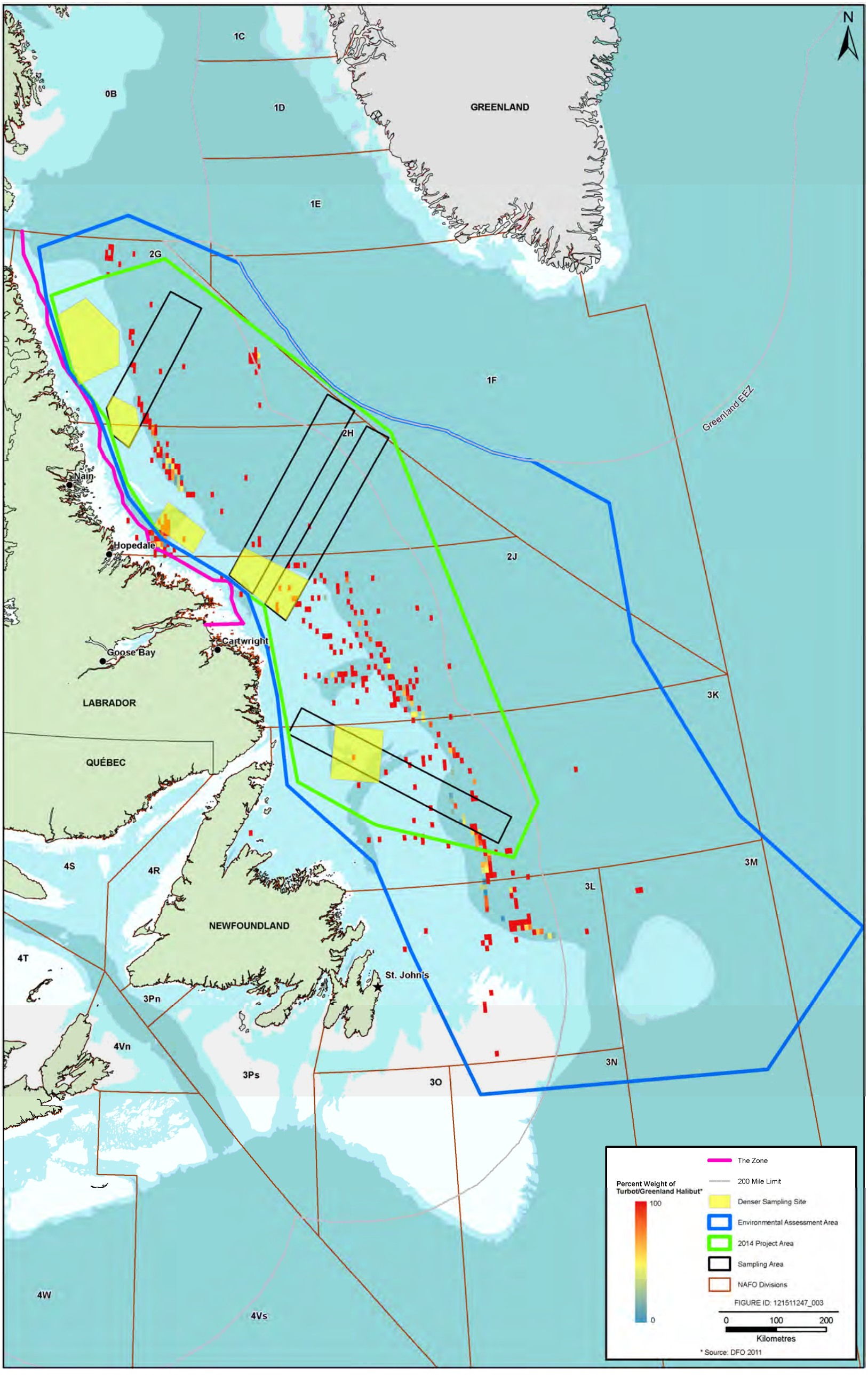


Figure A-9 Percent Weight of Greenland Halibut (Turbot) Harvested in the Study / Project / Assessment Area in 2011

