Environmental Assessment Update of HMDC's 2D/3D/4D Seismic Projects 2013-Life of Field Newfoundland Offshore Area

Prepared by

LGL LIMITED
environmental research associates

for

Hibernia

May 2015
Project No. SA1207

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1.0 Introduction

This document is an Update of the recently revised Environmental Assessment (EA) of Hibernia Management and Development Company's (HMDC) 2D/3D/4D Seismic Projects 2013-Life of Field (LOF) Newfoundland Offshore Area (LGL 2015; submitted to Canada-Newfoundland and Labrador Offshore Petroleum Board in February 2015). The revised EA (LGL 2015)[1] assessed the potential effects of 2D, 3D and 4D seismic survey activities within the defined Project/Study Area on the following Valued Environmental Components (VECs).

- Fish and fish habitat;
- Commercial fisheries;
- Seabirds;
- Marine mammals and sea turtles;
- Species at risk; and
- Potentially sensitive areas.

This Update addresses the validity of the revised EA (LGL 2015) and provides updates of material where necessary. This and any subsequent Updates are intended to assist the C-NLOPB in its regulatory review process by ensuring that both the scope of the assessment and the mitigation measures to which HMDC committed remain technically valid.

The following sections provide the information necessary to confirm the validity of the revised EA (LGL 2015) in question.

2.0 Project Description

The official name of the Project is the 2D/3D/4D Seismic Projects, (2013-Remaining Life of Field) Newfoundland Offshore Area. The Project is located in an offshore area about 255 km east-southeast of St. John's, Newfoundland and Labrador (Figure 2.1).

[1] The original EA dated May 2013 (LGL 2013a) had two addenda (LGL 2013b,c), changes to the Project Description dated July 2014 (LGL 2014), and associated HMDC responses to regulator comments. These documents are available on the C-NLOPB website (http://www.cnlopb.ca/env_active.shtml).

