Environmental Assessment of the Old Harry Prospect Geohazard Program 2010 - 2020

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Environmental Assessment

Report Prepared for:
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Executive Summary

This Screening presents information on the proposed geohazard program, as proposed by Corridor Resources Inc. and the results of the Environmental Assessment. The proposed program would be conducted offshore western Newfoundland within the Laurentian Channel on the Old Harry Prospect, partly within exploration license EL1105, and partly outside to the west of EL1105. The Old Harry Prospect is located in the north-eastern part of the Gulf of St. Lawrence. Part of the prospect lies within waters under the jurisdiction of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), and the other part where a joint agreement between Quèbec and Canada has yet to be established. Those parts of the prospect not covered by provincial/federal management agreements are considered Frontier Lands and are administered by the National Energy Board (NEB). The proposed initial geohazard survey will be located partly in lands administered by the C-NLOPB and partly in lands administered by the NEB. Additional surveys, up to eight, may or may not be located completely within EL1105.

A description of the proposed program and the existing physical, biological and socio-economic environments is included. Valued Environmental Components (VECs) were identified to focus the environmental effects analysis. The VECs selected for this assessment were:

- Marine Birds;
- Marine Fish, Shellfish, and Habitat;
- Marine Mammals and Sea Turtles;
- Species at Risk;
- Sensitive Areas; and
- Commercial Fisheries and other Users.

This Screening includes consideration of the environmental effects of the proposed geohazard survey on each of the VECs, including the potential effects of each of the planned activities and potential unplanned (*i.e.,* accidental) events. It also considers potential cumulative effects. Mitigation measures that are technically and economically feasible have been incorporated into the program design and planning. Monitoring programs are considered where appropriate. Provisions of relevant legislation and guidelines (*e.g.,* Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2008)) have been identified and incorporated into the proposed geohazard program.

The results of the Environmental Assessment are that no significant adverse environmental effects, including cumulative effects, will occur as a result of the Project.

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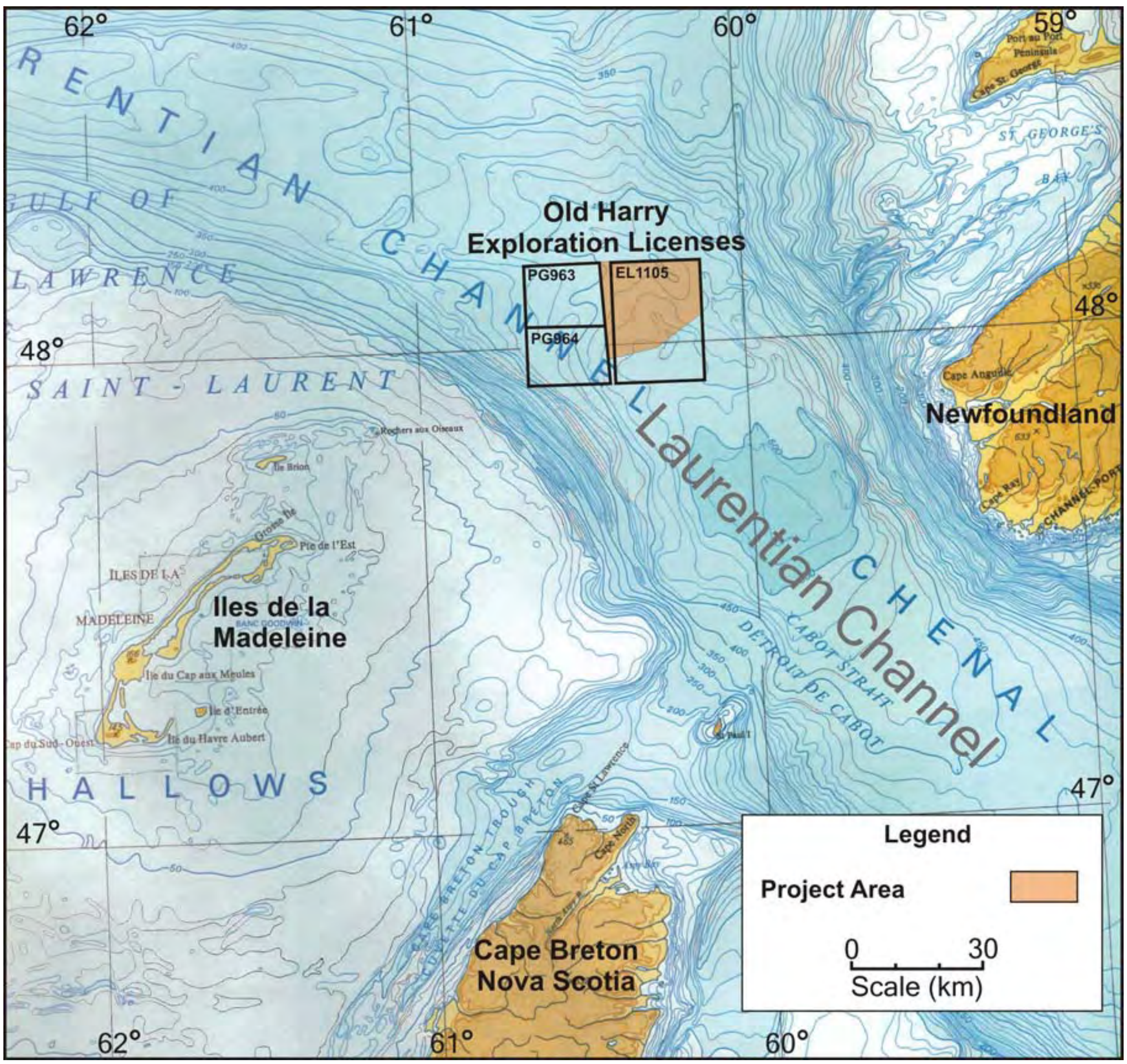
1.0 Introduction

Corridor Resources Inc. (Corridor) is proposing to conduct its first geohazard survey on the Old Harry prospect in the Gulf of St. Lawrence in the fall of 2010 (September/October) (Figure 1.1). The geohazard survey will be located partly within exploration licence EL1105 and partly outside, to the west of EL1105. Similar additional surveys, up to eight, are expected over the next ten years, during the open water periods, contingent on results of the initial fall survey. Future geohazard surveys may or may not be located completely within EL1105. The purpose of the geohazard surveys is to acquire information to assess seabed conditions and to identify potential hazards to drilling in the vicinity of future exploration well sites.

Figure 1.1 Location Map Showing General Location of the Old Harry Prospect in the Gulf of St. Lawrence



1.1 PROJECT OVERVIEW

The geohazard survey program will consist of 2-D high resolution airgun seismic, side scan sonar, sub-bottom profiling and multi-beam bathymetric data. The geohazard program will be executed by mobilizing seismic and associated survey equipment to a vessel of suitable characteristics. Each geohazard survey will require about 4 days of onsite survey time. An additional 1 to 2 days of onsite time will be required for seabed sampling, coring, and sea bottom photography. The initial proposed geohazard survey will cover an area of 4.5 km by 5.0 km (22.5 km^2). Up to eight subsequent programs will be conducted over a similar area within the larger Project Area (349.5 km^2), during the remainder of the License period (2013), and beyond (2020), if successful.

The Old Harry Prospect is located in the north-eastern part of the Gulf of St. Lawrence. Part of the prospect lies within waters under the jurisdiction of the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB), and the other part where a joint agreement between Quebec and Canada has yet to be established. Those parts of the prospect not covered by provincial/federal management agreements are considered Frontier Lands and are administered by the National Energy Board (NEB). The proposed initial geohazard survey will be located partly in lands administered by the C-NLOPB and partly in lands administered by the NEB.

1.2 THE PROPONENT

Corridor Resources Inc. is an oil and gas exploratory company incorporated in 1995 with operations in Eastern Canada. Their head office is located in Halifax, Nova Scotia. The Company has acquired several exploration prospects onshore and offshore in the Gulf of St. Lawrence region, as well as land-based petroleum exploration licences in New Brunswick, Quebec, Prince Edward Island, and offshore Nova Scotia.

The requisite vessel, subsurface equipment spread and related logistics and telecommunications resources will be provided by the contractor appointed by Corridor Resources Inc. and Corridor Resources Inc. will manage program authorization applications for the geophysical program. Corridor Resources Inc. contact is:

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1.3 REGULATORY CONTEXT

The three primary organizations in Atlantic Canada responsible for regulating the offshore oil and gas industry are the Canada Nova Scotia Offshore Petroleum Board (CNSOPB), the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and the National Energy Board (NEB). In Nova Scotia and Newfoundland and Labrador, the provincial governments and the Government of Canada have entered into Accords for the joint management of their respective offshore regions. Under these Accords, the CNSOPB and C-NLOPB were established to manage the resource under legislation of both the provincial and federal governments.

The majority of the Gulf of St. Lawrence region is currently considered Frontier Lands, an area where the offshore is not covered by provincial/federal management agreements. However, the initial survey area occurs mostly within EL1105 and a smaller portion of the initial geohazard survey occurs partly in Frontier Lands. Furthermore, most of the additional geohazard surveys are likely to occur completely within the limits of EL1105. Therefore, most of the activities associated with geohazard surveys will occur within the authorization from either the C-NLOPB or the NEB, or both.

The C-NLOPB regulates oil and gas activities in the Newfoundland and Labrador offshore area pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation* Act and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (*Accord Acts*). The NEB regulates seismic activities under the *Canada Oil and Gas Operations Act (Act)* and the associated *Canada Oil and Gas Geophysical Operations Regulations.*

The C-NLOPB's regulatory role includes the issuing of approvals and authorizations pertaining to offshore exploration activities. In terms of this Project the C-NLOPB has been designated as the Federal Environmental Assessment Coordinator (FEAC) under the *Canadian Environmental Assessment Act* (*CEAA*). Offshore geophysical surveys are included in the list of activities requiring federal assessment under *CEAA*. Several other federal agencies have an advisory role in the Environmental Assessment of the proposed geophysical program. Fisheries and Oceans Canada (DFO) is responsible for the protection of fish and fish habitat. Environment Canada is responsible for the protection of migratory birds under the *Migratory Birds Convention Act*, as well as discharges to the marine environment under Section 36 of the *Fisheries Act*. Transport Canada is responsible for provision of safe navigation (under the *Navigable Waters Protection Act*) and discharge of pollutants at sea (under the *Canada Shipping Act* and *Regulations* such as the *Pollutant Discharge Reporting Regulations, 1995* and Guidelines such as the *Guidelines for the Control of Ballast Water Discharge from Ships in Waters under Canadian Jurisdiction*).

A finalized Scoping Document was issued by the C-NLOPB and NEB on April 22, 2010 (Appendix A). This Screening has been submitted to fulfill the requirements of *CEAA* and the Scoping Document

1.4 RATIONALE FOR THE PROJECT

Geohazard surveys must be conducted in accordance with C-NLOPB and NEB requirements. Each survey will detect hazards or potential hazards (such as seabed instability, obstacles and shallow gas) in the immediate vicinity of the proposed well location. The surveys will also confirm suitable subsea conditions for drilling purposes. The purpose of the surveys is to demonstrate that drilling activities can be conducted in a manner that does not endanger personnel or the environment.

1.5 DOCUMENT ORGANIZATION

The Screening 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 details the consultation conducted as part of the proposed Project;
- Section 4 describes the existing physical (meteorology/oceanography, sea ice and icebergs, geology) environment setting;
- Section 5 details the methodology used to conduct the environmental effects assessment;
- Section 6 is the environmental assessment;
- Section 7 is the accidental events environmental assessment;
- Section 8 is the cumulative environmental assessment;
- Section 9 provides a summary of the residual adverse environmental effects;
- Section 10 addresses follow-up and monitoring;
- Section 11 describes the potential effects of the environment on the Project;
- Section 12 describes the environmental management for this Project;
- Section 13 provides an overall summary and conclusion; and
- Section 14 provides literature cited in the preparation of the environmental assessment.

2.0 Description of the Proposed Geohazard Survey

2.1 BACKGROUND OF THE PROJECT

The Old Harry Prospect is a large, doubly plunging anticline in the north-eastern part of the Gulf of St. Lawrence approximately 30 km long and 12 km wide.

Corridor has acquired three 2-D seismic data sets over the prospect: SOQUIP 1974 (re-processed), Corridor 1998 (new acquisition), and Corridor 2002 (new acquisition). At the time of writing this document, Corridor has not collected any 3-D seismic reflection data over the Old Harry Prospect. Corridor believes that there is ample 2-D seismic data to locate an initial exploration well to test the prospect.

A seismic-stratigraphic framework for the near seabed sediments in the vicinity of Old Harry has been established by previous work in the area (*i.e.,* Josenhans and Lehman, 1999). The results of previous work will be reviewed prior to beginning the initial geohazard survey (*i.e.,* review of piston core and grab sample data in the area), and the results will be considered in the interpretation of the new data acquisition.

2.2 OBJECTIVE OF THE PROJECT

The objectives of the geohazard program will be:

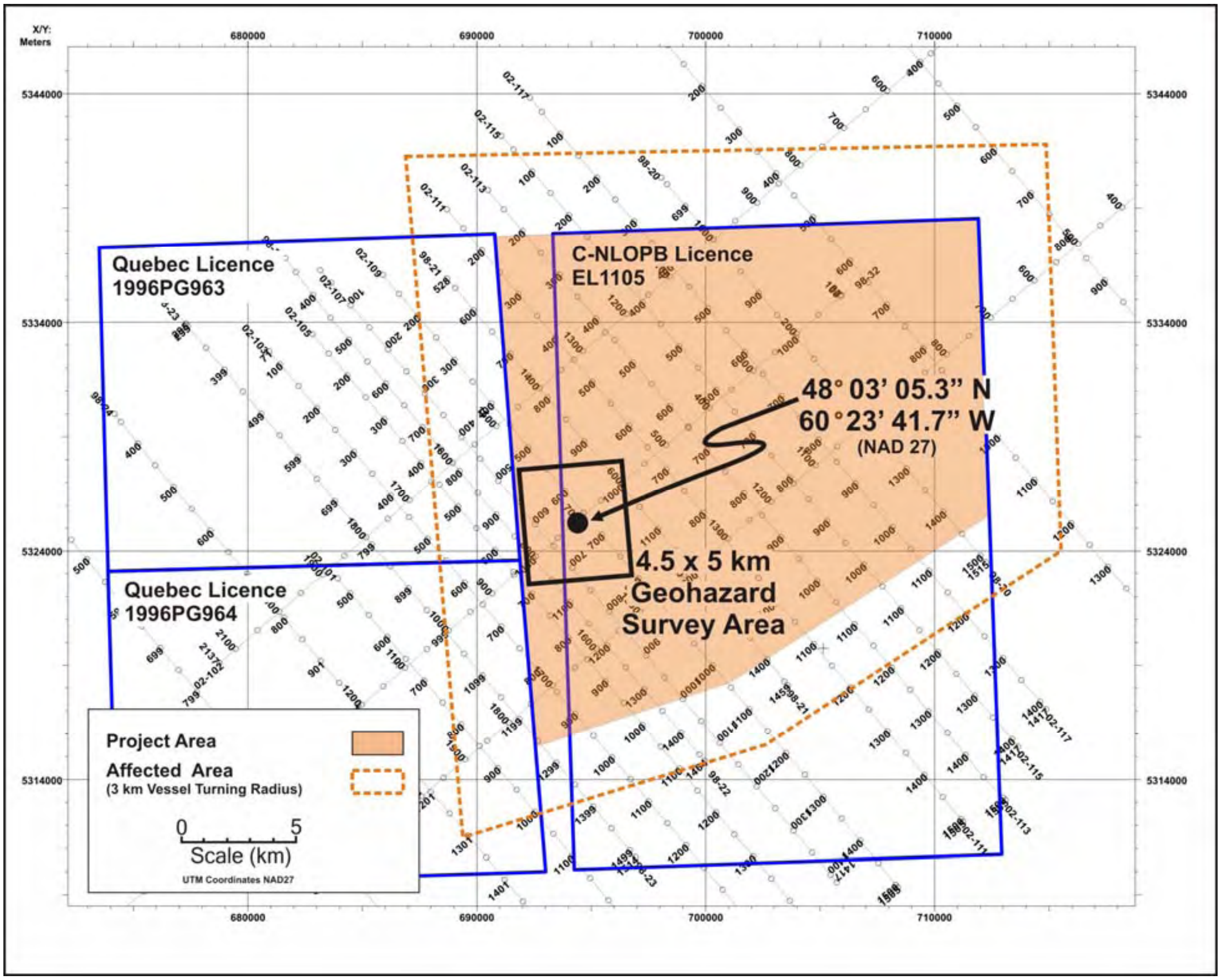
- Identification of shallow geological hazards (*i.e.,* slump scars, channels, faulting, shallow gas accumulations, gas hydrates and shallow trap closure);
- Acquisition of detailed bathymetry;
- Identification of surficial geology, boulder till, channel fill, slumping, faulting, gas-charged shallow sediments;
- Determination of the nature and characteristics of the seafloor sediments;
- Identification of iceberg scours, morphology of depositional units, ship wrecks, seafloor obstructions, and bedforms indicative of seafloor sediment dynamics; and
- Location and identification of seafloor installations, wrecks and cables.

2.3 LOCATION AND WATER DEPTH

The proposed Project Area is located approximately 95 km northeast of the Magdalen Islands and 71 km west-northwest of Cape Anguille, Newfoundland (Figure 1.1). The Project Area is located within a physiographic feature called the Laurentian Channel. Water depths in the area are approximately 450 m.

The initial proposed geohazard survey will comprise a single 4.5 km x 5 km (22.5 km^2) survey area, centered on the following NAD27 coordinates: Latitude: 48^o 03' 05.3" W; Longitude: 60^o 23' 41.7" N (Figure 2.1). The geohazard survey site is locatedpartly within EL1105 and partly within the area immediately west of EL1105 (Figure 2.1). Existing 2-D seismic reflection data from the area are show in Figure 2.1. The license is located within the main shipping lanes through the Gulf of St. Lawrence to Montreal.

Figure 2.1 Detailed Location Map of the Proposed Geohazard Project Area and Initial Survey Area



2.4 GEOHAZARD SURVEY METHODOLOGY

Each geohazard survey will be conducted using a standard suite of equipment typically utilized for geohazard surveys. Approximately 160 line kilometres of shallow penetration, 2-D seismic data will also be acquired during each geohazard survey. This work will require about 4 days on site survey time per survey. The following typical geohazard survey equipment is proposed: high resolution airgun seismic system, a side-scan sonar system, a sub-bottom profiler and an echo-sounder.

- High Resolution Seismic System - High-resolution, multi-channel seismic data will be acquired to two seconds depth, sampled at one millisecond. The data to be acquired will comprise 2-D seismic reflection data, with a line spacing of 250 m and tie lines at 500 m. There are no existing 3-D seismic data over the Old Harry Prospect. The acoustic source for the seismic data will comprise one or more airguns with a total operational volume of approximately 150 cubic inches. The exact airgun specifications will be provided when a contractor is selected. The receiver will be a single, multi-channel hydrophone streamer;
- Side-scan Sonar System - Seabed images will be acquired by means of side scan sonar or a multi-beam echo sounder. A mosaic will be created based on geo-referenced data. If side scan sonar or mutli-beam bathymetric systems identify potential debris, a proton magnetometer will be used. A camera system, sediment sampler and/or gravity/piston cores of the seafloor and near surface sediments will be used to corroborate the other data; and
- Seabed Imaging Systems - High-resolution sub-bottom profiles will be acquired by means of a boomer or sparker acoustic source towed within the water column at approximately 20 to 40 m off the seabed. The depth of penetration for this system is expected to be between 40 to 100 m.

Each geohazard survey will be executed by mobilizing appropriate geophysical survey equipment and seabed sampling equipment to a vessel of suitable characteristics. This vessel will meet all Canadian regulations and standards to work in Canadian waters. A guard vessel may accompany the survey vessel to provide advance warning of fishing activities in the area, and this vessel will meet similar criteria.

2.5 ALTERNATIVES TO THE PROJECT

A geohazard survey is required by the C-NLOPB and the NEB and, therefore, there is no alternative. The only alternative to the project is to not conduct the geohazard survey, which would subsequently result in not developing the Significant Discovery License (SDL) potential.

2.6 SAFETY

Helicopter support will be available for emergency response, as will the guard vessel (if used). Communications will follow Corridor protocols and will include phone/fax, an emergency signal and Canadian Coast Guard ship to shore radio. Procedures will be in place to address overdue contact.

Arrangements will be made with a medical service to cover the vessel, which will be staffed by individuals trained in adequate levels (which meet or exceed C-NLOPB and NEB guideline-specified levels) of First Aid and carry approved First Aid Kits.

All project-specific health, safety and environmental documentation will be provided to the C-NLOPB and/or NEB as appropriate, and in place prior to project initiation. Corridor's operational policies and procedures and a corresponding bridging document, to bridge the onshore HSE plans to local offshore requirements and the survey vessel's HSE policies and procedures, will be prepared and submitted to the C-NLOPB and/or NEB as appropriate, prior to carrying out the survey. All relevant legislation will be carried on the vessel and kept at the contractor's offices. Contractor personnel will be aware of the vessel's Safety Committee and a health, safety and environment coordinator will be designated.

2.7 SCHEDULE

The initial geohazard survey will require one trip out from port and return to port and is anticipated to take four days to complete the geohazard survey, dependent on weather. An additional 1 to 2 days will be required to complete seabed sampling, coring, and seabed photography. Subsequent surveys, up to eight, during the open water periods, will take place during the remainder of the License period (2013), and beyond (up to 2020), if successful. The fall 2010 geohazard survey site will encompass an area of 4.5 by 5.0 km's (22.5 km^2) in size (Figure 2.1). Future survey programs will be of similar size and duration, and occur within the Project Area boundaries, as identified for this Environmental Assessment.

3.0 Stakeholder Consultation

Regulatory agencies and key stakeholders have provided important information to the Environmental Assessment of the proposed geohazard survey program.

Corridor has contacted the NEB and C-NLOPB and the latter have initiated regulatory and public input through posting the Project Description submitted by Corridor and a draft Scoping Document for the assessment on the C-NLOPB website and circulating it to key federal agencies for comment and input. The Operator also sought input from the fishing industry.

3.1 ENVIRONMENT CANADA

Environment Canada provided specific guidance regarding concerns associated with the *Migratory Birds Convention Act* and associated regulations. The Environment Canada guidance is reflected in the proposed mitigative measures that will be in place during the survey and are outlined in the assessment (see Section 6.1.3 and Table 6.2). The Operator will initiate acquisition of the permit required (Seabird and Marine Mammal obstruction protocols for Atlantic Canada (2004)) in order to implement the (stranded) bird-handling protocol (*The Leach's Storm Petrel: General Information and Handling Instructions* (Appendix B) (Williams and Chardine 1999)). As well, it is intended that a Marine Mammal Observer (MMO) will also take seabird observations as per the pelagic seabird monitoring protocol developed by Canadian Wildlife Service (CWS). Environment Canada has also requested that a contingency plan be developed, as per standards published in the *Emergency Planning for Industry CAN/CSA-Z731-95*, to enable a quick and effective response in the event of a spill and will include protocols related to streamer-associated spill events.

3.2 COMMERICAL FISHERIES

A joint meeting was held among One Ocean, the Fish, Food and Allied Workers Union (FFAW), Corridor and Stantec to discuss the potential interactions with the commercial fishery during the geohazard survey. One Ocean pointed out that they are developing a risk assessment matrix for the fishing industry and oil and gas industry activities. The proposed risk assessment matrix is a tool for recommending mitigations to the different programs/surveys and will likely be distributed to the industry in June of 2010. The FFAW also pointed out that the main fishery in the area is the Redfish fishery and that there are only two vessels related to the Redfish fishery from the west coast of Newfoundland. The spring was identified as a potential concern in terms of the timing of a geohazard survey as that is when the Redfish fishery occurs. However, the number of fishers and species harvested can vary from year to year. The FFWA suggested that additional fish catch data be provided (five years of data instead of three), and the most recent data has been presented in Section 6.6.1.

Follow-up commitments include meeting with One Ocean and the FFWA prior to the initial fall survey when the vessel tender has been awarded and the specifics of the program have been identified, as well as daily contact when the program is underway.

The meeting notes, as prepared by Stantec, and the presentation, prepared by Corridor, are included in Appendix C.

4.0 Introduction

4.1 PHYSICAL ENVIRONMENT

The Gulf of St. Lawrence is a semi-enclosed sea, having two openings to the Atlantic Ocean, the Cabot Strait and the Strait of Belle Isle. The Gulf has a surface area of approximately 240,000 km^2, a volume of 3,553 km^3, an average depth of 152 m and maximum depths up to 535 m (DFO 2007a).

Present within the Gulf of Lawrence are numerous shallow areas and deep troughs. One particularly well known trough, called the Laurentian Channel, is a long, continuous trough which has a maximum depth of 535 m and extends approximately 1,500 km from the continental shelf in the Atlantic Ocean to its end point in the St. Lawrence Estuary. The Gulf is also characteristic of two secondary troughs, the Esquiman and the Anticosti Channels. Another predominant feature is the Magdalen Shallows, which is a plateau located in the southern Gulf (DFO 2007a).

The physical features present in the Gulf of St. Lawrence, as discussed above, are presented in Figure 4.1.

Figure 4.1 Physical Features Present in the Gulf of St. Lawrence

Reference: DFO 2007a

Other physical characteristics of the Gulf of St. Lawrence in the vicinity of the proposed Project, including meteorology, oceanography, and geology, are described in the following sub-sections. An in-depth discussion of the physical environment near the Project can be found in the 2005 Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment (SEA) (LGL 2005b) and the 2007 Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment Amendment (SEA Amendment) (LGL 2007). Therefore, as advised in the Old Harry Geohazard Survey Program Scoping Document (Appendix A), the information presented on the Physical Environment in these documents has been summarized in the following sub-sections to characterize the Physical Environment of the Project Area. More recent data has been provided where available.

4.2 METEOROLOGY

Meteorology is discussed below in terms of climate, wind and visibility.

4.2.1 Climate

The climate of the study area is dominated by the effects of the Gulf of St. Lawrence water which surrounds it and also by the eastward movement of continental air masses and their associated pressure systems. The climate is categorized as maritime temperate. Due to the severe winters experienced in the Gulf of St. Lawrence, the presence of buoys is limited. To assess the historical climate conditions in the study area, data was obtained from the Port Aux Basques weather station located on the south-western coast of Newfoundland approximately 100 km from the Project Area. The data is summarized in Table 4.1.

Table 4.1 Temperature and Precipitation Climate Data, 1971 - 2000, Port Aux Basques, NL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)												
Daily Average	-5.2	-6.4	-3.5	1	5.2	9.5	13.7	15	11.6	7	2.6	-2.2
Daily Maximum	-1.9	-3	-0.4	3.7	8.3	12.8	16.7	18.3	15	10	5.2	0.8
Daily Minimum	-8.4	-9.8	-6.6	-1.7	2.1	6.2	10.6	11.7	8.2	3.9	-0.1	-5.1
Precipitation (mm)												
Rainfall	52.8	39.2	61	101.8	124.2	114.1	115.3	114.1	123.1	147	126.2	97
Snowfall (cm)	93.5	75	51.7	21.5	3.4	0	0	0	0	3.4	19.6	75.3
Precipitation	146.4	115.1	113.9	126.5	128.2	114.1	115.3	114.2	123.1	150.5	147.6	174.7
Days with Precipitation												
>= 0.2 mm	24.9	20.8	18.9	16.1	15.4	15	15.8	14.7	16.2	17.7	19.5	8.6
>= 5 mm	8.9	6.5	6.6	6.7	6.7	6.3	6.2	6	7.1	8.3	8.6	4.7
>= 10 mm	4.6	3.7	3.7	4	4.4	4	3.6	3.7	4	4.8	4.9	3.3
>= 25 mm	0.96	0.74	0.78	1.1	1.2	1.1	1.1	1.1	1.2	1.6	1.4	0.92

Reference: Environment Canada 2010

Average daily temperatures in the vicinity of the Project Area ranged from - 6.4°C in February to 15°C in August. Above zero temperatures were recorded for all months except December, January, February and March. The highest amount of precipitation was recorded for the month of December and the least amount for the month of March. October was the month that recorded the highest amount of days (1.6) with rainfall greater than 25 mm.

In 2008 the average monthly air temperatures for several land based weather stations surrounding the Gulf of St. Lawrence (including Sept-Îles, Natashquan, Blanc-Sablon, Daniel's Harbour, Port Aux Basques, Charlottetown, Îles-de-la-Madeleine, Mont-Joli and Gaspè) were generally normal or slightly higher than temperatures recorded in 2007 (DFO 2009c). The southern and eastern portions of the Gulf however did exhibit greater abnormalities than the other areas, and March was an exceptionally cold month for all weather stations. The temperatures recorded for September, October and November in 2008 at the Port Aux Basques and Iles-de-la-Madeleine weather stations were all above 0°C. The months that recorded temperatures below 0 °C included December, January, February and March for both stations (DFO 2009c).

In terms of sea surface temperatures the minimum mean temperatures for February and March are approximately -0.8 °C and the maximums occur in August and September and are around 15 °C (LGL 2005b).

4.2.2 Wind Climate

Wind is an important aspect related to planning due to its role in current and wave generation, which in turn could produce forces on survey vessels and other geohazard survey equipment. Knowledge of the frequency of occurrence of wind speed is necessary to the planning of operations. From autumn through the winter and spring, many cyclonic disturbances pass through or near the Gulf. These storms can produce gale force winds that may persist for many hours and in some cases for several days. During the summer months when the tracks of cyclonic activity are displaced farther north, the persistent strong wind become less frequent over the Gulf.

The parameters used to describe the wind characteristics mostly commonly are: wind speed and wind direction. Data on percent wind speed by wind direction from 1954 – 2008 was acquired from the MSC50 data set for grid point 13511 (UTM – Northing, 5,331,208 m; Easting, 708,455 m) and is presented in Tables 4.2 to 4.5 for each season. Corresponding wind roses over the same time period and seasons are presented in Figures 4.2 to 4.5.

Table 4.2 Percent Wind Speed by Direction for Grid Point 13511 - September, October and November

Wind Speed (m/s)	Wind Direction												Total
	15	45	75	105	135	165	195	225	255	285	315	345	
0 - 4.99	1	0.89	0.95	0.87	0.97	1.26	1.6	1.93	2.14	1.91	1.62	1.24	**16.4**
5 - 9.99	2.49	2.03	1.85	1.61	2.16	3.44	5.41	6.81	6.42	6.59	5.63	3.74	**48.2**
10 - 14.99	1.34	1.2	0.87	0.86	1.31	2.12	2.95	3.63	3.73	4.91	3.79	24	**29.1**
15 - 19.99	0.37	0.22	0.21	0.27	0.4	0.5	0.39	0.34	0.62	1.2	0.96	0.53	**6.01**
20 - 24.99	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0	0.03	0.07	0.09	0.03	**0.33**
25 - 29.99	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**5.23**	**4.37**	**3.89**	**3.62**	**4.85**	**7.34**	**1.04**	**12.71**	**12.9**	**14.7**	**12.1**	**7.94**	**100**

Table 4.3 Percent Wind Speed by Direction for Grid Point 13511 – December, January and February

Wind Speed (m/s)	Wind Direction												Total
	15	45	75	105	135	165	195	225	255	285	315	345	
0 - 4.99	1.03	0.84	0.79	0.65	0.59	0.76	0.9	1.2	1.31	1.51	1.48	1.35	**12.4**
5 - 9.99	2.91	2.28	1.82	1.59	1.74	2.14	2.65	4.03	5.12	6.86	5.78	4.24	**41.2**
10 - 14.99	2.06	1.34	1.3	1.18	1.07	1.39	2	2.82	4.49	7.17	5.71	3.07	**33.6**
15 - 19.99	0.62	0.49	0.52	0.54	0.5	0.55	0.38	0.59	1.38	2.78	1.92	0.94	**11.2**
20 - 24.99	0.03	0.09	0.03	0.09	0.1	0.08	0.03	0.06	0.24	0.37	0.28	0.16	**1.56**
25 - 29.99	0	0	0	0	0	0	0	0	0.01	0	0.01	0	**0.02**
Total	**6.65**	**5.04**	**4.46**	**4.05**	**4**	**4.92**	**5.96**	**8.71**	**12.6**	**18.7**	**15.2**	**9.77**	**100**

Table 4.4 Percent Wind Speed by Wind Direction for Grid Point 13511 - March, April and May

Wind Speed (m/s)	Wind Direction												Total
	15	45	75	105	135	165	195	225	255	285	315	345	
0 - 4.99	2.42	2.39	2.3	2.09	2.06	2.41	2.97	3.22	2.97	2.97	2.74	2.55	**31.1**
5 - 9.99	4	3.25	2.7	2.57	2.7	3.95	4.87	4.73	3.95	4.15	4.56	4.37	**45.8**
10 - 14.99	1.96	1.92	1.29	1.24	1.21	1.42	1.72	1.41	1.42	2.1	1.93	1.78	**19.4**
15 - 19.99	0.42	0.6	0.24	0.26	0.21	0.16	0.12	0.09	0.24	0.5	0.36	0.32	**3.52**
20 - 24.99	0.04	0.03	0.01	0.02	0	0	0	0	0.01	0.02	0.02	0.02	**0.18**
Total	**8.84**	**8.19**	**6.55**	**6.18**	**6.19**	**7.95**	**9.68**	**9.44**	**8.59**	**9.74**	**9.61**	**9.03**	**100**

Table 4.5 Percent Wind Speed by Wind Direction for Grid Point 13511 - June, July and August

Wind Speed (m/s)	Wind Direction												Total
	15	45	75	105	135	165	195	225	255	285	315	345	
0 - 4.99	1.84	1.66	0.18	1.96	2.38	3.89	5.94	7.19	5.58	3.68	2.48	2.13	**40.5**
5 - 9.99	1.51	1.32	1.51	0.15	2.49	5.95	11	10.5	5.83	3.82	2.61	1.91	**50**
10 - 14.99	0.39	0.32	0.28	0.37	0.44	1.36	2.49	1.38	0.69	0.7	0.52	0.42	**9.23**
15 - 19.99	0.04	0.01	0	0	0.02	0.04	0.02	0	0.02	0.03	0.02	0.04	**0.26**
20 - 24.99	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**3.78**	**3.21**	**3.58**	**3.84**	**5.34**	**11.2**	**19.5**	**19.1**	**12.1**	**8.22**	**5.63**	**4.51**	**100**

Figure 4.2 Wind Rose for September, October and November

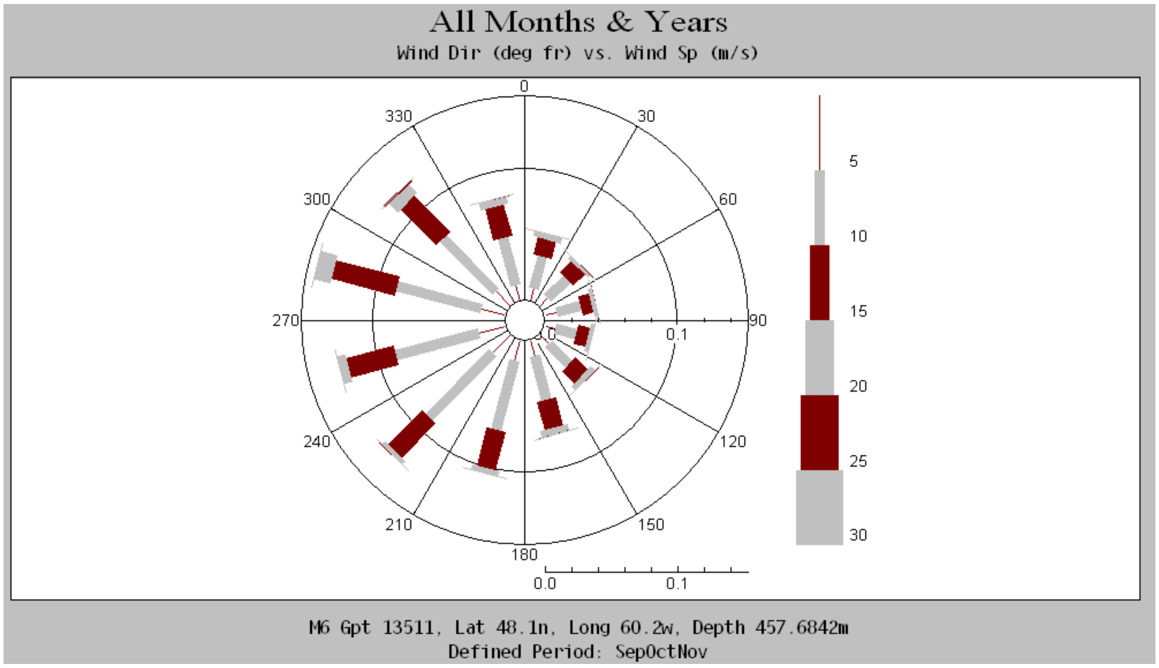


Figure 4.3 Wind Rose for December, January and February

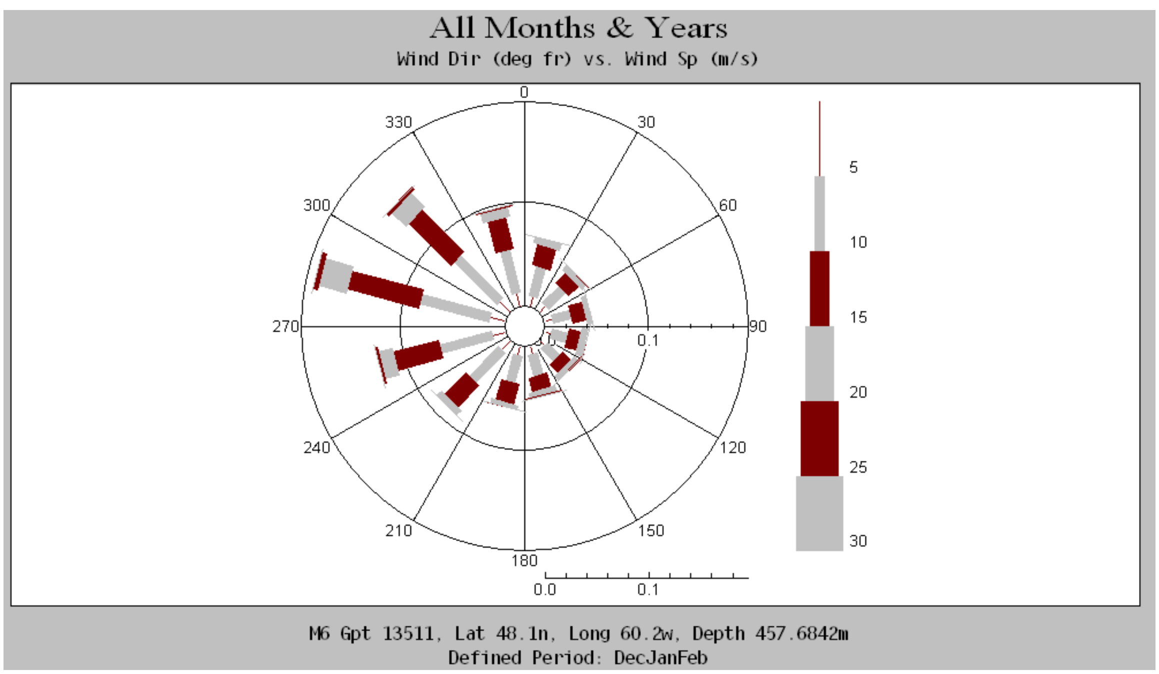


Figure 4.4 Wind Rose for March, April and May

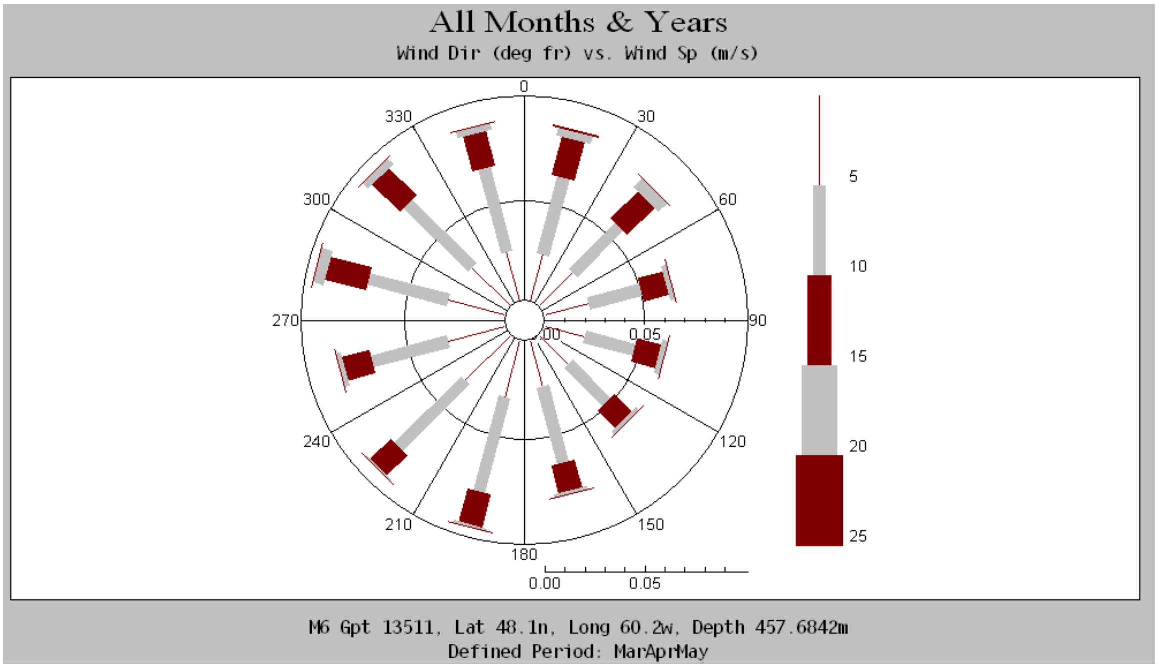
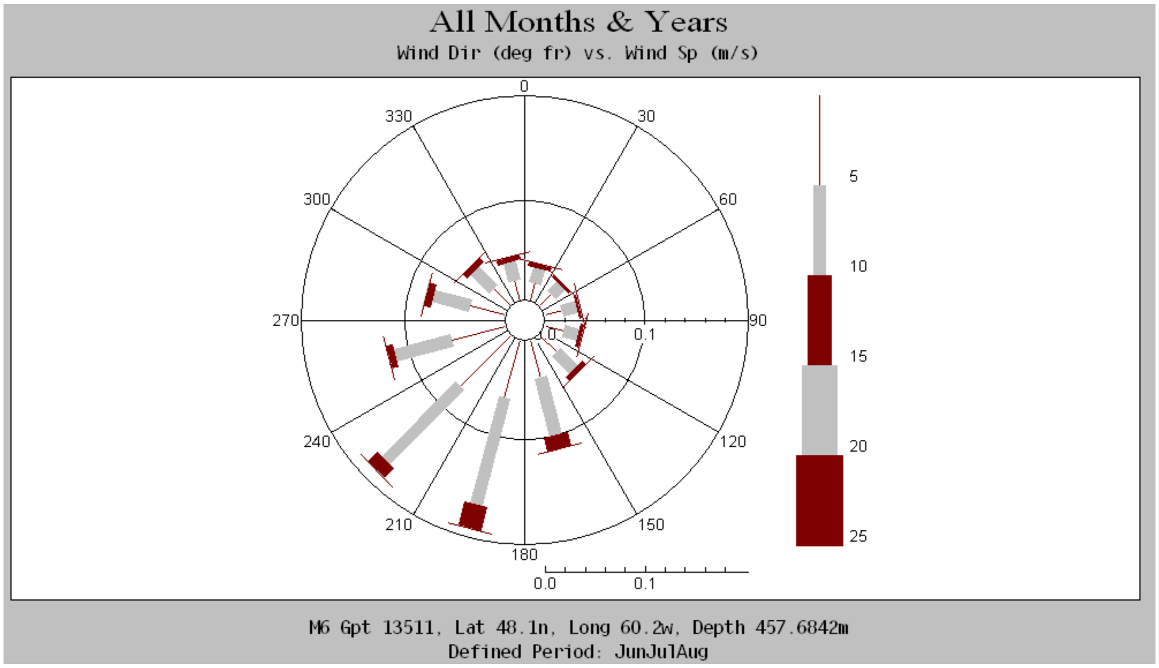


Figure 4.5 Wind Rose for June, July and August



Most wind speeds at grid point 13511 during the fall (September – November), winter (December – February) and spring (March – May) are between 5 and 9.9 m/s and are from the WNW direction. Approximately 50 % of the wind speeds during the summer (June – August) are also between 5 and 9.9 m/s however the winds are most commonly from the SW direction. There was no wind speeds reported during the summer greater than 20 m/s. Wind speeds between 20 and 24.9 m/s were experienced during the fall, winter and spring months and the highest percentage was reported during the winter, at less than 2 %.