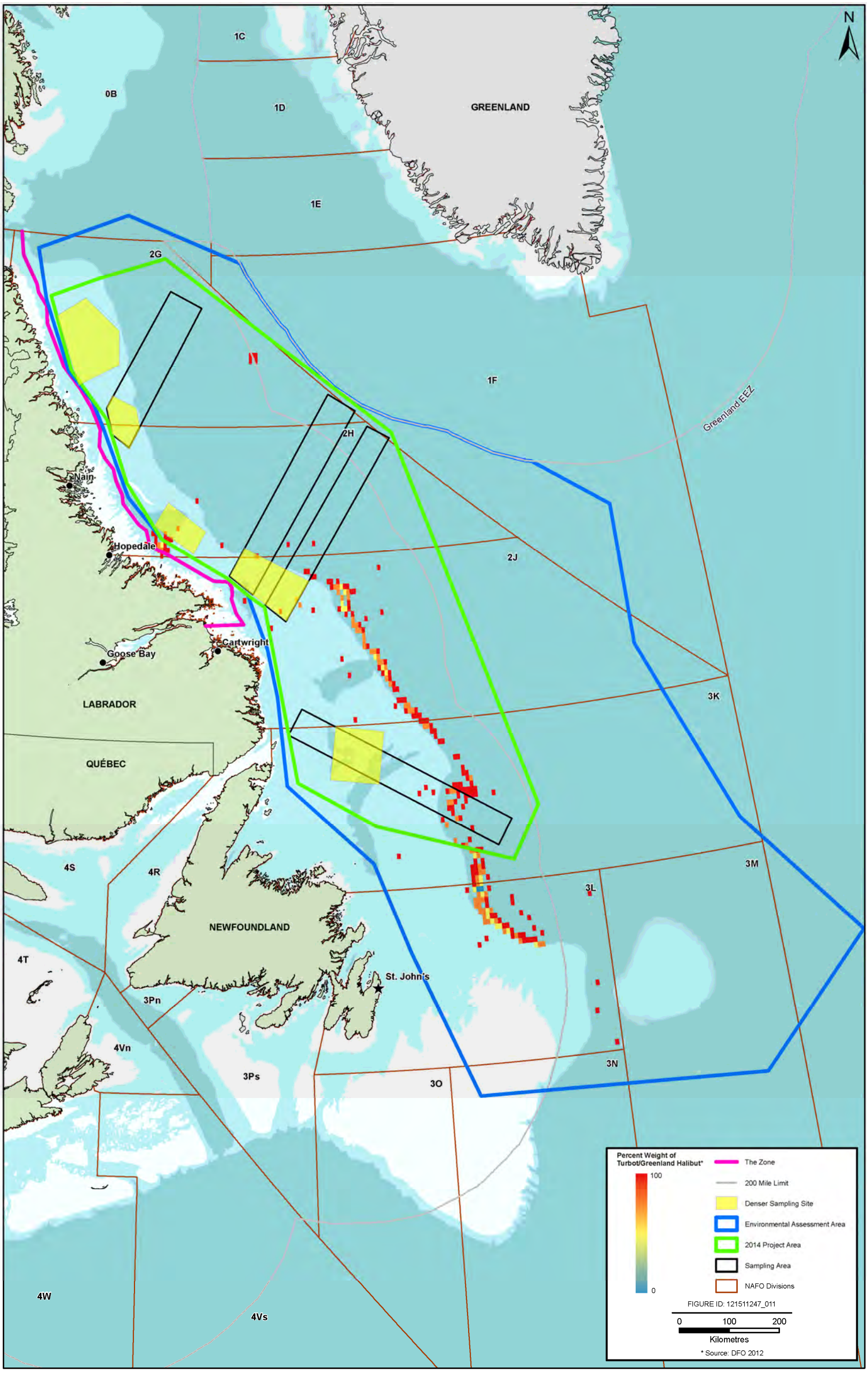


Figure A-10 Percent Weight of Greenland Halibut (Turbot) Harvested in the Study / Project / Assessment Area in 2012