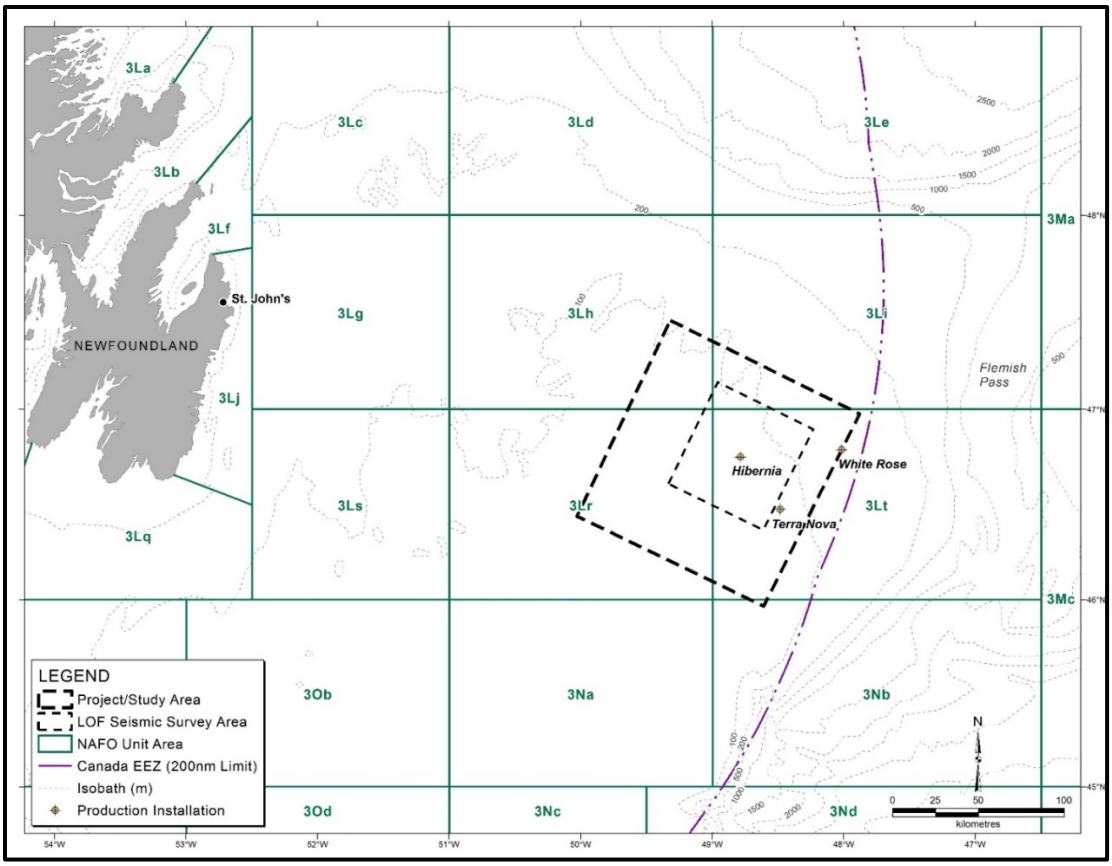


Figure 2.1 HMDC Project/Study Area and Life of Field (LOF) Seismic Survey Area (also shown are the NAFO Unit Areas).

2.1 Vessels and Equipment

The selected Project vessels(s) will be modern, fully equipped, and suited to the Grand Banks regional environment and task. In 2015 (and other years), there may be a primary seismic vessel plus a secondary source vessel (i.e., undershoot vessel); both vessels will not activate their sound sources simultaneously.

A typical 2D, 3D or 4D survey sound source consists of one or two air source arrays, 3,000 to 6,000 in^3 in total volumes, which operate at towed depths between 6 and 15 m. The air source operates on compressed air at pressures of 1,800 to 2,500 psi, and produces approximate peak-to-peak pressures of 100 to 180 bar-m.

Streamer configurations may vary from year to year. After 2015 (see Section 2.4 for details), 2D, 3D, and 4D seismic surveys may use up to 16 towed streamers with a maximum length of up to 10,050 m and deployed at depths ranging from 5 m to 30 m. Streamer equipment specifications will be provided when program designs are complete. The streamers incorporate solid flotation to minimize the environmental impact in the case of breaks or tears.

2.2 Spatial Scope

The spatial scope considered in the revised EA (LGL 2015) is presented in Figure 2.1. All survey activities will occur within the Project/Study Area, which encompasses the LOF Seismic Survey Area. Effects of the Project are considered for VECs that occur within the Study Area. Activities that will occur within the Project/Study Area include gear deployment and turning between seismic survey lines as well as data acquisition. Data acquisition will only occur in the LOF Seismic Survey Area.

2.3 Temporal Scope

The temporal scope stipulated in the revised EA (LGL 2015) is defined by a 1 May to 31 December annual window during the period 2013-Life of Field.

2.4 2015 Seismic Activities

HMDC plans to conduct a 4D Monitor 1 (M1) seismic program in 2015, preferably during the June to September period. The program will cover an approximate area of 616 km^2 within the LOF Seismic Survey Area. The purpose of the 4D M1 seismic program is to acquire high quality 4D monitor data while also acquiring higher quality 3D data. The imaging will be used to aid in the optimization of development well locations and to improve characterization of additional development opportunities.

The proposed 2015 4D survey sound source will consist of two air source arrays, with sufficient volume to output ~ 120 bar-meters peak-to-peak (see Table 2.1 in LGL 2015) to match the previous seismic survey conducted in 2013. The air source will operate at a towed depth of about ~ 6 m and a pressure of 2,000 psi. The two air source arrays will be discharged alternately (flip-flop arrangement), one each every 18.75 m along the survey line. Seismic air source array specifications may vary in subsequent years.

The 2015 4D seismic survey will use 12 towed streamers 6,000 m in length and deployed at a depth of 15 m to 25 m (see Table 2.1 in LGL 2015). The streamers will be separated by 75 m and will be solid or gel-filled to minimize the environmental impact from flotation fluid leaks in the case of breaks or tears. Lead-in and stretch sections may contain limited amounts of isopar flotation fluid.