4.2.3 Visibility and Fog

Fog is an important weather condition that results in poor visibility for the ships, helicopters and aircraft operating offshore. Sea fog can be dense and may often cover large areas.

Historical data for visibilities were acquired from the Port Aux Basques weather station and is presented in Table 4.6.

Table 4.6 Visibility Data Recorded at the Port Aux Basques Weather Station, 1971-2000

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

During the averaging period from 1971-2000 the number of hours with visibility less than 1 km was greatest during June and July. The number of hours with visibility greater than 9 km was highest during September, October and November.

Existing visibility conditions in the Gulf of St. Lawrence was assessed in the 2005 SEA report (LGL 2005b) using information available from AES-40 data set at grid point 5817, which is located offshore NL slightly north of Cape St. George. There was a relatively high occurrence (8-10 %) of reduced visibilities (less than 1 km) in January, February and March, due to snow. By April to July, as the sea surface air temperature increases and the temperature of the ocean remains cooler, the air becomes cooled by the ocean and saturated resulting in fog. An 11 % reduced visibility (less than 1 km) was recorded for the month of July. As fall approaches, the temperature difference between the air and the ocean lessens as does the amount of fog, with October reporting the lowest occurrences of reduced visibility, approximately 2 % (LGL 2005b).

4.3 OCEANOGRAPHY

The oceanic environment of the Gulf of St. Lawrence is described in the following sub-sections. Data for ocean currents, waves and sea ice is presented.

4.3.1 Ocean Currents

Knowledge of ocean currents is essential to the planning of oil and gas related operations in the Gulf. Circulation in the Gulf of St. Lawrence is influenced by a number of factors including tides, regional meteorological events, freshwater runoff and water exchange through the Strait of Belle Isle and the Cabot Strait. Generally the movement of water follows through the Cabot Strait, flowing counter clockwise around the Gulf to the mouth of the St. Lawrence River, across the Magdalen Shallows, and exits via the Cabot Strait. There are large, seasonally-variable runoffs of freshwater into the Gulf, mainly from the St. Lawrence River and rivers of the northern shore. Oceanographic conditions in the Gulf are complex. Masses of water with acutely contrasting temperature and salinity come together and mix. The Gulf can be considered a three-layer system during summer; the two upper layers undergo seasonal variations and become one during the winter months (DFO 2005).

Driven by wave and tidal movement, cold, dense water flows into the Gulf of St. Lawrence along the Strait of Belle Isle from the Arctic via the Labrador Current. Waters from the Atlantic Ocean enter the Gulf via the Cabot Strait, in the Laurentian Channel. The contrasting temperature and salinity is produced during the spring when an increase in freshwater flow enters the Gulf via the St. Lawrence River, the Saguenay River and other smaller rivers along the shores. The result is a higher temperature, low salinity surface layer of water that then begins to flow out of the Gulf into the Atlantic. Additional freshwater runoff occurs in the fall, driving circulation patterns in the Gulf, and causing the area to show properties of an estuarine environment (DFO 2007a).

At the start of winter the warmer, low salinity surface layer flowing into the Atlantic becomes less buoyant, due to the drop in air temperature and ice formation, and moves downward in the water column. Once spring arrives, a new summer surface layer is created causing the winter layer to be trapped below. This is referred to as the Cold Intermediate Layer (DFO 2007a).

Atmospheric conditions in the Gulf of St. Lawrence also play an important role in the circulation of water, as they have an effect on cloud cover, precipitation, evaporation and air temperature.

4.3.2 Waves

The wave climate in the Gulf of St. Lawrence can be characterized by extra-tropical storms occurring during October to March. Tropical storms can also occur between August and October; however hurricanes tend to have reduced to tropical or extra-tropical storms by the time they have reached the Gulf waters (LGL 2005b).

Wave climate in the Gulf of St. Lawrence was assessed by means of the MSC50 data set for grid point 13511. The minimum, maximum, mean and standard deviations of significant wave heights for each season are presented in Table 4.7. Maximum significant wave heights were greatest during the fall and winter seasons.

Table 4.7 Minimum, Maximum, Mean and Standard Deviation of Significant Wave Height at Grid Point 13511 by Season

Season	Minimum Wave Height (m)	Maximum Wave Height (m)	Mean Wave Height (m)	Standard Deviation (m)
Fall (Sept - Nov)	0.15	9.29	1.95	1.09
Winter (Dec - Feb)	0	9.46	2.41	1.35
Spring (March - May)	0	7.05	1.41	0.92
Summer (June - Aug)	0.1	7.56	1.14	0.63

The percent occurrence of peak wave period against significant wave heights for grid point 13511 for each season is presented in Tables 4.8 to 4.11.

Table 4.8 Percent Occurrence of Peak Wave Period against Significant Wave Height for Grid Point 13511 - September, October and November

Period	Significant Wave Height (m)										Total
	1	3	5	7	9	11	13	15	17	19	
0 - 0.99	0	2.05	9.82	2.25	2.19	0.72	0.67	0.13	0.02	0	**17.9**
1 - 1.99	0	0.46	25.1	13.2	2.58	0.95	0.61	0.2	0.05	0	**43.1**
2 - 2.99	0	0	0.81	20.6	1.29	0.29	0.22	0.01	0.01	0	**23.2**
3 - 3.99	0	0	0	4.04	5.94	0.12	0.07	0	0	0	**10.2**
4 - 4.99	0	0	0	0.07	3.76	0.07	0.03	0	0	0	**3.92**
5 - 5.99	0	0	0	0	0.95	0.31	0.01	0	0	0	**1.27**
6 - 6.99	0	0	0	0	0.02	0.29	0	0	0	0	**0.31**
7 - 7.99	0	0	0	0	0	0.08	0	0	0	0	**0.08**
8 - 8.99	0	0	0	0	0	0.03	0	0	0	0	**0.03**
9 - 9.99	0	0	0	0	0	0	0	0	0	0	**0**
Total	**0**	**2.51**	**35.7**	**40.2**	**16.7**	**2.87**	**1.6**	**0.35**	**0.08**	**0**	**100**

Table 4.9 Percent Occurrence of Peak Wave Period against Significant Wave Height for Grid Point 13511 - December, January and February

Period	Significant Wave Height (m)										Total
	1	3	5	7	9	11	13	15	17	19	
0 - 0.99	0.07	2.25	5.22	0.34	1.19	1.03	0.69	0.03	0.01	0.01	**10.9**
1 - 1.99	0	0.44	19.9	9.95	2.07	1.99	0.68	0.09	0	0	**35.1**
2 - 2.99	0	0	1.66	21.9	1.44	0.94	0.36	0.06	0	0	**26.3**
3 - 3.99	0	0	0.01	6.72	8.04	0.4	0.17	0.01	0	0	**15.4**
4 - 4.99	0	0	0	0.27	6.84	0.22	0.07	0	0	0	**7.41**
5 - 5.99	0	0	0	0	2.28	0.78	0.02	0	0	0	**3.07**
6 - 6.99	0	0	0	0	0.17	0.97	0.02	0	0	0	**1.16**
7 - 7.99	0	0	0	0	0	0.48	0.01	0	0	0	**0.49**
8 - 8.99	0	0	0	0	0	0.2	0	0	0	0	**0.2**
9 - 9.99	0	0	0	0	0	0.04	0	0	0	0	**0.04**
Total	**0.07**	**2.7**	**26.8**	**39.2**	**22**	**7.05**	**2.03**	**0.19**	**0.01**	**0.01**	**100**

Table 4.10 Percent Occurrence of Peak Wave Period against Significant Wave Height for Grid Point 13511 - March, April and May

Period	Significant Wave Height (m)											Total
	1	3	5	7	9	11	13	15	17	19	21	
0 - 0.99	0.63	7.59	15	6.95	5.48	1.93	1.66	0.11	0.04	0.02	0.01	**39.4**
1 - 1.99	0	0.62	24.7	9.29	3.25	1.39	0.27	0.03	0	0	0	**39.5**
2 - 2.99	0	0	0.9	12.3	0.97	0.32	0.08	0	0	0	0	**14.6**
3 - 3.99	0	0	0	2.53	1.9	0.09	0.05	0	0	0	0	**4.57**
4 - 4.99	0	0	0	0.05	1.29	0.03	0.02	0	0	0	0	**1.39**
5 - 5.99	0	0	0	0	0.37	0.06	0	0	0	0	0	**0.44**
6 - 6.99	0	0	0	0	0.02	0.07	0	0	0	0	0	**0.08**
7 - 7.99	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**0.63**	**8.21**	**40.6**	**31.1**	**13.3**	**3.89**	**2.09**	**0.14**	**0.04**	**0.02**	**0.01**	**100**

Table 4.11 Percent Occurrence of Peak Wave Period against Significant Wave Height for Grid Point 13511 - June, July and August

Period	Significant Wave Height (m)										Total
	1	3	5	7	9	11	13	15	17	19	
0 - 0.99	0	7.74	24.5	11.3	4.26	1	0.89	0.34	0.19	0.02	**50.3**
1 - 1.99	0	0.43	27.8	9.87	1.31	0.53	0.05	0.07	0.03	0.01	**40.1**
2 - 2.99	0	0	0.26	7.73	0.25	0.07	0	0.01	0	0	**8.32**
3 - 3.99	0	0	0	0.54	0.58	0.02	0	0	0	0	**1.14**
4 - 4.99	0	0	0	0	0.17	0	0	0	0	0	**0.17**
5 - 5.99	0	0	0	0	0.01	0	0	0	0	0	**0.02**
6 - 6.99	0	0	0	0	0	0	0	0	0	0	**0**
7 - 7.99	0	0	0	0	0	0	0	0	0	0	**0**
Total	**0**	**11.2**	**52.6**	**29.5**	**6.59**	**1.63**	**0.94**	**0.41**	**0.23**	**0.03**	**100**

The majority of the significant wave heights during the fall and winter occurred at 7 m and at 5 m during the spring and summer. Generally the summer months experienced the highest wave heights. During the fall, winter and spring the typical peak period is approximately 2 seconds and 1 second during summer months.

4.3.3 Ice

Another important feature of the Gulf of St. Lawrence is that it freezes over every year. Floating ice is present in two forms in the marine environment: sea ice and icebergs. Both types pose a potential hazard to marine vessels and drilling rigs. However, there tends to be a lot of variation in ice cover, thickness and break-up times from year to year.

The maximum pack ice extent in March, based on a 30 year median of ice concentration, in the Gulf of St. Lawrence is displayed in Figure 2.27 in Section 2.5.3 of the 2005 Western Newfoundland SEA document (LGL 2005b). This data shows the entire Project Area to be covered with ice during the month of March. It was also reported that this general area is typically ice free by the second week in May.

Each geohazard survey is scheduled to occur over four to six days during ice free periods, and therefore sea ice will not be an issue.

4.3.4 Bathymetry

Water depths within the Project Area and the vicinity of the Project range from 400 m to 500 m (refer to Figure 5.1). Water depths in the area of the proposed initial geohazard survey are approximately 450 m.

4.4 GEOLOGY

Geological formations in the Gulf of St. Lawrence are an essential component of marine habitats, they influence oceanic circulation and mixing and they allow for many human activities, including oil and gas exploration. The rocks which lay on the bottom of the Gulf are millions of years old and straddle three major geological regions including the Canadian Shield, the St. Lawrence Platform and the Appalachians. Some of these rocks lay exposed to the ocean while others are covered by sediment varying in depth from a few meters to hundreds of meters. Over the past two million years, approximately four glacial and interglacial periods have transformed these rocks greatly through erosion and sediment deposits with the latest being that of the Wisconsin glacier. Natural phenomenon, including the movement of icebergs, and human activities (*i.e.,* fishing trawls) have also played a role in transforming the seafloor of the Gulf to how it exists today (DFO 2005).The Project Area is located within the Laurentian Channel, which cuts into the lower Paleozoic to Mesozoic carbonates and redbed rocks. This u-shaped channel was formed by glacial over deepening of a pre-Quaternary drainage system.

The three dimensional configuration of the Quaternary sediments in the Gulf of St. Lawrence was studied by Josenhans and Lehman (1999) via an analysis of high resolution seismic reflection data and core samples. The results were interpreted and subdivided into three seismostratigraphic units including glacial till – ice-contact sediments, glaciomarine sediments and postglacial sediments. The glacial till – ice-contact sediments lay above bedrock and other older till deposits and its depth ranges from areas of discontinuous deposits to morainal deposits of up to 180 m thick. The glacial till – ice-contact unit was further interpreted to contain a stacking of multiple glacial till – ice-contact deposits which were sub-divided into the lower, middle and upper tills units. Samples taken from the lowermost till unit contained redish-brown clayey silt with grit and large clasts of clay and pebbles. The middle till unit occurs along the eastern margin of the Magdalen Plateau and extends down the southwestern flank of the Laurentian Channel. Sediments from this unit are dark brown in colour and made up of calcareous, silty-sandy muds with pebbles and red clayballs. The upper glacial till unit extends down the southwestern flanks of the Laurentian Channel and the sediments making up this unit consist of massive, dark grey clayey muds with clasts of limestone, black slate and igneous fragments. The glaciomarine sediments lie above the glacial till – ice-contact unit and consist of massive silty clays with gritty, pebbly sediments and rock fragments. The third seismostratigraphic unit, postglacial sediments, is the uppermost unit and consists of massive, grey clayey to sandy mud with some shell fragments. In general the thickest deposits of glacial sediments have been deposited on the southwestward slope of the Laurentian Channel.

An in depth discussion of the geology within the vicinity of the proposed Project is presented in the 2005 SEA report (LGL 2005b), Section 2.1.

5.0 Environmental Effects Assessment Methods

5.1 OVERVIEW

The approach and methods used for the environmental assessment are based largely on the study team's experience in conducting environmental assessments of similar projects in the region. The approach and methods used have proven effective for assessments conducted under federal, provincial, joint federal-provincial and multi-party processes including the C-NLOPB and NEB, as well as for environmental assessments in other jurisdictions. The environmental assessment focuses on the Valued Environmental Components (VECs) identified through issues scoping as described below.

The specific steps involved in the assessment for each VEC are as follows:

- Determining boundaries;
- Describing the existing conditions for each VEC in the vicinity of the Project;
- Identifying potential interactions between VECs and the project's components/activities and outlining existing knowledge regarding these potential interactions;
- Establishing significance criteria for evaluating residual environmental effects;
- Assessing environmental effects and mitigation;
- Assessing accidental events;
- Assessing cumulative effects;
- Providing a summary of the environmental effects assessment; and
- Identifying the need, if any, for follow-up and monitoring requirements.

Each of these is described in more detail in the following sections.

5.2 ISSUES SCOPING AND SELECTION OF VALUED ENVIRONMENTAL COMPONENTS

Project scope encompasses those components and activities considered for the purpose of environmental assessment. The scope of the proposed geohazard survey program includes all of the components and activities described in Section 2.2 and 2.4 of this report.

The issues scoping exercise conducted in relation to this environmental assessment included:

- Consultation with relevant regulatory agencies and other stakeholders;
- A review of the Old Harry Prospect Geohazard Program 2010 - 2020 Scoping Document and regulatory review comments;
- A review of available information on the existing biophysical and socio-economic environments of the region in which the program will occur, and of other environmental assessments undertaken in relation to similar projects;

- A review of relevant regulations and guidelines related to offshore exploration activities; and
- The professional judgment of the study team.

It is generally acknowledged that an environmental assessment must focus on those components of the environment that are valued by society and/or that can serve as indicators of environmental change and have the most relevance to the final decision regarding the environmental acceptability of a proposed undertaking. These components are known as VECs and may include biophysical and socio-economic components.

Based on the results of the issues scoping exercise described above, including the scoping document (Appendix A), the following VECs are considered in this Screening:

- Marine Birds;
- Marine Fish, Shellfish and Habitat;
- Marine Mammals and Sea Turtles;
- Species at Risk;
- Sensitive Areas; and
- Commercial Fisheries and other Users.

The rationale for the selection of these VECs is provided below:

- **Marine Birds**: The Gulf of St. Lawrence hosts a range of seabirds throughout the year. Sixteen seabirds are common to the Project Area and these species and their distribution patterns are further discussed in Section 6.1.1. Seabirds are a key component near the top of the food chain and are an important resource for tourism and recreational activities, and for scientific study. They are therefore important socially, culturally, economically, aesthetically, ecologically and scientifically;
- **Marine Fish, Shellfish and Habitat**: The commercial fishery is an important activity in the Gulf of St. Lawrence. The fish and fish habitat upon which the fishery depends is therefore an important consideration in the environmental assessment of activities which may influence the marine environment. Fish and their habitat are assessed as a single VEC because they are clearly interrelated. The consideration of fish and fish habitat as one VEC is in keeping with current practice in environmental assessment and provides for a more comprehensive, ecosystem-based approach, while at the same time minimizing repetition and enhancing brevity. A number of species of Marine Fish can be found within the vicinity of the Project Area and are further discussed in Section 6.2.1;
- **Marine Mammals and Sea Turtles**: Whales and seals are key elements in the biological and social environments in the Gulf of St. Lawrence. Although sea turtles are generally uncommon, they are considered a VEC because of some species' endangered and threatened status. There are eighteen species of Marine Mammals and three species of Sea Turtles potentially present within the vicinity of the Project Area and these are discussed in Section 6.3.1;

- **Species at Risk**: There are eighteen species of marine birds, fish, mammals and sea turtles that have designated status under the *Species at Risk Act* (*SARA*) and/or Committee on the Status of Endangered Wildlife in Canada (COSWEIC). Species at Risk are collectively considered a VEC due to regulatory concern and in recognition of their protected status under *SARA*;
- **Sensitive Areas**: Sensitive Areas are often associated with rare or unique marine habitat features, habitat that supports sensitive life stages of valued marine resources, and/or critical habitat for species at risk. As per the Scoping Document (Appendix A), Sensitive Areas in the Project Area include any Ecologically and Biologically Significant Areas (EBSAs) identified within the Gulf of St. Lawrence. There are, however, no legally defined sensitive areas located in the vicinity of the proposed Project; and
- **Commercial Fisheries and other Users**: Commercial fisheries and other Users were also selected as a VEC because historically, the fishery has played an important role in the Gulf of St. Lawrence and has helped to define much of the Atlantic province’s character. Other marine users of the area include marine transportation, research surveys and military exercises, and therefore area also considered.

These six VECs represent the key environmental components that are assessed in this document. This environmental assessment provides detailed effects analyses for each of these VECs.

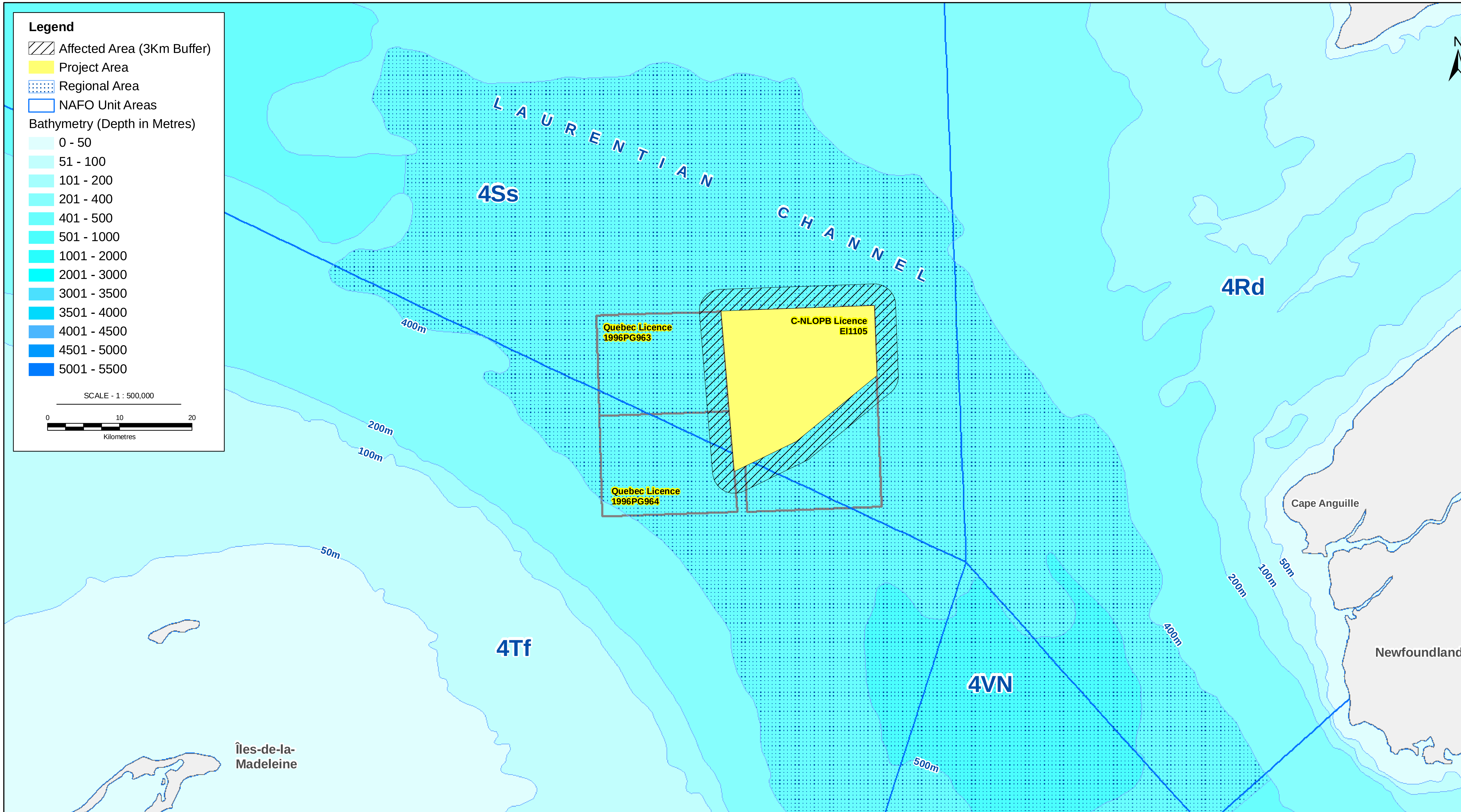
5.3 ENVIRONMENTAL EFFECTS ASSESSMENT ORGANIZATION

Boundaries

Boundaries provide a meaningful and manageable focus for an environmental assessment. They also aid in determining the most effective use of available study resources. The Project boundaries are described generally below and in further detail in Table 5.1, as part of the effects analysis for each of the VECs. Establishing the spatial and temporal scope of the environmental assessment for each VEC included consideration of project, ecological/socio-economic and administrative boundaries.

The Project boundaries are also illustrated in Figure 5.1 and have been categorized as follows:

- **Project Area**: A 349.5 km^2 area within and just outside the boundaries of the Corridor’s exploration licence EL1105, where an initial geohazard survey will take place within and outside EL1105 in the fall of 2010 over a 4.5 by 5 km survey area, and additional surveys, up to eight, of similar size and duration, will occur intermittently over the next ten years primarily within EL1105
- **Affected Area**: The area that could potentially be affected by project activities beyond the Project Area; this includes a “buffer zone” of 3 km required for vessel turning
- **Regional Area**: The area extending beyond the “affected area” boundary within the Laurentian Channel along the 400 m depth contour, between NL and the Îles-de-la-Madeleine



DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: **Figure 5.1**
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**PROJECT BOUNDARIES**	Stantec

Project boundaries are defined by the spatial and temporal extent of project components and activities and are determined primarily by project-specific characteristics. Spatial project boundaries are sometimes defined by project "footprints" and may vary between project components and activities. Temporal project boundaries are defined by the timing and duration of project activities, as described in Section 2.7. Administrative boundaries refer to the spatial and temporal dimensions imposed on the environmental assessment for political, socio-cultural or economic reasons. Administrative boundaries can include such elements as the manner in which natural and/or socio-economic systems are managed.

The spatial and administrative boundaries identified for each VEC in this assessment are described in Table 5.1. The temporal boundaries for each VEC are the same and are defined to include the five to six days required to complete a typical geohazard survey, as described in Section 2.4 within the open water period of the Laurentian Channel.

Table 5.1 Project Boundaries by VEC

VEC	Spatial Boundaries	Administrative Boundaries
Marine Birds	Includes the area in and around the Project Area and the Affected Area.	Marine birds are protected federally under the *Migratory Birds Convention Act*, which is administered by Environment Canada.
Marine Fish, Shellfish & Habitat	Includes the area within and around the Project Area and the Affected Area.	Marine fish and fish habitat are protected by federal legislation. Fish habitat is protected under the federal *Fisheries Act* and by DFO's Policy for the Management of Fish Habitat. This policy applies to all projects and activities in or near the water that could alter or destroy fish habitat by chemical, physical or biological means.
Marine Mammals & Sea Turtles	Includes the area within and around the Project Area and the Affected Area.	Marine Mammals and Sea Turtles are protected by federal legislation under the *Fisheries Act* and the *Species at Risk Act,* for those species who have designated status.
Species at Risk	Includes the area within and around the Project Area and the Affected Area.	Species at risk are protected under *SARA*, administered by Environment Canada, Parks Canada and DFO. *SARA* is intended to protect species at risk in Canada and their critical habitat (as defined by *SARA*). Only species on Schedule 1 of *SARA* are subject to the permit and enforcement provisions of the Act.
Sensitive Areas	Includes the area within and around the Project Area and the Affected Area.	There are no legally defined sensitive areas located in the vicinity of the proposed Project.
Commercial Fisheries and Other Users	Includes the area within and around the Project Area, the Affected Area, as well as NAFO Division 4Ss and 4Tf.	DFO manages the fisheries resources in the area and is primarily responsible for scientific surveys. Scientific surveys conducted outside of DFO (*i.e.,* private surveys) come under the jurisdiction of the Coast Guard, C-NLOPB, Quebec and CNSOPB. Boundaries for commercial fisheries have also been defined by the Northwest Atlantic Fisheries Organization (NAFO).

5.3.1 Existing Conditions

The existing conditions in the vicinity of the Project will be described for Marine Birds, Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Species at Risk, Sensitive Areas and Commercial Fisheries and other Users. As advised in the Project's Scoping Document (Appendix A), information regarding the existing biophysical and socio-economic conditions in and surrounding the Project Area has been summarized using environmental reports for western Newfoundland, including the 2005 Western Newfoundland SEA document (LGL 2005b) and the 2007 Western Newfoundland SEA Amendment document (LGL 2007).

5.3.2 Potential Interactions and Existing Knowledge

The assessment focuses on identifying and evaluating potential interactions between program components and activities and each of the VECs under consideration. As a first step in the effects analysis, potential program-VEC interactions are identified and discussed. Existing knowledge concerning these potential interactions is also reviewed and summarized.

5.3.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects are identified.

Where possible, a proactive approach to mitigating potential environmental effects has been taken by incorporating environmental considerations directly into program design and planning. Where required and feasible, additional measures are identified in the environmental assessment to further mitigate potential adverse effects. These mitigation measures are identified and discussed within the appropriate effects analysis section(s). Residual environmental effects predictions were made, taking into consideration these identified mitigation measures.

The federal and provincial governments of Canada have developed a set of mitigation measures to aid in minimizing the potential adverse effects resulting from marine seismic activities on Frontier Lands and compiled them into the Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP) (DFO 2007c). Within this statement, mitigation measures are categorized according to the following: planning of geohazard/seismic surveys, safety zone and start-up, shut down of air source array, line changes and maintenance shutdowns, operations in low visibility and additional mitigative measures and modifications (DFO 2007c). These mitigation measures have been adopted by the NEB and C-NLOPB (C-NLOPB 2008) and will be applied by Corridor, as appropriate, for geohazard surveys.

5.3.4 Residual Environmental Effects 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 assessment, environmental effects are evaluated as significant, not significant or positive, based on definitions of significance developed and used for each VEC (provided in Section 6).

The definitions for significant adverse environmental effects integrate key factors such as magnitude (*i.e.,* the portion of the VEC population affected), potential changes in VEC distribution and abundance, effect duration (*i.e.,* the time required for the VEC to return to pre-project levels), frequency, and geographic extent. They also include other important considerations such as interrelationships between populations and species, as well as any potential for changes in the overall integrity of affected populations. For each VEC, an adverse environmental effect that does not meet the criteria for a significant environmental effect is evaluated as not significant. A positive effect is one that may enhance a population or resource use activity.

5.3.5 Environmental Effects Assessment

This stage entails the assessment of the potential effects associated with the project's components/activities for each of the VECs under consideration. Effects were analyzed qualitatively and using the professional judgment of the Study Team and where possible, quantitatively using existing knowledge and appropriate analytical tools.

The evaluation of environmental effects takes into consideration:

- The potential interaction between Project activities for each of the Project phases and their environmental effects in combination with those of other past, present and likely future projects;
- The mitigation strategies applicable to each of the interactions; and
- The CEA Agency's evaluation criteria for determining significance (CEA Agency 1994) and any other evaluation criteria established by the Study Team to further characterize the nature and extent of the environmental effects, where required.

Environmental effects are classified by determining whether they are adverse or positive. This is indicated in Table 5.2 by the use of a bracketed ("A") or ("P").

The following includes some of the key factors that can be considered for determining adverse environmental effects, as per the Agency guidelines (CEA Agency 1994):

- Negative environmental effects on the health of biota;

- Loss of rare or endangered species;
- Reductions in biological diversity;
- Loss or avoidance of critical/productive habitat;
- Fragmentation of habitat or interruption of movement corridors and migration routes;
- Transformation of natural landscapes;
- Discharge of persistent and/or toxic chemicals;
- Toxicity effects on human health;
- Loss of, or detrimental change in, current use of lands and resources for traditional purposes;
- Foreclosure of future resource use or production; and
- Negative effects on human health or well-being.

The environmental effects assessment also includes summary tables for each VEC that summarize the potential effect of each project activity/component using the following criteria (see Table 5.2 as an example):

- Magnitude;
- Geographic extent;
- Frequency;
- Duration;
- Reversibility; and
- Ecological and socio-economic context.

Table 5.2 Potential Environmental Effects Assessment Summary

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Geohazard Survey and associated Seismic Activity								
Vessel Traffic								
Presence of Vessel								
Routine Marine Discharges								
Vessel Lights								

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

Magnitude describes the nature and degree of the predicted environmental effect. For the biophysical VECs (Marine Birds, Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles, Species at Risk), ratings for magnitudes were defined as follows (effects include mortality, sub-lethal effects or exclusion due to disturbance):

- Low Affects 0 to 10 percent of individuals in the affected area;
- Medium Affects 10 to 25 percent of individuals in the affected area; and
- High Affects greater than 25 percent of individuals in the affected area.

Geographic extent refers to the area where the particular effect in question will occur. Frequency and duration describe how often and for how long a disturbance will occur. Quantitative values are provided for geographic extent; frequency and duration (see Table 5.2).

Reversibility refers to the ability of a VEC to return to an equal or improved condition once the disturbance has ended (*e.g.,* reclaiming habitat area equal or superior to that lost). Predicted effects are rated as reversible or irreversible based on previous research and/or experience. Ecological, socio-cultural and economic context describes the current status of the VEC in the area affected by the Project due to past and/or existing human activities or natural factors.

These criteria are used to provide a common basis for summarizing the potential effects of each project activity for each VEC.

As described in Section 2.7 (Schedule) an initial geohazard survey is anticipated to take place in the fall of 2010, over approximately four to six days (weather-dependent) and encompass an area of about 22.5 km² within the Project Area. Additional surveys, up to eight, of similar duration and extent will be conducted within the proposed Project Area, during the open water period, over the next ten years (2010 – 2020). These additional surveys will be contingent on the results of the initial survey. The environmental effects assessment presented in Section 6.0, is therefore, based on a typical geohazard survey, with a 2-D seismic component employing airguns (as described in Section 2.4), occurring within the proposed Project Area at any given time over the next ten years.

As with Section 5.3.1 Existing Conditions, where appropriate, specific report sections relating to potential effects from geohazard and seismic surveys from the 2005 Western Newfoundland SEA document (LGL 2005b) and the 2007 Western Newfoundland SEA Amendment (LGL 2007) are cross-referenced (as requested in the Scoping Document). However, it is important to realize that the proposed Project represents geohazard surveys with small scale seismic components (likely employing one or more small airguns to a combined volume of 150 cubic inches), over a short period of time (a day and a half survey time and two and a half days vessel turning time). As such, some of the discussion regarding potential effects may be more applicable to large scale seismic programs, as not all literature distinguishes between the type and scale of the surveys being conducted.

5.3.6 Accidental Events

This stage entails the assessment of the potential accidental events associated with the project's components/activities for each of the VECs under consideration. Effects were analyzed qualitatively and using the professional judgment of the Study Team.

5.3.7 Cumulative Effects Assessment

Individual environmental effects are not necessarily mutually exclusive of each other but can accumulate and interact to result in cumulative environmental effects. This environmental assessment includes consideration of cumulative environmental effects for each VEC immediately following the discussion of the environment effects analysis.

Within-project cumulative effects (*i.e.,* those due to the accumulation and/or interaction of each project's own environmental effects) are considered as part of the project-specific environmental effects analyses described above (*i.e.,* the overall effect of each project on a VEC). This section focuses on the cumulative effects of the geohazard program in combination with other relevant projects and activities.

The region's natural and human environments have been affected by past and on-going human activities. The description of the existing (baseline) environment reflects the effects of these other actions. The evaluation of cumulative environmental effects considers the nature and degree of change from these baseline environmental conditions as a result of the proposed program in combination with other ongoing and planned projects and activities.

An important step in undertaking a cumulative effects assessment is the identification of other actions whose effects will likely act in combination with those of the project under review to bring about cumulative effects. *CEAA* requires that only the following type of projects and activities be considered including those that are certain (those that will proceed or there is a high probability of proceeding) and reasonably foreseeable (those that may proceed). The degree of certainty that the project will proceed must therefore be considered (CEA Agency 2008). The other projects and activities considered in this assessment therefore included those that are ongoing or likely to proceed and have been issued permits, licences, leases or other forms of approval. The cumulative effects assessment considers the cumulative effects of the proposed geohazard program in combination with:

- Marine transportation;
- Fishing activities;
- Research surveys;
- Military exercises;
- Other proposed oil and gas activities;
- Ongoing oil and gas activities (including existing production facilities);
- Seismic activity; and
- Other geohazard surveys.

There is a number of exploration licenses offshore western Newfoundland. However due to the distance from the location of these licenses to the location of the proposed Project, it is unlikely that potential projects in that area could cumulatively interact with the proposed Project to result in an adverse environmental effect.

5.3.8 Summary of Residual Environmental Effects Assessment

Significance ratings for the predicted residual environmental effects of each project component/activity and for the Project as a whole are provided in a summary table following the environmental effects analysis.

The evaluation of the significance of the predicted residual environmental effects is based on a review of relevant literature and professional judgment. In some instances, assessing and evaluating potential environmental effects is difficult due to limitations of information. Ratings are therefore provided to indicate the level of confidence in each prediction. The level of confidence ratings provide a general indication of the confidence within which each environmental effects prediction was made based on professional judgment and the effects from similar existing projects. The likelihood of the occurrence of any predicted significant adverse effect is also indicated, based on previous scientific research and experience.

5.3.9 Follow-up and Monitoring

Consideration of a follow-up program is required for a screening-level environmental assessment. The purpose of the follow-up program is to:

- Verify the accuracy of the environmental assessment; and
- Determine the effectiveness of mitigation measures.

Follow-up and monitoring will be considered where there are important Project-VEC interactions, where there is a high level of uncertainty, where significant environmental effects are predicted, or in areas of particular sensitivity.

Follow-up and monitoring programs should be well-defined and focused to allow for efficient use of time and resources. Follow-up and monitoring programs are typically associated with longer-term projects, but are considered in this assessment.

6.0 Environmental Effects Assessment

6.1 MARINE BIRDS

6.1.1 Existing Conditions

Hundreds of species of marine birds can be found in the Gulf of St. Lawrence and are divided into four groups:

- Inshore birds;
- Waterfowl;
- Shorebirds; and
- Offshore/pelagic birds.

Inshore birds feed in shallow waters, including shelf areas, and tend to return to land to rest over night. They include species such as cormorants, gulls and terns. Waterfowl species include eiders and scoters and there are approximately 18 different species of waterfowl found in the Gulf. Shorebirds are not present in the Gulf year round, instead they stop to feed in the area (in late summer to early fall) during their migration from the Arctic to more southern environments. Offshore or pelagic birds feed at sea over deep waters and do not have to return to land to rest. They do, however, return to land to breed in rocky cliffs and on islands. Such species include auks and petrels (DFO 2007a).

Inshore and offshore birds can be referred together as seabirds, and there are approximately 18 different species of breeding seabirds found in the Gulf of St. Lawrence. The majority of seabirds found in the Gulf nest in the Gaspè Peninsula and along Quebec's north shore, with smaller numbers found in western Newfoundland and the southern Gulf, due to the lack of suitable breeding habitats. At the end of the breeding season (typically fall), seabirds return to their offshore feeding areas (most commonly the waters of the Cabot Strait as they do not freeze over) or migrate to subtopic areas (DFO 2007a).

Due to the offshore location of this Project, the remainder of this section will focus on seabirds.

Generally the marine coast and waters of western Newfoundland have lower abundances of seabirds as these areas are less influenced by major oceanic currents, the adjacent waters have lower productivity and there is limited breeding habitat along the west coast of Newfoundland. Seabirds that could be present in the Project Area include shearwaters, fulmars, petrels, jaegers, skuas, phalaropes, gannets, cormorants, alcids, kittiwakes and gulls (LGL 2007). Some species of seabirds nest in the South Atlantic during the northern hemisphere winter, such as the Greater Shearwater, Sooty Shearwater and Wilson's Storm Petrel, and are present in Newfoundland waters during the summer and early fall (July to October) (LGL 2005b).

The most common inshore seabirds found in the Gulf of St. Lawrence include the Great Black-backed Gull (*Larus marinus),* the Herring Gull (*Larus argentatus*), the Ring-billed Gull (*Larus delawarensis*), the Black-headed Gull (*Larus ridibundus*), the Caspian Tern (*Sterna caspia*), the Common Tern (*Sterna hirundo*), the Arctic Tern (*Sterna paradisaea*), and the Leach's Storm-Petrel (*Oceanodroma leucorhoa*). The most common offshore seabirds in the Gulf include the Northern Gannet (*Morus bassanus*), the Great Cormorant (*Phalacrocorax carbo*), the Double-crested Cormorant (*Phalacrocorax auritus*), the Black-legged Kittiwake (*Rissa tridactyla*), the Atlantic Puffin (*Fratercula arctica),* the Black Guillemot (*Cepphus grille*), the Common Murre (*Uria aalge*), the Thick-billed Murre (*Uria lomvia*), and the Razorbill (*Alca torda*).

Seabirds, in general, tend to be most abundant near the study area between January through September and least abundant during October to December (LGL 2007). During the nesting season, seabirds concentrate around large nesting colonies. However, as mentioned, above only a small portion of these occur on western Newfoundland (LGL 2007). The general distributions, seasonal abundances and foraging strategies of seabirds found within the 2005 Western Newfoundland SEA (LGL 2005b) study area are presented in Table 3.10 in Section 3.5.1 of that document. According to the information presented in this table, the most common seabirds found in the 2005 Western Newfoundland SEA study area during the summer period (June – Sept) included the Northern Gannet, the Double-crested Cormorant, the Great Cormorant, the Herring Gull, the Great Black-backed Gull, the Common Tern and the Arctic Tern. The most common seabirds during the autumn period (Oct – Dec) included the Double-crested Cormorant, the Great Cormorant, the Herring Gull, the Iceland Gull and the Great Black-backed Gull. Species common to this area during the winter (Jan – Mar) included the Iceland Gull and the Great Black-backed Gull and those common during the spring (Apr-May) included the Double-crested Cormorant, the Great Cormorant, Herring Gull, the Iceland Gull, Great Black-backed Gull, the Common Tern and the Arctic Tern.

Up to date data was also acquired from Environment Canada regarding the Eastern Canadian Seabirds at Sea (ECSAS) program. This information pertains to seasonal distributions and abundance of the most common ten groups of seabirds (Northern Fulmar, shearwaters, Storm-petrels, Northern Gannet, large gulls, Black-legged Kittiwake, Dovekie, Murres, other Alcids and all waterbirds) found within the Scotian Shelf/Gulf of Maine, the Gulf of St. Lawrence and the Newfoundland-Labrador Shelves from March 2006 to November 2009 (Fifield *et al.* Unpublished). A summary of this data for the Gulf of St. Lawrence by seabird group and season is provided below in Table 6.1. Note that this data was collected for the entire Gulf of St. Lawrence, not just within the proposed Project Area.

Table 6.1 Weighted Median ± Standard Error and Range (min ± Standard Error, max ± Standard Error) of Densities (birds/km^2) by Seabird Group in the Gulf of St. Lawrence

Seabird Group	Spring (Mar - Apr)		Summer (May - Aug)		Fall (Sept - Oct)		Winter (Nov - Feb)	
	Weighted Median	Range	Weighted Median	Range	Weighted Median	Range	Weighted Median*	Range*
All Waterbirds	3.10 ± 0.43	0.37 ± 0.25; 4.52 ± 1.47	5.27 ± 0.60	2.21 ± 0.44; 14.31 ± 5.09	11.57 ± 3.97	7.41 ± 1.22; 12.11 ± 4.51	-	-
Northern Fulmar	1.19 ± 0.50	0; 1.61 ± 0.93	0.64 ± 0.35	0; 4.19 ±2.46	0.27 ± 0.17	0.17 ± 0.16; 0.39 ± 0.28	-	-
Shearwaters	0	0;0	0.24 ± 0.25	0; 0.87 ± 0.51	5.06 ± 3.90	0.20 ± 0.12; 8.27 ± 5.92	-	-
Storm-Petrels	0.12 ± 0.11	0; 0.12 ± 0.11	0	0; 0.21 ± 0.11	0	0; 0	-	-
Northern Gannet	0.94 ± 2.99	0; 0.94 ± 2.99	0.42 ± 0.19	0; 1.37 ± 0.63	2.42 ± 0.49	0.88 ± 0.26; 2.42 ± 0.49	-	-
Large Gulls	0.34 ± 1.33	0; 0.64 ± 1.74	0.40 ± 0.35	0.16 ± 0.21; 1.70 ± 0.79	0.93 ± 0.44	0.28 ± 0.20; 0.93 ± 0.44	-	-
Black-legged Kittiwake	0.50 ± 0.32	0; 0.50 ± 0.32	0.14 ± 0.12	0; 2.34 ± 1.66	0.79 ± 0.40	0.15 0.16; 5.81 ± 4.02	-	-
Dovekie	0	0; 0	0	0; 0.25 ± 0.24	0.10 ± 0.03	0.10 ± 0.03; 4.37 ± 1.58	-	-
Murres	0.74 ± 0.39	0; 2.33 ± 1.23	0.65 ± 0.73	0; 4.62 ± 1.75	0	0; 0.11 ± 0.09	-	-
Other Alcids	0.20 ± 0.20	0; 0.20 ± 0.20	0.11 ± 0.09	0; 4.03 ± 1.63	0.04 ± 0.05	0.04 ± 0.05; 1.12 ± 0.59	-	-

Reference: Filfield *et al.,* Unpublished
* - indicates no data for this region and season

From the above table it can be noted that overall seabirds exhibited the greatest density ranges during the fall season. From this data the most abundant seabird groups to the Gulf of St. Lawrence during the fall were that of shearwaters, the Dovekie and the Black-legged Kittiwake. During the spring it was that of the Northern Fulmar and Murres and during the summer Murres, the Northern Fulmar and other alcids.

Generally, seabird eggs are laid in late May to June and most species have left their nesting areas by July to August, with Northern Gannets leaving later, in October to November (LGL 2007). More specific information pertaining to the nesting, hatching and fledging of marine birds in and near the 2005 Western Newfoundland SEA study area is presented in Section 3.5.1 Table 3.13 of that document.

Seabirds prey on a variety of fish and crustacean species and their foraging strategy varies by species. As mentioned above the particular foraging strategy and types of prey of the seabirds that could be found within and/or near the Project Area have been summarized in Section 3.5.1, Table 3.10 and 3.14, in the Western Newfoundland SEA document (LGL 2005b). Both the Double-crested Cormorant and the Great Cormorant pursuit dive to feed, whereas the Herring Gull, the Iceland Gull, the Great Black-backed Gull, the Common Tern and the Arctic Tern surface feed, with the later two species also exhibiting pursuit plunging. The only species that was found to be common to the area (during summer only) that exhibited deep plunging as their foraging strategy was that of the Northern Gannet.

Of all the seabirds that could be found within or near the Project Area, only that of the Ivory Gull is listed as endangered under schedule 1 of *SARA* and is also considered endangered under the COSEWIC status. Therefore it will be further discussed in Section 6.4, Species at Risk. According to the information presented in Table 3.10 of the 2005 Western Newfoundland SEA document (LGL 2005b) however, the Ivory Gull tends to be absent from the area during Summer (June – Sept) and its occurrence is considered rare during Autumn (Oct – Dec), Winter (Jan – Mar) and Spring (Apr - May).