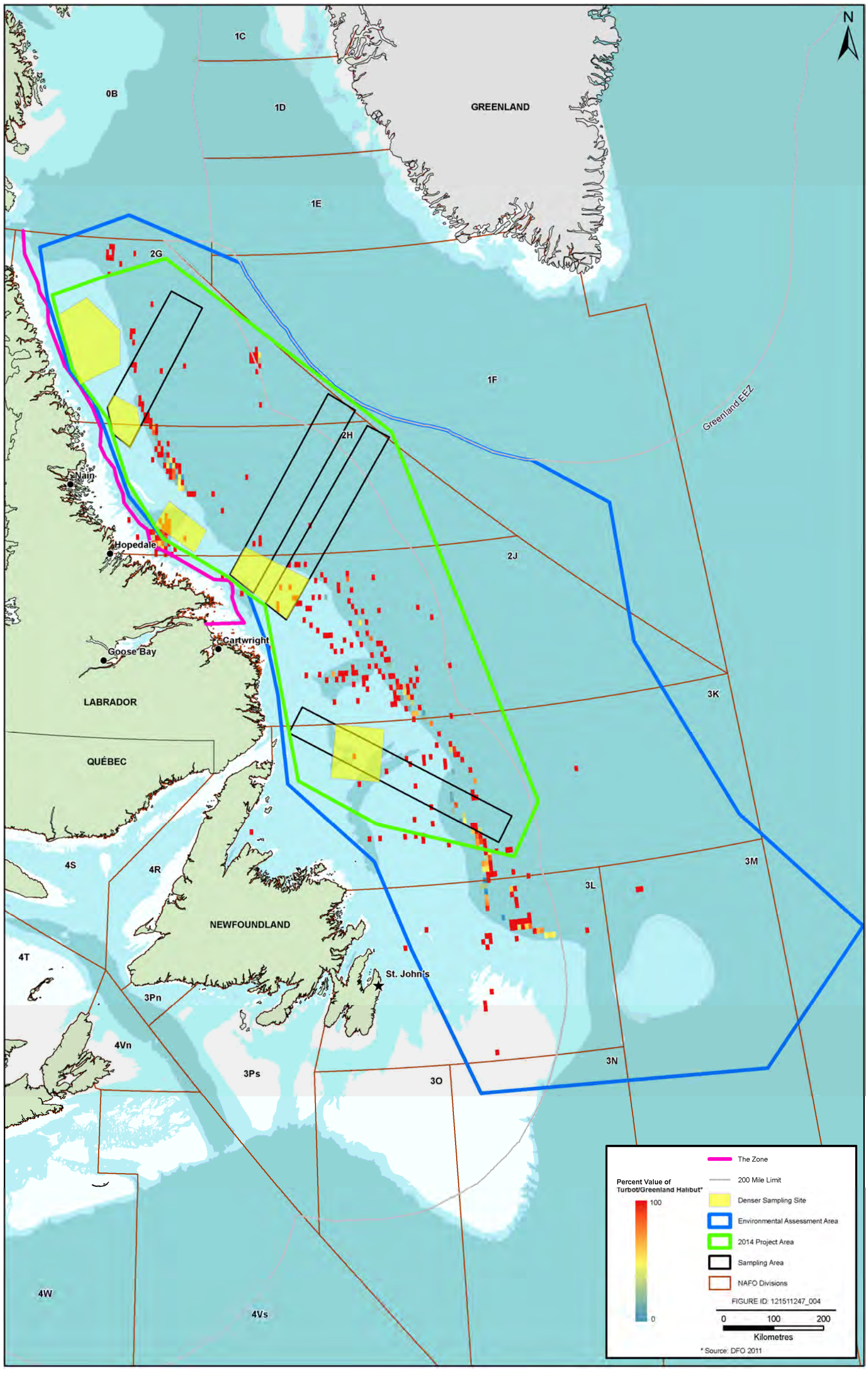


Figure A-11 Percent Value of Greenland Halibut (Turbot) Harvested in the Study / Project / Assessment Area in 2011