During the 2015 4D M1 seismic program, there could be up to four vessels in the field at any given time: (1) one full time acquisition vessel; (2) one full time guard vessel; (3) one full time support vessel; and (4) one undershoot source vessel. The undershoot source vessel will be utilized for a relatively short time (6-10 days, including standby time). The primary and secondary survey vessels that will be used in 2015 are the MV *Western Trident* and the MV *WG Tasman*, both state of the art vessels approved for operation in Canadian waters. Both vessels will tow dual alternating seismic air source arrays, while only the MV *Western Trident* will tow streamers.

2.5 Mitigation Measures

Guidance provided in the C-NLOPB's *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2012) will be used as the basis for the management and mitigation of environmental risks associated with the project. These guidelines recommend that operators implement the mitigation measures listed in the Fisheries and Oceans Canada (DFO) *Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment* (hereafter referred to as the Statement). Mitigation measures used will be consistent with the DFO Statement as well as those detailed in Section 5.8 of the revised EA (LGL 2015). Marine mammal and sea turtle sightings data collected during monitoring will be provided to DFO in St. John's (Dr. J. Lawson, Research Scientist).

A Canadian Wildlife Service (CWS) permit will be obtained to enable the MMO to salvage and release seabirds which may strand on the seismic vessel. A seabird salvage log will be maintained to record all seabird interactions as per the permit conditions. Handling of stranded, oiled and non-oiled birds will be in accordance with the CWS Bird Handling Permit and relevant CWS protocols. A seabird monitoring program will be instituted by the MMO(s) generally consistent with the protocols contained in Gjerdrum et al. (2012). Required strandings data will be provided to CWS.

To mitigate risks to fishers and fishing gear, a fisheries liaison officer (FLO) will be utilized as needed to assess risks prior to departure; to recommend mitigations while at sea; and to communicate directly with fishers as needed. Meetings will also be held with the fishing industry to share details of the project; to assess the likelihood of fishing activity in the area; and to address any concerns or issues identified (see Section 5.8.3 of LGL 2015 for further details).

In 2011, One Ocean reviewed fishing and petroleum industry processes and practices for offshore seismic survey operations in Newfoundland and Labrador with the intention of identifying opportunities to better understand and improve operational processes that would mutually benefit both industries. Results of the review are outlined in the document One Ocean Protocol for Seismic Survey Programs in Newfoundland and Labrador (One Ocean 2013a; see LGL 2015 appendix).

3.0 Physical Environment

A brief summary of the physical environment on the Grand Banks and the edge of the Continental Shelf was provided in Section 3.0 of the revised EA (LGL 2015). That summary remains valid for this EA Update.

4.0 Biological Environment

Newly available background information not included in the previous documents associated with this program is included in this section.

4.1 Fish and Fish Habitat

This section includes updates to the description of the Fish and Fish Habitat VEC in Section 4.2 of HMDC's revised EA (LGL 2015). The new information presented in this section does not change the effects predictions made in the revised EA (LGL 2015).

Current information was found for key points concerning the relationship between planktonic communities and oceanic conditions in the Project/Study Area, as well as information concerning benthic invertebrate communities in portions of the Project/Study Area, as well as NAFO Coral/Sponge Closure Area updates. There is also reference to a recent document on the recovery strategy and management plan for the three wolffish species which may occur in the Project/Study Area.

The Atlantic Zone Monitoring program (AZMP) was implemented by DFO in 1998 in an attempt to better understand, describe and forecast the state of the marine ecosystem. The main component of the AZMP is an observation program designed to assess the variability in nutrients, phytoplankton and zooplankton (DFO 2014a). The AZMP findings in relation to oceanographic conditions in the Project/Study Area for 2013 are summarized below.

- Sea-surface temperatures were at record highs in September 2013 on the Grand Banks, and generally above normal during ice-free months, across the Atlantic zone. Bottom temperatures were generally above normal across the zone.

- Nitrate inventories in both surface and subsurface waters were below normal on the Newfoundland and Labrador Shelf and Grand Banks.

- Overall abundance of phytoplankton was near the long-term (1999-2010) average throughout much of the Atlantic Zone in 2013. Although chlorophyll anomalies had been below normal across much of the Newfoundland and Labrador Shelf since 2011, they increased slightly on the Grand Banks in 2013.