6.1.2 Potential Interactions and Existing Knowledge

Potential effects related to Marine Birds and the Project includes:

- Disturbance due to vessel traffic noise;
- Physical displacement as a result of vessel presence;
- Attraction to vessel lighting and stranding;
- Direct and indirect effects associated with airgun noise (*i.e.,* noise disturbance and decline in prey availability); and
- Effects from routine discharges.

There is little information available on the effects of geohazard surveys, including airgun noise, on seabirds. The lack of data regarding seabirds and geohazard surveys may be a reflection of the fact that there is little evidence that problems occur (Davis *et al.* 1998). The sound created by airguns is focused downward below the surface of the water and sound levels at and immediately below the surface are likely greatly reduced compared to levels deeper in the water (LGL 2002).

Observations made during a seismic program in the Davis Strait area showed no evidence of mortality or distributional effects on marine birds (Stemp 1985). Parsons (in Stemp 1985) reported that shearwaters with their heads under water were observed within 30 m of seismic sources (explosives) and did not respond. Similarly, trained observers reported no ill effects on guillemot, fulmar and kittiwake species that were monitored during airgun seismic surveys in the North Sea (Turnpenny and Nedwell 1994). Evans *et al.* (1993) noted that there was no evidence to suggest that seabirds were either attracted to or repelled by seismic testing in the Irish Sea.

6.1.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, the following technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects of the Project on Marine Birds have been identified and are in compliance with the SOCP (DFO 2007C) and the C-NLOPB Program Guidelines (C-NLOPB 2008):

- Routine checks for stranded birds and implementation of appropriate procedures for release that will minimize the effects of vessel lighting on birds;
- Adherence to “The Leach’s Storm-Petrel: General Information and Handling Instructions” (refer to Appendix B) in the event that this species becomes stranded on the survey vessel (which involves the pre-submission of a permit application to the Canadian Wildlife Service);
- A pelagic seabird monitoring program will be implemented according to the protocols developed by the Canadian Wildlife Service (CWS);
- Compliance with the *Migratory Birds Convention Act* and regulations;
- The operator will shut down the airgun array if a species at risk (*i.e.,* Ivory Gull which, as discussed, is rarely observed between October to May and absent from the area between June and October) is observed within a 500 m radius of the array;
- Ship operations will adhere to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);
- Ramping up process will allow birds to move away from the noise source before it reaches maximum volume;
- Solid waste will be transported to shore;
- Equipment will be designed to meet regulatory requirements for emissions and regular maintenance plans will allow equipment to operate as efficiently as possible; and
- Avoidance of seabird colonies by the geohazard vessel.

6.1.4 Residual Environmental Effects Significant Criteria

A significant adverse residual environmental effect on marine birds is one that affects marine bird populations (*e.g.,* direct mortality, change in migratory patterns, habitat avoidance) in a way that causes a decline in abundance or change in distribution of population(s) of indicator/representative species within the Project Area. Natural recruitment may not re-establish the population(s) to its original level within one generation.

6.1.5 Environmental Effects Assessment

A summary of the potential environmental effects of the geohazard survey on marine birds is provided in Table 6.2.

Geohazard Survey and Associated Seismic Activity

The sound created by airguns is focused downward below the surface of the water. Above the water the sound is reduced to a muffled shot that should have little or no effect on birds that have their heads above water or are in flight. Most species of seabirds that may be present in the Project Area spend only a short time underwater during foraging so there would be minimal opportunity for exposure to noise from the seismic shooting associated with the geohazard survey. The Northern Gannet can plunge to a depth of 10 m but tends to only spend a few seconds under water thus minimizing its exposure (LGL 2005b) and as described in Section 6.1.1 this species tends to be common to the Project Area only during the summer (June – Sept). The Double-crested Cormorant and the Great Cormorant, as mentioned in Section 6.1.1, are also considered common to the Project Area during summer, as well as autumn and spring, and exhibit pursuit diving as their foraging strategy.

Only those species of the Alcidae (common murre, thick-billed murre, razorbill, black guillemot, and puffin) spend longer amounts of time underwater during forage dives. They, therefore, have the greatest potential to be exposed to the sounds produced by seismic activity associated with a geohazard survey. This group of seabirds uses their wings to propel them to great depths, 20-60 m in search of food. The average length of time spent underwater is approximately 25-40 seconds. However, some species have reached depths of 120 m and remained underwater for up to 202 seconds (LGL 2005b). According to the 2005 Western Newfoundland SEA document (LGL 2005b) of the alcid species that could be found within or near the Project Area their occurrence during each season of the year tends to be rare, scarce and uncommon (refer to Section 3.5.1 Table 3.10 of that document).

As mentioned above in Section 6.1.1, the Ivory Gull is an unlikely visitor in the Project Area and the risk of hearing impairment to Ivory Gull from seismic activity is low as this species would not spend considerable amounts of time below the surface of the water (as it is a surface feeder) or in close proximity to airgun pulses.

The nature of this program, however, will result in only temporary incremental increases in ambient noise and disturbance from the vessel in any one area. While it is possible that diving birds within close range of the seismic activity associated with a geohazard survey could be startled by the sound, the presence of the ship and the associated seismic equipment in the water will have already indicated unnatural stimuli to any birds in the vicinity (LGL 2005b). As well, the ramping up process will allow birds to move away from the noise source before it reaches maximum volume. It is unlikely that non-diving birds would be affected by airguns.

A precautionary note must be applied to any environmental effects discussion with respect to the effects of sound emissions on Marine Birds as although this information is based on the best available, scientific and data gaps associated with the environmental effects of sound emissions limit the degree of certainty associated with environment effects predictions.

Sound emissions as a result of the proposed Project activities are predicted to have low environmental effects on Marine Birds. With the implementation of all mitigation measures outlined above in Section 6.1.3 and in the C-NLOPB Program Guidelines (C-NLOPB 2008), the effects of sound emissions on Marine Birds are deemed not significant.

Presence of Vessel

The presence of a geohazard vessel could potentially affect marine birds through vessel lighting, operational and accidental discharges and associated noise. Effects due to lighting, discharges and noise are discussed in further detail within this Section (Section 6.1.5).

Routine Discharges and Waste Disposal

Limited amounts of hydrocarbons may enter the marine environment as a result of routine discharges (*e.g.,* deck drainage, gray water, black water) from a geohazard survey vessel. Ship operations will adhere to Annex I of the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78). Hydrocarbon concentrations associated with ship discharges are not generally associated with formation of a surface slick. They are therefore not likely to have a measurable effect on marine birds. The waste generated by a geohazard survey vessel will be limited due to the length of the survey program and will be brought back to shore.

Vessel Lighting

Lighting will be used as required for navigational purposes, on the back deck for safe operations and equipment monitoring. Light attraction will therefore be limited to nighttime operations.

Birds may be attracted to vessel lighting, particularly night flying birds such as storm-petrels. Birds may become disoriented and fly into vessel lights or infrastructure, injuring themselves and therefore being stranded. The Leach’s Storm-Petrel itself has short weak legs and has trouble being air-borne once it has landed on a solid flat surface (LGL 2005b). The Leach’s

Storm-Petrel is typically present in Newfoundland waters from April tunill early November. However, the greatest risk to them is during September when the adults and newly hatched chicks leave their nests to overwinter offshore (LGL 2005b). If a Leach's Storm-Petrel was to become stranded on a geohazard survey vessel, the handling instructions as outlined in Appendix B (The Leach's Storm Petrel: General Information and Handling Instructions) will be followed. The associated permit (Appendix B) required to implement this procedure will be completed prior to carrying out the proposed activities.

Birds may become disoriented by lights and have been observed flying continuously around them, consuming energy and delaying foraging or migration (Husky Oil 2000). Disorientation appears to occur most frequently during periods of drizzle and fog. Moisture droplets in the air, during conditions of drizzle and fog, refract the light and greatly increase the illuminated area, thus enhancing the attraction (Wiese *et al.* 2001). Since lighting is required at night for safety purposes, mitigation will include routine checks for stranded birds and implementation of appropriate procedures for release (Appendix B) that will minimize the effects of vessel lighting on birds in the Project Area. Therefore, the effect of vessel lighting on Marine Birds is deemed not significant.

Table 6.2 Potential Environmental Effects Assessment Summary – Marine Birds

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Project Activities								
Geohazard Survey and associated Seismic Activity	• Noise disturbance (A)	• Ramping up procedures	1	2	1	1	R	1
Vessel Traffic	• Noise disturbance (A)	• Avoidance of seabird colonies	1	2	1	1	R	1
Presence of Vessel	• Noise disturbance (A); • Attraction to vessel (A)	• Routine checks for stranded birds and appropriate handling procedures • Adherence to MARPOL 73/78	1	1	1	1	R	1
Routine Marine Discharges	• Oiling of birds (A)	• Adhere to Annex I of the International Convention for the Prevention of Pollution from Ships; • Equipment inspections and communication	1	2	1	1	R	1

Table 6.2 Potential Environmental Effects Assessment Summary – Marine Birds

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Vessel Lights	• Attraction to vessels (A) • Stranding (A)	• Routine checks for stranded birds and appropriate handling procedures • Bird observations by an Environmental Observer	1	1	1	1	R	1

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.2 MARINE FISH, SHELLFISH AND FISH HABITAT

6.2.1 Existing Conditions

The marine waters of the Gulf of St. Lawrence are home to many species of marine fish and shellfish. One of the main reasons for this diversity is the presence of warm, productive waters in the summer followed by cold waters, covered in ice during the winters. Approximately twenty species of marine fish are currently, or have been historically, fished commercially or experimentally in the Gulf (DFO 2005). Commercial fisheries are further discussed in Section 4.2.5.

There are three main types of marine fish present in the Gulf of St. Lawrence: pelagic fish, those that live and feed close to the surface; demersal or groundfish, those that live and feed close to the bottom; and shellfish, which include crustaceans and bivales. Approximately two thirds of all marine fish species known to occur in the Gulf are demersal. A list of the most commonly occurring pelagic and demersal marine fish and shellfish known to inhabit the Gulf of St. Lawrence in the vicinity of the proposed Project Area, are presented in Table 6.3.

Table 6.3 Summary of Fish Species with the Potential to Occur in the Project Area and their Status

Common Name	Latin Name	Status under *Species at Risk Act*	Status under COSEWIC	Relative Level of Occurrence in the Project Area	Potential Presence in the Project Area
Pelagic					
Atlantic argentine	*Argentina silus*	Not at Risk	Not at Risk	Low	Year Round
Atlantic hagfish	*Myzine glutinosa*	Not at Risk	Not at Risk	Moderate	Year Round
Atlantic herring	*Clupea harengus*	Not at Risk	Not at Risk	Moderate	Year Round; Fall Spawning
Atlantic mackerel	*Scomber scombrus*	Not at Risk	Not at Risk	Low	Migrate inshore in the spring; occupy moderately deep waters in winter.
Atlantic salmon	*Salmo salar*	Not at Risk	Not at Risk	Low	Year Round (adults)
Blue shark	*Prionace glauca*	No Status	Special Concern	Low (anticipated)[1]	Near surface in temperate waters.
Bluefin tuna	*Thunnus thynnus thynnus*	Not at Risk	Not at Risk	Low (anticipated)[1]	Migrate in to feed; leave October
Capelin	*Mallotus villosus*	Not at Risk	Not at Risk	Low	Mature fish migrate inshore in summer (to spawn)
Porbeagle shark	*Lamna nasus*	No Status	Endangered	Low (anticipated)[1]	More common in Canadian waters in spring, summer and fall.
Smooth skate	*Raja senta*	Not at Risk	Not at Risk	Moderate	Year Round
Thorny skate	*Raja radiata*	Not at Risk	Not at Risk	High	Year Round
Winter skate	*Raja ocellata*	Not at Risk	Endangered	Low	Year Round
Demersal					
American plaice	*Hippoglossus platessoides*	Not at Risk	Not at Risk	High	Year Round
Atlantic cod	*Gadus morhua*	Special Concern	Special Concern[2]	High	Year Round
Atlantic halibut	*Hippoglossus hippoglossus*	Not at Risk	Not at Risk	Moderate	Migrate to shallow waters in summer, return for winter
Atlantic hookear sculpin	*Artediellus atlanticus*	Not at Risk	Not at Risk	Low	Year Round; Fall Spawning
Atlantic softpout	*Melanostigma atlanticum*	Not at Risk	Not at Risk	Moderate	Year Round
Atlantic wolffish	*Anarhichas lupus*	Special Concern	Special Concern	Low	Year Round; Fall Spawning

Table 6.3 Summary of Fish Species with the Potential to Occur in the Project Area and their Status

Common Name	Latin Name	Status under *Species at Risk Act*	Status under COSEWIC	Relative Level of Occurrence in the Project Area	Potential Presence in the Project Area
Black dogfish	*Centroscyllium fabricii*	Not at Risk	Not at Risk	Moderate	Year Round
Checker eelpout	*Lycodes uahi*	Not at Risk	Not at Risk	Low	Year Round
Deepwater redfish	*Sebastes mentella*	Not at Risk	Not at Risk	High	Year Round; Fall Spawning
Acadian redfish	*Sebastes fasciatus*	Not at Risk	Not at Risk	High	Year Round; Fall Spawning
Fourbeard rockling	*Enchelyopus cimbrius*	Not at Risk	Not at Risk	Low	Year Round
Greater eelpout	*Lycodes esmarki*	Not at Risk	Not at Risk	Low	Year Round
Greenland halibut	*Reinhardtius hippoglossiodes*	Not at Risk	Not at Risk	High	Year Round
Haddock	*Melanogrammus aeglefinus*	Not at Risk	Not at Risk	Low	Move to deeper water in winter; inhabit shallow banks in summer.
Longfin hake	*Urophycis chesteri*	Not at Risk	Not at Risk	High	Year Round; Fall Spawning
Lumpfish	*Cyclopterus lumpus*	Not at Risk	Not at Risk	Moderate	Migrate to shallow waters to spawn, return during Fall
Marlin-spike grenadier	*Nezumia bairdi*	Not at Risk	Not at Risk	High	Year Round; Fall Spawning
Monkfish (goosefish)	*Lophius americanus*	Not at Risk	Not at Risk	Moderate	Year Round
Northern wolffish	*Anarhichas denticulatus*	Threatened	Threatened	Low	Year Round; Fall Spawning
Polar sculpin	*Coltunculus microps*	Not at Risk	Not at Risk	Low	Year Round
Pollock	*Pollachius virens*	Not at Risk	Not at Risk	Low	Migrate inshore during summer, winter offshore; Fall Spawning
Rock grenadier	*Coryphaenoides rupestris*	Not at Risk	Not at Risk	Low	Year Round; Fall Spawning
Roughnose grenadier	*Trachyrhynchus murrayi*	Not at Risk	Not at Risk	Moderate	Year Round
Sea raven	*Hemitripterus americanus*	Not at Risk	Not at Risk	Low	Year Round; Fall Spawning
Shortfin mako	*Isurus oxyrinchus*	Not at Risk	Threatened	Low (anticipated)[1]	Year Round
Silver hake	*Merluccius bilinearis*	Not at Risk	Not at Risk	Low	Year Round

Table 6.3 Summary of Fish Species with the Potential to Occur in the Project Area and their Status

Common Name	Latin Name	Status under *Species at Risk Act*	Status under COSEWIC	Relative Level of Occurrence in the Project Area	Potential Presence in the Project Area
Spiny dogfish	*Squalus acanthias*	Not at Risk	Not at Risk	Low	Present off southwestern NL in June, moves to southern Labrador late summer
Spotted wolffish	*Anarhichas minor*	Threatened	Threatened	Low	Year Round; Fall Spawning
Threebeard rockling	*Gaidropsarus ensis*	Not at Risk	Not at Risk	Low	Year Round
White barracudina	*Notolepis rissoi*	Not at Risk	Not at Risk	Moderate	Year Round
White hake	*Urohycis tenuis*	Not at Risk	Not at Risk	High	Year Round
Windowpane flounder	*Scophthalmus aquosus*	Not at Risk	Not at Risk	Low	Year Round
Witch flounder (greysole)	*Glyptocephalus cynoglossus*	Not at Risk	Not at Risk	High	Year Round
Wrymouth	*Cryptacanthodes maculatus*	Not at Risk	Not at Risk	Low	Year Round
Yellowtail flounder	*Limanda ferruginea*	Not at Risk	Not at Risk	Low (anticipated)[1]	Move from shallow to deep waters in the Fall

References: Environment Canada 2002, Scott & Scott 1988, Government of Canada 2008, DFO (pers. comm.)
[1] Not included in the Biodiverisity Portrait of the St. Lawrence (Environment Canada 2002) distribution mapping.
[2] Schedule 3. COSEWIC has designated the Laurentian North population as threatened and the Maritime population as special concern

For the remainder of this Section, any discussions regarding redfish will collectively include both the deepwater redfish and the Acadian redfish, as their species profiles are similar, with the major difference being that the deepwater redfish are generally distributed at greater depths than that of the Acadian redfish (LGL 2005b).

The Gulf of St. Lawrence is divided into two zones, the northern and southern Gulf (including the Magdalen Islands). Within each of these zones, fish habitat is divided into two areas, the shelf areas and the deep channels. The shallow waters along the shelf areas are characterized by warm high productivity waters in the summer, and serve as feeding, nursing and spawning grounds for both demersal and pelagic fish. The shallow waters surrounding the Magdalen Islands support high densities of American plaice and Atlantic cod. These species are the most dominant demersal fish found in the southern Gulf (DFO 2007a). The highly productive, warm water areas also serve as important feeding areas for marine fish that migrate to the area looking for food, such as spiny dogfish and bluefin tuna.

During the winter, the waters in the shelf areas become cold and tend to freeze resulting in the majority of the marine fish that feed in these areas during the summer migrating out of the area for the winter. Spiny dogfish and mackerel migrate completely out of the Gulf to more southern areas, whereas other species including Atlantic herring, Atlantic cod, white hake, American plaice, witch flounder and thorny skate stay within the Gulf, moving into the deeper, warmer waters of the Laurentian Channel and slope. Some of these species remain in this area for the entire winter, while others (Atlantic cod and Atlantic herring) migrate to the entrance of the Laurentian Channel in the Cabot Strait (DFO 2007a). The warmer, deep waters of the Laurentian Channel and slope also serve as feeding, nursing, and spawning grounds for certain deep water and slope species, including redfish, Greenland halibut, and witch flounder. Hence, they do not need to migrate during the winter to avoid harsh conditions (DFO 2007a).

A comprehensive review of the western Newfoundland offshore area was completed during a SEA completed in 2005 (LGL 2005b) and amended in 2007 (LGL 2007). The SEA (and subsequent amendment) study area was located immediately adjacent to the Old Harry Prospect and as such, these SEA documents provide a thorough assessment of the fish assemblage anticipated to inhabitat the Gulf of St. Lawrence study area under consideration for the current Project. Where appropriate, specific report sections (as requested in the C-NLOPB and NEB Scoping Document) of the Western Newfoundland SEA documents will be cross-referenced.

According to Environment Canada’s “Biodiversity Portrait of the St. Lawrence” (2002), the most abundant pelagic species found near the Project Area include Atlantic hagfish, thorny skate, smooth skate, black dogfish, and Atlantic herring (Table 6.2). The most abundant groundfish species include white barracudina, marlin-spike grenadier, Atlantic cod, longfin hake, white hake, redfish, lumpfish, witch flounder, American plaice, and the Greenland halibut (Table 6.2). Based on fish catch weight data collected from 2006 to 2008, the following fish species represent the principal commercial fisheries in zones 4Ss and 4Tf (crossed by the Project Area): mackerel, redfish, Atlantic cod, and witch flounder. Section 3.4.2 in the Western Newfoundland SEA (LGL 2005b) provides species-specific distribution and life history information for these commercially fished species. Commercial fisheries in the vicinity of the Project Area are further discussed in Section 6.6 of this report.

The Western Newfoundland SEA identified other important fish species in the Gulf of St. Lawrence area that are not commercially fished, namely Atlantic salmon and multiple species of wolffishes. The Atlantic salmon is an anadromous species inhabiting both marine and freshwater at different times throughout its life history. It was identified as an important recreational fishery species that could potentially be affected by oil and gas activities during the species’ migration from freshwater where they spawn, to the open ocean where they feed and grow (LGL 2005b). Three wolffish species were also identified as being important species within the Gulf of St. Lawrence LGL study area (LGL 2005b) as a result of their various species at risk designations. All three species have the potential to spawn within the vicinity of the study area (LGL 2005b) and they are known to spawn in the fall (Scott and Scott 1988, Rodger 2006).

Further consideration of risk is provided in Section 6.4. The species at risk designations of Atlantic cod are discussed in Section 6.4 as well.

Shellfish are also known to inhabit the proposed Project Area within the Laurentian Channel. The Western Newfoundland SEA identifies lobster (*Homarus americanus*), snow crab (*Chionoecetes opilio*) and northern shrimp (*Pandalus borealis*) as important commercial invertebrate species. Of these three species, the northern shrimp has the potential to breed in the fall. Mature shrimp typically breed in late fall or early winter (Rodger 2006). It is worth noting as well that large snow crab have been reported to occur at similar depths as the proposed project (*i.e.*, 200 to 500 m) (LGL 2005b). Species-specific life history details are provided in Section 3.4.1 of the 2005 Western Newfoundland SEA (LGL 2005b). A review of commercial fisheries data provided by DFO revealed several additional shellfish species that have been recorded in the vicinity of the Project Area including whelk, scallop, toad crab (likely *Hyas araneus* and/or *H. coarctatus*), rock crab (*Hemigrapsus sexdentatus*), and multiple types of clams (Atlantic razor (likely *Siliqua costata*), softshell (*Mya arenaria*) and surf clams) (DFO Fish Catch Data). Squid were also confirmed to be present in the vicinity of Old Harry Prospect (DFO Fish Catch Data).

Based on the 2006 – 2008 fish catch weight data for fishing zones 4Ss and 4Tf, several shellfish species can be identified as principal commercial species: lobster, snow crab, shrimp, rock crab, scallop, and whelk. Additional species-specific information is provided in the 2005 Western Newfoundland SEA document, Section 3.4.1(LGL 2005b). Section 6.6 of the current report also further discusses commercial fisheries species and activities relevant to the proposed project.

One invasive shellfish species has also been confirmed to occur in the waters off Newfoundland. The green crab (*Carcinus maenas*) was reported in Newfoundland waters in 2007 and is known as an aggressive invasive species (DFO 2010b). As with most invasive species, the presence of the green crab in the waters off Newfoundland has the potential to exert pressure on the ecosystem and on the existing fish and shellfish assemblage. A disruption to the natural balance of the ecosystem can, in turn, increase the vulnerability of indigenous species to further pressures, including interactions with potential anthropogenic activities. The initial survey activities for the proposed Project are scheduled to occur in the fall. Therefore those fish known or suspected to spawn in the fall within the vicinity of the Project Area are of highest concern for potential interactions with the geohazard survey activities. The Gulf of St. Lawrence fish species anticipated to be fall-spawners (or fall-maters) include Atlantic herring, rock grenadier, roughnose grenadier, marlin-spike grenadier, pollock, longfin hake, white hake, redfish, Atlantic hookear sculpin, sea raven, Northern wolffish, Atlantic wolffish and spotted wolffish (LGL 2005b, Rodger 2006, Scott and Scott 1988, and FishBase 2010). Spawning activities range from the deep waters preferred by the grenadiers and wolffishes (Rodger 2006, FishBase 2010), to the variable depths within which pollock will spawn (approximately 27 m to 91 m), to the sea raven's use of marine sponges as spawning beds, and to the year-round spawning activities of the bottom-dwelling white hake (Rodger 2006). In summary, the fall spawning fish species that potentially inhabit the Project Area (Table 6.2) require a range of spawning habitats.

Based on the results of the initial survey, additional survey activities may be carried out during ice-out conditions in the Gulf of St. Lawrence. Therefore, the annual spawning activities of the principal commercial fish and shellfish species recorded in zones 4Ss and 4Tf were reviewed (Table 6.4).

Table 6.4 Summary of Spawning and Hatching Periods for Principal Commercial Fisheries Species with the Potential to occur in the Project Area

Common Name	Latin Name	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Atlantic mackerel	*Scomber scombrus*												
Atlantic cod	*Gadus morhua*												
Redfish (Deepwater and Acadian)	*Sebastes mentella/ Sebastes fasciatus*												
Witch flounder (greysole)	*Glyptocephalus cynoglossus*												
Lobster	*Homarus americanus*												
Snow crab	*Chionoecetes opilio*												
Northern shrimp	*Pandalus borealis*												
Rock crab	*Hemigrapsus sexdentatus*												
Whelk	*Buccinum undatum*												
Scallop	potential for multiple spp.												

Data sources: Scott and Scott 1988, LGL 2005, Rodger 2006, DFO 1997, DFO 1998, DFO 2000, DFO 2002, and DFO 2010b

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

Atlantic mackerel move inshore to spawn in the spring, primarily in the south western Gulf of St. Lawrence which is outside the Project Area (Rodger 2006). Atlantic cod also spawn in the spring, although the spawning period can extend into the early fall as well. In the south western Gulf of St. Lawrence, cod spawning typically peaks in late June, although there is substantial diversity in spawning peaks across the population (Scott and Scott 1988). Atlantic cod also spawn at a wide range of depths, from 180 m to over 600 m (Rodger 2006). Witch flounder, also known as greysole, are known to form large prespawning concentrations in the Laurentian Channel (southwest of St. George's Bay) in January and February (DFO 2010b). Peak spawning in this area is anticipated to occur in late spring or early summer based on observations of fish maturity during the January prespawning aggregation in the Laurentian Channel (DFO 2010b).

Section 6.5 discusses interactions with potentially sensitive areas located near the Project Area including a cod spawning area, a potential redfish larvae extrusion area, and a potential redfish mating area. Redfish are deep-swimming fish that typically live at depths ranging from approximately 90 to 600 m. They stay close to the bottom during the day and move into the water column to feed at night (Rodger 2006). Redfish are lecithotrophic viviparous with internal fertilization (LGL 2005b). This means they give birth to live young (Scott and Scott 1988). They mate in the fall but extrusion of the larvae (*i.e.*, the birth of the live young) does not occur until the spring, typically between April and July (LGL 2005b). It has been suggested that the survival of redfish larvae may be affected by the stress on females (prior to larval release) that seismic activities and fishing activities can exert (LGL 2007). The Project Area overlaps the potential redfish mating area (Figure 6.1) used during the fall mating season. Larval development precedes larval extrusion and has been reported to occur in this species from February to June (Scott and Scott 1988). The Project Area does not overlap physically with the delineated larvae extrusion area (LGL 2007).

The principal commercial shellfish species in the 4Ss and 4Tf fishing zones represent a range of mating and spawning periods. The reproductive cycle of a lobster lasts approximately two years, with eggs being fertilized by sperm that had been stored by the female lobster for twelve months following the initial mating. Fertilization typically occurs in the summer; hatching occurs nine to twelve months after fertilization (DFO 2010b). Snow crab mating occurs after the females have their terminal moult, typically sometime from February to March. Mating pairs migrate to shallow waters in the spring; fertilized eggs are carried by the female for one to two years until the larvae hatch (DFO 2010b). Female rock crab seems to typically extrude eggs in late October; the eggs mature over the winter and hatch the following spring or summer into free-floating larvae (DFO 2000). Mature Northern shrimp breed in the late autumn or early winter with the eggs hatching in spring (Rodger 2006). Northern shrimp migrate vertically to follow their food sources, staying on the bottom during the day and migrating vertically at night (Rodger 2006).

Scallop spawning takes place from late August to early September, with fertilized eggs weighing more than sea water and falling to the sea floor; the first larval stage emerges within a few days (Hart and Chute 2004). Whelks are thought to be most abundant in the St. Lawrence Estuary and Bay of Fundy; they inhabit most bottom types from low water levels to depths of more than

50 m (Environment Canada 2009). They have the potential to mate and spawn over long periods of time, resulting in their reproductive activities ranging over the full year. More detailed species-specific life cycle descriptions of all potential inhabitants of the Project Area can be accessed in region-specific publications including LGL 2005b (Sections 3.4 and 3.8), LGL 2007 (Sections 3.3.1.1 and 5.4.1) and Environment Canada 2002 (on-line, interactive resource). Other reputable fish species publications can be reviewed as well, including Rodger 2006, Scott and Scott 1988, and FishBase 2010, although their species accounts are not necessarily specific to the Project Area.

The 2007 amendment to the Western Newfoundland SEA (LGL 2007) further discussed the importance of specific spawning areas within the Gulf of St. Lawrence (Sections 3.3.1.1, 3.7, and 5.4.1, LGL 2007). They specifically identified three species, Atlantic cod, deepwater redfish, and Acadian redfish (*Sebastes fasciatus*) that are known to spawn in the general vicinity of the Western Newfoundland SEA amendment area, which overlaps with the Old Harry Prospect. Redfish spawning is believed to occur in the fall, likely between September and December (Section 3.3.1.1, LGL 2007 and discussed above). Atlantic cod are spring spawners (as discussed above) and uncertainty regarding the specific timing and route of the northern Gulf cod migration has been a past issue with oil and gas activities in the area (LGL 2007). Additional species-specific spawning information is provided in Section 3.3.1.1 of the Western Newfoundland SEA Amendment (LGL 2007).

Three species presented in Table 6.2 are listed under schedule 1 of *Species at Risk Act (SARA):* Northern wolffish, Atlantic wolffish and spotted wolffish. The Atlantic cod is listed as special concern under Schedule 3 of *SARA*; COSEWIC has designated the Laurentian North population of Atlantic cod as threatened and the Maritime population as special concern. Another four species are listed under COSEWIC including the blue shark (special concern), the porbeagle shark (endangered), the winter skate (endangered) and the shortfin mako (threatened). These species at risk will be further discussed in Section 6.4.

The fish and shellfish habitat supported within the proposed Project Area is characteristic of the Laurentian Channel. Oceanographic characteristics have been discussed above in Section 4.0, and physical habitat features have been overviewed at the beginning of the current section. As in most marine environments, the distribution of the majority of fish and shellfish species listed above for the proposed Project Area varies temporally and spatially based on habitat needs at different life history stages. Fish and shellfish distribution varies seasonally in response to physical or chemical changes in the surrounding environment (*e.g.,* depth, salinity, temperature), and as a result of seasonal habitat requirements (*e.g.,* feeding, spawning, rearing). Long annual migrations are undertaken by most pelagic species such as herring and mackerel, and groundfish species such as Atlantic cod. The eggs of benthic spawners are found where oceanographic factors and bottom substrates are suitable, ranging from the marine sponges used by sea ravens to the hard, rocky substrate (and solid objects resting on the substrate) preferred by lumpfish. Other fish spawn in open water (*e.g.,* pollock and wolffish), making the offshore, open ocean important habitat. Juvenile fish often require habitat that allows them to hide from predators. In this case, even scallop shells can function as protective habitat (*e.g.,* hake).

6.2.2 Potential Interactions and Existing Knowledge

LGL (2005b) completed a very thorough review of available literature in their assessment of the potential effects of industrial sounds on marine animals (Section 4.1.5). The information presented in their detailed assessment has been summarized here in relation to potential interactions with inhabitants of the Old Harry Prospect Project Area. Additional existing knowledge is summarized from other sources as well, when available.

Fish and invertebrates can interact with geohazard surveys and their corresponding seismic activities on a physical and/or behavioural basis. The use of air guns during seismic activities creates sound pressure waves that bounce off the layers of rock which make up the ocean floor. In the worst case scenario, these pressure waves have the potential to be lethal to fish larvae or cause physical injury. From a behavioural perspective, seismic testing may startle fish and invertebrates or may affect one or more of their life history characteristics (*e.g.,* feeding, spawning or migration). These interactions are possible because many fish and invertebrate species have the ability to transmit and receive sound signals.

The hearing ability of fish is quite variable amongst species and within species (based on body size), resulting in a wide range of potential interactions with seismic activity. Fish sensitivity to sound pressure can be divided into three qualitative categories: highly sensitive fish are typically those with swim bladders and specialized auditory couplings to the inner ear (*e.g.,* herring); moderately sensitive fish are those with a swim bladder but lacking a specialized auditory coupling (*e.g.,* cod and redfish); and low sensitivity fish are those species with a reduced or absent fish bladder (*e.g.,* mackerel and flounder) (Fay 1988).

A disruption in the behavioural ecology of a species or group of marine animal species is a potential interaction that has received substantial attention and study over the past two decades. Following their literature review, LGL (2005b) confirmed well-documented interactions between seismic activities and the behavioural responses of fish and invertebrates. Exposure to seismic was determined to interact with the startle response, swimming patterns and vertical distribution of a range of finfish and crustaceans (LGL 2005b). More recent research has also reported that fish reacted to the sound of seismic shooting as evidenced by changes in swimming activity (Lokkeborg 2010).

Behavioural changes have been reported to be most likely within the area of the seismic program, but have been observed up to 33 km from the area of seismic activity (Engas *et al.* 1996). In a variety of Australian studies completed nearly ten years ago, finfish trials were conducted with caged fish and a nearby airgun (McCauley *et al.* 2000). The study results indicated that normal behavioural patterns returned within a half hour after airgun operations ceased (McCauley *et al.* 2000). Additional trials carried out with caged squid suggested that a ramped approach (rather than a sudden nearby startup) could reduce behavioural startle responses (McCauley *et al.* 2000).

LGL's 2005 (LGL 2005b) review of potential effects from industrial sounds on marine animals in the western Newfoundland offshore area acknowledged the variability existing amongst studies focused on assessing behavioural responses. They concluded that it was very difficult for them to make a final determination on the behavioural effects of exposure to seismic activities to fish and invertebrates (LGL 2005b, Section 4.1.5.1 *Summary of Behavioural Effects*). Potential project-specific behavioural effects resulting from the interactions described thus far are further discussed below in Section 6.2.5).

The interaction between seismic activities and marine fish or invertebrate species can also be of a physical nature. LGL (2005b) found that there was a lack of well-documented cases of acute post-larval fish or invertebrate mortality as a result of exposure to seismic sound under normal seismic operating conditions. While they confirmed that sub-lethal injury or damage has been observed, they felt it was typically observed in situations in which exposure was given to receive levels of sound higher than those expected in the field under normal seismic operating conditions (LGL 2005b, Section 4.1.5.1 *Summary of Pathological Effects*).

In March 2003, DFO organized a workshop to develop a "Decision Framework for Seismic Survey Referrals" which produced an inventory of ecological factors that should be considered when dealing with referrals for seismic surveys in Canadian waters (DFO 2004a). Conclusions regarding invertebrates can be summarized as follows:

- Information is lacking to evaluate the likelihood of sub-lethal or physiological effects on crustaceans during pre-molt, molting and post-molt periods;
- The ecological significance of seismic effects is expected to be low, except if effects of exposure to seismic sounds were to influence reproductive or growth activities; and
- The potential for seismic sound to disrupt communication, orientation, and detection of predator/prey, locomotion and other functional uses of sound has not been studied.

A preliminary study undertaken to address some of these uncertainties reported that there were no apparent effects on adult crab behaviour, health or catch rates but there was significant effect on egg development from a female exposed to seismic signals at a very close range (2 m) (Christian *et al.* 2003). LGL (2005b) also recognized that acute mortality of eggs and larvae have only been reported when eggs and larvae were exposed very close to seismic sources (where the received pressure levels were assumed to be very high). A more recent 2009 laboratory study (Payne *et al.* 2009) was conducted to determine the potential effect of seismic noise on monkfish (*Lophius americanus*) eggs and larvae (Payne *et al.* 2009). Seven trials were carried out with sound pressure levels at 205 dB peak to peak and no significant differences were observed between control and exposed larvae examined 48-72 hours post exposure. The authors concluded that modeled estimates of pressure levels at the water surface and literature on levels reported to affect mortality in eggs and larvae; it is unlikely that seismic surveys pose any real risk to either monkfish eggs or near hatch larvae that may float in veils on the sea surface during monkfish spawning.

A field- and laboratory-based pilot study examined the effect of seismic noise on American lobsters (*Homarus americanus*) (Payne *et al.* 2007). The study was designed to explore changes in biological endpoints and identify those that might require more detailed study. The following endpoints were assessed in lobsters exposed to seismic noise ranging from 202 to 227 dB peak-to-peak:

- Survival;
- Food consumption;
- Turnover rate (as a measure of equilibrium); and
- Serum protein, enzymes and calcium.

Seismic noise had no effect on delayed mortality or damage to mechano-sensory systems. There was no evidence of loss of appendages. Sublethal effects were observed with respect to feeding and serum biochemistry with effects sometimes being observed weeks to months after exposure (Payne *et al.* 2007).

An environmental effects monitoring (EEM) program was conducted during a seismic survey conducted by Hunt Oil Company of Canada, Inc. in Sydney Bight in November of 2005 (CEF 2005). This report specifically addressed the potential sublethal damage to the sensitive ear structures of fish, in this case Atlantic cod (*Gadus morhua*), and aimed to identify the distance at which such effects could occur. The most important finding of this study was that there appeared to be no detectable damage to sensitive fish ear structures or any other organs as a result of exposure to seismic airguns at ranges as close as 55 m.

In 2005, LGL (LGL 2005b) concluded that physical stress responses of fish after exposure to seismic energy all appeared to be temporary. Sublethal effects described in Payne *et al.* 2007 above suggest that physical effects have been observed on a time scale of weeks or months following exposure. However, it was suggested that additional studies, including those focused on moulting, egg development and animal behaviour, and are needed to fully understand the results and potential effects (Payne *et al.* 2007). The C-NLOPB review of physiological effects determined that the times necessary for biochemical changes to return to normal were variable, depending on numerous aspects of the biology of the species and of the sound stimulus (LGL 2005b). Overall, it was concluded that there was a relative lack of indication of serious physical effects of seismic energy on marine fish and invertebrates in relation to lethal or sub-lethal damage to animals, and temporary primary or secondary stress responses (LGL 2005b). Potential project-specific effects related to the physical interactions described herein are further discussed in Section 6.2.5, below.

This discussion of potential interactions and existing knowledge demonstrates that the primary means of interaction between geohazard surveys and marine fish and shellfish are physical or behavioural. Interactions with marine habitat are physical, which can lead to potential indirect interactions with fish and shellfish. For the initial survey activities planned under the current project, the potential for physical and behavioural interactions is highest for the fall spawning and fall mating fish species anticipated to inhabit the area: Atlantic herring, rock grenadier, roughnose grenadier, marlin-spike grenadier, pollock, longfin hake, white hake, deepwater redfish, Atlantic hookear sculpin, sea raven, Northern wolffish, Atlantic wolffish and spotted wolffish (LGL 2005b, Rodger 2006, Scott and Scott 1988, and FishBase 2010). In particular, the mating activities of redfish may interact with the Project activities should they occur between September and December. However, as detailed above (Section 6.2.1), the sensitive redfish extrusion area is being avoided, as this area does not overlap with the proposed Project Area.

Amongst the principal commercial fish species spawning outside the fall season, Atlantic cod and witch flounder spawning periods have the greatest potential for interaction with Project activities. Atlantic mackerel's migration to the inshore environment for spawning will avoid interaction with the geohazard surveys. There will be the potential for short-term interactions with all key commercial shellfish fisheries species with the exception of whelks. Whelks appear to prefer shallower environments than those found in the Project Area. Interactions with the mating and spawning activities of the principal commercial fisheries species are still anticipated to be minimal given the short duration of Project, the relatively small footprint of a Project survey, and the overall conclusions detailed above suggesting that literature reviews have found a lack of indication of serious physical effects of seismic energy on fish and shellfish species (LGL 2005b).

6.2.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, the following technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects of the Project on Fish, Shellfish and Habitat have been identified and are in compliance with the SOCP (DFO 2007c) and the C-NLOPB Program Guidelines (C-NLOPB 2008):

- Planning to: i) ensure only the minimum amount of energy necessary for the geohazard program is used; ii) minimize the proportion of the energy that propagates horizontally; iii) minimize the amount of energy at frequencies above those necessary for the purpose of the survey; iv) identify any significant adverse effect on a marine species' population or on any individual fish species that is listed as threatened or endangered (*SARA*) (*i.e.,* northern wolfish and the spotted wolfish); v) avoid displacing aggregations of fish, including threatened or endangered species, from breeding, feeding, or diverting them from a known migration route or corridor and spawning fish from a spawning area;
- A safety zone will be established (with a radius of at least 500 m as measured from the centre of the air source array(s));
- The survey vessel will implement a 30-minute ramp-up procedure by gradually increasing the number of sleeves fired simultaneously within an array (ramping up gives motile fish an

opportunity to move away from the immediate zone of influence before decibel levels reach maximum volume);

- When seismic surveying associated with the geohazard survey ceases during line changes, maintenance, or any other operational reason, the array must be shut down completely or reduced to a single source element;
- Ship operations will adhere to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);
- Adherence to the Pollution Prevention Regulations of the *Canada Shipping Act*;
- The Project will comply with subsection 36(3) of the *Fisheries Act* which prohibits the deposit of deleterious substances (administered by Environment Canada);
- Equipment inspections and communication with other vessels will minimize the potential of accidental damage to and leaks from streamers; and
- Solid waste will be transported to shore.

6.2.4 Residual Environmental Effects Significance Criteria

A significant adverse environmental effect is defined as one that affects fish and/or shellfish 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.

A non-significant adverse environmental effect is defined as an adverse effect that does not meet the above criteria.

A positive effect is defined as one that results in a measurable population increase and/or enhances the quality of habitat for fish and/or shellfish.

6.2.5 Environmental Effects Assessment

The assessment of potential environmental effects on fish, shellfish and marine habitat will be focused on key project components, including seismic activity associated with a geohazard survey, vessel traffic, the presence of a geohazard survey vessel, routine marine discharges and vessel lights. A key project-specific consideration of the effects assessment is the short duration of the proposed activities (*i.e.,* 6 days). The individual project activities are addressed below and a summary of potential effects from a typical geohazard survey (as described in Sections 2.3 and 2.4) is summarized in Table 6.5.

Geohazard Survey and Associated Seismic Activity

Overall, most available literature indicates that the effects of noise on fish are transitory and if short-lived and outside a critical period, are expected not to translate into biological or physical effects. In most cases, it appears that behavioural effects on fish as a result of seismic operation should result in minimal effects on individuals and populations. The issue of primary concern is the potential for interactions during particularly sensitive periods, such as spawning. The Science Review Working Group (CNSOPB 2002), which evaluated two proposed seismic surveys near Cape Breton, agreed that although the duration of behavioural effects of seismic activity on marine fish are uncertain, indications exist that displacement of marine fish is short-term.

Oil exploration generally is considered to have a negligible effect on the survival and recovery of the northern and spotted wolfish populations in the Gulf of St. Lawrence (DFO 2004b). Critical habitats of species listed under COSEWIC and *SARA* legislation are not expected to be affected. Egg and larval mortality is likely possible only within a few metres of the airgun array, physical injury of adult fish may be possible only within a few tens of metres and auditory damage is likely possible only within a few hundreds of metres. Further, each geohazard survey is proposed to occur within a small geographical area (approximately 22.5 km^2) and over a short timeframe (four to six days). Project activities are therefore predicted to result in a not significant adverse effect. Any effect from the Project is not expected to cause a decline or change in abundance or distribution that will last more than one generation.

Vessel Traffic, Presence of Vessel, and Vessel Lights

Davis *et al.* (1998) summarized that most schools of fish will not show avoidance if they are not in the path of the approaching vessel. Schools that the vessel passes over may show lateral avoidance or compress towards the bottom. Observed responses indicate that the fish schools are quite variable and depend on species, life history stage, current behaviour, time of day, whether the fish have fed and how the vessel sound propagates in a particular setting. The overall potential effects of vessel traffic and the presence of the vessel are summarized in Table. 6.5.

Vessel lights are not anticipated to affect pelagic or demersal fish or shellfish species. Surface dwelling species may suffer minimal, temporary disturbance over the four nights the survey is taking place.

Routine Marine Discharges

Routine discharges from a geohazard survey vessel can include domestic waste and ballast water (bilge water is not permitted to be discharged). All domestic waste will be transported to shore and all routine discharges will meet the *Pollution Prevention Regulations* of the *Canada Shipping Act*. As such, the effects to fish, shellfish or marine habitat from routine marine discharges is considered not significant.