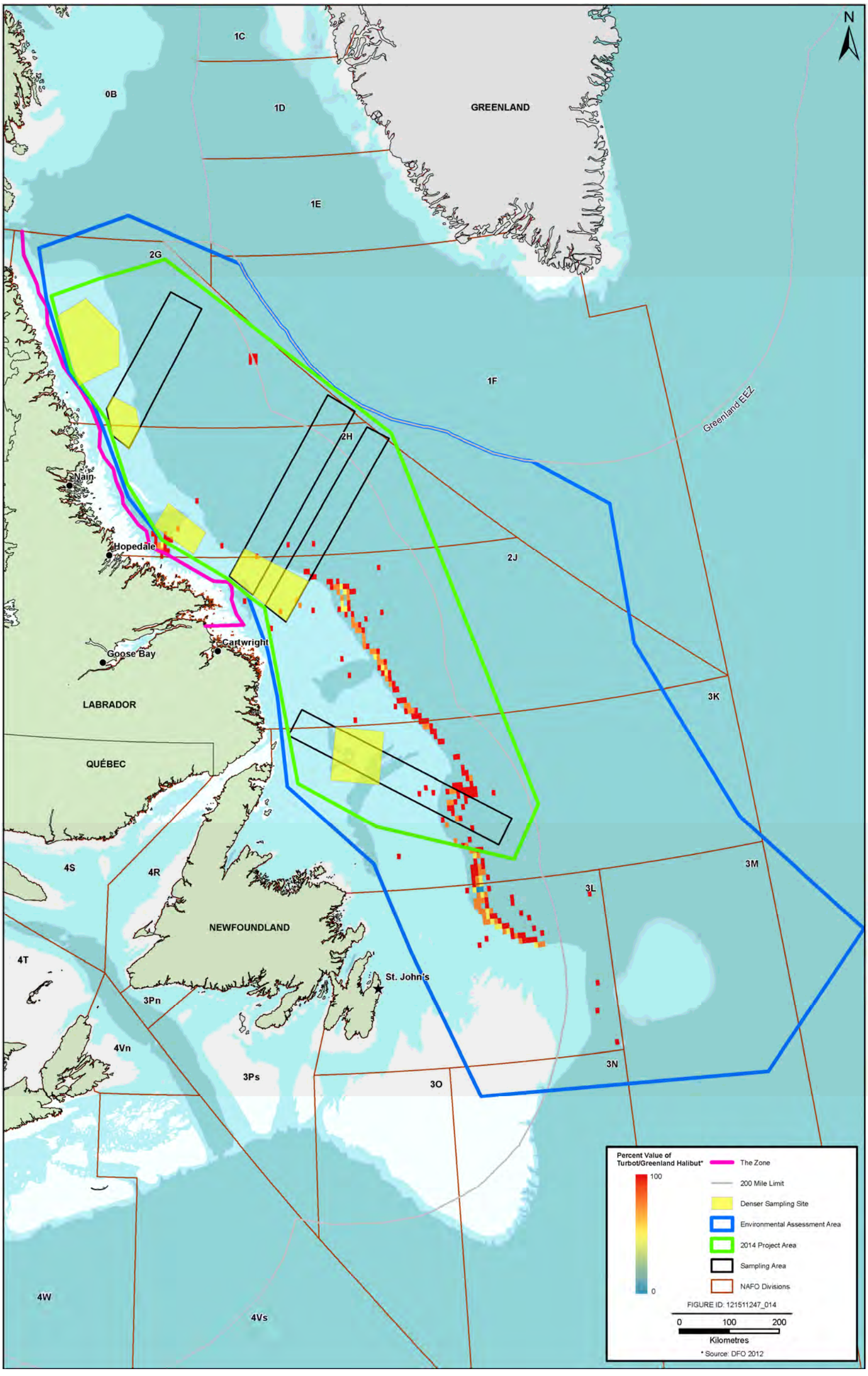


Figure A-12 Percent Value of Greenland Halibut (Turbot) Harvested in the Study / Project / Assessment Area in 2012