- High abundance levels of non-copepod zooplankton (e.g., larval stages of benthic invertebrates and carnivores that feed on other zooplankton) were observed on the Newfoundland Shelf and Grand Banks in 2013.

- The abundance levels of zooplankton species *Pseudocalanus* spp. and *Calanus finmarchicus* have demonstrated above normal levels since 2009, including in 2013.

The benthic invertebrate communities of portions of the Project/Study Area have been described extensively in the Eastern Newfoundland SEA (CNLOPB 2014) and are briefly summarized below. The information presented in this section pertains to studies completed on the continental shelf and slope of the Project/Study Area.

- Some of the key deep subtidal invertebrate species in the Eastern Grand Banks area include snow crab (*Chionoecetes opilio*), Iceland scallops (*Chlamys islandica*), sea scallops (*Placopecten magellanicus*), northern shrimp (*Pandalus borealis*), striped pink shrimp (*Pandalus montagui*), Atlantic surf clams (*Spisula solidissima*), propeller clams (*Cyrtodaria silique*), pale sea urchin (*Strongylocentrotus pallidus*), hooded shrimp (Cumacea), and whelks (*Buccinum* sp.).

- A number of research studies have characterized benthic communities on the Grand Banks (Schneider et al. 1987; Kenchington et al. 2001; Gale 2013; Gilkinson 2013) and associated slopes (Houston and Haedrich 1984).

- Schneider et al. (1987) reported observing epifaunal communities of the northeastern part of the Grand Banks that were dominated by bivalves and echinoderms such as brittlestars, urchins, and sand dollars.

- Trawling impact studies conducted by Prena et al. (1999) and Kenchington et al. (2001) using video grabs and benthic sled and trawl bycatch sampling characterized benthic communities on the northeast slope of the Grand Banks within the Project/Study Area over a three year period. Kenchington et al. (2001) documented 246 benthic taxa which were primarily echinoderms, polychaetes, crustaceans, and molluscs.

- In contrast to other survey types, DFO RV trawl surveys were dominated by relatively large taxa such as sponges, anemones, shrimp, crab and urchins. Other taxa included echinoids such as sand dollars, sea stars, brittle stars and basket stars (LGL 2012, 2013a).

- Many benthic communities in the Eastern Newfoundland SEA (CNLOPB 2014) Study Area are quite diverse compared to higher trophic levels and can be expected to vary over time and with changing environmental conditions.