Table 6.5 Potential Environmental Effects Assessment Summary – Marine Fish, Shellfish and Habitat

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Geohazard Survey and associated Seismic Activity	• Behavioural effects (A); • Physical effects (A)	• Ramp-up procedures; • Minimize seismic energy used	1	2	1	1	R	1
Vessel Traffic	• Behavioural effects (A)		0	1	1	1	R	1
Presence of Vessel	• Behavioural effects (A)		1	1	1	1	R	1
Routine Marine Discharges	• Nutrient loading (A); • Contamination (A)	• Solid waste transported to shore; • Adherence to MARPOL 73/78 and *Pollution Prevention Regulations*	0	1	1	1	R	1
Vessel Lights	• Fish Attraction or Avoidance (A)		0	1	1	1	R	1

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.3 MARINE MAMMALS AND SEA TURTLES

6.3.1 Existing Conditions

Marine mammals present in the Gulf of St. Lawrence can be sub-divided into two orders: Pinnipedia (seals) and Cetacea (whales, dolphins, and porpoises). A total of 22 species of marine mammals and sea turtles can be found near the proposed Project Area in the Gulf of St.

Lawrence (LGL 2007). Table 6.6 below gives a summary of the species of marine mammal and sea turtles potentially present in the Gulf of St. Lawrence within the vicinity of the proposed Project Area.

Table 6.6 Marine Mammals and Sea Turtles Found Within or Near the Project Area

Common Name	Latin Name	Status under *Species at Risk Act*	Status under COSEWIC	Potential Occurrence in the Project Area
Cetaceans				
Mysticetes (Toothless or Baleen Whales)				
North Atlantic right whale	*Eubalaena glacialis*	Schedule 1 - Endangered	Endangered	Rare
Minke whale	*Balaenoptera acutorostrata*	No Status	No Status	Common
Fin whale	*Balaenoptera physalus*	Schedule 1 - Special Concern	Special Concern	Common
Sei whale	*Balaenoptera borealis*	Schedule 1 - Endangered	Endangered	Data Deficient
Blue whale	*Balaenoptera musculus*	Schedule 1 - Endangered	Endangered	Uncommon
Humpback whale	*Megaptera novaeangliae*	Schedule 3 - Special Concern	No Status	Common
Odontocetes (Toothed Whales)				
Harbour purpoise	*Phocoena phocoena*	Schedule 2 - Threatened	Special Concern	Common
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	No Status	No Status	Common
White-beaked dolphin	*Lagenorhynchus albirostris*	No Status	No Status	Uncommon
Long-finned pilot whale	*Globicephala melas*	No Status	No Status	Common
Killer whale	*Orcinus orca*	Schedule 1 - Special Concern	Threatened	Uncommon
Beluga	*Delphinapterus leucas*	Schedule 1 - Threatened	Threatened	Rare
Northern bottlenose whale	*Hyperoodon ampullatus*	Schedule 1 - Endangered	Endangered	Uncommon
Sperm whale	*Physeter macrocephalus*	No Status	No Status	Common
Common (short-beaked) dolphin	*Delphinus delphis*	No Status	No Status	Common
Pinnipedea				
Harbour seal	*Phoca vitulina*	No Status	No Status	Common
Grey seal	*Halichoerus grypus*	No Status	No Status	Common
Harp seal	*Phoca groenlandica*	No Status	No Status	Common
Hooded seal	*Crystophora cristata*	No Status	No Status	Common
Sea Turtles				
Leatherback turtle	*Dermochelys coriacea*	Schedule 1 - Endangered	Endangered	Seasonally Common
Loggerhead turtle	*Caretta caretta*	No Status	No Status	Uncommon
Kemp's ridley turtle	*Lepidochelys kempii*	No Status	No Status	Very Rare

Reference: LGL 2005b; LGL 2007

Profiles on each of the above listed species can be found in the 2005 Western Newfoundland SEA document (LGL 2005b), Sections 3.6.1 – 3.6.4, and in the 2007 Western Newfoundland SEA Amendment document (LGL 2007), Section 3.5.1.3. A brief summary of the information presented in these sections is provided below in terms of species distribution.

Mysticetes (Toothless/Baleen Whales)

Of the fifteen Cetacean species found in the Gulf of St. Lawrence, there are six species of baleen whales (fin, minke, blue, humpback, sei and the northern right whale). The majority of these species use the Gulf as feeding grounds, with the Laurentian Channel and the Magdalen Islands being popular areas (DFO 2005). Humpback, fin and minke whales are less common off the west and southwest coasts of Newfoundland than elsewhere off the coasts of the Island (LGL 2005b). Humpback whales feed in the Gulf during the summer however the majority of their sightings have been in the northeastern part of the Gulf. There is evidence that fin whales are present in the Gulf of St. Lawrence from July to September and tend to migrate through the Laurentian Channel to winter off northern Nova Scotia. Minke whales have also been observed in the Gulf from July to September but are more frequent in the northern Gulf (LGL 2005b). Blue whales can be found in the Gulf of St. Lawrence from January through November. However, they are most abundant from August to October (LGL 2005b). North Atlantic right whales are only occasionally sighted in the Gulf of St. Lawrence and are rare to waters off western Newfoundland (LGL 2005b). Sei whale sightings in the vicinity of the Project Area have also been limited (LGL 2007).

The blue whale, the north Atlantic right whale and the sei whale have all been listed as endangered under Schedule 1 of SARA and COSEWIC. The fin whale has been designated as of special concern under both Schedule 1 of SARA and COSWEIC. The humpback whale is listed under Schedule 3 of SARA as of special concern. These species will be further discussed in Section 6.4.1.

Odontocetes (Toothed Whales)

As presented in Table 6.4, there are nine species of toothed whales that could potentially be found near or within the Project Area. The sperm whale, long-finned pilot whale, Atlantic white-sided and common dolphin and harbour porpoise are likely to be common in the western Newfoundland offshore region, whereas the northern bottlenose whale, killer whale, white-beaked dolphin are likely to be uncommon in this area and the beluga is considered rare (LGL 2005b). The distribution of sperm whales is based highly on their social structure, whereby adult females and young are typically found in tropical and subtropical waters and adult males in higher latitude waters. Sperm whales are capable of diving to depths greater than 1200 m to feed and can stay submerged for greater than two hours at a time, however they majority of their dives last approximately a half hour. Sperm whales are generally distributed over areas of steep underwater topography, as are the long-finned pilot whale. The majority of the sightings of the Atlantic white-sided dolphin the Gulf were also recorded in areas with steep bottom topography. Evidence suggests that the harbour porpoise is common to the northern portion of the Gulf from July to September; however sightings also show this species to be present in the southern and central portions of the Gulf as well (LGL 2005b).

A cetacean distribution study conducted by DFO in the summer of 2007 (Lawson and Gosselin 2009) found dolphins (unknown species) to be the most abundant species sighted in the Cape Breton, Gulf of St. Lawrence and Scotian Shelf survey area, overall. This was also true within the vicinity of the proposed Project Area.

The northern bottlenose whale has been listed as endangered under Schedule 1 of *SARA* and under COSEWIC. The beluga whale is listed as threatened under Schedule 1 of *SARA* and under COSEWIC. The killer whale is designated as of special concern under Schedule 1 of *SARA* and as threaten under COSEWIC and the harbour porpoise is considered threatened under Schedule 2 of *SARA* and of special concern under COSEWIC. These species will be further discussed in Section 6.4.1.

Pinnipeds (Seals)

There are four species of seals potentially found near and within the Project Area (harbour seal, harp seal, hooded seal and the grey seal). Both the harp and hooded seals are migratory species, whereas the harbor and grey seals are year round resident species (DFO 2005). The harp seal is likely common in the western Newfoundland offshore area during late fall to early spring and rare during other times of the year (LGL 2005b). The hooded seal is likely to be common offshore western Newfoundland in the spring and rare during other times of the year. Both the harbour and grey seals are likely to be common in the western Newfoundland offshore regions, with the distribution of the harbour seal being continuous in the Gulf and that of the grey seal to be more concentrated in the south (LGL 2005b).

Each of the above species of seal is hunted commercially of the Atlantic coast of Canada. Ice conditions often determine the amount of hunting effort in any given area, however, the majority of the seal hunt occurs off the north and east coasts of Newfoundland and off southern Labrador. The majority of the sealing in this area occurs between late March and the end of April (DFO 2008).

Sea Turtles

There are three species of sea turtles that could potentially be found within and near the Project Area. The leatherback turtle is a migratory species, moving around in between breeding and feeding areas. They tend to migrate into the Gulf during the summer to feed on the abundance of jellyfish (DFO 2005). The leatherback turtle is listed as an endangered species under the *Species at Risk Act*, and will be further discussed in Section 6.4. The presence of both the loggerhead turtle and Kemp's ridley turtle in the offshore area of western Newfoundland is considered to be rare.

6.3.2 Potential Interactions and Existing Knowledge

Potential interactions, issues and concerns related to Marine Mammals and Sea Turtles and the Project include:

- Noise from airgun array (physical effects including mortality and strandings and hearing impairment and behavioural effects such as displacement, change in dive or respiratory patterns, change in social behaviours, change in vocalization patterns and communication masking);
- Vessel traffic (potential disturbance/displacement and/or ship strikes); and
- Accidental spill from streamers or fuel.

Physical Effects

Mortality and Strandings

To date there is no evidence that the noise associated with the operation of airguns during a geohazard survey has caused serious injury or even death to near-by marine mammals. Although there is no conclusive evidence, there is a possibility that noise associated with the operation of airguns can cause behavioural changes in certain species of marine mammals that could lead to strandings (LGL 2008). Such behaviour changes include swimming into shallow water in avoidance of the sound, a change in dive behaviour that could lead to tissue damage, a physiological change that could lead to tissue damage and direct tissue damage due to the sound, *i.e.,* bubble formation (LGL 2008).

Hearing Impairment

Temporary or even permanent hearing impairment may be possible when marine mammals are exposed to strong sounds. Temporary threshold shift (TTS) is the mildest hearing impairment lasting from minutes to days and hearing recovers rapidly when the exposure to the sound stopped. Permanent threshold shift (PTS) on the other hand can induce physical damage to the sound receptors in the ear. PTS can result in partial or complete deafness, or reduced ability to hear sounds at varying frequencies (LGL 2008). In 2000, the U.S. National Marine Fisheries Service (NMFS) developed noise exposure criteria for marine mammals and seals which stated that such species should not be exposed to impulsive sounds with received levels of greater than or equal to 180 and 190 dB re 1 μPa_{rms} respectively (LGL 2008). Research since 2000 has provided evidence that the 2000 sound criteria for marine mammals is probably lower than necessary to induce TTS and that the sound criteria developed for seals is probably too low, at least in the case of the harbour seal. Hence, these criteria are currently under review. Recommendations for new criteria were published in 2008 (Southall *et al.* 2007) suggest that hearing thresholds should be specific to the types of sound being emitted and differences in hearing abilities among the different marine mammal groups (*i.e.,* low frequency cetaceans, mid-frequency cetaceans, high frequency cetaceans and pinnipeds in water and air).

There has however been no evidence that TTS or PTS has occurred in marine mammals exposed to sounds as a result of seismic activity (*i.e.,* airgun pulses) (LGL 2008). The frequencies of sound by which baleen whales are sensitive are lower than those to which toothed whales are most sensitive. The natural background noise at these low frequencies typically tends to be higher. Therefore, as concluded by Southall *et al.* (2007), TTS is likely not to occur in baleen whales at levels any lower than those which would likely cause TTS in toothed whales. Seals could endure TTS at slightly lower received levels than toothed whales (LGL 2008). Southall *et al.* (2007) also speculated that received sound levels would need to exceed the TTS threshold by 15 dB in order for there to be a risk of PTS. However, this may not be the case if the marine mammals were to experience one or more pulses at a very high peak pressure, but as stated above there is no specific evidence that exposure to noise associated with seismic activity can result in PTS in marine mammals.

Other Physiological Effects

Potential non-auditory physiological effects include stress, neurological effects, bubble formation and various types of organ or tissue damage. There is, however, limited information available to conclude that the sounds associated with seismic activities can cause physiological effects in marine mammals. The information that is available suggests that if such effects are possible they would be limited to short distances and in relation to projects involving a large array of airguns which is not the case with typical geohazard surveys.

Behavioural Effects

Disturbance

Disturbance includes subtle changes in behavior, and more conspicuous changes in activities such as displacement from important feeding and breeding areas.

Avoidance behavior has been documented for several baleen whale species when exposed to strong noise impulses related to airgun operations. This potential effect is strongly dependent upon the species and individual however. Observers on seismic vessels off the U.K. from 1997 to 2000 reported that in good sighting conditions, the number of baleen whales seen when airguns were shooting was similar to the number seen when airguns were not shooting (LGL 2008). However, another UK study (DFO 2010a) showed that baleen whales could be affected by seismic activities. In this study, sighting rates, distance from airgun and orientation were compared during periods when the airgun were operating and weren't operating. The results of the study showed that baleen whales and killer whales demonstrated localized avoidance and toothed whales lateral spatial avoidance (DFO 2010a). During the same study, long finned pilot whales only showed a change in orientation and no effects were documented for sperm whales. A study conducted on the northern bottlenose whale in the Gully and outer Scotian Shelf concluded that marine mammals did exhibit avoidance at close distances to the airgun arrays. However, the overall number of mammals observed in a 2 km radius did not seem to change when the airguns were and were not in operation (DFO 2010a). Humpback whales, gray whales and bowhead whales react to seismic noise pulses by deviating from their normal migration route and/or interrupting feeding and moving away from the sound source (LGL 2005b). Ship based studies offshore Newfoundland, near the Orphan Basin and Laurentian Sub-basis, found only small differences in sighting rates and swim directions during periods of active and non-active seismic surveys for blue, fin, sei, and minke whales (LGL 2008). Two other studies conducted offshore Newfoundland in the same area in 2004 and 2005 documented that dolphin sightings were higher during non-seismic periods than during seismic periods (LGL 2008). Both baleen and toothed whales have shown avoidance and tolerance to seismic impulses. However, as mentioned above, this behavior is strongly dependent on the species, individual and area.

Very little information exists on the reactions of pinnipeds to sounds from seismic exploration in open water. Visual monitoring from seismic vessels has shown that pinnipeds frequently do not avoid the area within a few hundred metres of an operating airgun array (LGL 2008).

No data exist on the reactions of sea turtles to seismic sound pulses. It is likely that sea turtles will exhibit behavioural changes and/or avoidance within some distance of a seismic vessel (LGL 2005b).

Change in Dive and Vocalization Patterns

Changes in dive and vocalization patterns can occur as a result of exposure to seismic sound. A recent study in the Gulf of Mexico of eight tagged sperm whales exposed to the ramping up of airgun sounds showed that neither dive nor direction of movement changed for any of the individuals, although some changes in foraging behavior were observed (LGL 2008).

There is evidence that some baleen and toothed whales continue to call when exposed to seismic sound, as well as that they can adapt the frequencies of their calls in response to background noise (*i.e.,* seismic noise) (LGL 2008). One study in particular noted that blue whales in the St. Lawrence Estuary changed their vocal behavior by calling more on days when seismic activity was occurring than on those days when it wasn't (DFO 2010a).

Consequences of Physical and Behavioral Effects

A number of consequences related to the potential physical and behavioral effects of seismic sound on marine mammals can occur including reduced communication (*i.e.,* masking), hampered passive acoustic detection of prey and predators, avoidance of human threats, hampered parental care, chronic effects and indirect effects. Such potential effects are not well understood or studied. There have been a few studies relating to the potential for communication masking in the presence of seismic sound. However, it is believed that due to the impulsive nature of seismic sound marine mammals can still emit and receive calls in-between the sound impulses (LGL 2008).

Collisions

Large vessels traveling at more than 14 knots are the principal source of ship strike mortalities in whales (Mead *et al.* 2001). High speed container ships are considered to be potentially one of the greatest threats to blue whales. The geohazard survey vessel will be travelling at low speeds during the course of each survey. Therefore, the potential for a ship strike during the Project is minimal.

6.3.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, the following technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects of the Project on Marine Mammals and Sea Turtles have been identified and are in compliance with the SOCP (DFO 2007c) and the C-NLOPB Program Guidelines (C-NLOPB 2008):

- At the planning stage, the survey should be planned to use the minimum amount of energy necessary, minimize the amount of energy that propagates horizontally and minimize the amount of energy at frequency levels above those necessary for the purpose of the study;
- Avoid displacing aggregations of marine mammals and sea turtles, including threatened or endangered species under Schedule 1 of SARA (i.e. North Atlantic right whale, Sei whale, Blue whale, Belgua, Northern bottlenose whale and the Leatherback turtle), from breeding, feeding, or diverting them from a known migration route or corridor;
- A safety zone will be established (within a radius of at least 500 m as measured from the centre of the air source array);
- The operator will shut down the airgun array if a species at risk is observed within a 500 m radius of the array;
- The survey vessel will implement a 30-minute ramp-up procedure by gradually increasing the number of sleeves fired simultaneously within an array;
- Use of an environmental observer during the geohazard surveys to observe the safety zone;
- Implementation of a marine mammal monitoring program according to the protocol described in ESRF Report #156 Recommended Seabird and Marine Mammal Observation Protocols for Atlantic Canada (2004), as outlined in the C-NLOPB guidelines (C-NLOPB 2008);
- Use of cetacean detection technology if the whole safety zone is not visible to the environmental observer or during periods of reduced visibility;
- When seismic surveying associated with the geohazard survey ceases during line changes, maintenance, or any other operational reason, the array must be shut down completely or reduced to a single source element;
- Ship operations will adhere to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);
- Solid waste will be transported to shore; and

- Equipment designed to meet regulatory requirements for emissions and regular maintenance plans to ensure equipment operates as efficiently as possible.

6.3.4 Residual Environmental Effects Significance Criteria

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

A non-significant adverse environmental effect is defined as an adverse effect that does not meet the above criteria.

A positive effect is defined as one that results in a measurable population increase and/or enhances the quality of habitat for Marine Mammals and Sea Turtles.

6.3.5 Environmental Effects Assessment

A summary of the potential environmental effects of a typical geohazard survey (as described in Section 2.4) on marine mammals and sea turtles is provided in Table 6.7.

Geohazard Survey and Associated Seismic Activity

Sound is extremely important to marine mammals. It is integral to both their ability to communicate and to gather information about their surroundings. Research has shown that marine mammals hear and may react to many man-made sounds, including sounds made during seismic exploration.

While the hearing abilities of baleen whales have not been studied directly, behavioral evidence suggests that these animals hear well at frequencies below 1 kHz and the anatomy of the baleen whale inner ear seems to be well adapted for low frequency hearing (LGL 2008). Baleen whales are thought to be more sensitive to low frequency sounds than are the smaller toothed whales, which have been directly studied. Therefore, baleen whales are likely able to hear seismic sounds at greater distances from the source than are toothed whales (LGL 2008). In addition, baleen whales have often been seen well within distances where seismic sounds would be audible and yet show no obvious reaction to those sounds (LGL 2005b). Other studies show that some species of baleen whales may be able to hear at higher frequencies, from about 7 Hz to 22 kHz (LGL 2008).

As mentioned above, the hearing capabilities of several species of toothed whales have been studied directly. The small to medium-sized toothed whale species that have been studied have relatively poor hearing sensitivity below 1 kHz and very good sensitivity above several kilohertz.

Currently, no data exist on the hearing sensitivities of larger, deep-diving species such as sperm whales and beaked whales. The sounds produced by airguns are in the frequency range of low hearing sensitivity for toothed whales. However, they are high intensity sounds and their received levels can sometimes remain above the hearing thresholds of toothed whales for distances out to several tens of kilometers (LGL 2008). There is no evidence that toothed whales react to airgun pulses at such long distances or even at intermediate distances where sound levels are well above the ambient noise level.

Data on underwater hearing sensitivities are available for five species of phocinid seals, two species of monachid seals, two species of otariids, and the walrus (LGL 2008). In general, the pinniped species that have been studied have higher hearing sensitivities at lower frequencies, lower best frequencies, and poorer sensitivity at the best frequency than odontocetes. The hearing sensitivity of most pinniped species that have been tested ranges between 60 and 85 dB re 1 μPa from 1 kHz to 30 to 50 kHz. In the harbour seal, thresholds deteriorate gradually below 1 kHz to approximately 97 dB re 1 μPa at 100 Hz (LGL 2008). Based on these data, it is likely that airgun pulses are readily audible to pinnipeds.

To date, there have been very few studies on the behavioral reactions of seals to seismic operations. However, information has been obtained from various monitoring studies. Visual monitoring has shown only minor avoidance and behavior changes of seals to airguns (LGL 2005b).

Limited data are available on the hearing sensitivities of sea turtles. The frequency of best hearing sensitivity has been reported as 250 to 300 Hz to 500 to 700 Hz (Ridgway *et al.* 1969; Bartol *et al.* 1999). As these frequencies overlap those prominent in airgun pulses, it is likely that airguns are audible to sea turtles. Observed behavioral responses in sea turtles exposed to airgun sounds included increased swimming speed, increased activity, change in swimming direction and avoidance (DFO 2004a). The distance over which an airgun array might be audible to a sea turtle is impossible to estimate due to an absence of absolute hearing threshold data. However, because of the high source levels of airgun pulses, this distance is likely to be considerable. It is unlikely that sea turtles are any more sensitive to seismic operations than are marine fish and mammals, and similar mitigation measures could also help reduce the risk or severity of exposure. However, sea turtles are harder to detect visually and acoustically than many species of marine mammals and therefore certain mitigation measures based on sightings and acoustic detection might be less effective (DFO 2004a).

Summary

While marine mammals and sea turtles may react to the sound emitted by airguns, during the seismic component of a geohazard program, the proposed initial survey and subsequent surveys will be of short duration (four to six days) and will occur over a relatively small area within the Project Area boundary. Therefore sound emissions as a result of the proposed Project activities are predicted to have low physical effects on marine mammals and sea turtles (including species at risk). Hence, with the implementation of mitigation measures outlined in the C-NLOPB Program Guidelines (C-NLOPB 2008), the sound emission effects of the Project on the marine mammals and sea turtles (including species at risk) are deemed not significant.

Vessel Traffic

Reactions of baleen whales to vessels have been studied directly for species such as gray whales, humpback whales, and bowhead whales. Reactions have been found to vary from approach to avoidance. In general, baleen whales tend to change their behaviour in response to strong or rapidly changing vessel noise (Watkins 1986; Beach and Weinrich 1989). Behavioural changes include course changes, changes in surfacing and respiration patterns, and displays such as breaching, flipper slapping, and tail slapping (Wyrick 1954; Edds and Macfarlane 1987; Stone *et al.* 1992).

Similar to baleen whales, responses of toothed whales to vessels vary within and among species and range from avoidance to approach and bowriding (Baird and Stacey 1991a; 1991b; Stacey and Baird 1991; Mullin *et al.* 1994a; 1994b). For dolphins, reactions to vessels appear to be related to the dolphins' activity state and their history of harassment. Dolphins that are resting tend to avoid vessels, those that are foraging tend to ignore vessels, and those that are socializing may approach vessels (Richardson *et al.* 1995). Dolphins that have been sensitized by previous harassment tend to avoid vessels (Au and Perryman 1982). Larger toothed whales, such as sperm whales and beaked whales generally seem to avoid survey vessels (Sorensen *et al.* 1984).

Large vessels traveling at more than 14 knots are the principal source of ship strike mortalities in whales (Mead *et al.* 2001). Given that a geohazard survey vessel will likely travel at a speed of 4 to 5 knots and emit seismic energy during operation, the potential for a collision with marine mammals and sea turtles is minimal.

Few studies have described responses of pinnipeds in the water to vessel traffic. Based on anecdotal evidence, pinnipeds in open water appear to show little reaction to vessels (Richardson *et al.* 1995).

There is limited information pertaining to the potential effects of vessel traffic on sea turtles although it is believed that the potential response, if any, would be minimal compared to the potential responses to seismic sound (LGL 2005b).

Summary

It is probable that any behavioral changes in baleen whales, toothed whales, pinnipeds and sea turtles (including species at risk) triggered by a geohazard survey vessel will be temporary. The proposed surveys(s) are of short duration (four to six days) and will occur over a relatively small area within the Project Area boundary. Thus disturbance from vessel traffic is expected to be low. With the implementation of mitigation measures outlined in the C-NLOPB Program Guidelines (C-NLOPB 2008) significant adverse environmental effects as a result of vessel traffic are deemed not significant.

Routine Discharges

Routine discharges from a geohazard survey vessel will include ballast water (bilge water is not permitted to be discharged). Domestic waste however will be brought ashore and disposed appropriately. All routine discharges will meet the Pollution Prevention Regulations of the *Canada Shipping Act*. There will be minimal environmental effects to marine mammals and sea turtles associated with this Project activity and thus deemed not significant.

Table 6.7 Potential Environmental Effects Assessment Summary – Marine Mammals and Sea Turtles

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Geohazard Survey and associated Seismic Activity	• Communication masking (A); • Behavioral effects (avoidance, change in migration patterns, reproductive and feeding behavior) (A); • Physical effects (auditory damage, mortality) (A)	• Observer for marine mammals • Ramp-up; procedure	1	2	1	1	R	1
Vessel Traffic	• Collision (A); • Ship strike (A)	• Observer for marine mammals; • Slow vessel speed	1	1	1	1	R	1
Presence of Vessel	• Collision (A)	• Observer for marine mammals Slow vessel speed	1	1	1	1	R	1
Routine Marine Discharges	• n/a							
Vessel Lights	• Attraction (P)	• n/a	0	1	1	1	R	1

Table 6.7 Potential Environmental Effects Assessment Summary – Marine Mammals and Sea Turtles

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

6.4 SPECIES AT RISK

Species at Risk are considered a VEC due to regulatory concern and in recognition of their protected status under *SARA*.

6.4.1 Existing Conditions

A summary of all species found within and/or near the Project Area that are considered at risk under *SARA* and/or COSWIC are presented in Table 6.8. Individual species descriptions are provided in the following series of sub-sections.

Schedule 1 of *SARA* is the official list of wildlife species at risk. Schedules 2 and 3 of *SARA* contain lists of species that are designated by COSEWIC and that need to be re-assessed by COSEWIC.

Table 6.8 Species at Risk in the Vicinity of the Project

Species	*SARA* Status	COSEWIC Status
Marine Birds		
Ivory Gull *(Pagophila eburnean)*	Schedule 1 - Endangered	Endangered

Table 6.8 Species at Risk in the Vicinity of the Project

Species	*SARA* Status	COSEWIC Status
Marine Fish & Shellfish		
Northern wolffish *(Anarhichas denticulatus)*	Schedule 1 - Threatened	Threatened
Spotted wolffish *(Anarhichas minor)*	Schedule 1 - Threatened	Threatened
Atlantic wolffish *(Anarhichas lupus)*	Schedule 1 - Special Concern	Special Concern
Atlantic cod *(Gadus morhua)*	Schedule 3 – Special Concern	Not Active
Atlantic cod *(Gadus morhua)*(Laurentian North Population)	No Status	Threatened
Atlantic cod *(Gadus morhua)*(Maritimes Population)	No Status	Special Concern
Atlantic cod (*Gadus morhua)*(Newfoundland and Labrador Population)	No Status	Endangered
Winter skate *(Leucoraja ocellata)*(Southern Gulf of St. Lawrence Population)	No Status	Endangered
Blue shark (*Prionace glauca)*	No Status	Special Concern
Shortfin mako *(Isurus oxyrinchus)*	No Status	Threatened
Porbeagle shark *(Lamna nasus)*	No Status	Endangered
Marine Mammals & Sea Turtles		
Blue Whale *(Balaenoptera musculus)*(Atlantic Population)	Schedule 1 - Endangered	Endangered
North Atlantic Right Whale *(Eubakaena glacialis)*	Schedule 1 - Endangered	Endangered
Leatherback Sea Turtle *(Dermochelys coriacea)*	Schedule 1 - Endangered	Endangered
Northern Bottlenose Whale *(Hyperoodon ampullatus)*(Scotian Shelf Population)	Schedule 1 - Endangered	Endangered
Beluga Whale *(Delphinapterus leucas)*(St. Lawrence Estuary Population)	Schedule 1 - Threatened	Threatened
Fin Whale *(Balaenoptera physalus)*(Atlantic Population)	Schedule 1 - Special Concern	Special Concern
Killer Whale *(Orcinus orca)*(Northwest Atlantic Population)	No Status	Special Concern
Harbour Porpoise *(Phocoena phocoena)*(Northwest Atlantic Population)	Schedule 2 - Threatened	Special Concern
Humpback Whale *(Megaptera novaeangliae)*(Western North Atlantic Population)	Schedule 3 - Special Concern	Not at Risk

Reference: *SARA* Registry 2010

Marine Birds

There is only one marine bird species at risk that is likely to occur in or near the Project Area, that of the Ivory Gull (*Pagophila eburnea*) (Schedule 1, Endangered). The wintering grounds of the Ivory Gull are thought to be along the edge of pack ice in the North Atlantic Ocean, particularly in the Davis Strait, the Labrador Sea, the Strait of Belle Isle and the north Gulf of St. Lawrence. Various studies conducted from 2002-2005 suggest that the Canadian breeding population of the Ivory Gull has decreased. They nest on flat terrain or on sheer cliffs during May and early June. Outside their breeding season, they live near the edges of pack ice, as mentioned above. The Ivory Gull is a surface feeder and primarily feeds on small fish and small mammals (*SARA* Registry 2010). As discussed in Section 6.1.1, this species is rare to the area during October to May and absent during June to October. Therefore, no interaction of the Project with the Ivory Gull is anticipated.

Marine Fish & Shellfish

There are eight species of marine fish that could potentially be found within or near the Project Area that are considered at risk, including the northern wolffish, the spotted wolffish, the Atlantic wolffish, the Atlantic cod, the winter skate, the shortfin mako, the blue shark and the porbeagle shark. The status of these species is presented in Table 6.8.

Wolffish

Three species of wolffish, each of which have been designated a status under *SARA* and COSEWIC, can be found in the vicinity of the Project Area and therefore have been taken into consideration for this Project. The northern and spotted wolffish have been given a designation of threatened under both *SARA* and COSEWIC whereas the Atlantic wolffish is considered of special concern.

The northern wolffish can be found in cold continental shelf waters at depths up to 900 m but prefer depths of approximately 100 m. Spawning occurs in fall and females can lay up to 27,000 extremely large eggs. This species is non-migratory and usually make nests to guard their eggs. They feed upon benthic invertebrates (*SARA* Registry 2010).

The spotted wolffish is a bottom dwelling predatory fish that can be found in cold continental shelf waters, at depths ranging from 50 m to 600 m. Spawning occurs in summer (*SARA* Registry 2010).

The Atlantic wolffish inhabits cold deep waters with rocky or hard clay bottoms along the continental shelf. Within the western Atlantic Ocean, this species can be found in the Strait of Belle Isle and in the Gulf of St. Lawrence. Spawning typically occurs in September in shallow waters. Juvenile fish however remain in deeper waters. Their diet is composed of hard shelled benthic invertebrates and smaller fish (*SARA* Registry 2010).

Atlantic Cod

Generally the Atlantic cod can be found in waters of continental shelves and slopes, inshore or offshore, with spawning typically occurring in shallow waters (*SARA* Registry 2010). The Atlantic cod has been designated as special concern under Schedule 3 of *SARA*. COSEWIC has also issued status designations for this species but has separated this species into different populations. The Newfoundland and Labrador population has been designated as endangered, the Maritimes population as special concern and the Laurentian North population as threatened. Due to their designated status and the fact that, as stated in Section 6.2, there is uncertainty regarding the specific timing and route of the northern Gulf cod migration, all three populations are assessed for this Project.

The Newfoundland and Labrador population of the Atlantic cod includes those species that inhabitat waters ranging from the northern tip of Labrador, southeast to the Grand Banks of Newfoundland. Three stocks of cod are typical for this region and include, the Northern Labrador cod (NAFO Divisions 2GH), Northern cod (NAFO Divisions 2J3KL) and Southern Grand Bank cod (NAFO Divisions 3NO) (COSEWIC 2003).

The Maritimes population includes five different DFO stocks which include the Southern Gulf of St. Lawrence (NAFO Division 4T), Cabot Strait (NAFO Division 4Vn), Eastern Scotian Shelf (NAFO Divisions 4VsW), the Bay of Fundy/Western Scotian Shelf (NAFO Division 4X) and cod found in the Canadian waters of Georges Bank (NAFO Division $5Ze_{j,m}$) (COSEWIC 2003).

The Laurentian North population of the Atlantic cod includes two DFO indentified stocks, St. Pierre Bank (NAFO Division 3Ps) and the Northern Gulf of St. Lawrence (NAFO Divisions 3Pn4RS) (COSEWIC 2003).

Winter Skate

The southern Gulf of St. Lawrence population of the winter skate has been designated as endangered under COSEWIC. The winter skate is endemic to the Northwest Atlantic and in Canadian waters this species tends to be concentrated in three areas, the southern Gulf of St. Lawrence, the eastern Scotian Shelf, and the Canadian portion of Georges Bank. This is a bottom dwelling species that prefers sand and gravel bottoms and occurs at depths up to 371 m. However, there are more commonly found at a depth of 111 m. Spawning occurs during late summer to early fall and their diets consist mainly of various shellfish, amphipods and small fish (COSEWIC 2005a).

Shortfin Mako

The Atlantic population of the shortfin mako has been designated as threatened under COSEWIC. This species is highly migratory and its distribution pattern is dependent on water temperature, but it can withstand significant changes in temperature as well as food availability. Migration to the Atlantic coast of Canada and to the warm waters of the Gulf, typically occurs in later summer and fall. They feed primarily on tuna, mackerel, bluefish, swordfish and marine mammals and are considered one of the fastest swimming sharks in the world (*SARA* Registry 2010).

Blue Shark

The blue shark is widespread and highly migratory. It has been designated as of special concern by COSWEIC. In Atlantic Canada they can be found in almost all offshore surface waters to a depth of 350 m, and peak occurrence occurs in the late summer and fall. The blue shark has a 9-12 month gestation period and females produce litters approximately every two years. They are opportunistic feeders and tend to eat a variety of prey including squids, birds and marine mammal carrion (COSEWIC 2006).

Porbeagle Shark

The porbeagle shark has been designated as endangered by COSEWIC. In Canadian waters the porbeagle shark can be found from northern Newfoundland into the Gulf of St. Lawrence and around Newfoundland to the Scotian Shelf and Bay of Fundy. This shark is a pelagic species but is more commonly found on continental shelves in waters between 5 and 10 °C. Mating occurs off southern Newfoundland and at the entrance to the Gulf of St. Lawrence, between late September and November. Pregnant females are present in the area from late September through to December and are seldom seen from January through to June (COSEWIC 2004).

Marine Mammals and Sea Turtles

Blue Whale

The Atlantic population of the blue whale has been designated as endangered under both *SARA* and COSEWIC. During spring, summer and fall, the blue whale can be found along the north shore of the Gulf of St. Lawrence and off eastern Nova Scotia. In the summer, they can also be found off the south coast of Newfoundland and in the Davis Strait. They typically migrate south for the winter. However, they have a tendency to remain in the Gulf of St. Lawrence during milder winters with light ice cover. They inhabit both coastal and open ocean waters and are frequently observed in highly productive coastal waters where there is an abundance of krill, their primarily food source. Blue whales can dive for on average of 5 to 15 minutes after breathing at the water's surface. They mate and give birth during fall and winter in warmer southern waters. The blue whale is one of the largest and loudest (calls of 186 dB) animals in the world (*SARA* Registry 2010).

North Atlantic Right Whale

The North Atlantic right whale is a migratory species that typically inhabitants coastal waters and spend their summers feeding in cooler waters and in warmer waters during winters. This species has been designated as endangered under Schedule 1 of *SARA* and under COSEWIC. Two stocks of the north Atlantic right whale can be found in Canadian waters, the eastern North Atlantic stock and the western North Atlantic stock. The western North Atlantic stock can be found from the coast of Florida to Newfoundland and Labrador and in the Gulf of St. Lawrence. They feed primarily on zooplankton (*SARA* Registry 2010).

Northern Bottlenose Whale

The northern bottlenose whale is confined to the waters of the northern Atlantic Ocean. The Scotian Shelf population of the northern bottlenose whale has been designated as endangered under Schedule 1 of *SARA* and COSEWIC. The Scotian Shelf population is largely found in and around the Gully. These whales are non-migratory, are never seen in water less than 800 m deep and differ greatly from other northern bottlenose whales found in other populations (*SARA* Registry 2010).

Beluga Whale

The St. Lawrence Estuary population of the beluga whale has been designated as threatened under Schedule 1 of *SARA* and COSEWIC. This population of the beluga represents the southern limit of the species. Their habitat is generally ice-covered in winter and their summers are spent in warmer, shallow, turbid waters. This species feeds on various types of invertebrates and fish including squid, tube worms, capelin and Greenland and Atlantic cod (*SARA* Registry 2010).

Fin Whale

The Atlantic population of the fin whale has a designation of special concern under both *SARA* and COSEWIC. This species tends to make seasonal migrations from low latitude areas during the winter to high latitude summer feeding areas. Summer concentrations of the fin whale can be found in the Gulf of St. Lawrence, on the Scotian Shelf, in the Bay of Fundy, in the nearshore and offshore waters of Newfoundland and Labrador (COSEWIC 2005b). Little is known about their overwintering or breeding areas.

Killer Whale

The northwest Atlantic population of the killer whale is designated as special concern under COSEWIC. Little information regarding the distribution of the killer whale in this area has been documented, but they are widespread in the area (COSEWIC 2008). The distribution seems to be dependent on the availability and accessibility of their prey. The killer whale can withstand significant changes in salinity, temperature and turbidity.

Harbour Porpoise

The northwest Atlantic population of the harbour porpoise is widely distributed over continental shelves and is made up of three sub-populations found in Canadian waters, Newfoundland-Labrador, Gulf of St. Lawrence, and the Bay of Fundy/Gulf of Maine. This population of the harbour porpoise has been designated as threatened under Schedule 2 of *SARA* and of special concern under COSEWIC. This species is well adapted to cold water and often inhabits bays and harbours during summer. They feed upon a variety of small fishes including cod, herring, hake, capelin and sand lance (*SARA* Registry 2010).

Humpback Whale

The western north Atlantic population of the humpback whale commonly occurs off the east and south coasts of Newfoundland, off southeastern Labrador, on the edges of the Grand Banks and in the Gulf of St. Lawrence. This population of the humpback whale has been designated as special concern under Schedule 3 of *SARA*. This whale will migrate southward during the fall to overwinter and breed in warmer waters and return in the spring and summer in order to feed. They typically take advantage of seasonal ocean currents during their migrations (*SARA* Registry 2010).

Leatherback Turtle

The leatherback sea turtle is a migratory turtle that breeds in tropical and subtropical waters and feed in temperate waters. The leatherback turtle has been designated as endangered under Schedule 1 of *SARA* and COSEWIC. These turtles spend the majority of their life at sea but do come ashore to nest and lay eggs. Leatherback turtles nest from November to April (*SARA* Registry 2010).

6.4.2 Potential Interactions and Existing Knowledge

The potential interactions and existing knowledge to marine bird, marine fish and shellfish and marine mammal and sea turtles species at risk would be the same as those described for non-listed species and has been discussed already in Sections 6.1.3, 6.2.3 and 6.3.3, respectively.

6.4.3 Mitigation

Based on the potential interactions identified above and existing knowledge regarding these interactions, the following technically and economically feasible mitigation measures to reduce or eliminate potential adverse effects of the Project on species at risk have been identified and are incompliance with the SOCP (DFO 2007c) and the C-NLOPB Program Guidelines (C-NLOPB 2008):

- The operator will shut down the airgun array if a species at risk (i.e. Ivory Gull, North Atlantic right whale, Sei whale, Blue whale, Beluga, Northern bottlenose whale and the Leatherback turtle) is observed within a 500 m radius of the array;
- Ship operations will adhere to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);
- An environmental observer capable of liaising with the fishing industry will be provided during the geohazard surveys;
- The source vessel will implement a 30-minute ramp-up procedure by gradually increasing the number of sleeves fired simultaneously within an array. This ramping up will give marine birds, motile fish and marine mammals and sea turtles an opportunity to move away from the immediate zone of influence before decibel levels reach maximum volume.
- Solid waste will be transported to shore; and
- All equipment designed to meet regulatory requirements for emissions and regular maintenance plans to ensure equipment operates as efficiently as possible.

6.4.4 Residual Environmental Effects Significance Criteria

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*.

6.4.5 Environmental Effects Assessment

The environmental effects to marine birds, marine fish and shellfish and marine mammals and sea turtles species at risk are the same as those assessed for non-listed species and have been described in Sections 6.1.6, 6.2.6 and 6.3.6, respectively. In addition, a study by DFO (2004b) determined that oil and gas exploration activities are considered to have negligible effects on the ability of both northern and spotted wolfish to survive and recover.

Based on existing knowledge of the effects of a typical geohazard survey activities on species at risk and with the mitigation that will be implemented, the Project is predicted to have only minor effects on species at risk. As no non-permitted contravention of any of the prohibitions stated in Sections 32 to 36 of *SARA* will occur, the residual adverse environmental effects of the Project on species at risk is deemed not significant.

6.5 SENSITIVE AREAS

6.5.1 Existing Conditions

Within the estuary and Gulf of St. Lawrence, ten areas have been designated as ecologically and biologically significant areas (EBSA) and they include:

- Western Cape Breton;
- St. George’s Bay;
- Northumberland Strait;
- The southern fringe of the Laurentian Channel;
- The south-western coast of the Gulf;
- The lower estuary;
- Western Anticosti Island;
- Northern Anticosti Island;
- The Strait of Belle Isle; and
- The west coast of Newfoundland.

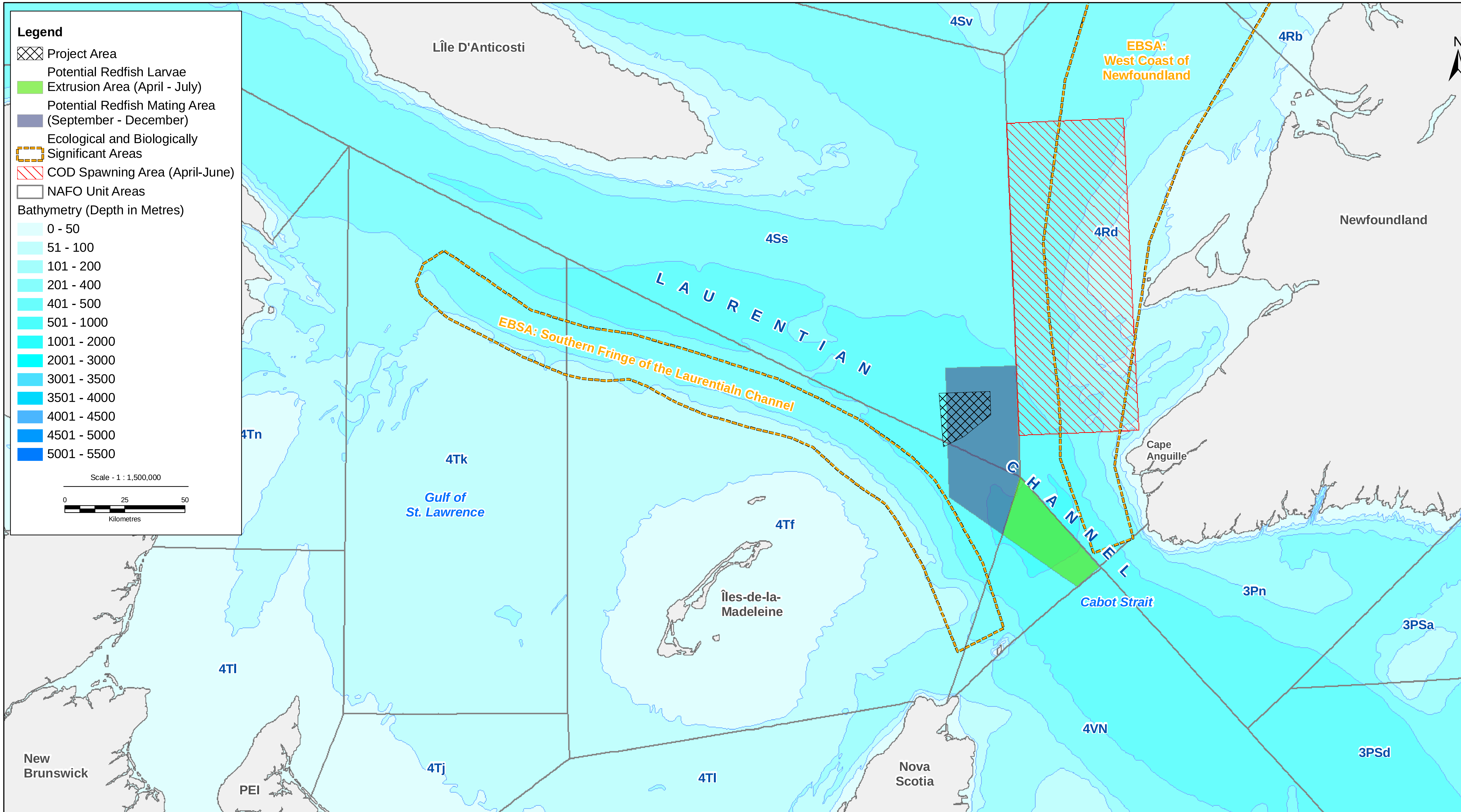
The two areas that would be of major concern to the proposed Project would include the southern fringe of the Laurentian Channel and the west coast of Newfoundland. Neither of these areas however, falls within the Project Area, Affected Area or Regional Area. Other areas such as Western Cape Breton, St. George’s Bay, Northumberland Strait and south-western coast of the Gulf could potentially be of concern depending on the route taken by a geohazard survey vessel to arrive at the Project Area.