APPENDIX B

2013 DFO Research Vessel Survey and

DFO-Industry Post-season Crab Survey Locations

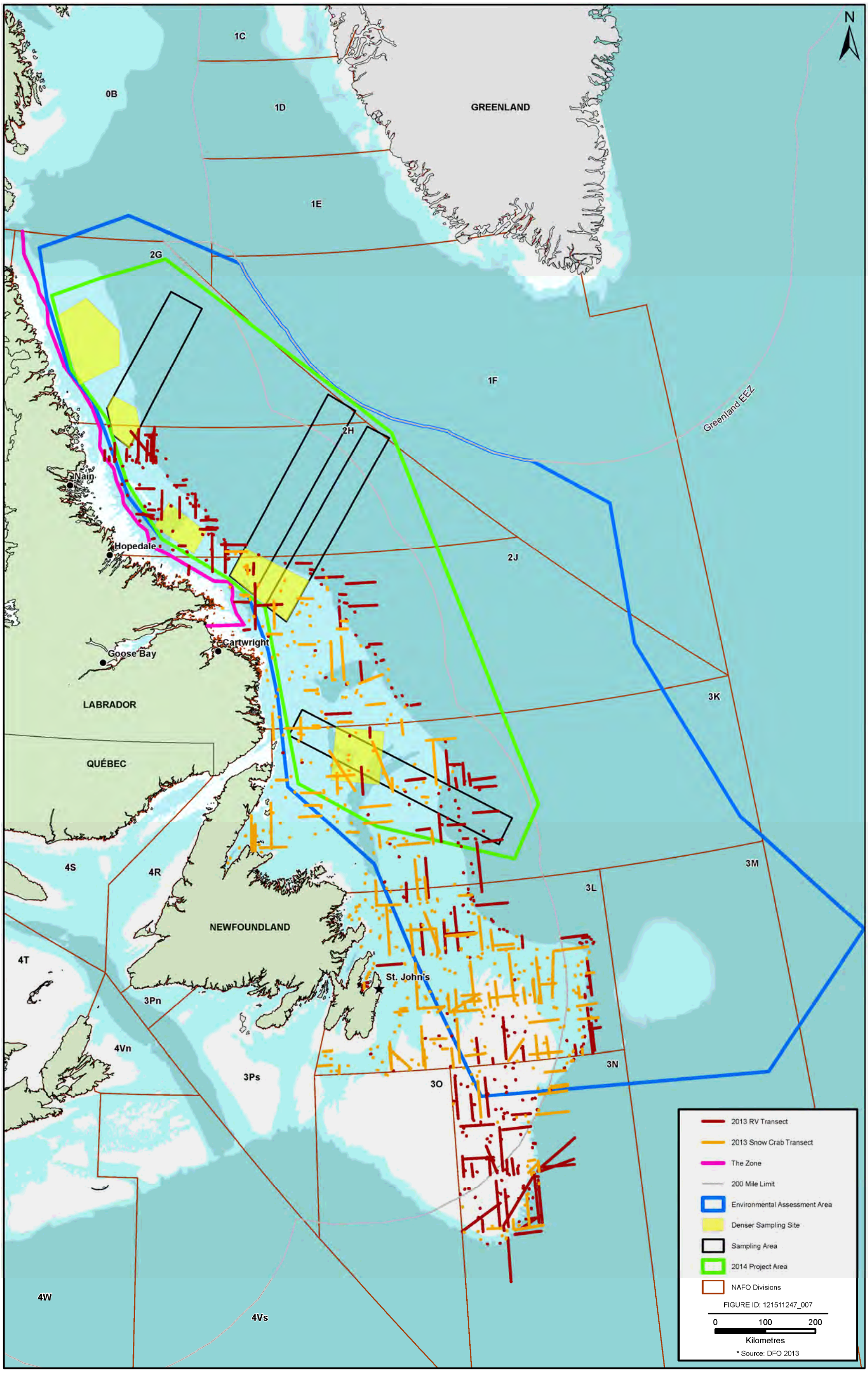


Figure B-1 **2013 DFO Research Vessel Survey and DFO-Industry Post-season Crab Survey Locations in the Study / Project / Assessment Area**