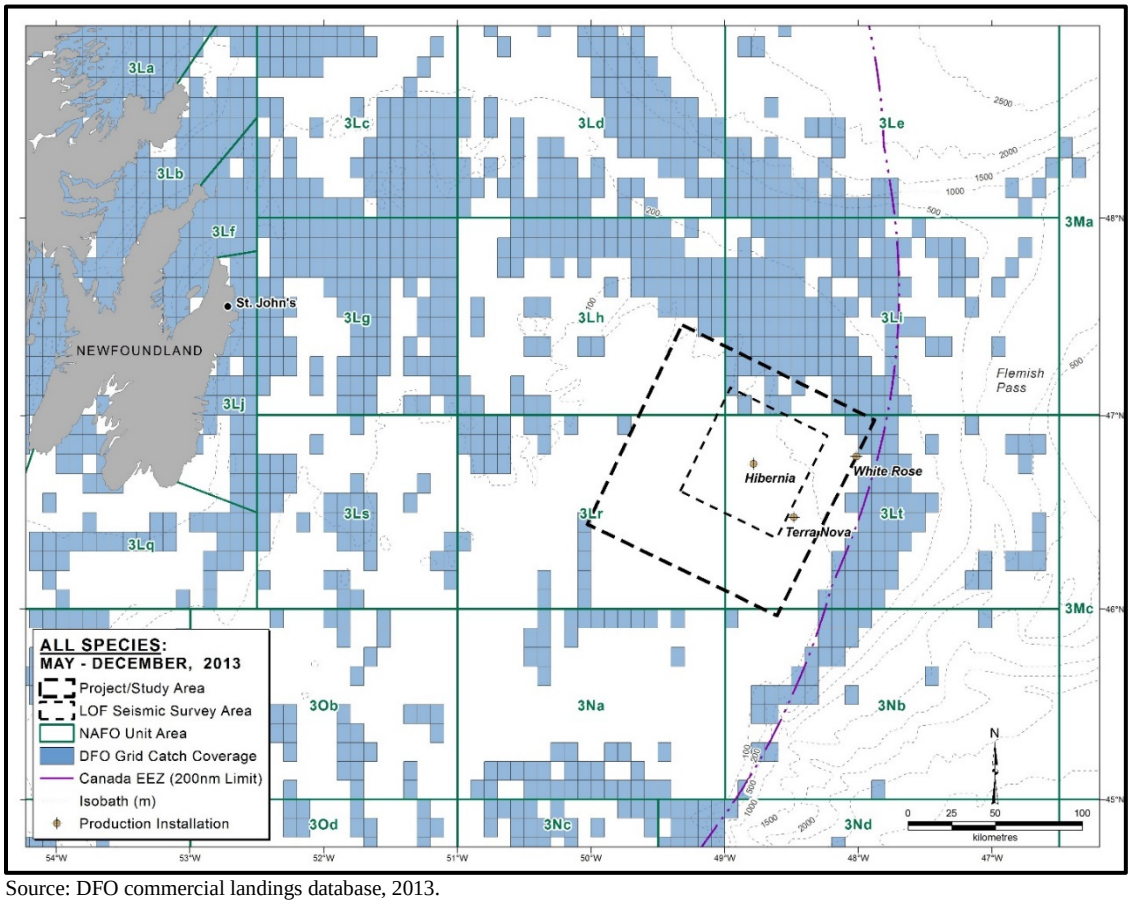
For more information on the life history and biology of some of the key benthic species in the SEA Study Area, see Table 4.58 of the Eastern Newfoundland SEA (CNLOPB 2014).

In 2008 and 2009, the North Atlantic Fisheries Organization (NAFO) Scientific Council identified areas of significant coral and sponge concentrations within the NAFO Regulatory Area. NAFO Coral/Sponge Closure Area Five was updated in 2015. Specifically, a new area of the Beothuk Knoll was designated as a closed area for bottom fishing bringing the total number of high sponge and coral concentration area closures to 13. These areas are closed to all bottom fishing activities until at least 31 December 2020 (NAFO 2015a).

4.2 Commercial Fisheries

This section includes updates to the description of the Commercial Fisheries VEC in Section 4.3 of HMDC's revised EA (LGL 2015). The new background information presented in this section does not change the effects predictions made in the revised EA (LGL 2015).

Analysis of 2013 commercial fisheries data for the Project/Study Area indicated no major differences from the distributions of harvest locations indicated in the revised EA (LGL 2015) for May-December, 2005–2012 (see Figure 4.5 and Appendix 2 *in* LGL 2015). There have been relatively few commercial catches recorded in the Project/Study Area in recent years, with even fewer catches recorded in 2013 when the harvest consisted entirely of snow crab. Contrary to previous years, there were no northern shrimp catches recorded within the Project/Study Area in 2013. Note that there will be no shrimp fishery in NAFO Division 3L in 2015 (NAFO 2015b). In 2013, snow crab were harvested using pots (fixed gear) only in NAFO Unit Areas 3Lt and 3Li in the northern portion of the Project/Study Area (Figure 4.1; Table 4.1). In 2013, snow crab was harvested in the Project/Study Area between April and July, the majority of the harvest occurred in May (Table 4.1; Figure 4.2).



Source: DFO commercial landings database, 2013.

Figure 4.1 Distribution of Commercial Fisheries Harvest Locations, All Species, May-December, 2013.

Table 4.1 Commercial Catch Weights and Values in the Project/Study Area, May–December, 2013 (values indicate the frequency of catch weight and value quartile codes attributed to harvested species; gear types and months associated with the fishery are also indicated).