The southern fringe of the Laurentian Channel EBSA covers approximately 5,941 km^2 and is illustrated in Figure 6.1 (DFO 2007b). This area is characterized by its average to maximum uniqueness, average concentration and adaptive values for pelagic fish and for its low to average uniqueness and average concentration and adaptive values for groundfish. This area, however, only partially covers a critical wintering area for the Atlantic cod leaving out the southern slope in the Cabot Strait. The middle of the channel also serves as wintering areas for a number of groundfish species. The south-eastern boundary of this area overlaps slightly with the Cape Breton Channel which serves as a migration corridor for the southern Gulf stock of the Atlantic cod, coastal white hake and other groundfish species during the spring and fall. This area also serves as feeding grounds for witch flounder and deep water white hake. The north-eastern boundary of this area is also important for marine mammals (DFO 2007b).

The west coast of Newfoundland EBSA covers approximately 18,238 km^2 and is illustrated in Figure 6.1 (DFO 2007b). This area is characterized for its maximum uniqueness, concentration and adaptive values for groundfish, its low to average uniqueness, average to maximum concentration and adaptive values for pelagic fish and its low to maximum uniqueness, concentration and adaptive values for marine mammals. Groundfish populations concentrate in a number of areas found within or partially within this EBSA. Western Newfoundland serves as the main area for juvenile Atlantic cod, redfish, American plaice and Atlantic wolfish. The Esquiman Channel, which is not entirely covered by this EBSA, is used as a migration corridor for Atlantic cod and redfish. This corridor can be heavily populated during spring and fall. The Esquiman Channel serves as a refuge area for Atlantic herring and a summer feeding ground for the Atlantic herring spiny dogfish, silver hake and pollock. This area also serves as the principal cod spawning area and capelin and Atlantic herring larvae are also in abundance. The northern and southern most areas of this EBSA are most significant for marine mammals.

The Gulf of St. Lawrence has also been designated as a Large Ocean Management Area under DFO. These areas form the planning basis for implementation of integrated-management plans (DFO 2009b).

In additional to the EBSA, there are a few other potentially sensitive areas located near the Project Area, as outlined in the 2005 and 2007 Western Newfoundland SEA (LGL 2005b; LGL 2007), which include a cod spawning area, a potential redfish larvae extrusion area and a potential redfish mating area. The location of each of these areas is presented in Figure 6.1. A number of Piping Plover critical habitat locations were also identified on the coast of Newfoundland (Stephenville Crossing, Sandy Point, Flat Pay Peninsula, Searston, Little Codroy, East of Windsor Point, J.T. Cheeseman Provincial Park, Jerret Point-Windsor Point, Big Barrachois, Second). However, due to the coastal locations of these areas, they have not been further assessed. Three coastal locations in west-southwest Newfoundland have also been designated as Important Bird Areas (IBAs) including Codroy Valley Estuary, Grand Bay West to Chesseman Provincial Park and Gros Morne National Park, each of which lie greater than 75 km away from the Project Area.



DATE: March 29, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: **Figure 6.1**
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**SENSITIVE AREAS**	Stantec

The cod spawning area is located west of the Port au Port Peninsula and is closed to groundfish fishing between April 1 and June 15. This area was originally established in 2002 and was resized since then (LGL 2007).

As identified in Section 6.2, redfish mate during the fall (September to December), and as illustrated in Figure 6.1, the majority of the Project Area lies within the boundaries of the redfish mating area. Redfish larvae extrusion also occurs near the Project Area approximately 30 km away, as illustrated in Figure 6.1. However, this occurs during April to July.

6.5.2 Potential Interactions and Existing Knowledge

The majority of the potentially sensitive areas identified in Section 6.5.1 and the two EBSAs do not intersect with the boundaries of the proposed Project Area, except that of the potential redfish mating area (refer to Figure 6.1). Therefore, a direct potential interaction with the Project on redfish mating is possible. This potential interaction has been discussed in greater detail in Section 6.2.2.

6.5.3 Mitigation

The mitigation measures, which have already been identified in Sections 6.2.3, can be used to reduce or eliminate potential adverse effects of the Project on the potential redfish mating area.

6.5.4 Residual Environmental Effects Significance Criteria

A significant adverse residual environmental effect on Sensitive Areas is one that alters the valued habitat of the identified Sensitive Areas 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.

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

6.5.5 Environmental Effects Assessment

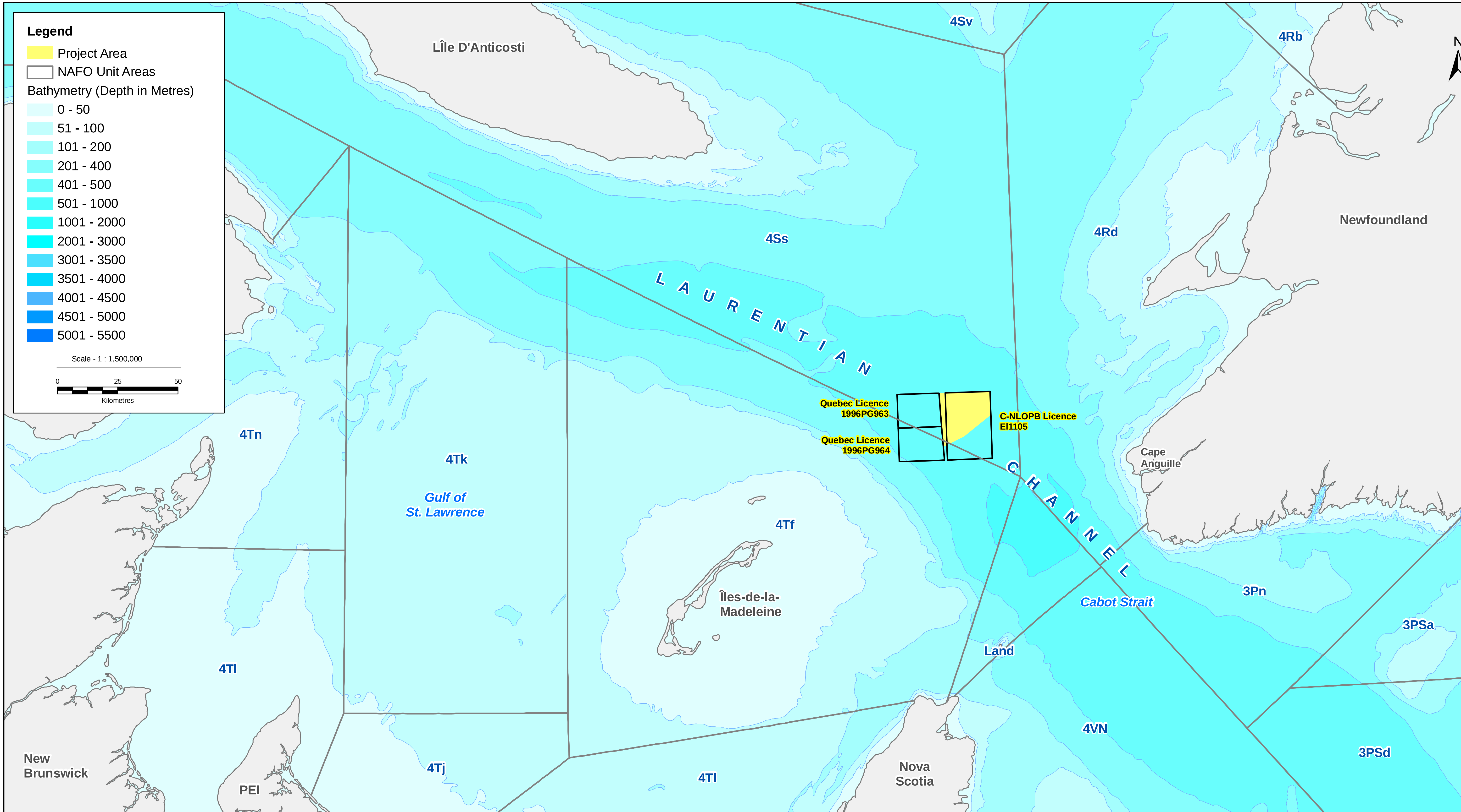
Of the potentially sensitive areas described in Section 6.5.1, the Project Area intersects only that of the potential redfish mating area. Effects related to geohazard surveys and associated seismic activities on this area have been previously assessed in Section 6.2.5. Due to the short duration of the proposed Project (*i.e.,* four to six days) and the implementation of the proposed mitigation measures, the potential adverse environmental effects of the Project on the potential redfish mating area are deemed not significant.

6.6 COMMERCIAL FISHERIES AND OTHER OCEAN USERS

6.6.1 Existing Conditions

Commercial Fisheries

This area of the Gulf of St. Lawrence is commercially fished by fleets from Quebec and all four Atlantic provinces. Management of the commercial fishing activity in the Gulf of St. Lawrence by DFO is conducted through the Quebec, the Maritimes, the Gulf, and the Newfoundland Regional offices. Many of the major species are fished according to quota systems (*i.e.,* groundfish) while others are fished according to availability (*i.e.,* herring and mackerel) or specific season lengths (*i.e.,* lobster and crab). Licenses and quotas are set by DFO for individual species management areas, NAFO divisions and subdivisions. The NAFO divisions are illustrated in Figure 6.2. All major fish groups including groundfish, pelagic and shellfish fished in the Project Area occur in NAFO subdivisions 4Tf and 4Ss and included mackerel, herring, spiny dogfish, eel, skate, blue shark, shortfin mako, porbeagle, American plaice, Atlantic halibut, catfish, cod, Greenland halibut, haddock, witch flounder, winter flounder, monkfish, polluck, redfish, scuplins, tomcod, white hake, windowpane flounder, yellow tail, lobster, shrimp, snow crab, rock crab, toad crab, Atlantic razor clam, scallop, soft shell clam, squid, stimpson's surf clam, surf clam, and whelk.



DATE: March 29, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.2
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**NAFO UNIT AREAS**	Stantec

Fisheries in Northwest Atlantic Fisheries Organization Division 4Ss and 4Tf

Landings data for NAFO division 4Ss and 4Tf for 2004, 2005, 2006, 2007 and 2008 were acquired from DFO from the Quebec, the Gulf and the Newfoundland regions. These data are presented in Tables 6.9 and 6.10. This data represents the most up to date verified data at the time of writing (May 2010). The NAFO Divisions 4Ss and 4Tf units cover an area substantively more expansive than the Project Area. However, general information on trends associated with the fishery for this division could provide insight and knowledge for the Project Area, as well as a general overview.

During this time period, the majority of the harvest was landed in the Quebec region. For the entire NAFO Division 4Ss the landings were dominated by shrimp, lobster, snow crab and Greenland halibut in 2004, 2005, 2006, 2007 and 2008. For the entire NAFO Division 4Tf the landings were dominated by snow crab, lobster and herring in 2004 and 2005, by snow crab, lobster and mackerel in 2006, by lobster, snow crab and rock crab in 2007 and by lobster, snow crab and cod in 2008. All catch data reported had been fished between April and December of each year.

Table 6.9 2004, 2005, 2006, 2007 and 2008 Landed Value of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit 4Ss

Species	2004		2005		2006		2007		2008	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Pelagic										
Herring	512	235	277	54	39	16	18	8	37	11
Eel					26	25				
Skate					218	55				
Spiny Dogfish	2	1	1	1						
Groundfish										
American plaice	175	125	291	207	23	20	779	531	5,199	4,429
Atlantic halibut	23,159	137,672	19,608	110,776	10,381	60,403	36,665	210,653	27,462	155,859
Catfish	10	3	17	6						
Cod	9,946	14,943	11,012	13,210	11,969	13,003	14,176	20,497	14,974	22,961
Greenland halibut	26,709	55,856	46,928	98,739	11,615	19,348	288,837	539,224	198,853	386,068
Witch flounder					166	257	51	85		
Monkfish	22	20	151	95	46	51	229	133	609	378
Redfish	15,843	10,484	53,267	44,173	49,696	40,923	19,498	17,046	4,787	3,167
White hake	163	89	189	104	163	60	179	119	114	72
Shellfish										
Lobster	68,067	993,501	94,160	1,378,438	93,650	1,206,846	109,479	1,524,675	133,555	1,520,234
Shrimp	11,449,450	14,419,491	11,016,469	14,8080,63	9,246,339	2,546,569	4,031,118	5,615,584	7,017,315	7,890,467
Snow crab	153,032	975,918	172,253	569,625	146,095	325,702	184,869	703,294	190,841	742,805
Scallop	2,157	4,433								

Table 6.10 2004, 2005, 2006, 2007 and 2008 Landed Value of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit 4Tf

Species	2004		2005		2006		2007		2008	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Pelagic										
Mackerel	976,216	392,024	729175	417778	1,331,365	640,537	583,131	281,310	429,494	230,658
Herring	3,016,469	785,280	1158558	388073	155,913	62,877	55,065	14,925	121,413	48,703
Eel	55	17	35	37	26	26	17	34	23	28
Skate	654	654	1626	353	1,435	743	943	482	1,119	607
Shortfin Mako							55	111	52	104
Portbeagle							354	709	424	849
Spiny Dogfish	8,315	4,687	45	61	101	94	6	6	16	20
Blue Shark			37	37	32	29			24	27
Mako Shark	170	169	160	320	100	200	544	533	23	23
Groundfish										
American plaice	184,104	152,466	128,167	101,569	198,205	168,997	137,328	114,177	34,481	27,056
Atlantic halibut	33,546	209,101	41,847	269,631	27,677	182,074	28,764	191,115	50,855	360,403
Catfish	16	12	43	63	244	226	126	139	44	40
Haddock	728	706	1419	2,564	1,256	2,291	1,435	1,969	1,208	1,657
Cod	737,334	921980	1,150,657	1,220,984	1,308,453	1,572,404	476,005	627,128	680,364	905,947
Greenland halibut	21,739	46,240	42,517	61,642	53,089	80,207	21,073	35,246	16,069	27,916
Witch flounder	228,747	262,561	365,383	340,009	429,025	511,741	310,232	366,395	276,076	297,806
Monkfish	180	136	3,901	1,929	1,297	647	975	506	2,710	1,922
Polluck	502	293	2,169	1,175	10,724	10,496	3,876	2,458	736	455
Redfish	99,575	73,525	522	269	1,270,577	341,799	66,335	55,507	275,615	240,161
Scuplins	163	5	786	150	108	46	675	255	215,964	189,039
Tomcod	109	42	100	57	8	2	83	88	72	70
White hake	19,655	13,654	17,913	12,331	11,086	7,402	6,088	4,359	17,826	11,391
Windowpane flounder	23,551	17,935	51,576	42,112	22,165	23,959	104,498	104,498	67,057	87,208
Winter flounder	151,942	103,889	174,070	153,681	160,956	164,417	121,699	139,663	111,928	140,313
Yellowtail	309,383	128,792	168,450	132,820	181,366	191,872	141,824	165,177	91,350	118,799
Shellfish										
Lobster	2,486,112	2,486,112	2,453,010	34,370,076	2,459,173	31,177,933	2,481,499	33,316,778	2,625,401	29,773,860
Snow crab	7,268,029	48,002,316	8,790,766	38,383,413	6,243,323	17,432,383	2,428,454	26,516,893	5,579,765	24,596,638
Rock crab	678,724	530,816	781,631	596,235	766,703	636,937	802,518	657,700	644,257	566,208
Toad crab			165,354	122,388	197,078	155,583	195,776	152,133	165,368	127,603

Table 6.10 2004, 2005, 2006, 2007 and 2008 Landed Value of Fisheries Harvest for Northwest Atlantic Fisheries Organization Unit 4Tf

Species	2004		2005		2006		2007		2008	
	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)	Weight (kg)	Landed Value ($)
Atlantic razor clam	11,874	26,173	26,374	58,150	10,354	22,829	21,437	47,259	11,766	25,942
Scallop	139,843	253,444	239,516	474,963	148,396	399,520	385,827	10,402,011	314,464	621,925
Soft shell clam			87	228	407	958	506	521	988	2,124
Squid					320	46			6	13
Stimpson's surf clam	21,283	16,423	8,159	8,111	8,873	7,165	16,713	12,896	7,576	5,846
Surf clam	95,878	68,575	140,014	140,925	126,653	123,419	156,567	165,493	174,307	188,088
Whelk	367,733	334,805	441,714	446,397	394,942	415,447	381,915	404,620	352,386	388,482

The harvesting locations for NAFO Divisions 4Ss and 4Tf, which fell in the vicinity of the Project Area, by species, geo-referenced by latitude and longitude, are presented in Figures 6.3 to 6.17. Note that not all of the catch data summarized in Tables 6.9 and 6.10 included harvest locations coordinates and as such the commercial fishery figures may not illustrate the same information as portrayed in the tables.

As is evident in these Figures, there is minimal fish effort within and surrounding the Project Area. No harvesting locations were recorded within the Project Area. The closest harvest location to the Project Area laid to the southeast, just outside the Project Area, and was recorded for whelk in 2006. In general, however, the fishing effort in the immediate vicinity of the Project Area is low.

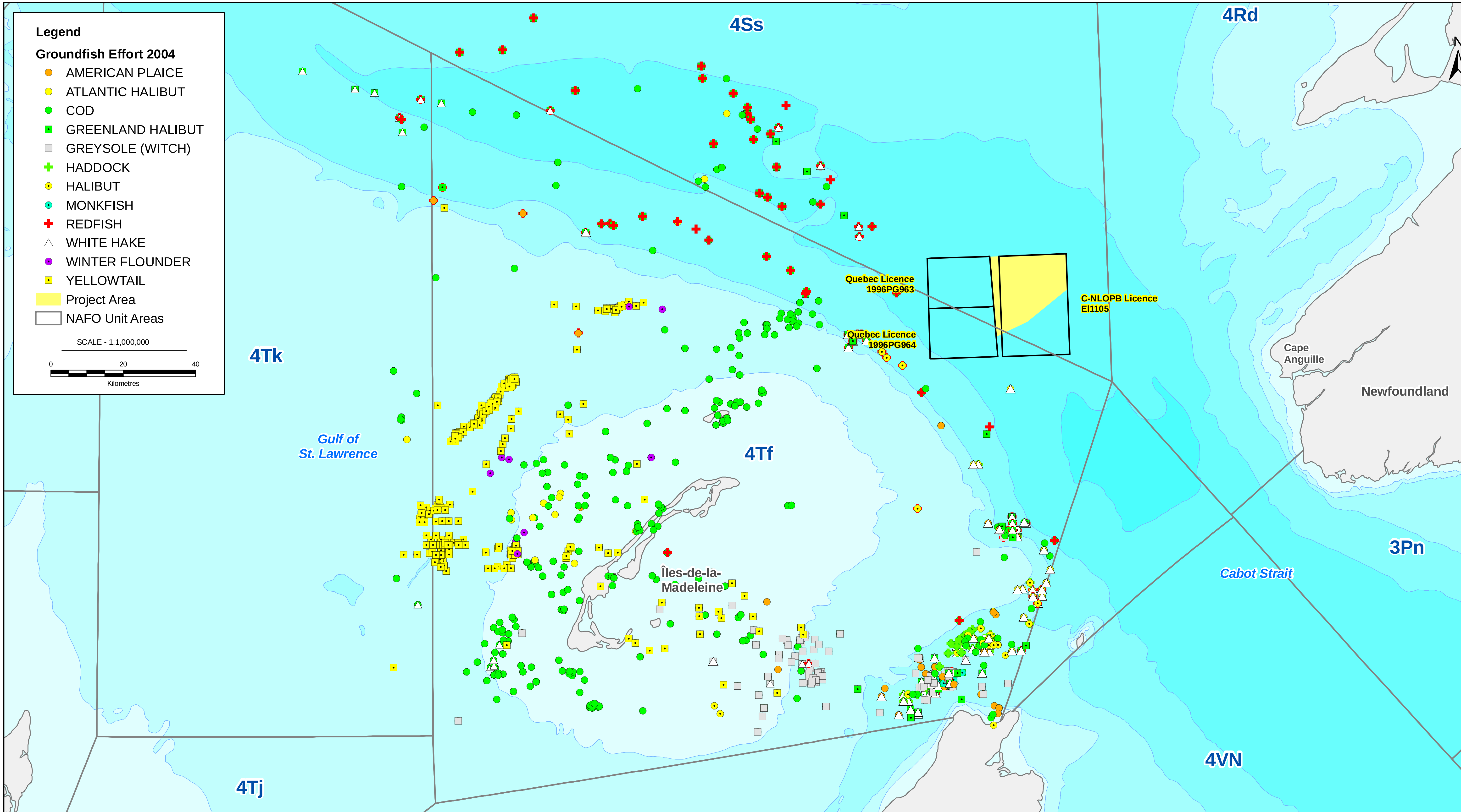
Principal Commercial Fish and Shellfish Species

Based on the landed weight data collected and analyzed for the years of 2004 – 2008, for both NAFO Divisions 4Ss and 4Tf (Tables 6.9 and 6.10), the main fish and shellfish species commercially fished in the vicinity of the Project Area included lobster, shrimp, snow crab, rock crab, scallops, whelk, mackerel, herring, cod, deepwater redfish and witch flounder. Species descriptions for the majority of the fish and shellfish species listed above (except whelk, scallop and rock crab) is provided in the 2005 Western Newfoundland SEA (LGL 2005b), Sections 3.4.1 and 3.4.2. The whelk is a coastal gastrod mollusk common to cold waters at depths up to 30 m (DFO 1997). Both the sea scallop and rock crab are also considered coastal species found at depths up to 40 m. Due to the offshore location of the proposed Project, project activities are not expected to interact with the commercial fishing of the whelk, sea scallop or rock crab.

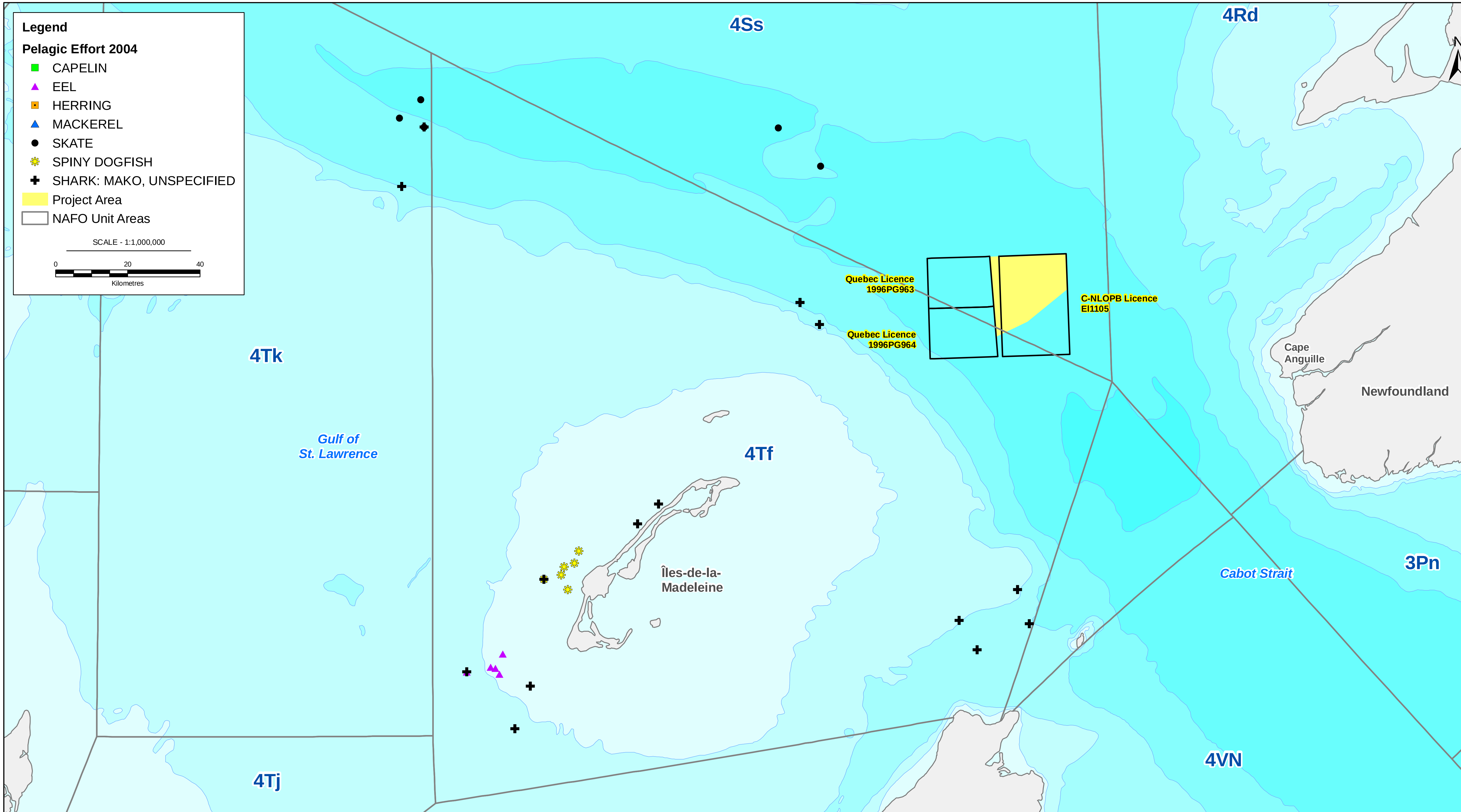
Historical Fisheries

Although the fishing effort for the Atlantic cod in the vicinity of the Project Area is low (refer to Figures 6.3 – 6.11), this species has been over-exploited in offshore western Newfoundland waters in the past. The commercial cod fishery began in the 1600s or earlier. According to DFO, cod landings between the 1600s and the 1800s ranged from 100,000 t to 400,000 t annually. In the 1950-1970s, cod stocks average 900,000 t and peaked at 2,000,000 t. In the early 1970's, all cod stocks in the Northwest Atlantic were put under a quota regulation (DFO 2010b). In the late 1980's to early 1990's, landings of cod started to decline significantly and in 1993 a moratorium on the cod fishery was imposed. The cod fishery was closed from September of 1993 to May of 1998, when it reopened with a total allowable catch (TAC) of 3,000 t. The TAC was increased to 6,000 t in 1999 to 2002. In 2003, the cod fishery closed again and reopened in 2004 with TAC of 3,000 TAC. In 2005 and 2006, the TAC was 4,000 tonnes, and in 2007, 2008 and 2009 it was at 2,000 t (Swain *et al.* 2009 and DFO 2009a).

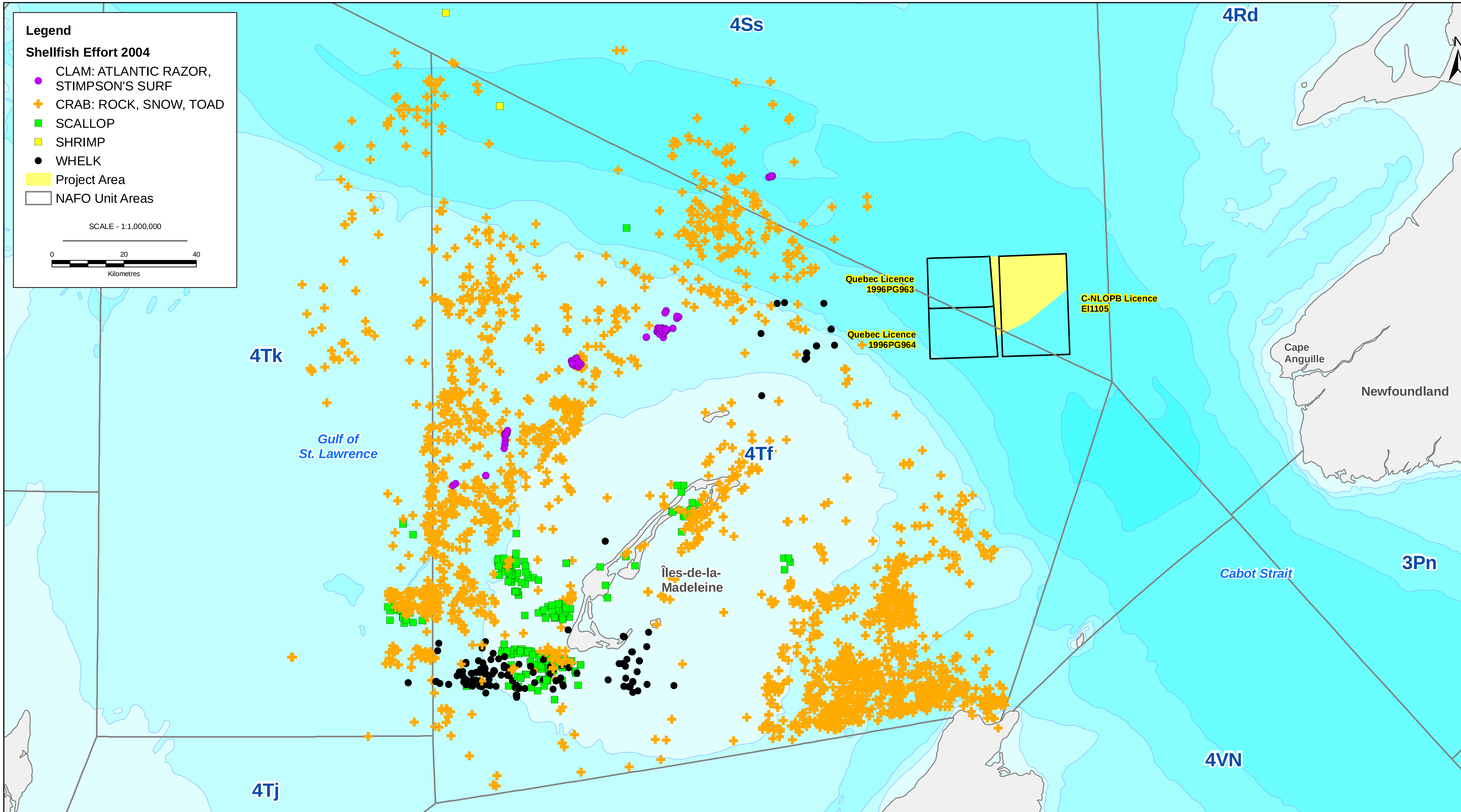
Historical fisheries offshore Western Newfoundland have been described in further detail in the 2005 Western Newfoundland SEA (LGL 2005b) in Section 3.4.4.2.



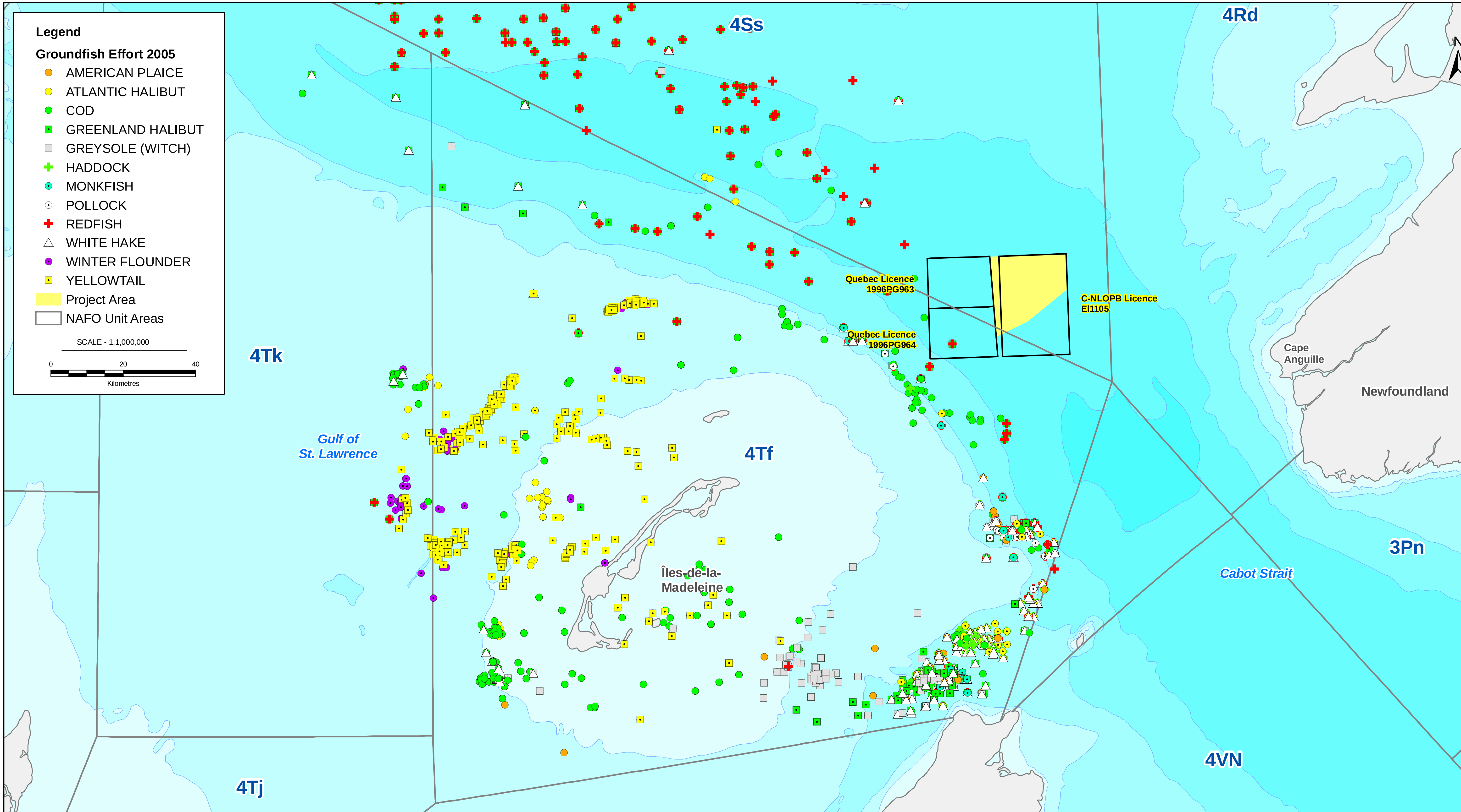
DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.3
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2004 GROUNDFISH**	Stantec



DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA		FIGURE NO.: Figure 6.4
PREPARED BY: G. Mesheau			
PREPARED BY: 121510339	**2004 PELAGIC**		Stantec



DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: **Figure 6.5**
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2004 SHELLFISH**	Stantec



DATE: May 04, 2010

PREPARED BY: G. Mesheau

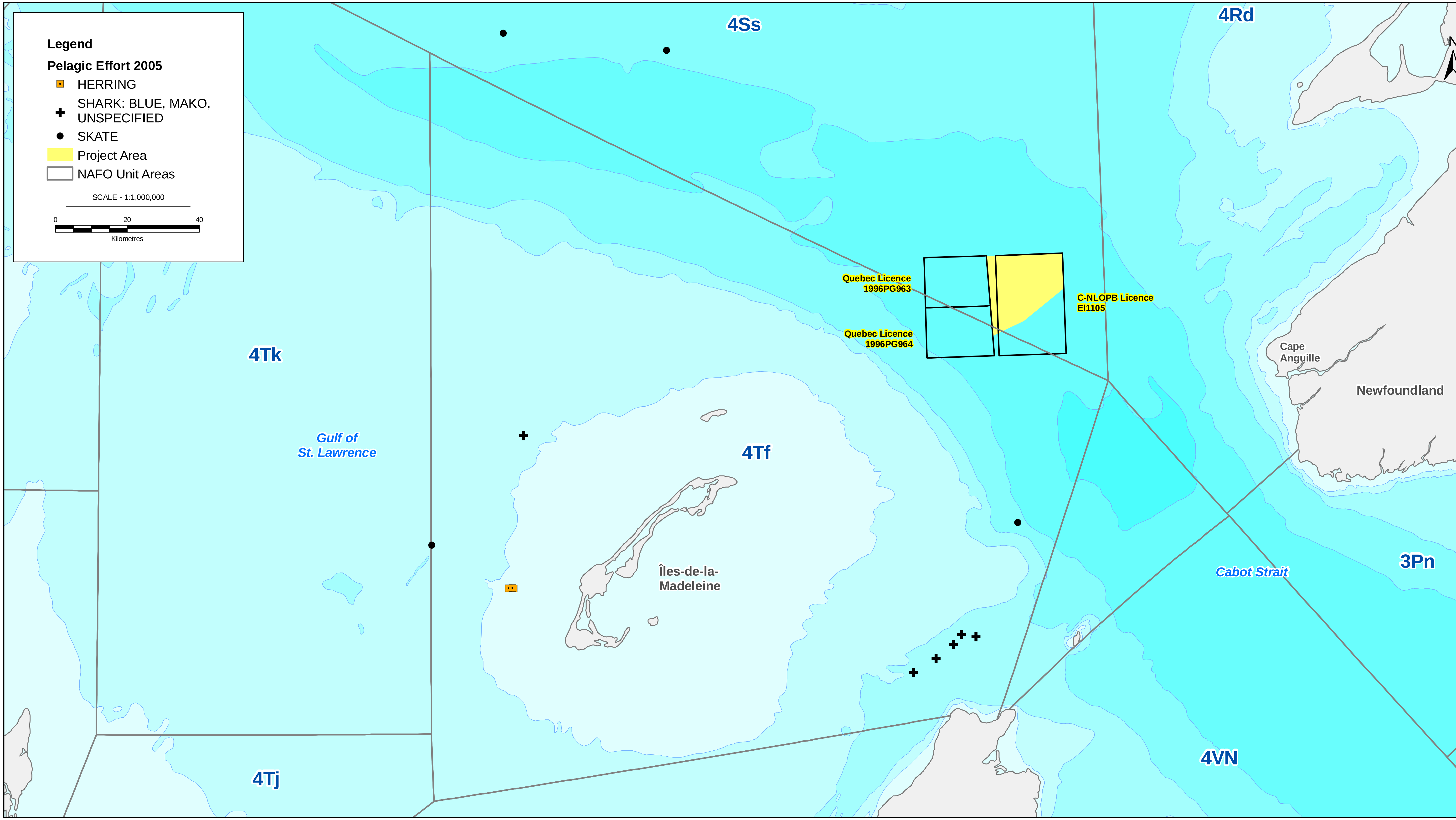
PREPARED BY: 121510339

OLD HARRY PROSPECT GEOHAZARD SURVEY AREA

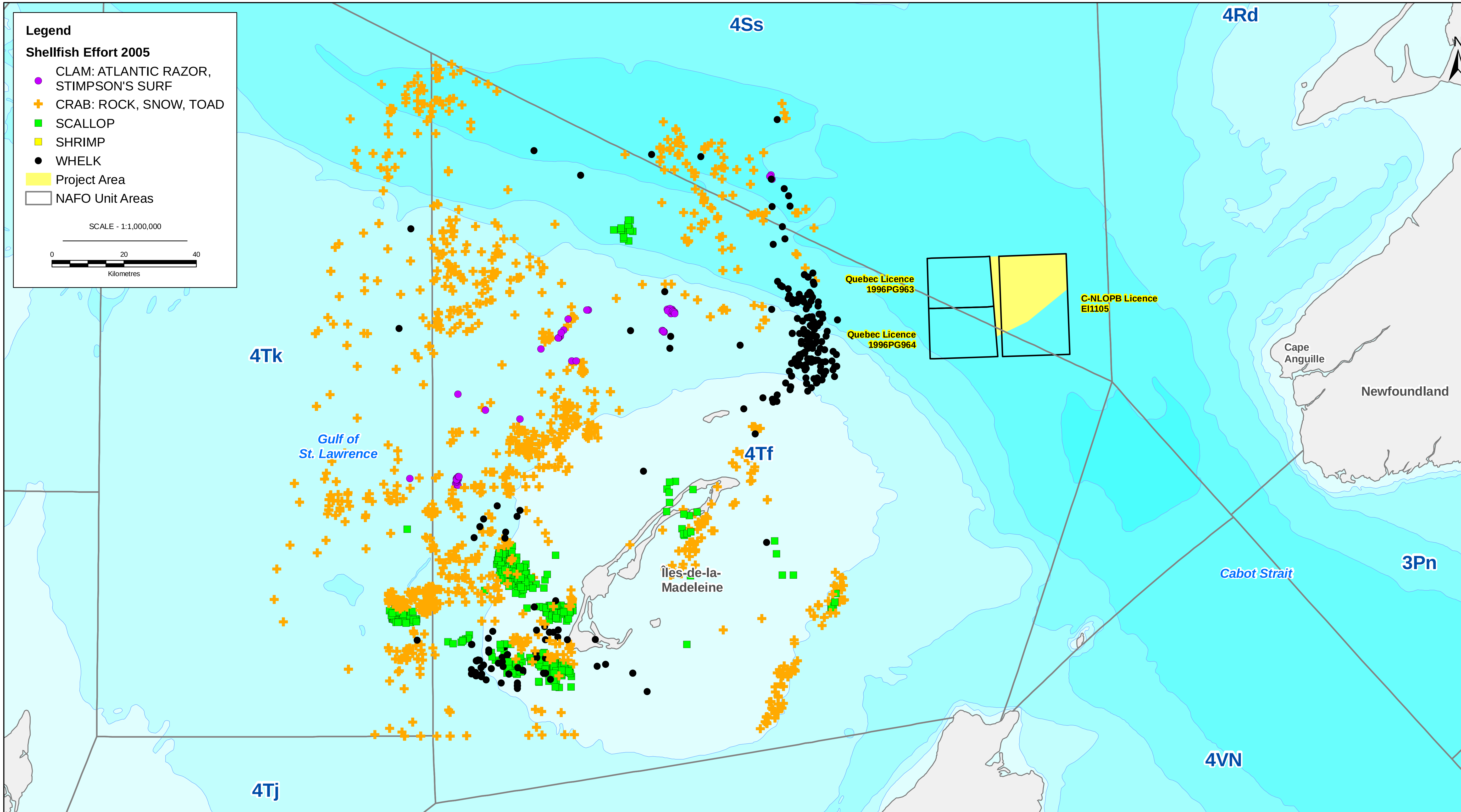
2005 GROUNDFISH

FIGURE NO.: **Figure 6.6**

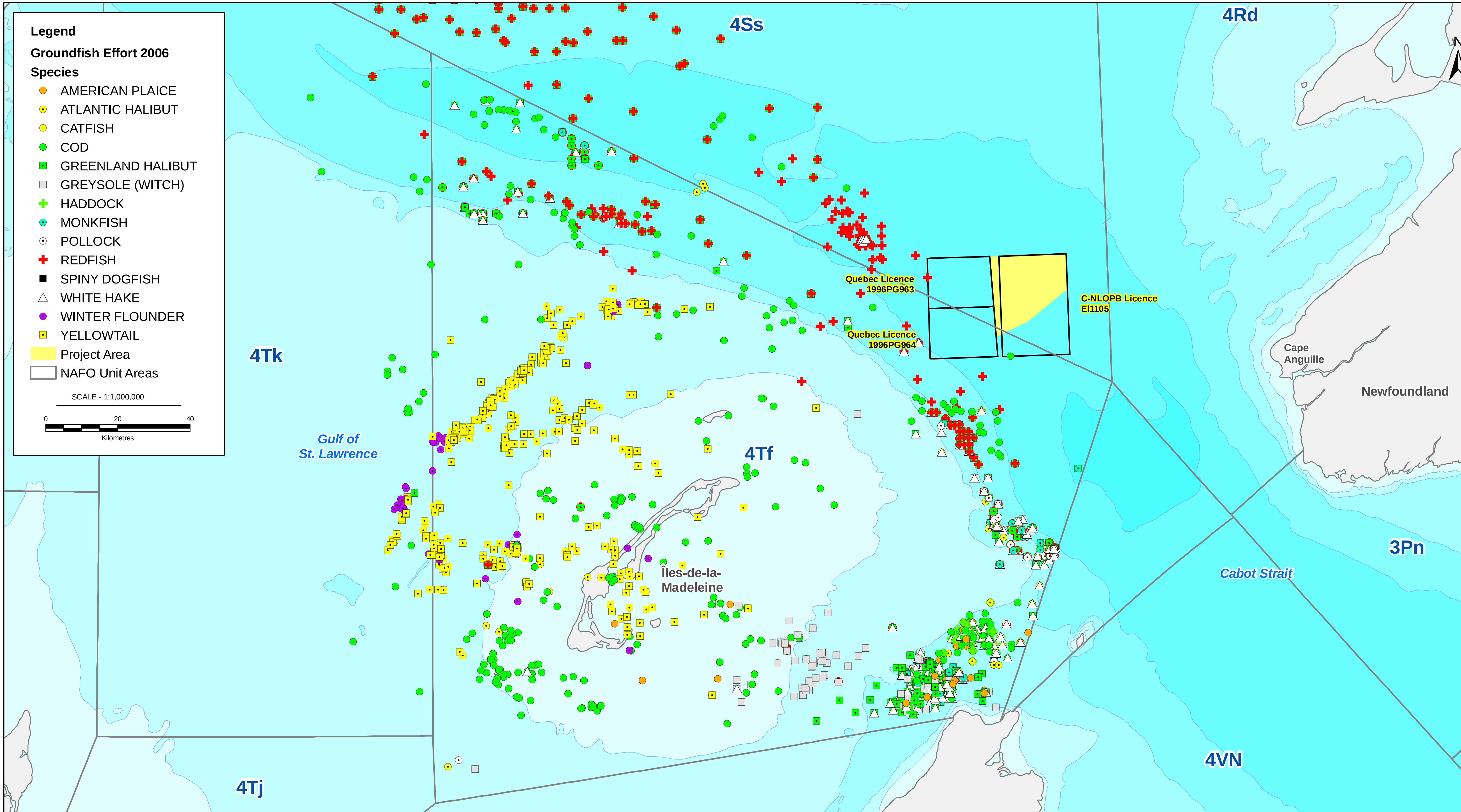
Stantec



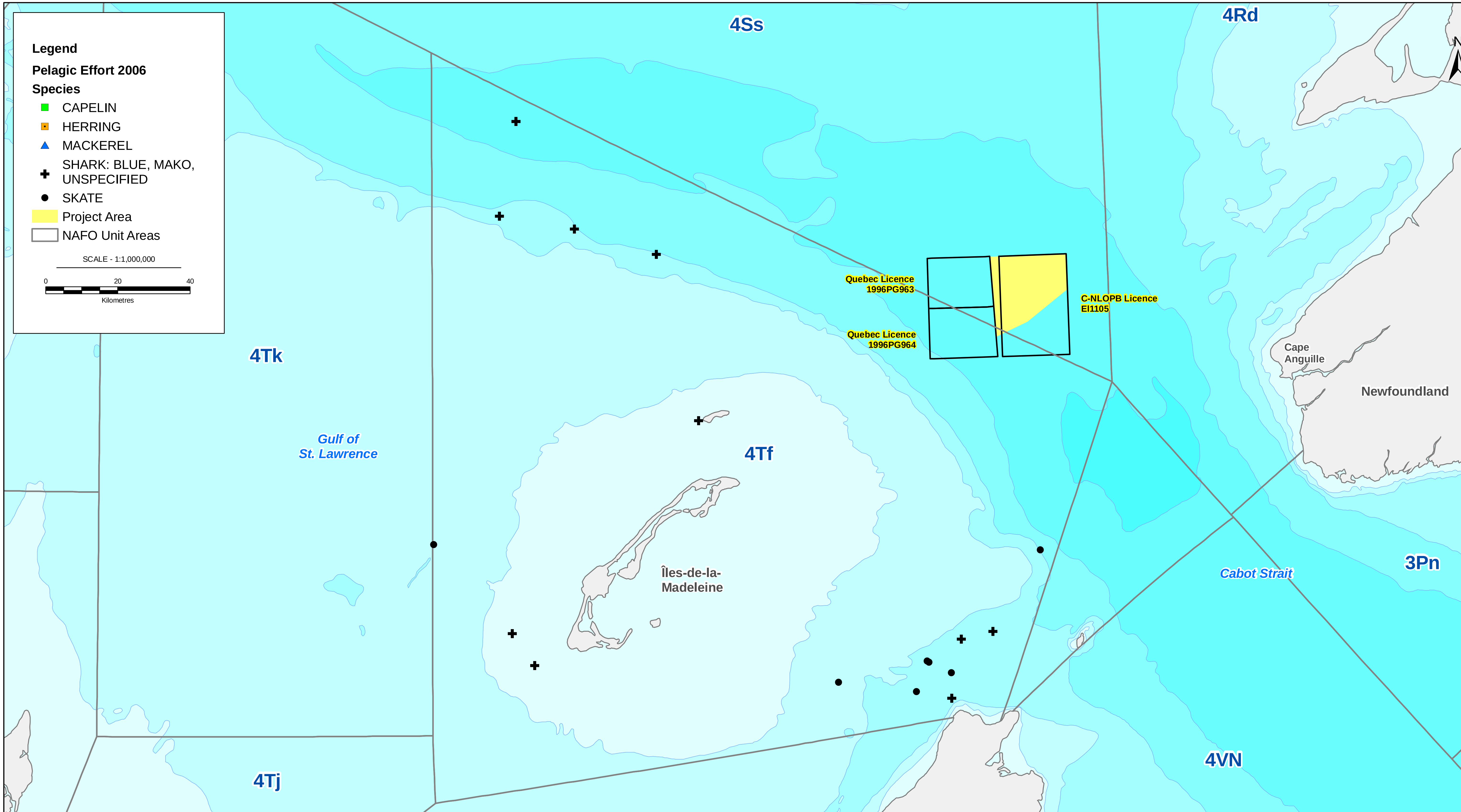
DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: **Figure 6.7**
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2005 PELAGIC**	Stantec