APPENDIX C

Sensitive Areas in the Study / Project / Assessment Area

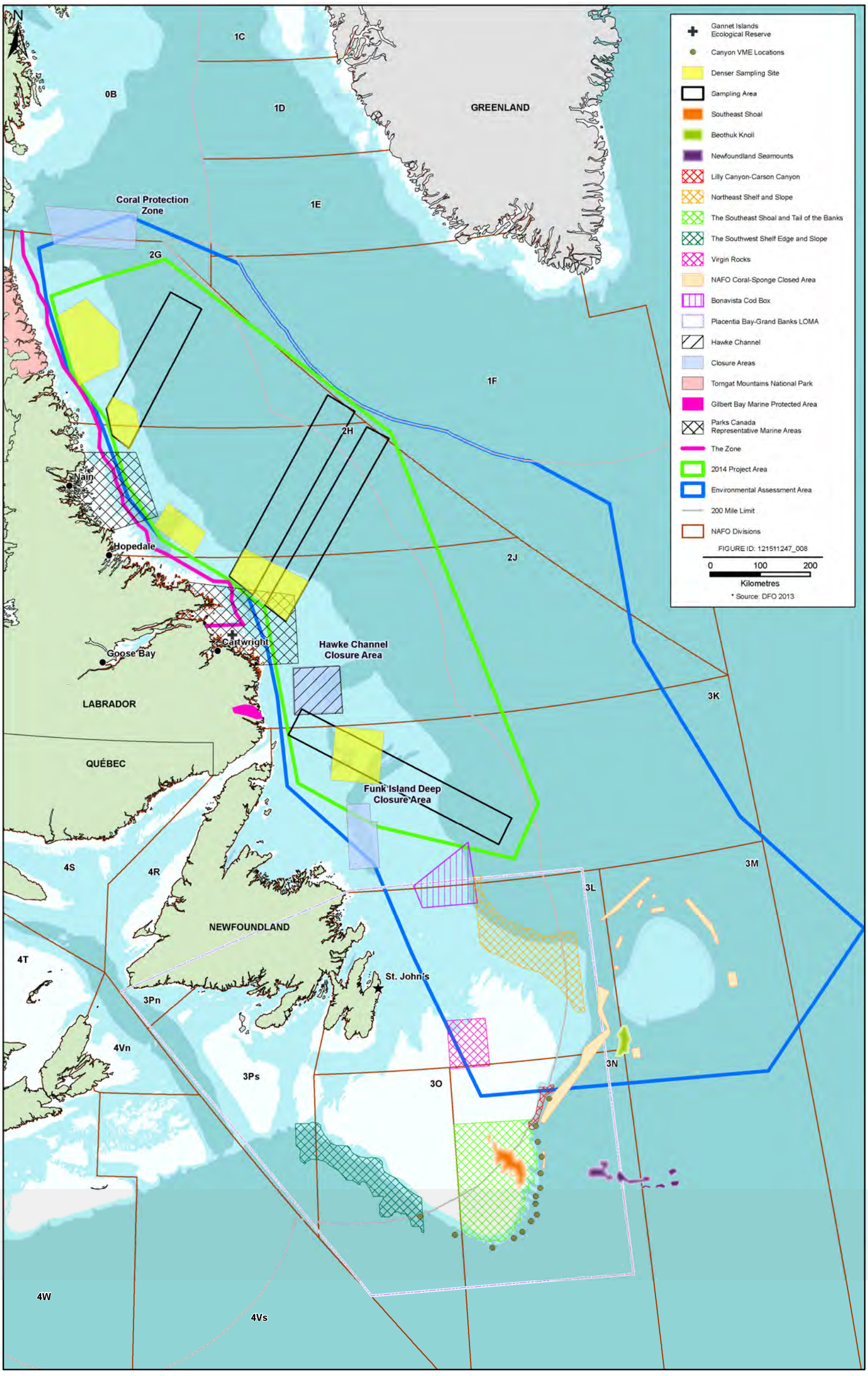


Figure C-1 Sensitive Areas in the Study / Project / Assessment Area

APPENDIX D

Vessel Oil Spill Contingency

Accidental Release / Spills and Wastes at Sea

In the event that the vessel or associated operations causes or discovers a fuel / oil spillage or slick, the vessel's Emergency Response Plan will be followed, as directed by the Client / vessel Party Chief.

Vessels will be required to comply with either the IMO MARPOL Convention or DFO's (Domestic) *Pollution Prevention Regulations* under the *Canada Shipping Act*. Vessel personnel will comply with those strictures. All spills and wastes will be handled in a manner to comply with the *International Convention for the Prevention of Pollution from Ships, 1973*, as amended by the Protocol of 1978 (MARPOL) while at sea. Generally, no materials / wastes will be discharged from the ship unless it meets MARPOL standards. Accidental releases / spills will be handled as follows.

Oil Spill Actions and Reporting Procedures

Should any petroleum-based product (i.e., oil, diesel fuel, gasoline, etc.) be observed, any operations causing the spill will cease immediately. The spilled material will be contained; the source of leak will be located immediately as quickly as possible for clean up. The leak will be isolated and repaired as soon as possible.

Operations will not resume until the leak has been repaired or an alternative method of moving the petroleum product has been established. The spilled material will be cleaned up immediately using absorbent material on board the vessel / spill kit. The vessel will have all equipment that is required (i.e., emergency spill kit), as it is International Convention for the Safety of Life at Sea certified. Any absorbent material contaminated with petroleum products will be appropriately stored on board the vessel until it can be disposed of properly, in accordance with the vessel's Waste Management Plan.