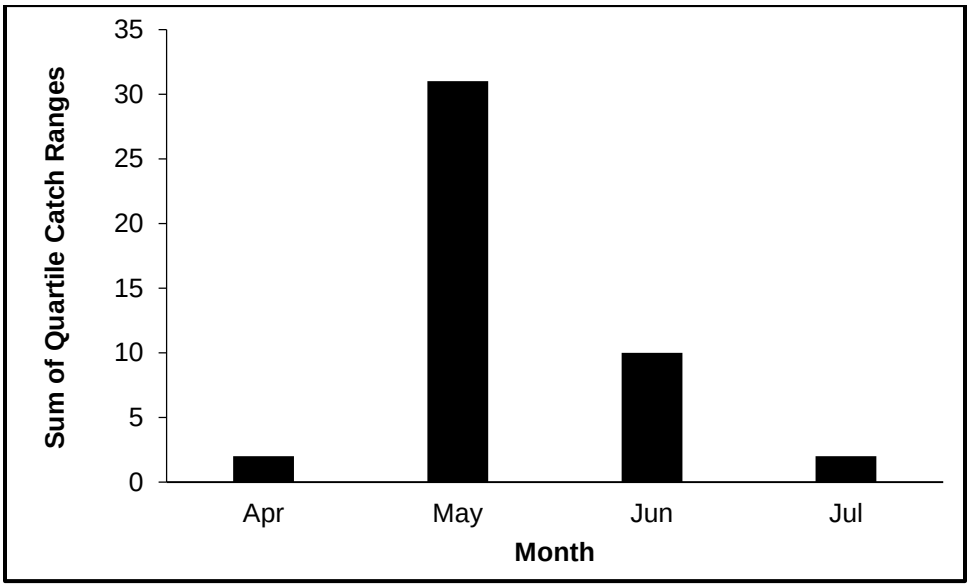
Species	Catch Weight Quartile Code Counts [a]				Catch Value Quartile Code Counts [b]				Month Caught	Gear Type
	1	2	3	4	1	2	3	4		
Snow Crab	3	9	8	0	1	9	8	2	Apr–Jul	Pot (Fixed Gear)

Source: DFO commercial landings database, 2013.

[a] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch weights in a given year, all species combined). 2013 quartile ranges: 1 = 0 – 2,565 kg, 2 = 2,566 – 11,872 kg, 3 = 11,873 – 48,585 kg, 4 = ≥ 48,586 kg.

[b] Quartile ranges provided by DFO (quartile ranges calculated annually by DFO based on total catch values in a given year, all species combined). 2013 quartile ranges: 1 = $0 – $8,934, 2 = $8,395 – $35,699, 3 = $35,700 – $125,728, 4 = ≥ $125,729.

[c] Total counts of the number of catch records per species; the total quartile range counts for catch weight and catch value are equal.



Source: DFO commercial landings database, 2013.
Sum of catch weight quartile codes (i.e., 1–4) for all catch records for all species; the greater the sum of quartile codes, the greater the catch weight for a given month.

Figure 4.2 Monthly Sum of Catch Weight Quartile Codes, May–December, 2013, for All Species in the Project/Study Area.

4.2.1 Species Collected during DFO Research Vessel Surveys

DFO Research Vessel (RV) data collected during annual multi-species trawl surveys during 2007–2011 were presented in the revised EA (see Section 4.2.5 *in* LGL 2015). Analysis of the latest available dataset for spring (June) and fall (November) surveys in the Project/Study Area in 2012 indicated no major differences from the predominant species captured in terms of catch weights and locations in previous survey years (see Table 4.1 *in* LGL 2015). Minor exceptions included lack of reported harvests of either northern wolfish (*Anarhichas denticulatus*) or deepwater redfish (*Sebastes mentella*) in the 2012 surveys.

4.2.2 Industry and DFO Science Surveys

Fisheries research surveys conducted by DFO and the fishing industry were described in Section 4.3.5 of the revised EA (LGL 2015). The tentative schedule of the 2015 DFO multispecies science surveys (RV surveys) is presented below in Table 4.2 (G. Sheppard, DFO, pers. comm. 2015). Spring RV surveys are currently set to begin at the end of March and continue into mid-June. DFO fall RV surveys will begin in mid-September and end in early-December.