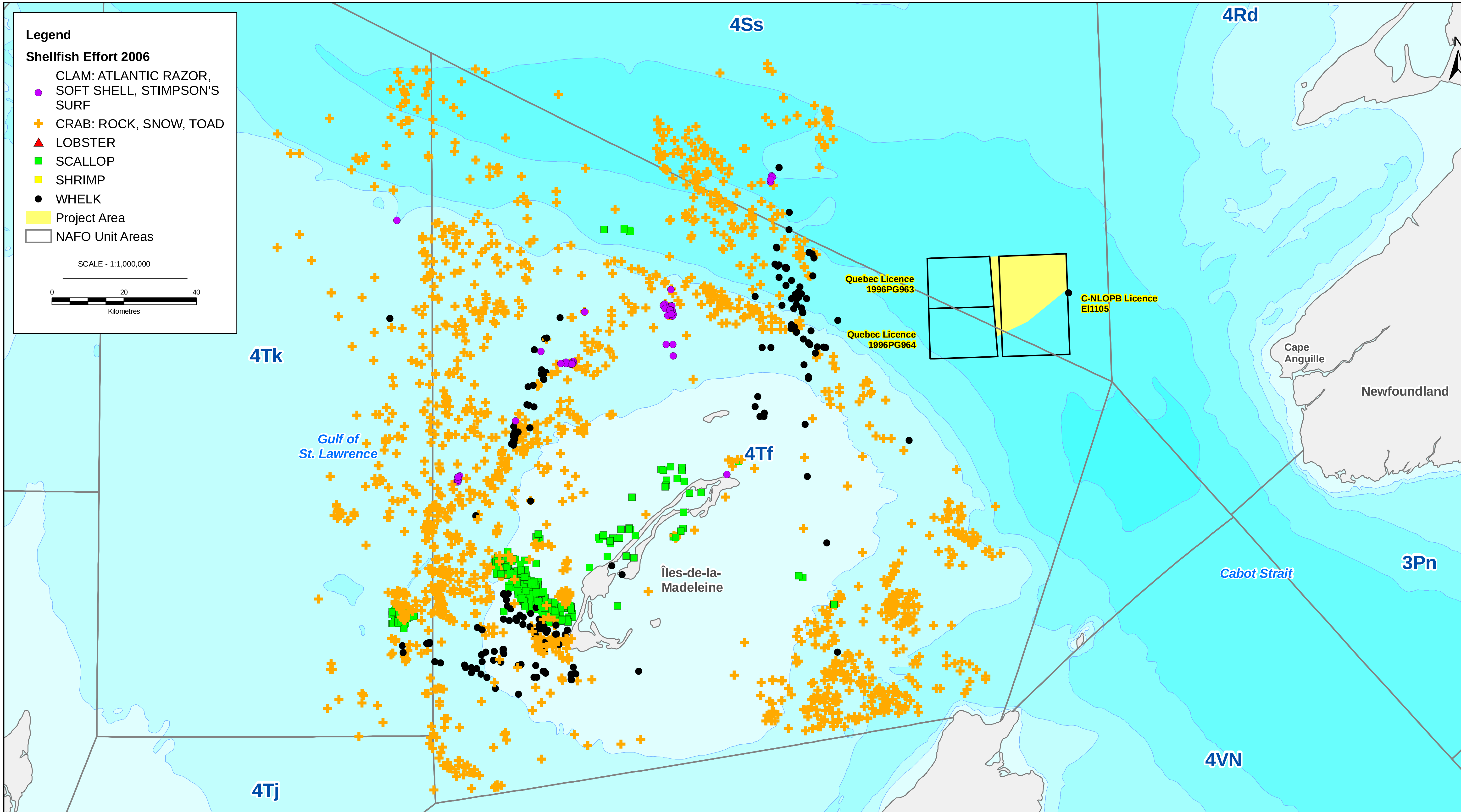
DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.8
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2005 SHELLFISH**	Stantec



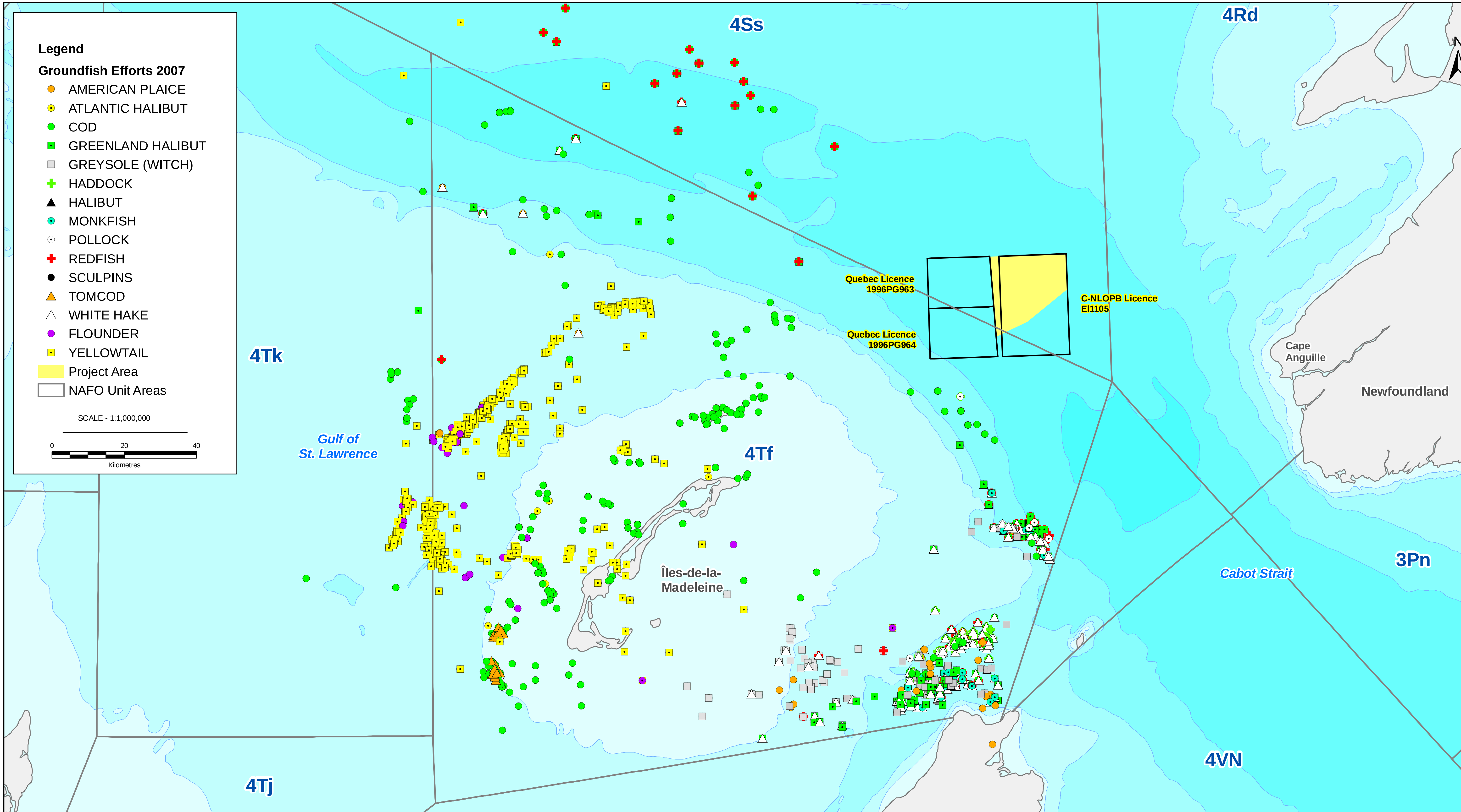
DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.9
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2006 GROUNDFISH**	Stantec



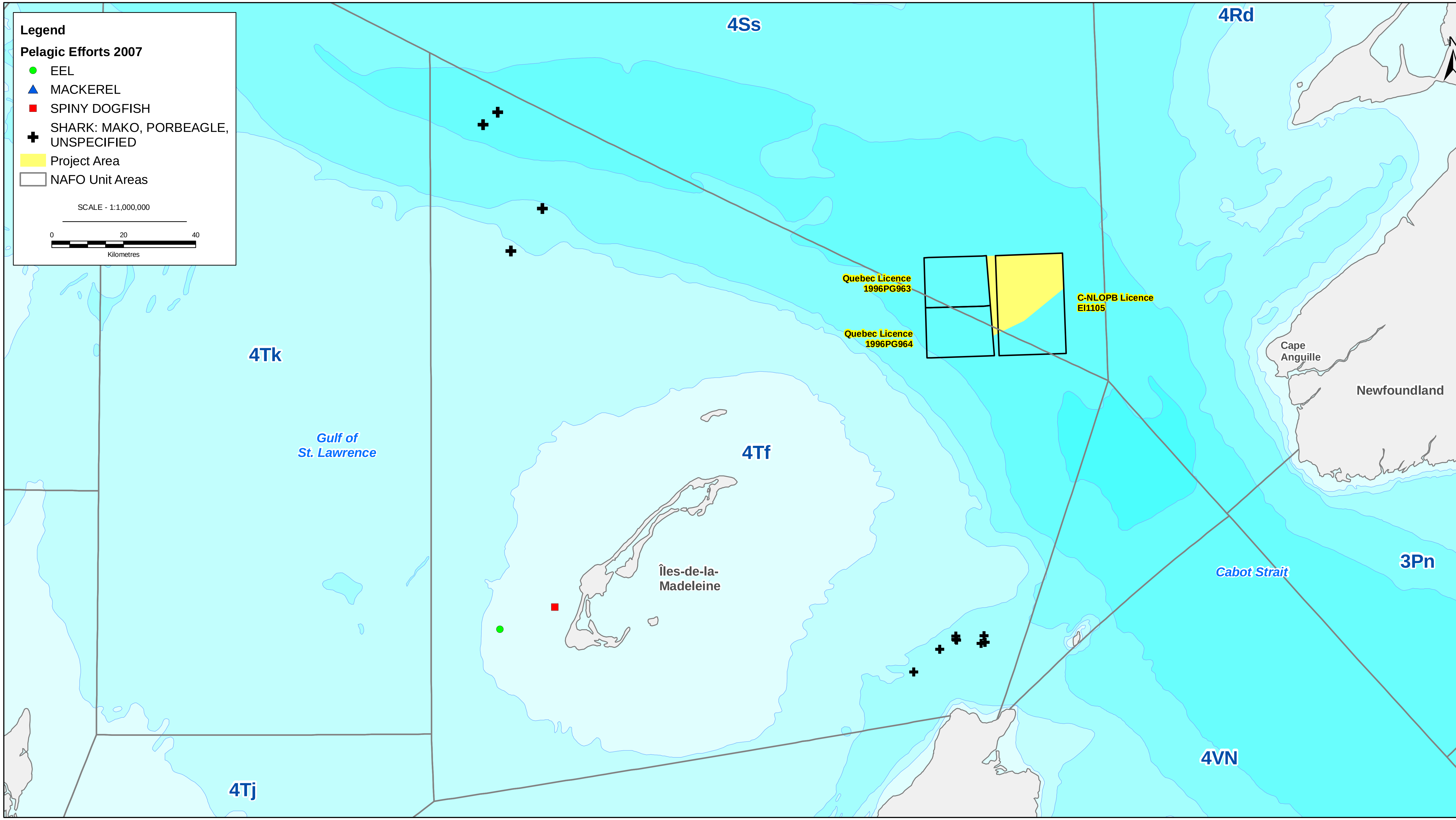
DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.10
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2006 PELAGIC**	Stantec



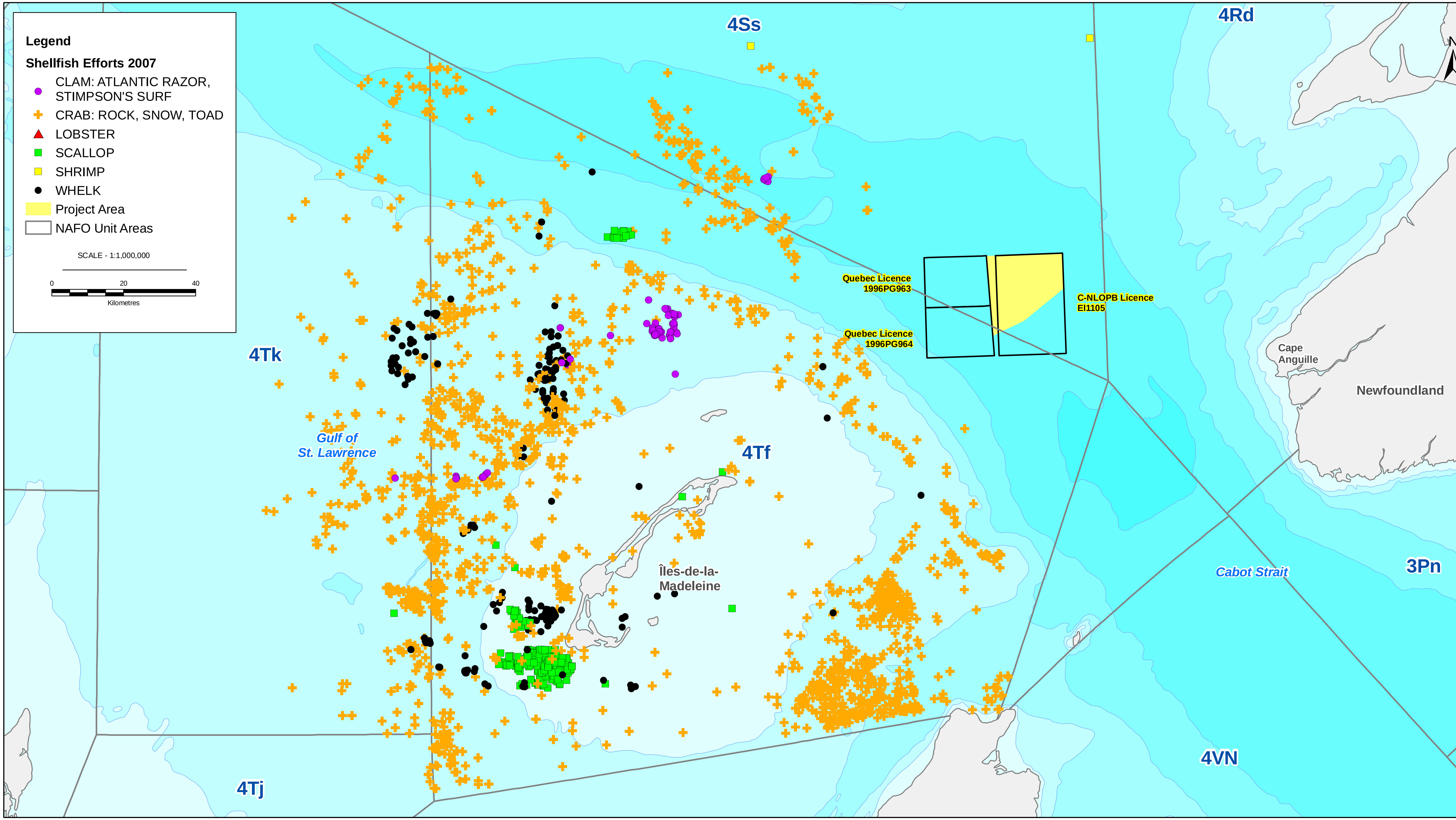
DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.11
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2006 SHELLFISH**	Stantec



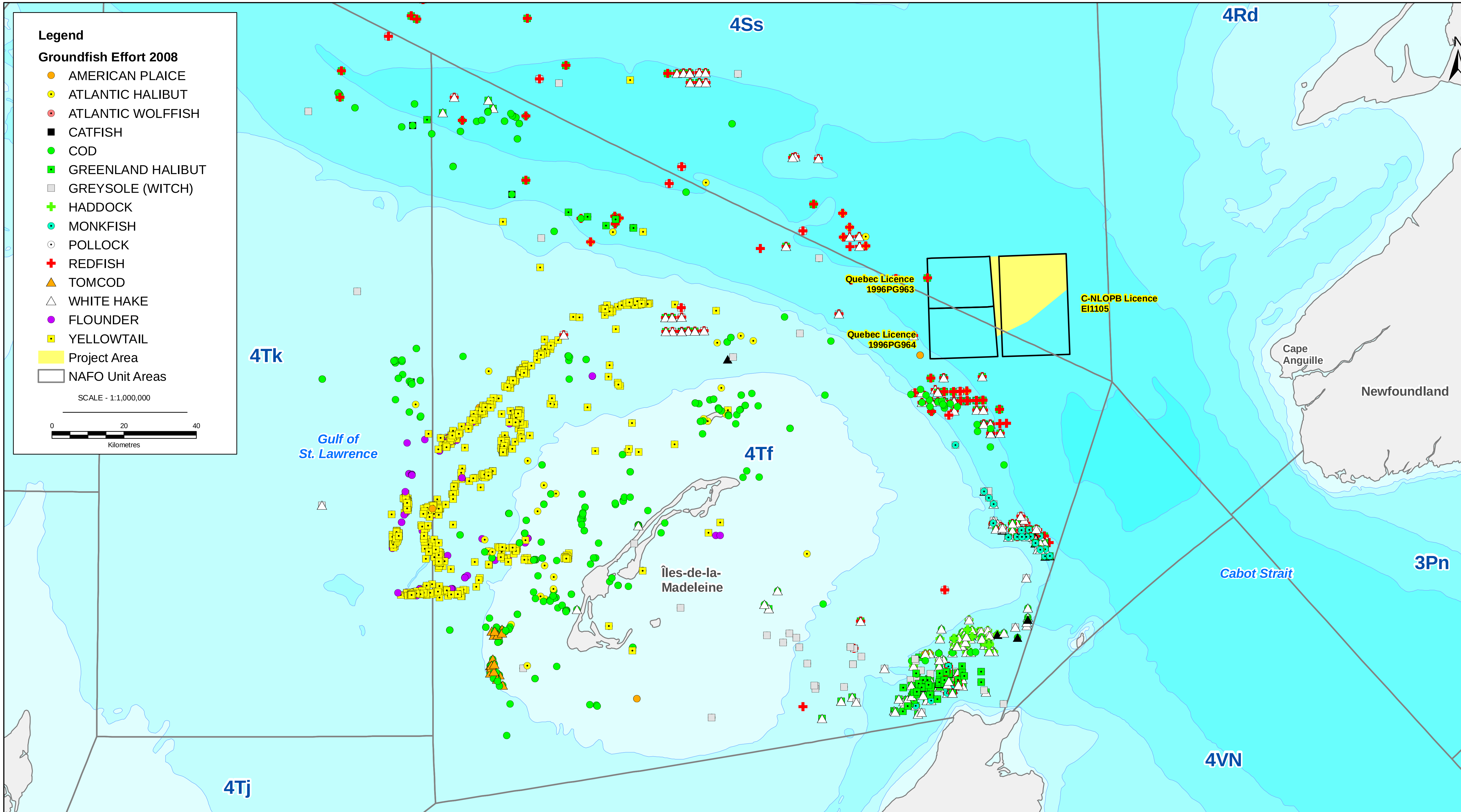
DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.12
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2007 GROUNDFISH**	Stantec



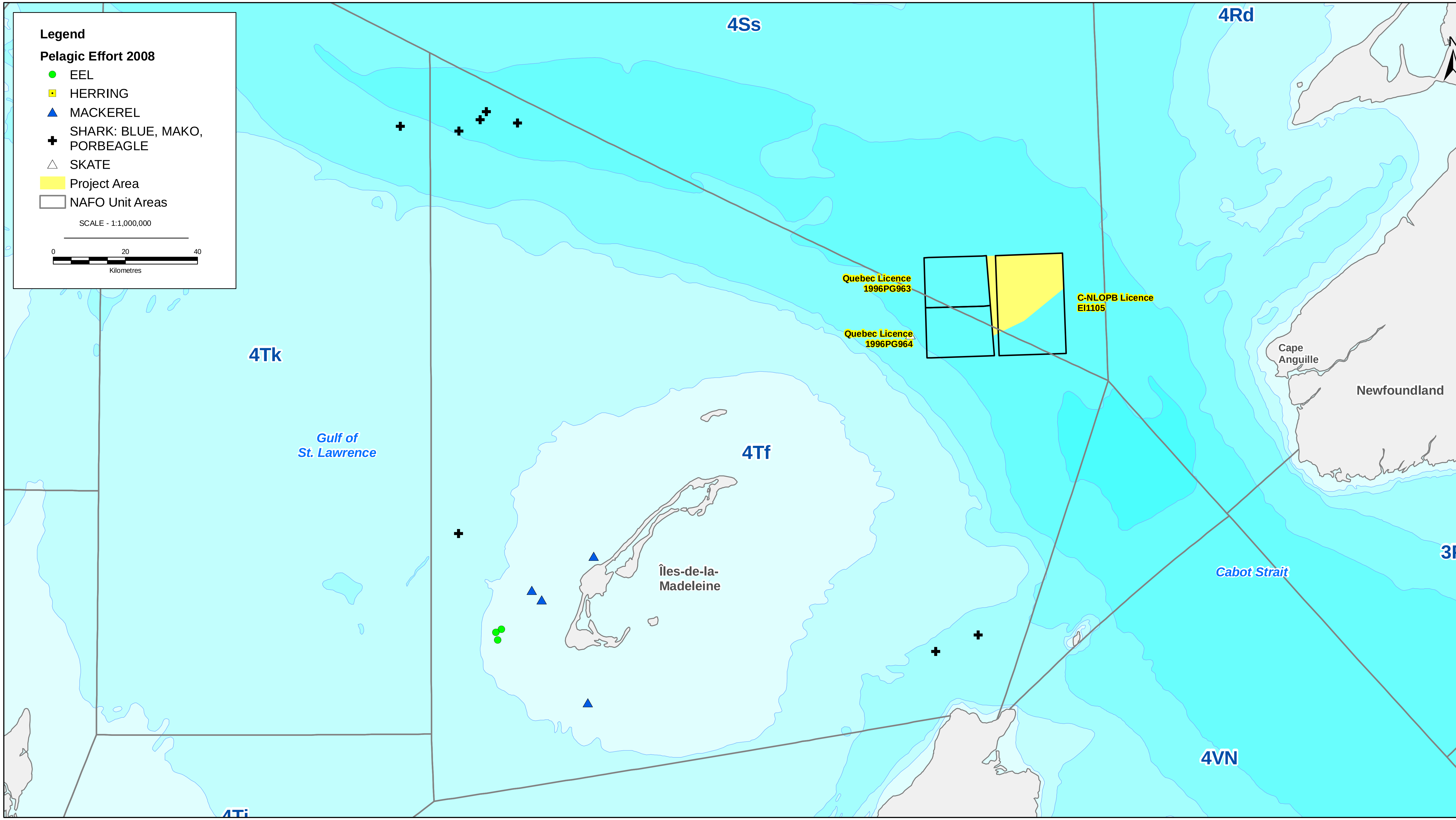
DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: **Figure 6.13**
PREPARED BY: G. Mesheau		
121510339	**2007 PELAGIC**	Stantec



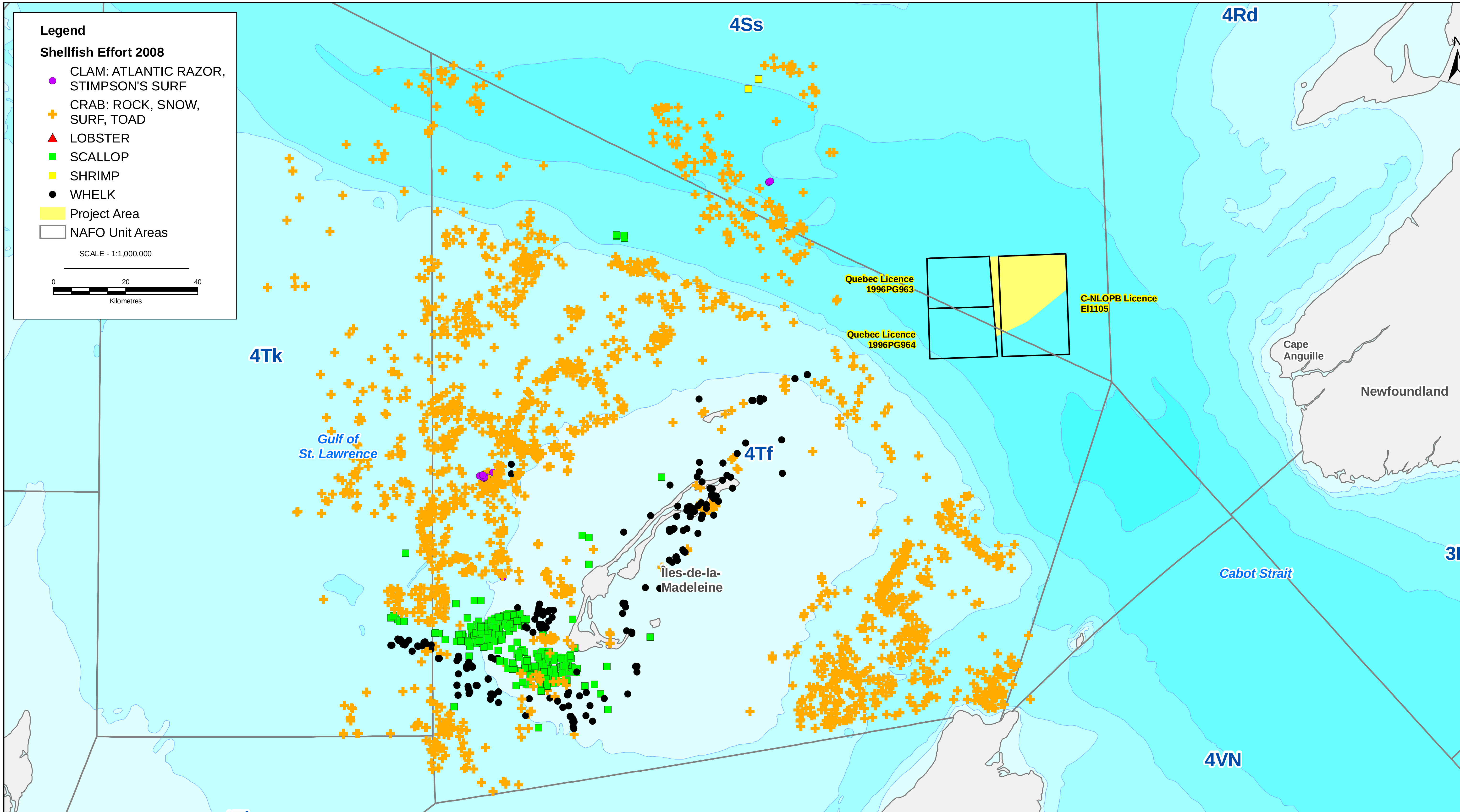
DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.14
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2007 SHELLFISH**	Stantec



DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.15
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2008 GROUNDFISH**	Stantec



DATE: May 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.16
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	**2008 PELAGIC**	Stantec



DATE: April 04, 2010	OLD HARRY PROSPECT GEOHAZARD SURVEY AREA	FIGURE NO.: Figure 6.17
PREPARED BY: G. Mesheau		
PREPARED BY: 121510339	2008 SHELLFISH	Stantec

Other Users

During the Western Newfoundland SEA (LGL 2005b) public consultation process, Mi'kmaq groups from the area reiterated the province's requirement to notify aboriginal peoples about any land development issues. Historically, in the 16th and 17th centuries the Mi'kmaq created a "Domain of Islands" in the Gulf of St. Lawrence (Heritage NF 1997). However, there are no known active aboriginal fishing grounds within the Project Area. It is anticipated that commercial fishing licenses are issued to aboriginal peoples fishing in the 4Ss and 4Tf areas, but there is no known commercial fishing activity within the Project Area boundaries (refer to Figures 6.3 to 6.17). Therefore, the only expected interaction is in relation to vessel traffic.

The Project Area is adjacent to the major shipping route that traverses the St. Lawrence River estuary and across the Gulf of St. Lawrence immediately south of Anticosti Island (LGL 2005b). Traffic density in this vicinity is four to eight ships per day, many of which are container vessels (LGL 2005b). DFO carries out stock assessment surveys and research activities throughout the maritime marine environment, which may overlap with proposed Project activities. The DFO Science Advisory Schedule can be accessed on-line (http://www.meds-sdmm.dfo-mpo.gc.ca/csas/applications/events/eventIndex_e.asp#March) closer to the time of the proposed surveys to determine if there are any DFO activities scheduled to overlap with the Project. This on-line resource included activities scheduled through the month of April, but no later, at the time of this report.

There is no known military use of the Project Area, nor any anticipated active petroleum industry sites within the vicinity of Old Harry Prospect. While there are several exploration licences in the coastal waters of Western Newfoundland, none exist in the offshore Old Harry Prospect area other than those held by Corridor Resources. As such, marine transportation dominates other potential users of the Laurentian Channel area and further discussion of other users will focus on marine traffic.

Vessel traffic in the area of the proposed location of the geohazard survey is an important consideration. The main navigation lane between the Cabot Strait and the St. Lawrence River is in the vicinity of the proposed Project location. The majority of vessels enter the Gulf of St. Lawrence via the Cabot Strait. However, there may be other vessel traffic along shipping routes through the Strait of Canso and the Strait of Belle Isle. The main shipping lanes through the Gulf of St. Lawrence to Montreal overlap with the proposed work. Additional global shipping lanes exist in close proximity to the proposed Project Area, including those routes between the Maritimes and Europe, the Maritimes and the U.S. and within the Atlantic Provinces (Geocommons 2010).

6.6.2 Potential Interactions and Existing Knowledge

The initial geohazard survey is planned for the fall season and additional surveys may occur during other open water periods. The timing of these surveys therefore have the potential to overlap with some commercial fisheries activities in the Laurentian Channel area. The strategic environmental assessment of the Western Newfoundland and Labrador Offshore area (LGL 2005b) identified physical interference with harvesting as a concern to fish harvesters. Conflicts with fixed gear, which can become entangled with streamers, were identified as a key concern (LGL 2005b). As discussed above (Section 6.6.1) however, no harvesting locations were recorded within the Project Area boundaries. Therefore, no interactions with fixed gear are anticipated during the geohazard surveys planned to occur in the proposed Project Area.

Most of the information available on potential interactions between the fishing industry and the offshore oil and gas industry has been gathered through stakeholder consultations undertaken as part of Environmental Assessments for petroleum exploration and development projects in Atlantic Canada and elsewhere. Studies include the Terra Nova EIS (Petro-Canada 1995), the White Rose EIS (Husky Oil 2000), the Laurentian Sub-Basin SEA (JWEL 2003), the Orphan Basin SEA (LGL 2004) and the Western Newfoundland and Labrador Offshore Area SEA (LGL 2005b). These consultations have identified the primary issues as being potential interference with harvesting activities and fishing gear (as described above), potential effects on fish catchability, potential interference with DFO research surveys, and potential biophysical effects on fish and subsequent reductions in fish landings. Potential interaction with the Redfish fishery was identified during consultations with Corridor, One Ocean and the FFAW (refer to Section 3.2). However, as shown in Figures 6.3 to 6.17, no redfish harvest locations have overlapped with the Project Area during 2004 to 2008.

Fishers elsewhere in the world have expressed concerns with respect to offshore exploration and development. Lam (2001) provides a review of fisheries-related issues in the United Kingdom over more than three decades of offshore oil and gas development. Issues and concerns relevant to this Environmental Assessment include loss of access, damage to gear and compensation for damage, and communication between the two industries. Similarly, issues can include space use conflicts and reduced catch due to seismic activity (Peterson 2004). Numerous other such reports exist, all of which highlight the importance of communication between the fishing and oil and gas industry, often through the establishment of formal liaison mechanisms to deal with specific issues.

Changes in catchability have been reported as an effect of fish interactions with seismic surveys. Multiple studies using a number of methods to estimate fish distribution in open sea fisheries showed a decrease in gadoid abundance during seismic surveys (Løkkeborg and Soldal 1993; Engås *et al.* 1996). The areas apparently affected extended up to 33 km from the survey centre but the most pronounced reduction in catch occurred within the seismic shooting area (Engås *et al.* 1996). It has been suggested (Engås *et al.* 1996) that cod may swim toward the bottom and remain immobile during disturbance by sound and Løkkeborg and Soldal (1993) have suggested that this change in behaviour could explain increases in catch rates of cod in saithe trawls during seismic activity. Chapman and Hawkins (1969) illustrated how whiting in mid-water schools moved deeper below air sleeves. Pearson *et al.* (1992) showed rock fish catches declined, mainly due to changes in fish depth rather than to dispersal of the shoals.

Water depths in the area of the proposed geohazard surveys and associated seismic components are approximately 450 m. As discussed above no interactions are anticipated between the geohazard surveys activities and commercial fishing grounds. Therefore, the Project has the greatest potential to interact with commercial fishing traffic.

During the initial fall survey, interactions with commercial fishing traffic would be limited to those vessels involved in the fall fisheries, occurring in the deeper waters of the Laurentian Channel, including Atlantic halibut, American plaice, northern shrimp, Atlantic cod and redfish fishery. All other fisheries during that time of year occur in shallower coastal waters. The groundfish fishery is generally undertaken between mid-April and the end of October. Both cod and redfish fisheries may be underway during the initial fall Project activities. Therefore, minimal interactions are possible between the Project and the cod and redfish fisheries vessels. Interactions with all fishing vessels will be minimized as a result of the short duration of the project and the small area covered by each geohazard survey (*i.e.*, about 22.5 km^2). Additional mitigation measures are summarized below in Table 6.9.

The two most lucrative fisheries in the Gulf are the lobster and snow crab fisheries, neither of which will interact with the initial Project survey as both seasons will be closed prior to the fall Project start-up. The lobster fishery is open from the beginning of May to the end of June, and therefore has the potential to interact with subsequent geohazard surveys if conducted during this time. However, as an inshore fishery, no interactions are anticipated with the geohazard surveys activities. The snow crab fishery is an offshore fishery; the season for snow crab ranges from spring to early summer. Employing the mitigative measures described below and considering the short duration and small geographical area of the proposed subsequent surveys, interactions with the snow crab fishery will be minimal.

Other Users

In the event that DFO research activities or stock assessments are underway in the vicinity of the Project Area during the proposed geohazard surveys, interactions and potential effects could occur either as a result of behaviour responses, fishing interference or displacements (LGL 2005b). During each geohazard survey, it is expected that some commercial traffic will be passing in the vicinity of the Project Area. Therefore, the mobilization and presence of the geohazard surveys vessel may interact with marine traffic in the Cabot Strait, which includes the Laurentian Channel.

The incremental amount of vessel traffic as a result of this Project is anticipated to be negligible compared to existing vessel traffic in the area and interactions will be minimal.

6.6.3 Mitigation

Commercial Fisheries

The LGL Western Newfoundland SEA (2005b) confirmed that strong communication at sea is an effective means of minimizing interference between offshore oil and gas exploration projects and fishing activities. Communication is required between operators, regulators and the fishing industry in the planning and execution phases of geohazard surveys to minimize interactions and effects from survey activities. The Old Harry Prospect geohazard survey will be planned and coordinated with the fishing industry and with DFO to reduce potential conflict with commercial fishing activities (*i.e.,* fisheries vessel traffic), sensitive life cycle stages of various fish species, and DFO assessment surveys (if any are anticipated to overlap with the four day geohazard survey, as outlined in the following section). Communication can be established through a single point of contact (SPOC) for each stakeholder and can be enhanced through the use of an Environmental Observer capable of serving as a Fisheries Liaison Officer.

The current Old Harry Prospect project will adhere to recommendations that communication be maintained at sea by the Project vessels via marine radio (LGL 2005b). This will facilitate information exchange with fisheries participants, including vessel operators. Relevant operations information including vessel schedule and location will be publicized using the Notices to Shipping (Continuous Marine Broadcast and NavTex) and CBC Radio's Fisheries Broadcast, as recommended by the Western Newfoundland SEA for the western Newfoundland Offshore Area (LGL 2005b).

Consultation has been carried out and consisted of a focused consultation of key stakeholders to advise them of the proposed project and to solicit issues or concerns they may have (refer to Section 3.0).

Each survey will be conducted in adherence to all pollution prevention regulations named under Section 6.2.3 above (Mitigation, Marine Fish, Shellfish and Habitat) and will be consistent with the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2008). Any accidental spills will be reported to the C-NLOPB and NEB as appropriate, and the Canadian Coast Guard Emergency Response immediately.

Other Users

Representative(s) from DFO will be contacted prior to commencement of the Project to confirm the presence or absence of DFO vessels in the vicinity of the Project Area during the four to six day geohazard survey activities. Scheduling will be coordinated with DFO, as required, to avoid or minimize disruption to existing DFO research activities or stock assessments being carried out in the Old Harry Prospect area.

Geohazard surveys are conducted under the marine safety regulations of Transport Canada. The bridge crew maintains close surveillance of approaching vessels. Radar reflectors are attached to the streamers for detection by other vessels. Interactions with marine traffic will be minimized using the strong communication based mitigation measures as described above for Commercial Fisheries (6.5.3). Additionally, a Notice to Shipping will be issued at least ten days prior to the commencement of any survey work and again upon completion of the work to alert vessel operators in the area. This Notice to Shipping will be provided to the Canadian Coast Guard's Marine Communications and Traffic Services (MCTS) center.

6.6.4 Residual Environmental Effects Significance Criteria

Commercial Fisheries

For fisheries, residual environmental effects significance criteria are defined as follows: a significant adverse effect is one where the Project results in an unmitigated net loss of Commercial Fisheries. A non-significant adverse effect is defined as one where the Project does not result in an unmitigated net loss of Commercial Fisheries.

A positive effect is defined as one that results in a measurable increase in fisher income.

Other Users

A significant effect is one that has a detrimental effect on the use of the Cabot Strait by marine traffic for a duration of time sufficient to affect a long-term change in the long established traffic patterns.

A positive effect is defined as one that enhances marine traffic activities.

6.6.5 Environmental Effects Assessment

The assessment of potential environmental effects on commercial fisheries and other users will be focused on key project components, including the seismic activity associated with a geohazard survey, vessel traffic, the presence of a geohazard survey vessel, routine marine discharges and vessel lights. As with previous VEC effects assessments in this report, a key project-specific consideration is the timeline of the proposed Project activities (*i.e.,* four to six days). The individual project activities are addressed below and a summary of potential effects is summarized in Table 6.11.

Goehazard Survey and Associated Seismic Activity

Commercial Fisheries

The environmental effects of a Project survey's operations on commercial fisheries are presented in Table 6.11. According to LGL (2005b), the Western Newfoundland Offshore Area undergoes such intensive fishing pressure that the environmental effects of trawling on benthos and fish and the effects of longlines and gillnets on fish populations greatly exceed any potential effects from oil exploration activities. However, they do concede that the effects of exploration activities will add some negligible, but not measureable, additional stress on fish and fisheries (LGL 2005b).

Considering the Project Area (*i.e.*, no commercial fishing grounds in the vicinity), existing effects of commercial fishing activities, the small footprint of a Project survey area, the short duration, and the subsequently limited potential to interact with fisheries activities, the effects on commercial fisheries of the Project are predicted to be minimal and not significant.

Other Users

Based on the known marine traffic routes and the proposed mitigation, the effects of geohazard and associated seismic activities on marine traffic will be not significant.

Vessel Traffic, Presence of Vessel, and Vessel Lights

As detailed above, schooling fish are not anticipated to show avoidance behaviour when they are not in the direct path of the approaching vessel (Davis *et al.* 1998), although observed responses are variable under a wide range of conditions. Fish catch has the potential to change in response to geohazard survey vessel traffic and vessel presence. The short duration of the survey activities and strong communication with commercial fishers concerning project scheduling and location will minimize effects (see Table 6.8). Vessel lights are not anticipated to interact with commercial fishing activities.

Communication with other users (*i.e.,* DFO and other marine traffic vessels) in the Project Area prior to the commencement of Project activities and during the operation of a geohazard survey vessel will minimize effects on these users. Therefore, the overall effect of Project activities on other users is considered not significant.