Oil spills will immediately be reported to the appropriate federal authorities. Any incident involving the spillage of oil or petroleum lubricating products into the marine environment must be reported immediately to the Vessel Traffic Reporting Arctic Canada Traffic Zone (NORDREG). In addition, the incident will be reported to the 24-hour Spill Report Centre.

Spill Reporting NT 24hr Spill Report Line

1 800 265 0237

VHF Channel 16

The next call shall be made to the Canadian Coast Guard. The spill has to be reported under the vessel's registration number. The Coast Guard will determine within a couple of days if an investigation is required.

Other Hazardous Materials/Wastes

Organic solvents, paints, cleaning agents and other chemicals may be used aboard the vessel. All hazardous materials aboard the vessel must be stored in an area that is clearly marked and labelled. All hazardous materials must have the appropriate Hazards Data Distribution System sheets on file and stored in the ship's Workplace Hazardous Materials Information System (WHMIS) station. All crew must be trained in WHMIS procedures prior to the vessel's sailing. In the event of a spill, stop the activity that resulted in the spill, contain the area as quickly as possible and consult the Material Safety Data Sheet / Control of Substances Hazardous to Health sheet for the spilled material to determine the appropriate clean up method. Clean up the spilled material and store the material in an appropriate manner on board the vessel until it can be disposed of properly, in accordance with the vessel's Waste Management Plan.