Table 4.2 Tentative Schedule of Relevant DFO RV Surveys in 2015.

NAFO Division	Start Date	End Date	Vessel
3P	31 Mar	14 Apr	*Needler*
3P	14 Apr	28 Apr	*Needler*
3P + 3O	29 Apr	12 May	*Needler*
3O + 3N	12 May	26 May	*Needler*
3L + 3N	27 May	13 Jun	*Needler*
3O	16 Sep	29 Sep	*Needler*
3O + 3N	29 Sep	13 Oct	*Needler*
2H	04 Oct	13 Oct	*Teleost*
2H + 2J	14 Oct	27 Oct	*Teleost*
3N + 3L	14 Oct	27 Oct	*Needler*
2J + 3K	27 Oct	10 Nov	*Teleost*
3L	28 Oct	10 Nov	*Needler*
3K	11 Nov	24 Nov	*Teleost*
3K + 3L	11 Nov	24 Nov	*Needler*
3K + 3L Deep	24 Nov	08 Dec	*Teleost*

Start/end dates subject to change as trip plans are finalized.

4.3 Seabirds

This section includes updates to the description of the Seabirds VEC in Section 4.4 of HMDC's revised EA (LGL 2015). The following is revised text for Sections 4.4.2, 4.4.3.3 and 4.4.3.7 of the revised EA (LGL 2015). The new background information presented in this section does not change the effects predictions made in the revised EA (LGL 2015).

4.3.1 Breeding Seabirds in Eastern Newfoundland (Section 4.4.2 of EA; LGL 2015)

Hundreds of thousands of pairs of seabirds nesting on the Avalon Peninsula reflect the richness of the offshore regions off southeastern Newfoundland. The seabird breeding colonies on Baccalieu Island, the Witless Bay Islands and Cape St. Mary's are among the largest in Atlantic Canada. More than 4.4 million pairs nest at these three locations alone (Table 4.3 which is an updated version of Table 4.8 in the revised EA). This includes the largest Atlantic Canada colonies of Leach's Storm-Petrel (3,336,000 pairs on Baccalieu Island), Black-legged Kittiwake (13,879 pairs on Witless Bay Islands), Thick-billed Murre (1,000 pairs at Cape St. Mary's) and Atlantic Puffin (234,000 pairs on Witless Bay Islands). These birds and along with non-breeding seabirds feed on the Grand Banks during the nesting season from May to September. In addition, Funk Island, 150 km northwest of the Grand Banks supports the largest colony of Common Murre (470,000 pairs) in Atlantic Canada. Many of these birds could reach the Project/Study Area in the non-breeding season.

Table 4.3 Numbers of Pairs of Marine Birds Nesting at Marine Bird Colonies in Eastern Newfoundland.

Species	Wadham Islands	Funk Island	Cape Freels and Cabot Island	Baccalieu Island	Witless Bay Islands	Mistaken Point	Cape St. Mary's	Middle Lawn Island	Corbin Island	Green Island
Northern Fulmar	-	13[a]	-	-	13[a]	-	Present[a]	-	-	-
Manx Shearwater	-	-	-	-	-	-	-	7[d]	-	-
Leach's Storm-Petrel	6,000[a]	-	250[b]	3,336,000[b]	314,020[a]	-	-	13,879[e]	100,000[b]	103,833[b]
Northern Gannet		6,075[a]		2,564[a]	-	-	14,789[a]	-	-	-
Herring Gull	-	150[a]	-	46[a]	2,045[c]	-	Present[b]	20[b]	5,000[b]	Present[b]
Great Black-backed Gull	Present[b]	75[a]	-	2[a]	15[e]	-	Present[b]	6[b]	25[b]	-
Black-legged Kittiwake	-	100[a]	-	5,096[a]	13,950[a]	4,750[g]	10,000[b]	-	50[b]	-
Arctic and Common Terns	376[b]	-	250[b]	-	-	--	-	-	-	Present[b]
Common Murre	-	470,000[a]	2,600[b]	1,440[a]	268,660[a]	100[g]	15,484[a]	-	-	-
Thick-billed Murre		250[a]	-	73[a]	240[a]		1,000[b]	-	-	-
Razorbill	30[a]	200[a]	25[b]	406[a]	846[a]	Present[b]	100[b]	-	-	-
Black Guillemot	25[a]	1[b]	-	113[a]	20c	Present[b]	Present[b]	-	-	-
Atlantic Puffin	7,140[a]	2,000[a]	20[b]	45,300[a]	324,650[a]	50	-	-	-	-
TOTALS	13,511	478,864	3,145	3,391,040	924,459	4,900	41,373	13,912	105,075	103,833