Routine Marine Discharges

Routine discharges from a geohazard survey vessel can include domestic waste and ballast water (bilge water is not permitted to be discharged). All domestic waste will be transported to shore and all routine discharges will meet the *Pollution Prevention Regulations* of the *Canada Shipping Act*. As such, the effect to commercial fisheries is considered not significant.

The transport of domestic waste to shore is not expected to affect existing marine traffic. As such, there is no effect of routine marine discharges on other users.

Table 6.11 Potential Environmental Effects Assessment Summary – Commercial Fisheries and other Users

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Planned Activities								
Geohazard Survey and associated Seismic Activity	• Change in fish catch (A); • Interference with marine traffic (A)	• Coordination and communication with fishing industry and DFO; • Use of an Environmental Observer; • Notice to Mariners • Awareness of shipping lanes; • Notice to Shipping	1	2	1	1	R	1
Vessel Traffic	• Change in fish catch (A); • Interference with marine traffic (A)	• Coordination and communication with fishing industry and DFO; • Use of an Environmental Observer; • Notice to Mariners; • Awareness of shipping lanes; • Notice to Shipping	2	1	1	1	R	1
Presence of Vessel	• Change in fish catch (A); • Interference with marine traffic (A)	• Coordination and communication with fishing industry and DFO; • Use of an Environmental Observer; • Notice to Mariners; • Awareness of shipping lanes; • Notice to Shipping	1	1	1	1	R	1
Routine Marine Discharges	• Change in fish catch (A); • Nutrient enrichment, contamination (A)	• Transport of solid waste to shore; • Adherence to the *Pollution Prevention Regulations*	0	1	1	1	R	1
Vessel Lights	• n/a							

Table 6.11 Potential Environmental Effects Assessment Summary – Commercial Fisheries and other Users

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

7.0 Accidental Events

There are two possible sources of accidental spills associated with the project. The spilling of fuel oil or lube used in the ships operation (diesel) and the spill of the flotation fluid (Isopar), a dearomatized diesel contained within the seismic streamers that will be used as part of a geohazard survey. Equipment inspections and communication with other vessels will minimize the chance and/or amount of leakage from the vessel or streamer.

Marine Birds

Depending on the timing, location, and environmental conditions of such an event, there could be oiling of marine birds. However, the likelihood of such an event is extremely low and 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. Storage and containment of lube oil minimizes volumes lost during a rupture. Therefore, the quantities lost are minimal. Floatation fluid may be lost from the streamer if the streamer becomes damaged. The fluid will most likely be a synthetic isoparaffinic hydrocarbon that has a low order of toxicity (LGL 2005b). The potential for damage to streamers will be minimized by equipment inspections and communication with other vessels. If such a fluid formed a surface slick, it could affect seabirds. The maximum amount of fluid that could be lost however is approximately 180 L if one section of the streamer were completely breached. This fluid would evaporate and disperse relatively quickly. Effects of an oil spill resulting from an accidental release associated with this Project are, therefore, expected to be minimal and not significant on marine birds.

Marine Fish, Shellfish and Habitat

Fish and shellfish also have the potential to interact with material discharged during a spill event. Spilled substances can adhere to physical habitat structures or influence chemical habitat parameters (*e.g.,* water quality). All fish and shellfish past the egg and larval stage will likely actively avoid a hydrocarbon spill by swimming away (Irwin *et al.* 1997). A hydrocarbon spill can affect local abundance and availability of phytoplankton and zooplankton to fish, but fish are not expected to remain within the area affected by the spill. If fish eat contaminated zooplankton, they will accumulate hydrocarbons themselves. However, fish are also able to metabolize hydrocarbons and there is no potential for biomagnification (LGL 2005a). Effects of an oil spill resulting from an accidental release associated with this Project are therefore expected to be minimal and not significant on juvenile and adult fish.

Eggs and larvae are more subject to harmful physiological effects from a fuel spill because they cannot actively avoid the spill and they have not developed any detoxification mechanisms. Recruitment to a population would not be affected unless more than 50 percent of the larvae in a large portion of the spawning area were lost (Rice 1985). When the survival of herring larvae was reduced by 58 percent as a result of the *Exxon Valdez* spill, no effect was detected at the population level (Hose *et al.* 1996). Thus, the effect of a localized spill on egg and larval survival would likely be undetectable from the high rate of natural mortality. Effects of accidental spills are therefore expected to be minimal and not significant on fish eggs and larvae. Additionally, the likelihood of an accidental spill is considered very low given modern technologies, appropriate maintenance of equipment and vessels, and heightened awareness of spill prevention.

Marine Mammals and Sea Turtles

An accidental fuel spill could release product (diesel) from a geohazard survey vessel. There have been no measurable long-term and lethal effects from external exposure, ingestion or bioaccumulation of oil demonstrated in whales (LGL 2005b). Whales can detect oil in the water but still may swim through it, resulting in direct exposure that could include eye irritation and ingestion while feeding or breathing within the slick. Baleen could be oiled, resulting in reduced filtering efficiency, but the effects are minimal and quickly reversible (LGL 2005b). Whales and seals are also able to metabolize most of any ingested oil and will recuperate quickly if exposure is not prolonged. Sea turtles appear to be more sensitive to the effects of an oil spill than seals or whales. However, it is not known whether sea turtles can detect an oil spill. Limited observations indicate they do not avoid spills (LGL 2005b) and exposure to oil has caused reduced lung diffusion capacity, decreased oxygen consumption, temporary lesions, damaged nasal and eyelid tissue and decreased digestion efficiency (LGL 2005b).

Each survey will be conducted with a dedicated geohazard survey vessel having equipment, systems, and protocols in place for prevention of pollution in accordance with international standards and certification authorities. Storage and containment of lube oil minimizes volumes lost during a rupture. Therefore, the quantities lost are minimal.

Although it is unlikely, floatation fluid may be lost from the streamer if the streamer becomes damaged. If the fluid formed a surface slick, it could affect marine mammals and sea turtles. However, the fluid would evaporate and disperse relatively quickly. Any fluid losses will be reported to the C-NLOPB and NEB as appropriate, and the Canadian Coast Guard. Marine mammals and sea turtles would likely avoid any slick that might form. Thus an accidental event, including the loss of fuel, is expected to have no significant adverse environmental effect on marine mammals and sea turtles.

Commercial Fisheries and other Users

An accidental spill of diesel fuel or lube oil from a survey vessel could potentially affect Commercial Fisheries and other Users. Accidental spills could result in fishing gear fouling and potential loss of income through reduced catch value or suspended fishing. However, the likelihood of such an event is extremely low and 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. As well as described in Section 6.6.1 there is likely no commercial fishing occurring within the Project Area. The loss of fuel during an accidental event is not expected to have an effect on other users. Therefore the residual adverse environmental effect of an accidental event on Commercial Fisheries is rated not significant.

Summary

The potential environmental effects associated with an accidental event on marine birds, marine fish and shellfish, marine mammals and sea turtles and commercial fisheries are summarized below in Table 7.1.

The potential effects related to an accidental event on a species at risk would be the same as the effects to any other species of marine birds, marine fish and shellfish and marine mammals and sea turtles.

Table 7.1 Potential Environmental Effects Assessment Summary – Accidental Events

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Accidental Event – Loss of Product from a Fuel Spill or Streamer Rupture								
Marine Birds	• Oiling of birds (A) • Mortality (A)	• Spill Response Plan • Equipment inspections • Surveys conducted in good weather conditions • Storage of lube oil • Adherence to pollution prevention protocols	1	2	1	1	R	1
Marine Fish and Shellfish	• Oiling (A) • Avoidance of Habitat (A)	• Spill Response Plan • Equipment inspections • Surveys conducted in good weather conditions • Storage of lube oil • Adherence to pollution prevention protocols	1	2	1	1	R	1
Marine Mammals and Sea Turtles	• Oiling (A) • Avoidance of Habitat (A)	• Spill Response Plan • Equipment inspections • Surveys conducted in good weather conditions • Storage of lube oil • Adherence to pollution prevention protocols	1	2	1	1	R	1
Sensitive Areas	• n/a							

Table 7.1 Potential Environmental Effects Assessment Summary – Accidental Events

Project Components/ Activities	Potential Interactions/ Environmental Effects (P or A)	Mitigation	Potential Environmental Effects Summary					
			Magnitude	Geographic Extent	Frequency	Duration	Reversibility	Ecological and Socio-Economic Context
Commercial Fisheries	• Reduced fish catch • Suspended fishing	• Spill Response Plan • Equipment inspections • Surveys conducted in good weather conditions • Storage of lube oil • Adherence to pollution prevention protocols	1	2	1	1	R	1

KEY:

Magnitude Context
0 = Negligible adversely (essentially no effect)
1 = Low effects
2 = Medium effects
3 = High

Frequency
1 = <11 events/yr
2 = 11-50 events/yr
3 = 51-100 events/yr
4 = 101-200events/yr
5 = >200 events/yr
6 = continuous

Reversibility
R = Reversible
I = Irreversible
(Refers to population)

Ecological and Socio-economic
1 = Relatively pristine area not affected by human activity
2 = Evidence of existing adverse
3 = High level of existing adverse

Geographic Extent
1 = <1 km radius
2 = 1-10 km radius
3 = 11-100 km radius
4 = 101-1,000 km radius
5 = 1,001-10,000 km radius
6 = >10,000 km radius

Duration
1 = <1 month
2 = 1-12 months
3 = 13-36 months
4 = 37-72 months
5 = >72 months

n/a = Not applicable

8.0 Cumulative Environmental Effects Assessment

There is little potential for environmental effects resulting from the proposed geohazard surveys to overlap with other existing programs either temporally (four to six days for each survey) or spatially (average site survey area of about 22.5 km² within the proposed Project Area boundaries). Potential cumulative environmental effects external to the Project include marine transportation, commercial fishing, oil and gas exploration including seismic activity and research surveys. During each geohazard survey, it is expected that some commercial traffic will be passing in the vicinity of the Project Area. As well, commercial fishing vessels may be operating in the vicinity of the Project Area.

A summary of the potential cumulative environmental effects on marine birds, marine fish and shellfish, marine mammals and sea turtles and commercial fisheries and other users is described below. The potential cumulative environmental effects on species at risk would be the same as those for any other species discussed. Note that no legally defined sensitive areas overlap with the Project Area.

Marine Birds

Other geohazard surveys, seismic programs, oil and gas exploration, commercial fishing, research surveys and commercial shipping may result in cumulative effects on seabirds. Seabirds may also be affected by projects and activities that occur outside the Project Area, but within their migratory ranges. As well, changes in prey and predator populations may affect marine bird populations.

Vessel traffic may affect marine birds through vessel lighting, oily discharges, and noise. Chronic routine discharges, such as deck drainage and ballast and accidental releases of hydrocarbons, can expose birds to oil. Chronic releases may be equally or more important to long-term population dynamics of seabirds. However, all routine survey vessel discharges will adhere to MARPOL 73/78.

The incremental amount of vessel traffic as a result of this Project will be negligible compared to existing vessel traffic in the area. Furthermore, the Project is predicted to have minor to negligible effects on marine birds therefore, the cumulative environmental effects of Project activities on Marine Birds within the Project Area are predicted to be not significant.

Marine Fish, Shell Fish and Habitat

During the geohazard surveys, it is expected that some commercial traffic will be passing in the vicinity of the Project Area. As well, commercial fishing vessels may be operating in the vicinity. There are no ongoing exploration activities anticipated within the immediate vicinity of the Project Area.

No cumulative effect is expected with noise and traffic external to the Project, given the restricted access of non-project vessels near a geohazard survey vessel. The incremental amount of vessel traffic as a result of this Project will be negligible compared to existing vessel traffic in the area. Cumulative effects resulting from any of the Project activities will not be additive or cumulative because the Project activities are transitory. Therefore, the cumulative environmental effects of the Project in combination with other projects and activities on Marine Fish and Shellfish are rated not significant.

Marine Mammals and Sea Turtles

There is little potential for environmental effects resulting from the proposed geohazard surveys within the Project Area to overlap with other existing activities in the area either temporally (four to six days) or spatially (average geohazard survey area will be about 22.5 km^2). The proposed Project will include mitigation measures such as airgun ramp-up (and, if necessary, shut down) and an Environmental Observer capable of liaising with the fishing industry, which should result in no significant cumulative environmental effects to Marine Mammals and Sea Turtles.

Commercial Fisheries

Cumulative effects on commercial fisheries are related to the space-use conflicts and noise associated with other users of the offshore resources. Geohazard survey vessel activity is a minor component of total marine transportation in the vicinity of the Project Area. The additional vessel activity from the survey is negligible compared to the existing vessels in the area. As well as discussed in Section 6.6.1, no commercial fishing efforts have overlapped with the Project Area during the years assessed (2004 – 2008).

In general, because the sounds generated by geohazard surveys are intermittent and non-stationary, the most likely cumulative effects will be associated with other concurrent activities (*e.g.,* cargo ships, tankers, oil and gas exploration, other geohazard surveys, seismic surveys, fishing vessels). Studies in the Gulf of Mexico showed that seismic surveys produce a relatively minor contribution to the overall underwater noise environment (MMS 2004). The cumulative effect is short term, intermittent and localized, and therefore, not significant to the success of commercial fisheries.

In the unlikely event of another geohazard survey being conducted within the proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and interference. This will reduce or eliminate the likelihood that the sound levels from two surveys will be additive in a particular area, and reduce the potential for cumulative effects on fishing activities.

In general, a geohazard survey vessel activity and noise will constitute a minor incremental contribution to the overall noise generated by other such sources and space-user conflict, and will be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed Project is not expected to result in or contribute to any significant cumulative effects on commercial fisheries.

9.0 Residual Adverse Environmental Effects Summary

Short-term residual adverse environmental effects could result from the Project. However, such disturbances are likely to be transitory and normal behaviour usually resumes after vessel passage. Given the short duration and limited geographic extent of a typical geohazard survey proposed to occur within the Project Area and with the application of mitigation measures, the residual environmental effects of the Project, including cumulative environmental effects, is predicted to be not significant.

A summary of the residual adverse environmental effects for Marine Birds, Marine Fish, Shellfish and Habitat, Marine Mammals and Sea Turtles and Commercial Fisheries and other Users is presented in Table 9.1. Residual adverse environmental effects summaries for Species at Risk would be the same as any other species assessed under their respective VEC. Note that there are no legally defined sensitive areas that overlap with the Project Area.

Table 9.1 Residual Adverse Environmental Effects

VEC		Project Activities					Accidental Event
		Geohazard Survey and associated Seismic Activity	Vessel Traffic	Presence of Vessel	Routine Discharges	Vessel Lights	Loss of Product from Fuel Spill/Streamers
Marine Birds	Significance	NS	NS	NS	NS	NS	NS
	Level Of Confidence	2	2	2	2	2	3
	Likelihood	n/a	n/a	n/a	n/a	n/a	n/a
Marine Fish and Shellfish	Significance	NS	NS	NS	NS	NS	NS
	Level Of Confidence	2	3	3	3	3	3
	Likelihood	n/a	n/a	n/a	n/a	n/a	n/a
Marine Mammals and Sea Turtles	Significance	NS	NS	NS	NS	NS	NS
	Level Of Confidence	2	3	3	3	n/a	3
	Likelihood	n/a	n/a	n/a	n/a	n/a	n/a
Commercial Fisheries and other Users	Significance	NS	NS	NS	NS	NS	NS
	Level Of Confidence	2	2	2	3	3	3
	Likelihood	n/a	n/a	n/a	n/a	n/a	n/a

Key:
S (Significant Adverse Effect); NS (Not Significant Adverse Effect); P (Positive Effect).
Level of Confidence: 1 (Low); 2 (Medium); 3 (High).
Likelihood: 1 (Low Probability); 2 (Medium Probability); 3 (High Probability).

* Likelihood defined only for effects that are evaluated as significant (CEA Agency 1994).
n/a = Not Applicable.

10.0 Follow-up and Monitoring

Follow-up, as defined by *CEAA*, is not required for this Project.

Corridor will have an Environmental Observer capable of liaising with the fishing industry on board during each geohazard survey program to monitor interactions with fishing vessels and serve as a liaison between the survey vessel and fishing operations. The observer will also report any dead birds on board the vessel. As well, routine checks will be done for stranded birds that may have been attracted to vessel lighting. Handling procedures for the Leach's Storm-Petrel in particular, will follow the general information and handling instructions as described in Appendix B. The Environmental Observer will record sightings of marine mammals on a daily basis throughout each geohazard survey, weather permitting. Marine mammal and sea turtle monitoring and observation protocols will be consistent with the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2008). A pelagic seabird monitoring program will be implemented according to the protocols developed by the Canadian Wildlife Service (CWS).

Environmental mitigation measures, as per Appendix II of the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2008) as well as those listed in the SOCP will be applied to each geohazard survey.

Any fluid losses will be reported to the C-NLOPB and the Canadian Coast Guard and any seabird mortalities will be recorded by the on-board observer.

11.0 Effects of the Environment on the Project

The effects of the environment on a geohazard program have been considered during the planning and environmental assessment stages of program development. Successful geohazard programs have been executed in offshore Newfoundland waters for more than two decades. The potential effects of the environment on the program include:

- Meteorology and oceanography (extreme conditions may affect schedule and program operations); and
- Sea ice and icebergs (surveys will not be conducted in areas with hazardous ice conditions and will be conducted during open water periods).

Wind and wave conditions result in most environmental constraints on geohazard surveys. Geohazard surveys are usually suspended once wind and wave conditions reach certain levels as the potential for streamer damage increases and ambient noise increase can affect the data.

Sea ice should have no effect on the Project given the Project time frame (during open waters). There is a potential that spring / early summer icebergs may cause some survey delays if survey lines have to be altered to avoid them.

Mitigation measures applied to potential effects of the environment on the Project include the following:

- Monitoring government and industry 24-hour forecasts to plan deployment / retrieval of the streamers;
- If sudden bad weather impedes the retrieval of the gear, the streamers will be lowered into the water column (and the vessel will continue towing), until the weather permits gear retrieval; and
- Surveys will not be conducted in areas with hazardous ice conditions.

Effects of the biological environment on the Project are, therefore, unlikely.

12.0 Environmental Management

Corridor will act as the Program Operator for the initial fall 2010 geohazard survey and for any additional surveys carried out over the next ten years. The vessel contractor is unknown at this time. However, Corridor's policies and procedures would apply as well as those of the geohazard survey vessel contractor once awarded. Such polices would likely include:

- Fisheries liaison/interaction policies and procedures, including:
  - Routine advisories, where appropriate, of vessel movement and survey path;
  - Continued participation with One Ocean; and
  - Use of an environmental observer capable of liaising with the fishing industry during the surveys.
- Corridor's policies and procedures including:
  - Corridor Resources HSE and ERP Bridging Document for Geohazard Survey Program. This document is in preparation and it will serve to link Corridor's existing Corporate Health and Safety Manual, their Corporate Environment Management Manual and their Corporate Emergency Response Manual for onshore activities to the offshore environment as well as with systems in place by the successful vessel contractor (*i.e.,* Vessel Safety and Emergency Response Plans).

Corridor is committed to conducting all project activities in an environmentally responsible manner and promoting employee, contractor and public awareness of environmental issues. Corridor has and will continue to integrate environmental considerations into early decision making in order to identify and wherever practical, mitigate potentially negative consequences of their proposed activities. Corridor intends to implement, wherever practical, progressive industry standards, codes and practices, and government policies and guidelines for environmental protection in assessing, planning, constructing and operating all proposed projects as well as preventing and minimizing waste and emissions through throughout the life cycle of their Project.

13.0 Summary and Conclusion

This Screening presents information on the geohazard surveys, as proposed by Corridor Resources, and the results of the Environmental Assessment. The proposed program would be conducted offshore over the Old Harry Prospect in the Gulf of St. Lawrence in Newfoundland waters. The VECs selected for this assessment were:

- Marine Birds;
- Marine Fish, Shellfish, and Habitat;
- Marine Mammals and Sea Turtles;
- Species at Risk;
- Sensitive Areas; and
- Commercial Fisheries and other Users.

The results of the Environmental Assessment are that no significant adverse environmental effects, including cumulative effects, will occur as a result of the Project.

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15.0 Appendices

APPENDIX A	Corridor Resources Inc. Old Harry Prospect Geohazard Program 2010 - 2020 Scoping Document
APPENDIX B	Leach's Storm-Petrel: General Information and Handling Instructions
APPENDIX C	Consultation

APPENDIX A
Corridor Resources Inc. Old Harry Prospect Geohazard Program 2010 - 2020 Scoping Document

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

April 22, 2010

Mr. Paul Durling
Chief Geophysicist
Corridor Resources Inc.
Suite 301, 5475 Spring Garden Road
Halifax, NS B3J 3T2A1C 1B6

Dear Mr. Durling:

Re: Corridor Resources Inc.
Old Harry Prospect 2010 – 2020 Geohazard Program
CEA Act Environmental Assessment

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) has reviewed the information provided by Corridor Resources Inc. (Corridor Resources) on April 19, 2010 describing the proposed expansion to the spatial and temporal scope of the geohazard program.

The "*Proposed Geo-Hazard Survey over a part of the Old Harry Prospect in the Gulf of St. Lawrence*" (January 2010) project description had been previously submitted to the C-NLOPB in February 2010. At this time it was determined that, in accordance with the *Canadian Environmental Assessment Act* (CEAA), a screening level of environmental assessment was required for the proposed geohazard program.

The basis for the addendum was to modify/expand the Project Activity Area and increase the temporal scope of the program up to 2020. With this new information, the C-NLOPB has revised the March 2, 2010 Scoping Document to include the new information. The April 22, 2010 Revised Scoping Document is attached for your information and use in preparation of the environmental assessment report. Please note, as stated on page 1 of the Scoping Document,

> ***The C-NLOPB and NEB have determined that the environmental assessment report and any supporting documents to be submitted by Corridor Resources Inc, will fulfill the requirements of a Screening. The C-NLOPB and NEB, therefore, pursuant to Section 17 (1) of the CEA Act, formally delegates the responsibility for preparation of an acceptable Screening environmental assessment to Corridor Resources Inc., the project proponent. The C-NLOPB and NEB will prepare the Screening Report, which will include the determination of significance.***

If you have any questions regarding the environmental assessment process or wish to discuss the Scope of the Project, I may be reached at 709-778-1431 or via email at dhicks@cnlopb.nl.ca.

Yours truly,

Original signed by Darren Hicks

Darren Hicks
Environmental Analyst

Enclosure

cc D. Burley
E. Young

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

Corridor Resources Inc.
Old Harry Prospect Geohazard Program
2010 - 2020

Revised Scoping Document

Prepared by:
Canada-Newfoundland and Labrador Offshore Petroleum Board
Environmental Affairs Department
St. John's, NL

1 Purpose

This document provides scoping information for the Environmental Assessment (EA) of the proposed geohazard survey program, offshore Newfoundland in the Old Harry prospect in the Gulf of St. Lawrence and all other related activities (the Project). Corridor Resources Inc. (Corridor Resources) is proposing to undertake up to nine wellsite geohazard surveys and sediment sampling over the Old Harry Prospect from 2010 to 2020. The objectives of the geo-hazard program are to: identify shallow geological hazards (i.e. Slump scars, channels, faulting, shallow gas accumulations, gas hydrates and shallow trap closure); acquire detailed bathymetry; identify surficial geology, boulder till, channel fill, slumping, faulting, gas-charged shallow sediments; determine the nature and characteristics of the seafloor sediments; identify iceberg scours, morphology of seabed depositional units, seafloor obstructions, and bedforms indicative of seafloor sediment dynamics; and locate and identify seafloor installations, wrecks and cables

A Project Description was submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) on February 10, 2010 and a Scoping Document was developed by the C-NLOPB on March 2, 2010. Since this time, Corridor Resources has provided the C-NLOPB with information on a proposed expansion of the Project Area and temporal scope. This Scoping Document reflects those changes. The expanded Project Area will comprise the northern portion of Exploration Licence (EL) 1105 and a portion immediately adjacent to, and to the west of EL 1105. The expanded Project Area will accommodate vessel turning while acquiring geohazard surveys. The temporal scope has been expanded for geohazard surveys to be conducted from 2010 through to 2020.

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

This document has been developed by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and the National Energy Board (NEB) in consultation with federal and provincial fisheries and environmental departments[1].

2 CEA Act: Regulatory Considerations

The Project will require authorizations pursuant to Section 138 (1)(b) of the *Canada-Newfoundland Atlantic Accord Implementation Act* and Section 134(1)(a) of the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (Accord Acts) and paragraph 5(1)(b) of the *Canada Oil and Gas Operations Act.*

The C-NLOPB and the NEB have determined, in accordance with paragraph 3 (1)(a) of the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (FCR), that an EA of the project under section 5 of the *Canadian Environmental Assessment Act* (CEA Act) is required.

[1] Appendix 1 contains a list of the departments and agencies consulted during the preparation of the document.

Pursuant to Section 12.2 (2) of the CEA Act, the C-NLOPB will be assuming the role of the Federal Environmental Assessment Coordinator (FEAC) for this screening and in this role will be responsible for coordinating, in consultation with the NEB, the review activities by the expert government departments and agencies that participate in the review.

> ***The C-NLOPB and NEB have determined that the environmental assessment report and any supporting documents to be submitted by Corridor Resources Inc. will fulfill the requirements of a Screening. The C-NLOPB and NEB, therefore, pursuant to Section 17 (1) of the CEA Act, formally delegates the responsibility for preparation of an acceptable Screening environmental assessment to Corridor Resources Inc., the project proponent. The C-NLOPB and NEB will prepare the Screening Report, which will include the determination of significance.***

3 Scope of the Project

The project to be assessed consists of the following components:

3.1 Up to nine geohazard surveys will be carried out in the Old Harry Prospect area (EL 1105) located in the Gulf of St. Lawrence. and a portion immediately adjacent to, and to the west of EL 1105. This portion will accommodate vessel turning while acquiring geohazard surveys. The proposed geohazard surveys are located approximately 70 km northeast of the Magdalen Islands and 80 km west-northwest of Cape Anguille, Newfoundland. The survey area is located within a physiographic feature called the Laurentian Channel. Water depths in the area of the proposed 2010 survey are approximately 470 m. The Old Harry prospect is a large, doubly plunging anticline in the north-eastern part of the Gulf of St. Lawrence. The structure is about 30 km long and 12 km wide.

3.2 The geohazard surveys will be conducted using a standard suite of equipment typically utilized for wellsite/geohazard surveys. Approximately 160 line kilometres of shallow penetration, 2-D seismic data will be acquired during the 2010 survey. This work will require about 4 days on site survey time. The following geohazard survey equipment may be employed to investigate the proposed survey area ;: high resolution airgun seismic system, a side-scan sonar system, a sub-bottom profiler, echo-sounder, magnetometer, seabed camera system and sediment grab samples. High resolution, multi-channel seismic data will be acquired to two seconds depth, sampled at one millisecond. The data to be acquired will comprise 2D seismic reflection data, with a line spacing of 250 m and tie lines at 500 m. The acoustic source for the seismic data will comprise one or more airguns with a total operational volume of approximately 150 cubic inches. The exact airgun specifications will be provided when a contractor is selected. The receiver will be a single gun, multi-channel hydrophone streamer. Seabed images will be acquired by means of a side scan sonar or multi-beam echo sounder. A mosaic will be created based on geo-referenced data. If side scan sonar or multi-beam bathymetric systems identify potential debris, a proton magnetometer will be used. A camera system, sediment sampler and/or gravity-piston cores of the seafloor and near surface sediments will be used to corroborate the other data. High-resolution sub-bottom profiles will be acquired by means of a boomer or sparker acoustic source towed within the water column at approximately 20 to 40 m off the seabed. The depth of penetration for this system is expected to be between 40 to 100 m.

3.3 The timing of survey activities will begin in the fall of 2010. Additional geohazard surveys may be acquired during open water periods in the expanded project area up to 2020. The 2010 geohazard survey will require one trip out from port and return to port and is anticipated to take four days to complete the geo-hazard survey, dependent on weather. An additional 1 to 2 days will be required to complete seabed sampling, coring, and seabed photography.

4 Factors to be Considered

The EA shall include a consideration of the following factors in accordance with Section 16 of the CEA Act:

4.1 The purpose of the project;

4.2 The environmental effects[2] of the Project, including those due to malfunctions or accidents that may occur in connection with the Project and any change to the Project that may be caused by the environment;

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

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

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

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

4.7 The need for, and the requirements of, any follow-up programs in respect of the Project consistent with the requirements of the CEA Act and the SARA. (Refer to the Canadian Environmental Assessment Agency's 2002 "OperationalPolicy Statement" regarding Follow-up Programs[3]); and

[2] The term "environmental effects" is defined in Section 2 of the CEA Act as any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the *Species at Risk Act*, any effect of any change referred to in paragraph (*a*) on health and socio-economic conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes by aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or any change to the project that may be caused by the environment, whether any such change or effects occurs within or outside Canada.

[3] CEA Agency Guidance documents and Operational Policy Statements are available on its web site: http://www.ceaa-acee.gc.ca/012/newguidance_e.htm#6.

4.8 Report on consultations undertaken by Corridor Resources with interested other ocean users who may be affected by program activities and/or the general public respecting any of the matters described above.

5 Scope of the Factors to be Considered

Corridor Resources will prepare and submit to the C-NLOPB an EA for the above-described physical activity, and as described in the "*Proposed Geohazard Survey for the Old Harry Prospect*" (February 2010) project description and correspondence from Corridor dated April 19, 2010.

The EA will address the factors listed above; the issues identified in Section 5.2 (following), and document any issues and concerns that may be identified by the proponent through regulatory, stakeholder, and public consultation.

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

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

5.1 Boundaries

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

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

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

5.1.1 Spatial Boundaries

Project Area

The area in which geohazard survey activities is to occur, including the area of the buffer zone normally defined for line changes.

Affected Area

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

Regional Area

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

5.1.2 Temporal Boundaries

The temporal scope should describe the timing of project activities. Scheduling of project activities should consider the timing of sensitive life cycle phases of the VECs in relation to physical activities.

5.2 Summary of Potential Issues

The EA report for the proposed geohazard survey program should contain descriptions of the biological and physical environments, as identified below. Where applicable, information may be summarized from existing environmental assessment reports for The Gulf of St. Lawrence and Western Newfoundland. The EA report should provide only summary descriptions of those biological and physical parameters. However, where new information is available, (*e.g*., fisheries data) for any of the following factors, the new data and/or information should be provided. If information is not updated, justification must be provided. Where information is summarized from existing EA reports, it should be properly referenced; with specific reference to those sections of the existing EA report summarized.

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

Physical Environment

5.2.1 The EA shall provide a brief summary description of the meteorological and oceanographic characteristics, including extreme conditions, and any change to the Project that may be caused by the environment.

Marine Resources

5.2.2 Marine and/or Migratory Birds

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.3 Marine Fish and Shellfish

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.4 Marine Mammals and Sea Turtles

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.5 Species at Risk (SAR)

Provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.6 “Sensitive” Areas

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

- A description, to the extent possible, of any ‘Sensitive” Areas in the Project Area (including Ecologically and Biologically Significant Areas (EBSAs) identified within the Gulf of St. Lawrence), deemed important or essential habitat to support any of the marine resources identified;
- Environmental effects due to the project, including cumulative effects, on those “Sensitive” Areas identified; and
- Means by which adverse effects upon “Sensitive” Areas may be mitigated through design, scheduling and/or operational procedures.

Marine Use

5.2.7 Noise/Acoustic Environment

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.8 Presence of Geohazard Survey Vessel(s)

The EA shall provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

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

5.2.9 Fisheries and Other Ocean Users

Provide a summary description, where applicable, of the information presented in existing environmental reports for the Gulf of St. Lawrence and Western Newfoundland. New or updated information should be provided, where applicable, to address any changes to the following:

- A description of fishery activities (including traditional, existing and potential commercial, recreational and aboriginal/subsistence and foreign fisheries) in the Project Area;
- Consideration of underutilized species and species under moratoria that may be found in the Study Area as determined by analyses of past DFO research surveys and Industry GEAC survey data, with emphasis on those species being considered for future potential fishers, and species under moratoria;
- Traditional historical fishing activity, including abundance data for certain species in this area, prior to the severe decline of many fish species (e.g., a general overview of survey results and fishing patterns in the survey areas for the last 20 years);
- An analysis of the effects of Project operations and accidental events upon the foregoing. The analysis should include consideration of recent scientific literature

on effects of seismic activity on invertebrate species, including identified data gaps;

- Fisheries liaison/interaction policies and procedures;
- Program(s) for compensation of affected parties, including fisheries interests, for accidental damage resulting from project activities;
- Means by which adverse effects upon commercial fisheries may be mitigated through design and/or operational procedures; and
- Environmental effects due to the Project, including cumulative effects.

5.2.10 Accidental Events

- Discussion on the potential for spill events related to the use and maintenance of streamers.
- Environmental effects of any accidental events arising from streamers or accidental releases from the seismic and/or support vessels (e.g., loss of product from streamers). Cumulative effects in consideration of other oil pollution events (e.g., illegal bilge disposal) should be included.
- Mitigations to reduce or prevent such events from occurring.
- Contingency plans to be implemented in the event of an accidental release.

Environmental Management

5.2.11 The EA shall outline Corridor Resources's environmental management system and its components, including, but not limited to:

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

Biological and Follow-up Monitoring

5.2.12 Discuss the need for and requirements of a follow-up program (as defined in Section 2 of the CEA Act) and pursuant to the SARA. The discussion should also include any requirement for compensation monitoring (compensation is considered mitigation).

Details regarding the monitoring and observation procedures to be implemented regarding marine mammals, sea turtles and seabirds (observation protocols should be consistent with the C-NLOPB "*Geophysical, Geological, Environmental and Geotechnical Program Guidelines*" (May 2008)).

5.3 Significance of Adverse Environmental Effects

The Proponent shall clearly describe the criteria by which it proposes to define the "significance" of any residual adverse environmental effects that are predicted by the EA. This definition should be consistent with the November 1994 CEAA reference guide "*Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects*", and be relevant to consideration of each VEC (including components or subsets thereof) that is identified. SARA species shall be assessed independent of non-SARA species. The effects assessment methodology should clearly describe how data gaps are considered in the determination of significance of effects.

5.4 Cumulative Effects

The assessment of cumulative environmental effects should be consistent with the principles described in the February 1999 CEAA "*Cumulative Effects Assessment Practitioners Guide*" and in the March 1999 CEAA operational policy statement "*Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act*". It should include a consideration of environmental effects that are likely to result from the proposed project in combination with other projects or activities that have been or will be carried out. These include, but are not limited to, other geohazard survey activities; fishing activities, including Aboriginal fisheries; other oil and gas activities; and marine transportation. The C-NLOPB and the NEB websites list all current and active offshore petroleum activity within the NL and NEB offshore area respectively, and provide a listing of activities undergoing environmental assessment.

6 Projected Timelines for the Environmental Assessment Process

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

ACTIVITY	TARGET	RESPONSIBILITY
EA review upon receipt from Proponent	6 weeks	C-NLOPB & NEB & Regulatory Agencies
Compile comments on EA	1 week	C-NLOPB, in consultation with NEB
Submission of EA Addendum/Response to EA Comments	2 weeks	Proponent
Review of EA Addendum/Response Document	3 weeks	C-NLOPB & NEB & Regulatory Agencies
Screening Report (Determination of Significance of Project Effects)	3 weeks	C-NLOPB, NEB
Total	15 weeks	

APPENDIX 1

Departments and Agencies Consulted by C-NLOPB

Federal Authorities under the *Canadian Environmental Assessment Act*

Department of National Defence

Environment Canada

Fisheries and Oceans Canada

Health Canada

Natural Resources Canada

Transport Canada

National Energy Board

Other Departments/Agencies

Canadian Environmental Assessment Agency

Provincial Departments (Government of Newfoundland and Labrador)

Department of Environment and Conservation

Department of Fisheries and Aquaculture

Department of Natural Resources

1. Regulatory Requirements
   The proponent should be aware of the general applicability of Section 36(3) of the federal *Fisheries Act* to the proposed undertaking. Deleterious substances (e.g. lubricating fluids, fuels, etc.) cannot be deposited into water frequented by fish. Any operational drainage must not be harmful to fish.

   Migratory birds, their eggs, nests, and young are protected under the federal *Migratory Birds Convention Act* and the complementary regulations (Migratory Bird Regulations, Migratory Bird Sanctuary Regulations). Certain species are recognized to be at risk under the federal *Species at Risk Act* (SARA), provincial species at risk legislation, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or by the Atlantic Canada Conservation Data Centre. The proponents should be reminded that they are expected to comply with the *Migratory Birds Convention Act* and *Regulations* during all project phases. Migratory birds include those species listed in the Canadian Wildlife Service (CWS) Occasional Paper "Birds protected in Canada under the *Migratory Birds Convention Act*".

   The proponent should be reminded that the *Species at Risk Act* (SARA) amends the definition of "environmental effect" in subsection 2(1) of the CEAA to clarify, for greater certainty, that EAs must always consider impacts on a listed wildlife species, its critical habitat or the residences of individuals of that species.

   The proponent should also be aware of the potential applicability of the *Canadian Environmental Protection Act* (CEPA). The *Canadian Environmental Protection Act* enables protection of the environment, and human life and health, through the establishment of environmental quality objectives, guidelines and codes of practice, and the regulation of toxic substances, emissions and discharges from federal facilities, international air pollution, and ocean dumping.

2. Sensitive Areas
   Any Ecologically and Biologically Significant Area (EBSA) within the study area, as well as those adjacent to the project area, should be described in the environmental assessment, particularly in relation to existing species and their habitat.

3. Migratory Birds
   Marine birds and species at risk have been identified as valued ecosystem components (VEC's) for this project. The CWS is satisfied with the factors outlined in the scoping document to describe these VEC's in the EA.

   Additionally, the following sections should be considered in the development of the EA.

4. Species at Risk
   Any Species at Risk that may be found in the project area should be considered in the environmental assessment. Additional information on SARA, including a list of species scheduled under the Act, is available at http://www.sararegistry.gc.ca/default_e.cfm .

5. Information Sources

   The proponent should be aware of Environment Canada's Eastern Canadian Seabirds at Sea (ECSAS) program. This program has conducted over 4000 surveys covering 7800 km of ocean track in the Newfoundland and Labrador offshore area since 2006. The most up to date data for the study area should be included in the EA. This information is available by contacting Dave Fifield at David.Fifield@ec.gc.caor 709-772-3425.

   While proponents are also encouraged to employ peer-reviewed literature to support their conclusions, few studies on the interactions between birds and seismic survey activities have been conducted1, and none have been conclusive. It is important to recognize the limited applicability of available research findings in the discussion of impacts (i.e., conclusions likely do not apply to interactions with large concentrations of birds). It should also be noted that, while the Eastern Canadian Seabirds at Sea dataset contains the most recent seabird data available for the Newfoundland and Labrador offshore area, surveys have not been dedicated to determining impacts of seismic on seabirds, but rather are distribution data collection exercises.

   While an EA may conclude that the overall impact of a seismic survey on seabirds is relatively small, it remains important that the opportunity for this activity to impact federally-protected avian species be properly acknowledged in the EA. Accordingly, it is also expected that the proponent commit to all reasonable measures to mitigate the potential for such impacts to occur. These measures are outlined in the following sections.

6. Mitigation

   Mitigation measures related to adverse effects, including cumulative effects, should be identified. Measures should be consistent with the *Migratory Bird Convention Act* and SARA and with applicable management plans, recovery strategies and action plans. Mitigation should reflect a clear priority on impact avoidance opportunities. The following specific measures should be among those which are considered in preparing a mitigation strategy:

   - Should storm-petrels or other species become stranded on vessels, the proponent is expected to adhere to the protocol described in Williams and Chardine's brochure entitled, *The Leach's Storm Petrel: General Information and Handling Instructions*. This document has been previously provided to the C-NLOPB. Should an additional copy be required please contact us. A permit is required to implement the Williams and Chardine protocol. **The proponent should be advised that it is required to complete a permit application form prior to proposed activities.** This form is available from Andrew Macfarlane at the Canadian Wildlife Service, who can be reached by phone at 506-364-5033 or email at andrew.macfarlane@ec.gc.ca.

   - Ramping-up the air gun array over a 30-minute period - a procedure typically used for other animal groups - may encourage marine birds to leave the survey area and may reduce the potential for adverse interactions between the project and marine birds accordingly.

- It is expected that the proponent demonstrate how they will minimize or prevent the release of hazardous substances onboard the seismic vessel (e.g. streamer fluid, chemicals for streamer repairs, fuels, lubricants) into the marine environment. Attention should be paid to impact avoidance and pollution prevention opportunities and a contingency plan should be developed to enable a quick and effective response in the event of a spill. Other management practices and preventative maintenance plans should be outlined such as a protocol to prevent streamer-associated spill events. This protocol should describe conditions that will allow the seismic program to be conducted without spill incidents (e.g., the range of environmental conditions within which streamers can operate, monitoring to detect leaks or tears). Further details are outlined under the "Effects of Accidents and Malfunctions" section.

7. <u>Data Collection</u>
This survey provides a good opportunity to collect additional seabird data from the area. CWS has developed a pelagic seabird monitoring protocol that we are recommending for all offshore projects. This protocol is a work in progress and we would appreciate feedback from the observers using it in the field. A guide sheet to the pelagic seabirds of Atlantic Canada is available through CWS in Mount Pearl.

In an effort to expedite the process of data exchange, the Canadian Wildlife Service would appreciate that the data (as it relates to migratory birds or species at risk) collected from these surveys be forwarded in digital format to our office following completion of the study. These data will be centralized for our internal use to help ensure that the best possible natural resource management decisions are made for these species in Newfoundland and Labrador. Metadata will be retained to identify source of data and will not be used for the purpose of publication. The Canadian Wildlife Service will not copy, distribute, loan, lease, sell, or use of this data as part of a value added product or otherwise make the data available to any other party without the prior express written consent.

8. <u>Effects of Accidents and Malfunctions</u>
The mandatory assessment of environmental effects which could result from accidents and malfunctions should include a consideration of potential spill events, such as spills from damaged seismic streamers. The assessment should be guided by the need to ensure compliance with the general prohibitions against the deposit of a deleterious substance into waters frequented by fish (Section 36, *Fisheries Act*) and against the deposit of oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds (Section 35, Migratory Birds Regulations). In addition, it should be focused on potential worst–case scenarios (e.g., concentrations of marine birds, presence of wildlife at risk). Based on this analysis, the EA should describe the precautions that will be taken and the contingency measures that will be implemented to avoid or reduce the identified impacts.

In developing a contingency plan that would support the assessment of accidents and malfunctions, and a determination that impacts could be avoided or reduced, it is recommended that the Canadian Standards Association publication, *Emergency Planning* *for Industry* CAN/CSA-Z731-95 (Reaffirmed 2002), be consulted as a useful reference. All spills or leaks, including those from machinery, fuel tanks or streamers, should be promptly contained, cleaned- up and reported to the **Environmental Emergencies 24 Hour Report Line (St. John's 709-772-2083; Other areas 1-800-563-9089 of NL)**.

9. Effects of the Environment on the Project
   Seismic operations will be somewhat sensitive to environmental conditions (e.g., wind, waves, ice). The EA should focus on how such conditions acting on the project could have consequences for the environment (e.g., increased risk of spills and impacts on valued ecosystem components). Marine weather information can be found on the Meteorological Service of Canada website at www.weatheroffice.gc.ca/marine. Additional information on regional climatology can be found at www.climate.weatheroffice.ec.gc.ca, or by contacting Environment Canada directly. Also, ice information can be found on the Canadian Ice Service website at www.ice-glaces.ec.gc.ca.

10. Routine Discharges
    The *Offshore Waste Treatment Guidelines* (OWTG) require a description of "specific pollution prevention measures the operator plans to implement to reduce waste generation and discharge" (NEB *et al.*, 2002, 3). It is recommended that the following be considered to minimize routine discharges and waste:
    - means that would promote recovery, recycling and removal of materials that otherwise would go overboard, be incinerated or be taken back to shore for disposal;
    - means that would reduce greenhouse gases and other emissions to air;
    - means that would involve replacing fluids and chemicals with less toxic alternatives.

11. Notices
    Regarding works and/or activities that have the potential to impact upon navigation, the proponent is advised to contact the Navigation Protection Program (NPP) staff according to the following directions prior to project commencement.

    A "Notice to Shipping" is to be issued ten days prior to the commencement of any survey work, and again upon completion of the work to alert vessel operators in the area. Contact the Canadian Coast Guard's Marine Communications & Traffic Services (MCTS) Centre by telephone at (709) 772-5578 to arrange this. This is to be done on an annual basis.

The following information is provided for project planning and any questions should be directed at the applicable government agency.

Fisheries Act
Subsection 36(3) of the Act specifies that unless authorized by federal regulation, no person shall deposit or permit the deposit of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter any such water.

Canadian Environmental Protection Act (CEPA)

CEPA and its complementary management instruments (e.g., agreements, regulations, notices, codes of practice, guidelines, policies, plans) govern such matters as environmental quality, toxic substances, hazardous waste management and disposal at sea.

***Migratory Birds Convention Act* and associated Regulations**

Migratory birds, their eggs, nests and young are protected under the *Migratory Birds Convention Act* (MBCA) and complementary regulations. Migratory birds include those species listed in the Canadian Wildlife Service Occasional Paper No. 1 *Birds Protected in Canada under the Migratory Birds Convention Act* (1991). The Act and regulations include the following prohibitions:

- "no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird";
- "no person shall deposit or permit to be deposited oil, oily wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds".

APPENDIX B
Leach's Storm-Petrel: General Information and Handling Instructions

The Leach's Storm-petrel:
General Information and Handling Instructions

Urban Williams (Petro-Canada)
&
John Chardine (Canadian Wildlife Service)

The Grand Banks is an area that is frequented by large numbers of seabirds, representing a variety of species. Large populations are found in this area in both summer and winter, and come from the Arctic, northern Europe, and the south Atlantic, as well as from colonies along the Newfoundland Coast. One of the species found in the area of the Terra Nova Field is the Leach's Storm-Petrel (*Oceanodroma leucorhoa*).

The Bird:

Leach's Storm-Petrels are small seabirds, not much bigger than a Robin. They have relatively long wings and are excellent fliers. Leach's Storm-Petrels are dark brown in colour and show a conspicuous white patch at the base of the tail. In the hand, you can easily notice a small tube at the top of their bill, and you will also notice that the birds have a peculiar, not unpleasant smell (although some Newfoundlanders call these birds "Stink Birds"). Storm-Petrels are easy prey for gulls and other predators, and so to protect themselves from predation, Leach's Storm-Petrels are only active at night when on land at the breeding colonies.

Nesting Habitat:

Leach's Storm-Petrels are distributed widely in the northern hemisphere, however, their major centres of distribution are Alaska and Newfoundland. The bird breeds on offshore islands, often in colonies numbering tens or hundreds of thousands of pairs, even millions at one colony in Newfoundland. The nest is a chamber, sometimes lined with a some grass, located at the end of a narrow tunnel dug in the topsoil.. Depending on the colony, burrows may be under conifer or raspberry thickets or open grassland.

Reproduction:

In Newfoundland, Leach’s Storm-Petrels lay their single egg in May and June. The egg is incubated by both parents alternately, sometimes for stretches exceeding 48 hours. The egg is incubated for 41-42 days, which is a long time for such a small egg. The peak hatching period is in the last half of July. The young petrel remains in the tunnel for about 63-70 days. Once breeding is over in late-August or early September, the birds disperse from the colonies and migrate to their wintering grounds in the Atlantic. September is the most important period for migration of Storm-Petrels to the offshore areas such as near the Terra Nova field.

Populations:

Canada alone supports more than 5 million pairs of Leach's Storm-Petrels. Most of them are found in Newfoundland. The Leach’s Storm-Petrel colony located on Baccalieu Island is the largest known colony of this species.

Nesting sites for Leach’s Storm-Petrels are found along the southeast coast of Newfoundland. These are - i) Witless Bay Islands (780,00 nesting pairs), ii) Iron Island (10,000 nesting pairs), iii) Corbin Island (100,000 nesting pairs), iv) Middle Lawn Island (26,000 nesting pairs), v) Baccalieu Island (3,336,000 nesting pairs), vi) Green Island (72,000 nesting pairs), and vii) St. Pierre Grand Columbier (100,000 nesting pairs).

Feeding Habits:

Leach’s Storm-Petrels feed at the sea surface, seizing prey in flight. Prey usually consists of myctophid fish and amphipods. The chick is fed planktonic crustaceans, drops of stomach oil from the adult bird, and small fish taken far out at sea. Storm-Petrels feed far out from the colony and it would be reasonable to assume that birds nesting in eastern Newfoundland can be found feeding around the Terra Nova site.

The Problem:

As identified in the C-NOPB Decision 97-02, seabirds such as Leach’s Storm-Petrels are attracted to lights on offshore platforms and vessels. Experience has shown that Storm-Petrels may be confused by lights from ships and oil rigs, particularly on foggy nights, and will crash into lighted areas such as decks and portholes. Fortunately, this type of accident does not often result in mortality, however, once on deck the bird will sometimes seek a dark corner in which to hide, and can become fouled with oil or other contaminants on deck.

Period of Concern:

Leach's Storm-Petrels are in the Terra Nova area from about May until October and birds could be attracted to lights at any time throughout this period. The period of greatest risk of attraction to lights on vessels appears to be at the end of the breeding season when adults and newly fledged chicks are dispersing from the colonies and migrating to their offshore wintering grounds. September is the most important period for migration of storm-petrels to the offshore areas. Past experience suggests that any foggy night in September could be problematic and may result in hundreds or even thousands of birds colliding with the vessel.

The Mitigation:

On nights when storm-petrels are colliding with the vessel, the following steps should be taken to ensure that as many birds as possible are safely returned to their natural habitat.

- All decks of the vessel should be patrolled as often as is needed to ensure that birds are picked up and boxed (see below) as soon as possible after they have collided with the vessel. After collision, birds will often "freeze" below lights on deck or seek dark areas underneath machinery and the like.
- Birds should be collected by hand and gently placed in small cardboard boxes. Care should be taken not to overcrowd the birds and a maximum of 10-15 birds should be placed in each box, depending upon its size. The birds are very easy to pick up as they are poor walkers and will not fly up off the deck so long as the area is well-lit. They will make a squealing sound as they are picked up- this is of no concern and is a natural reaction to be handled (the birds probably think they have been captured to be eaten!).
- When the birds are placed in the box the cover should be put in place and the birds left to recover in a dark, cool, quiet place for about 5-10 minutes. The birds initially will be quite active in the box but will soon settle down.
- Following the recovery period, the box containing the birds should be brought to the bow of the boat or to some other area of the vessel that has minimal (if any) lighting. The cover should be opened and each bird individually removed by hand. The release is usually accomplished by letting the bird drop over the side of the vessel. There is no need to throw the bird up in the air at release time. If the birds are released at a well-lit part of the vessel they usually fly back towards the vessel and collide again.
- If any of the birds are wet when they are captured (i.e. they drop into water on the deck) then they should be placed in a cardboard box and let dry. Once the bird is dry it can be released as per the previous instruction. Also, temporarily injured birds should be left for longer to recover in the cardboard box before release.
- Any birds contaminated with oil should be kept in a separate box and not mixed with clean birds. Contact Canadian Wildlife Service at (709) 772-5585 for instructions on how to deal with contaminated birds.
- In the event that some birds are captured near dawn and are not fully recovered before daylight, they should be kept until the next night for release. Storm-Petrels should not be released in

daylight as at this time they are very vulnerable to predation by gulls. Birds should be kept in the cardboard box in a cool, quiet place for the day, and do not need to be fed.

- Someone should be given the responsibility of maintaining a tally of birds that have been captured and released, and those that were found dead on deck. These notes should be kept with other information about the conditions on the night of the incident (moonlight, fog, weather), date, time, etc). THIS IS A VERY IMPORTANT PART OF THE EXERCISE AS IT IS THE ONLY WAY WE CAN LEARN MORE ABOUT THESE EVENTS.

Handling Instructions:

- Leach's Storm-Petrels are small, gentle birds and should be handled with care at all times.
- It is recommended that the person handling the birds should wear thin rubber gloves or clean, cotton work gloves. The purpose of the gloves is to protect both the Storm-Petrel and the worker.
- As mentioned Storm-Petrel's have a strong odor that will stick to the handler's hands. Washing with soap and water will remove most of the smell.
- Handling Leach's Storm-Petrels does not pose a health hazard to the worker, however some birds may have parasites on their feathers, such as feather lice. These parasites do not present any risk to humans, however, as a precaution we recommend wearing cotton work gloves or thin rubber gloves while handling birds and washing of hands afterwards.

Wilson's Storm Petrels:

A relative of the Leach's Storm-Petrel is the Wilson's Storm-Petrel. They breed in the south Atlantic and Antarctica and migrate north in our spring to spend the summer in Newfoundland waters. This species is very numerous on the Grand Banks in the summer, and shares the same nocturnal habits as the Leach's Storm-Petrel. Thus it is possible that Wilson's Storm-Petrels may also be attracted to the lights of a vessel at night. The two species are very similar and should be handled in the same way as described above for our Leach's Storm-Petrel.

Permits:

A permit to handle storm-petrels issued by the Canadian Wildlife Service will be held on board the vessel to cover personnel involved in bird collision incidents.

Canadian Wildlife Service – Permit Application

Salvage of Live Seabirds for Release

Name e-mail address Organization Address	Tel: Fax:

Project Title

Project Description

Purpose of Project : Project Status: ☐ new ☐ ongoing Project duration (years) ___________________	
Summary Description:	
Area of Activities:	Date of Activities:
Species expected to be salvaged for release:	
Methods or protocol followed for handling and release:	

Proposed disposition of dead birds: Other Participants (nominees) -

Signature of Applicant:	Date:

Send completed form to:

e-mail address: andrew.macfarlane@ec.gc.ca

mailing address: Canadian Wildlife Service
Environment Canada
17 Waterfowl Lane
PO Box 6227
Sackville NB E4L 1G6

Phone: (506) 364-5044 / 364-5033
Fax: (506) 364-5062

- GENERAL CRITERIA -

Project Purpose: The applicant must provide a brief statement of the project's goals and objectives.

Project Summary: The applicant must provide a brief summary description of the project and why it is expected that salvage of live seabirds may be necessary.

Species to be salvaged: The applicant must indicate which species of birds are likely to need to be handled and released:

Methods: The applicant must describe in detail the methods of capturing, handling and release of the birds.

Disposition of Materials: The applicant must describe the method and location of specimen disposal, i.e., released, incinerated, buried, or included in a collection and where.

Other Participants: All participants involved must be listed.

APPENDIX C
Consultation

Old Harry Project Consultation

<u>Date/Time</u>: Thursday, 29 April 2010, 2 PM
<u>Event</u>: Fishery Consultation
<u>Location</u>: FFAW Offices, St. John's, NL
<u>Corridor Reps</u>: D. Murphy, P. Durling
<u>Consultant Reps</u>: S. Whiteway, E. Way (Stantec)
<u>Attachments</u>: PowerPoint Presentation

Attendees: 2	
• Maureen Murphy (One Ocean)	• Robyn Saunders (FFAW)

Summary of Main Issues Discussed:
• Timing of 2010 survey and future surveys
• Fisheries data
• Schedule another meeting/discussion closer to the geohazard survey (approximately one month in advance), when vessels are tendered

Notes from Workshop:

- Roundtable introductions and overview of FFAW and One Ocean (Board and Working Group)
- P.D. gave an overview presentation on Corridor and the Old Harry Project

<u>Timing</u>

- M. Murphy – what time of year/month would the surveys occur in?
    - First survey will be mid-September through October. Subsequent surveys are planned for any ice-free time of year
- R. Saunders – What is the time period covered by this EA?
    - 2010 through 2020 as recommended by the C-NLOPB
    - Could be just one survey. Before any future drill programs, would have additional surveys. Would like to continue discussions prior to future surveys and perhaps talk with local harvesters on the west coast. Any future geohazard programs would be completed after exploration drilling
    - 2010 geohazard program will include 1 day to and from the site, 4 to 5 days doing geohazard and 1 to 2 days doing sampling and seabed photography. M. Murphy acknowledged that one week is typical for a geohazard survey

<u>Mitigations</u>

- M. Murphy – One Ocean Working Group is developing a risk assessment matrix for the fishing industry and Oil & Gas industry activities. Is a tool for recommending mitigations appropriate to the different programs/surveys, including Fishery Guide Vessels, picket vessels, guard vessels, and support vessels. It is being reviewed by the One Ocean's Board of Directors and will be distributed to Industry in June 2010. Will ensure Corridor receives a cop

Commercial Fishery Data

- R. Saunders – Redfish is the main fishery in the area and is fished using mobile gear. Spoke with FFAW staff on the west coast who reported that there were 2 vessels fishing. Fall is not a bad time for a survey as the redfish fishery occurs in the spring. However, the number of fishers and species harvested can vary year-to-year. May need to go back more than 3 years with DFO data as 2009 was an 'off' year for the fishery. Species harvested depends on the market price. As an example, 2009 was a low year for cod and shrimp due to low prices
    - Confirmed that 2006, 2007, and 2008 data is mapped in the EA and provided the mapped data and discussion for 'all year'. 'Fall only' was previously provided by e-mail to One Ocean and FFAW
    - S.W. – The C-NLOPB requires updates on commercial fisheries and SAR every two years. These updates are brief but include updated maps showing fishery data from EA plus new data
- M. Murphy – 2009 data is now available

Future Meetings

- M. Murphy – please let us know the specifics of the program when you know and we can organize another meeting. Touch base when the tenders for the vessels are settled
- R. Saunders – Can get in contact approximately one month before the survey
- M. Murphy – When the program is underway, will be in touch daily

Overview of Proposed Geohazard Survey Old Harry Prospect, Gulf of St. Lawrence

Presentation to
One Ocean & Fish, Food and Allied Workers

April 29, 2010

Disclaimer

Foreward Looking Statements

This presentation contains certain forward-looking statements and forward-looking information (collectively referred to herein as "forward-looking statements"). In particular, this presentation contains forward-looking statements pertaining to the following: business plans and strategies; the 2008 capital budget; the quantity of natural gas reserves, OOIP and OGIP; production levels; expectations regarding the ability to raise capital and to continually add to reserves through exploration and development; and treatment under governmental regulatory regimes. Undue reliance should not be placed on forward-looking statements, which are inherently uncertain, are based on estimates and assumptions, and are subject to known and unknown risks and uncertainties (both general and specific) that contribute to the possibility that the future events or circumstances contemplated by the forward-looking statements will not occur. There can be no assurance that the plans, intentions or expectations upon which forward-looking statements are based will in fact be realized. Actual results will differ, and the difference may be material and adverse to Corridor and its shareholders. Forward-looking statements are based on Corridor's current beliefs as well as assumptions made by, and information currently available to, Corridor concerning anticipated financial performance, business prospects, strategies, regulatory developments, future natural gas commodity prices, future natural gas production levels, the ability to obtain equipment in a timely manner to carry out development activities, the ability to market natural gas successfully to current and new customers, the impact of increasing competition, the ability to obtain financing on acceptable terms, and the ability to add production and reserves through development and exploration activities. Although management considers these assumptions to be reasonable based on information currently available to it, they may prove to be incorrect. By their very nature, forward-looking statements involve inherent risks and uncertainties (both general and specific) and risks that forward-looking statements will not be achieved. These factors include, but are not limited to risks associated with oil and gas exploration, financial risks, substantial capital requirements, bank financing, government regulation, environmental, prices, risks may not be insurable and reserves estimates. Further information regarding these factors and additional factors may be found under the heading "Risk Factors" in Corridor's Annual Information Form for the year ended December 31, 2009. The forward-looking statements contained in this presentation are made as of the date hereof and Corridor does not undertake any obligation to update publicly or to revise any of the included forward-looking statements, except as required by applicable law. The forward-looking statements contained herein are expressly qualified by this cautionary statement.

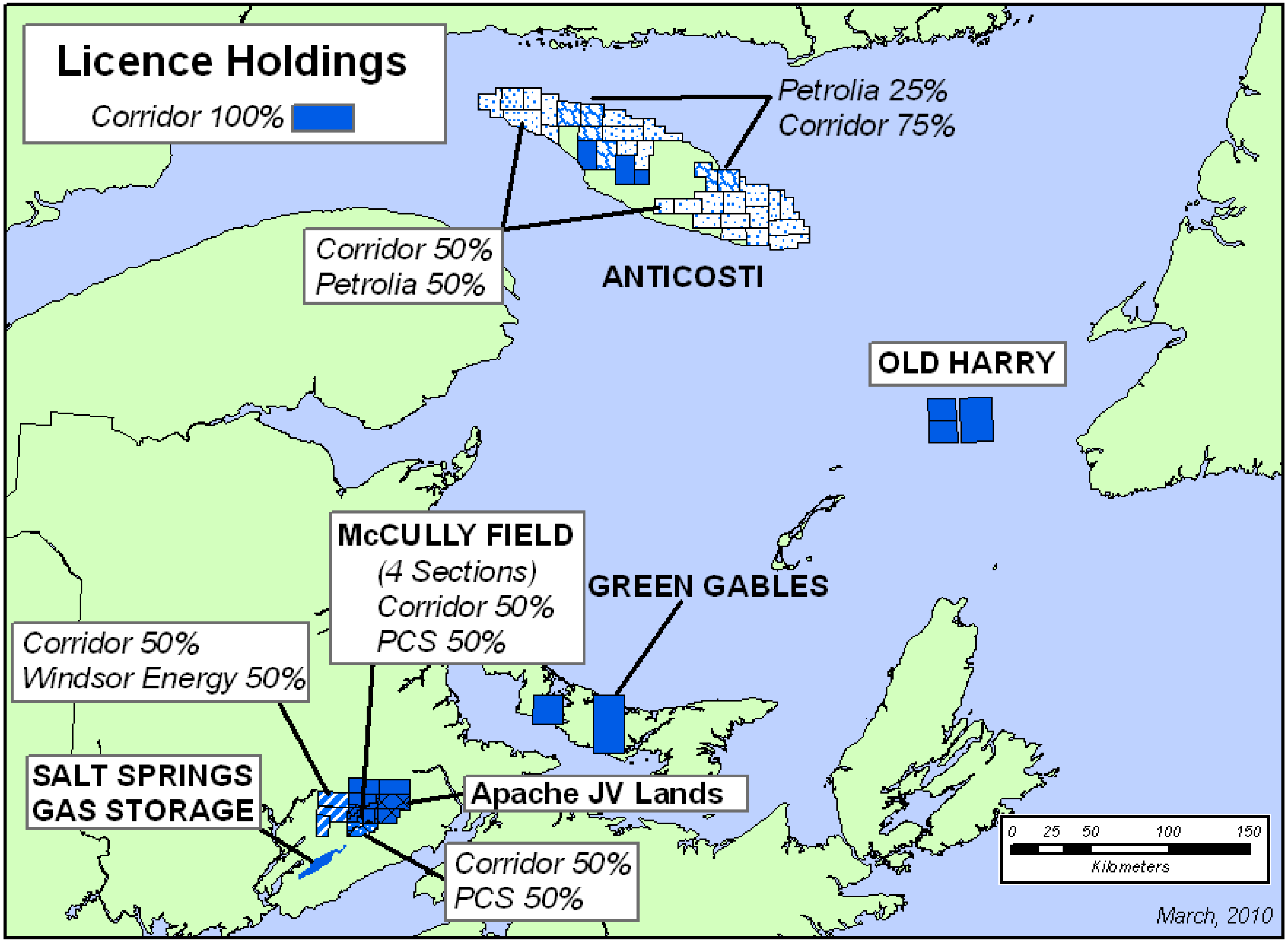
Company Overview

- Leading independent explorer and natural gas producer in Eastern Canada
- Portfolio of growth opportunities
  - Incremental step-out drilling on 12,000 acre McCully structure
  - Multi-TCF shale gas potential and oil discovery with new farm-in operating partner
  - Exploration interest in drilling the Old Harry structure offshore in the Gulf of St. Lawrence
  - Light-oil exploration opportunity on Anticosti Island
- Strong technical team with onshore and offshore experience
- Conservative capital structure (no debt)

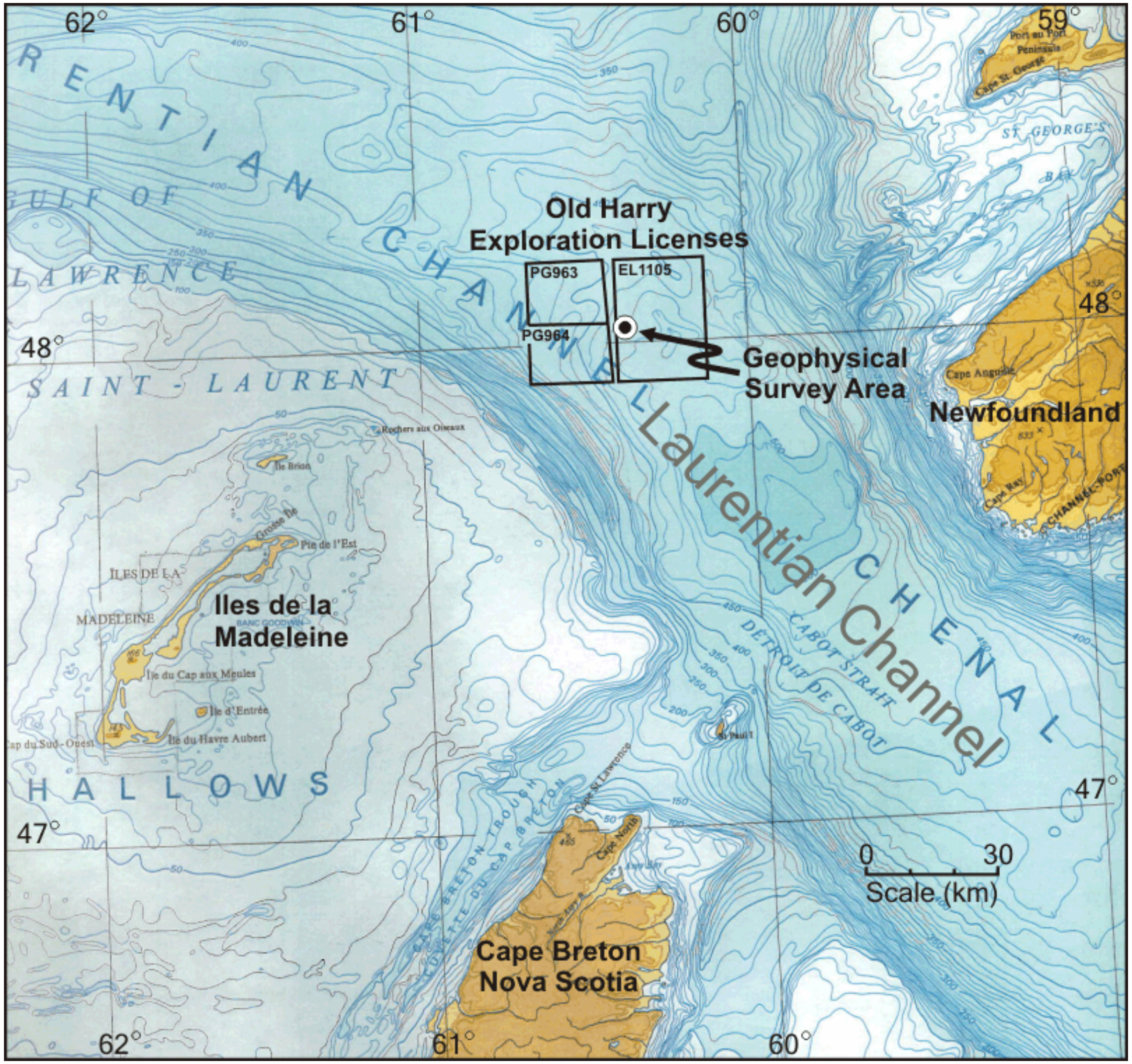
Company Overview

- Corridor owns and operates midstream facilities at its McCully Field
- 20+ kilometers of gathering pipelines transport gas to the McCully gas plant
- Current field production is approximately 20 million cubic feet per day (in service June, 2007)
- 50 kilometer transmission pipeline delivers sales gas from the gas plant to Maritimes & Northeast Pipeline

Licence Holdings

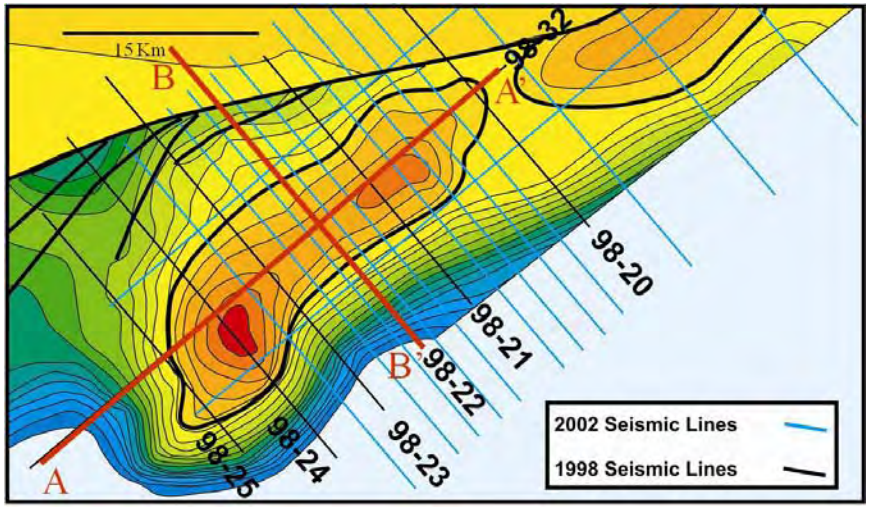


Location Map



56,000 Acre Size

corridor resources inc.



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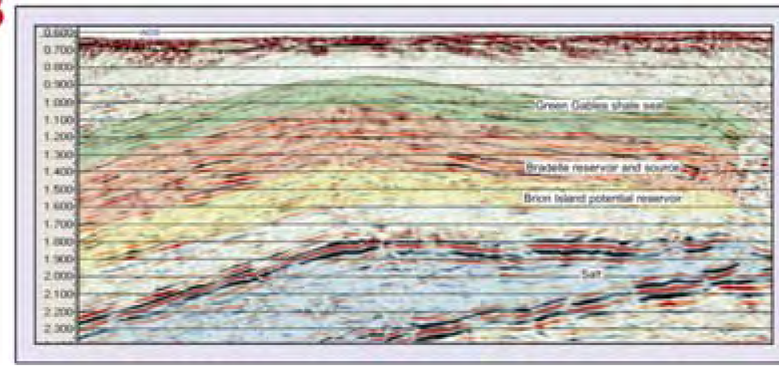

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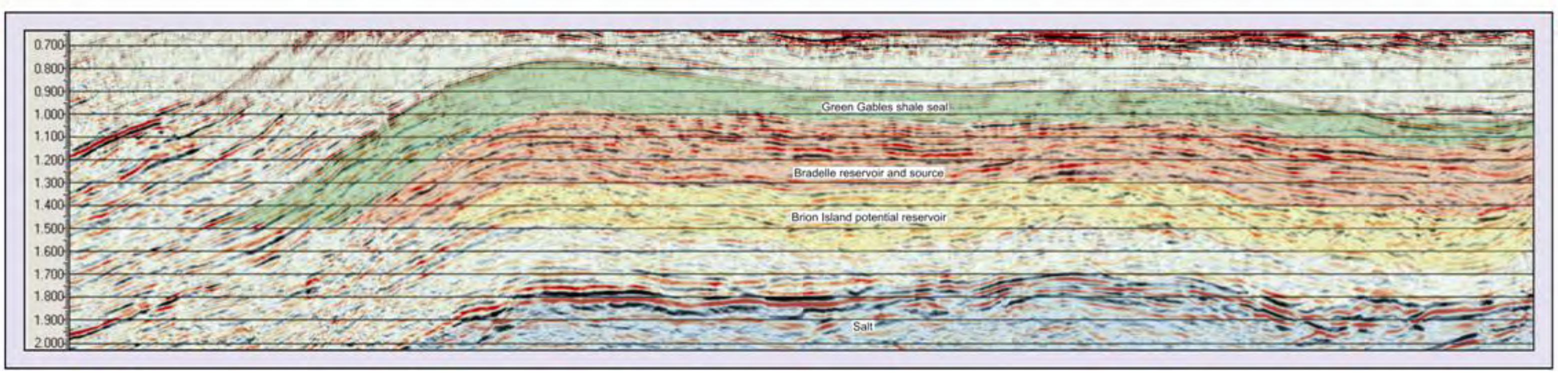
A

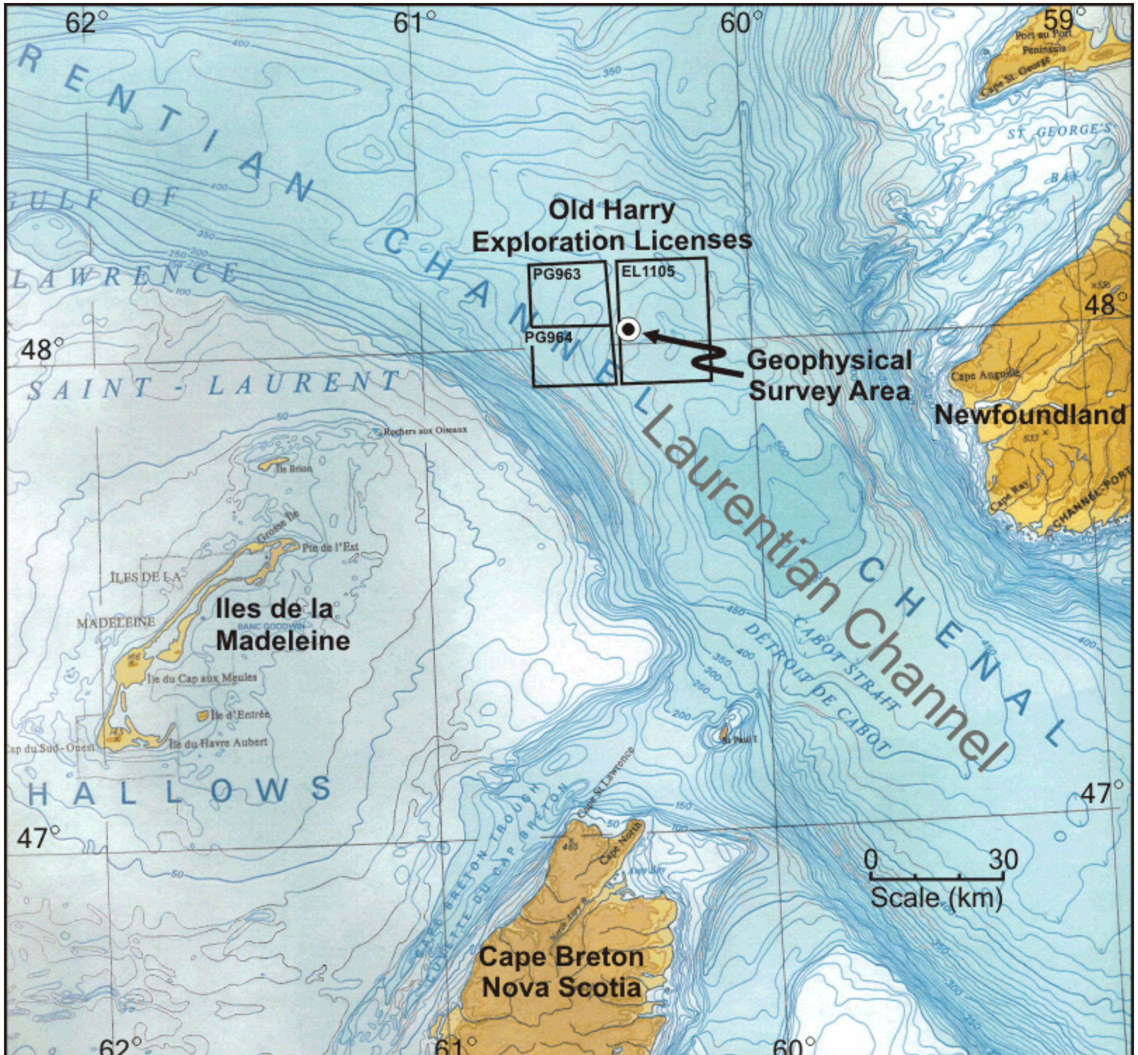


A'

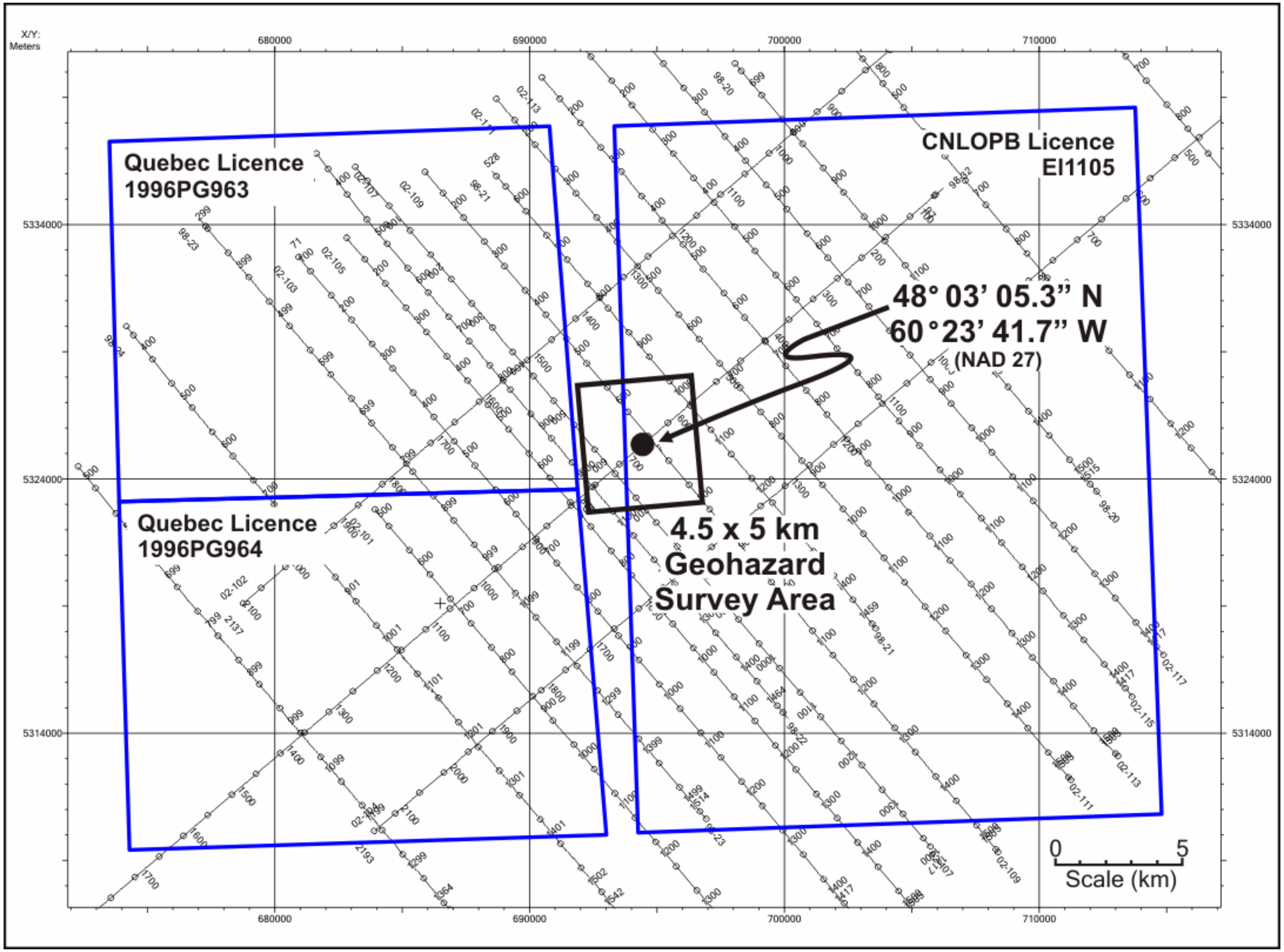
Old Harry
Executive Summary

- 56,000 acres (88 mi^2) of early, simple, four-way closure
- Thick oil-prone source rock and coal source rock with a large fetch area
- Good reservoir rock derived from the Canadian Shield
- Overlying shale seal is 1000’ thick
- Multi-TCF or billion bbl reserves potential
- Six satellite seepage slicks
- Flat spots, amplitude, frequency and AVO anomalies within the same horizon
- Thousands of mi^2 of unexplored basin with excellent source, reservoir and trap potential
- Corridor is currently soliciting partner interest in drilling an exploration well on the Newfoundland side of the prospect in 2011/2012

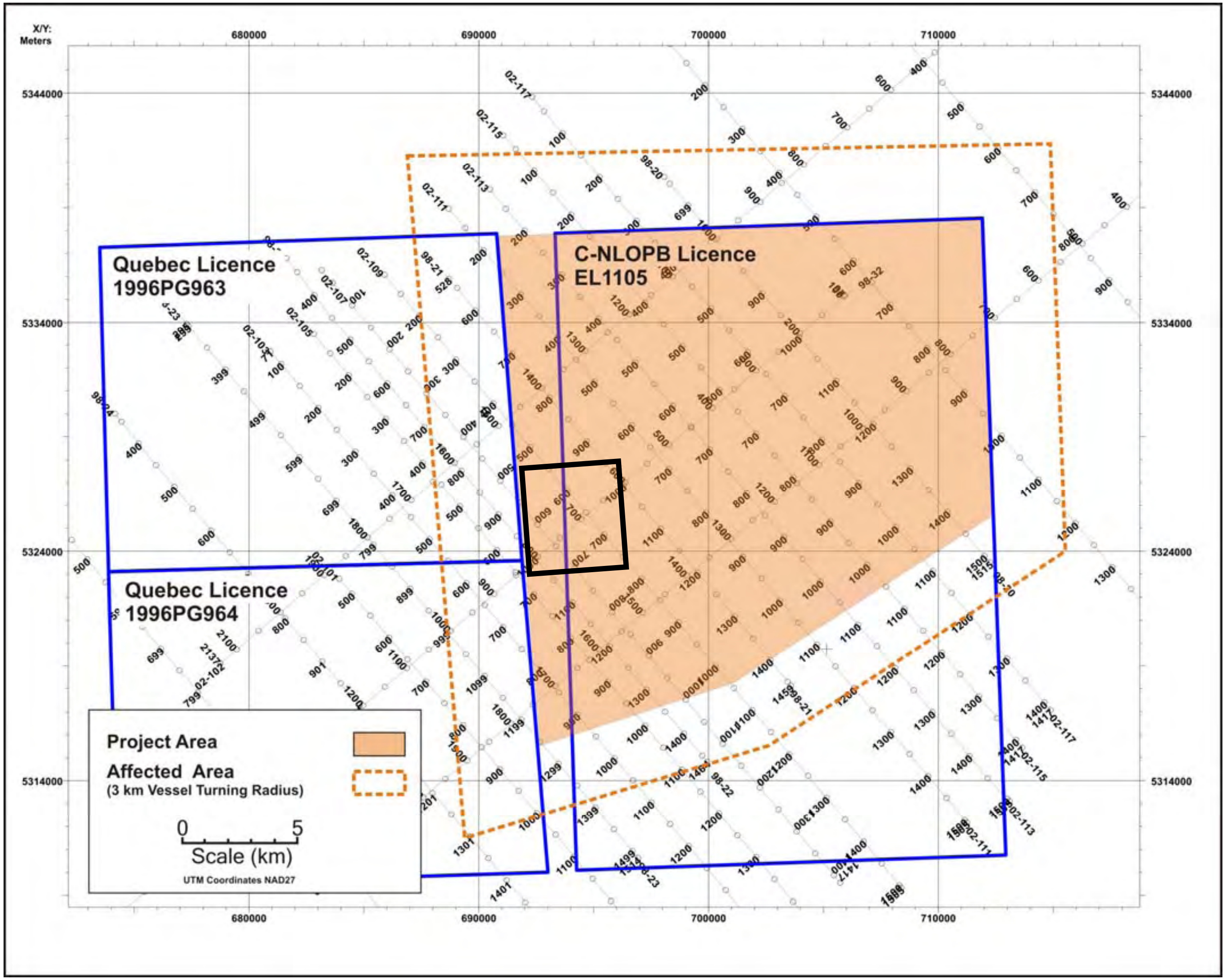
Location Map



Geohazard Survey Area



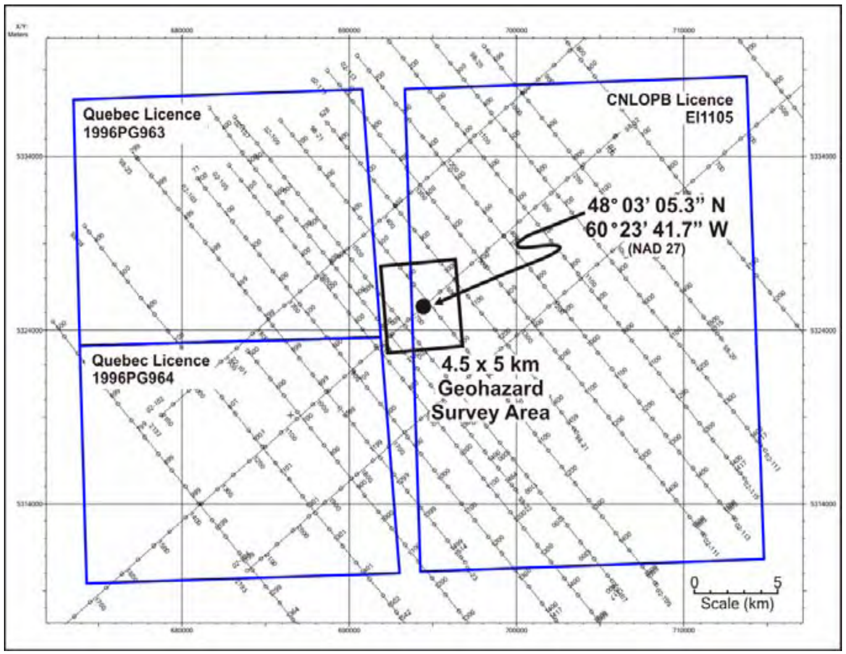
EA Project Area



Objectives of Geohazard Survey

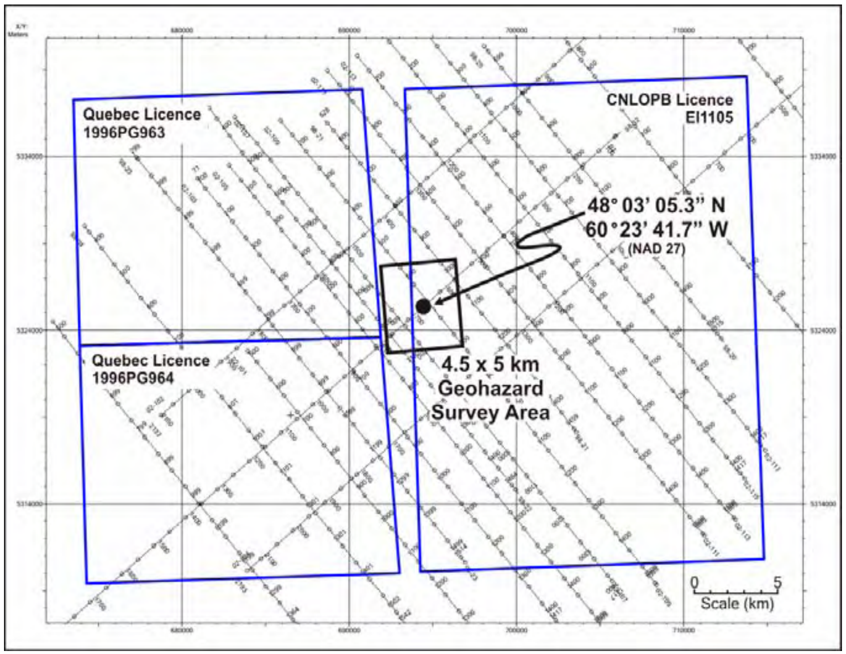
- Identification of shallow geological hazards (i.e. Slump scars, channels, faulting, shallow gas accumulations, gas hydrates and shallow trap closure);
- Acquisition of detailed bathymetry;
- Identification of surficial geology, boulder till, channel fill, slumping, faulting, gas-charged shallow sediments;
- Determining the nature and characteristics of the seafloor sediments;
- Identification of iceberg scours, morphology of seabed depositional units, seafloor obstructions, and bedforms indicative of seafloor sediment dynamics; and
- Location and identification of seafloor installations, wrecks and cables.

Geohazard Survey Data Collection



- High Resolution Seismic Data
  - Small airgun array (~150 cu in)
  - Single, multi-channel hydrophone streamer
  - 250 m line spacing, 500 m tie line spacing
- Side-scan sonar system.
- Seabed Imaging
  - High resolution sub-bottom profiles
  - Boomer or sparker deep towed system about 20-40 m off the seabed
- Seabed camera, magnetometer and sediment grab samples.

Geohazard Survey



- Survey vessel (contractor dependant).
- Shore based facilities (contractor dependant).
- Schedule:
  - 1 day transit to/from location;
  - 4 days of geophysical surveying;
  - 1-2 days for seabed sampling and photography.
- Future Geohazard surveys:
  - Up to 8, depending on success of first well;
  - During ice free times of the year;
  - Consultation will be done in advance of any future programs.

Thank You.