Sources: [a]EC-CWS, unpubl. data; [b]Cairns et al (1989); [c]Bond in press; [d]Fraser et al. (2013); [e]Robertson et al. (2002); [f]Russell (2008).

4.3.1.1 Sulidae (gannets) (Section 4.4.3.3 of EA; LGL 2015)

More than 23,000 pairs of Northern Gannets nest on three colonies in eastern Newfoundland (Table 4.3). Gannets are common near shore and scarce beyond 100 km from shore. The Project/Study Area is beyond the range of most Northern Gannets. It is expected to be scarce visitor from April to October within the Project/Study Area.

4.3.1.2 Alcidae (Dovekie, murres, Black Guillemot, Razorbill and Atlantic Puffin) (Section 4.4.3.7 of EA; LGL 2015)

Murres

Geolocators were applied to Thick-billed Murres (19) and Common Murres (20) from five nesting colonies in the Northwest Atlantic. Location data indicated that murres exhibit both site fidelity and flexibility to wintering areas (McFarlane et al. 2014). During the non-breeding season (September to April), Thick-billed Murres occurred in the offshore from Davis Strait south to the Flemish Cap and Southeast Grand Banks. During the same time period, Common Murres occurred in areas off eastern Newfoundland, including the Flemish Cap and the Southeast Grand Banks (McFarlane et al. 2014).

4.4 Marine Mammals and Sea Turtles

This section includes updates to the description of the Marine Mammal and Sea Turtle VEC in Section 4.5 of HMDC's revised EA (LGL 2015). The new background information presented in this section does not change the effects predictions made in the revised EA (LGL 2015).

4.4.1 Updated COSEWIC Designations

The following are updated COSEWIC designations for particular marine mammals included in Table 4.10 of the revised EA (LGL 2015). These changes in designation do not affect the effects assessment or requirement for mitigation measures.

- Sei whale (*Balaenoptera borealis*) (Atlantic population) – changed from *data deficient* to *high-priority candidate* species;
- Sperm whale (*Physeter microcephalus*) (Atlantic) – changed from *low-priority candidate* species to *mid-priority candidate* species;
- Harp seal (*Pagophilus groenlandicus*) (Atlantic) – changed from *mid-priority candidate* species to *high-priority candidate* species; and
- Hooded seal (*Cystophora cristata*) (Atlantic) – changed from *mid-priority candidate* species to *high-priority candidate* species.

4.4.2 Updated Population/Abundance Estimates

The revised EA contained abundance estimates for some cetacean species in Newfoundland and Labrador waters from Lawson and Gosselin (2009). These have since been corrected for perception and availability biases (Lawson and Gosselin, unpublished). Table 4.4 lists the observed and corrected abundance estimates.

Table 4.4 Raw and Corrected Cetacean Abundance Estimates, Newfoundland and Labrador Waters.

Species	Abundance estimate from Lawson and Gosselin (2009)	Corrected abundance estimates (Lawson and Gosselin, unpublished)
Fin whale *Balaenoptera physalus*	890	1,555
Humpback whale *Megaptera novaeangliae*	1,427	3,712
Minke whale *Balaenoptera acutorostrata*	1,315	4,691
Atlantic white-sided dolphin *Lagenorhynchus acutus*	1,507	3,384
Short-beaked common dolphin *Delphinus delphis*	576	1,806
White-beaked dolphin *Lagenorhynchus albirostris*	1,842	15,625
Harbour porpoise *Phocoena phocoena*	1,195	3,326

In addition to the updated abundance estimates from Lawson and Gosselin (unpublished), several other marine mammal and sea turtle population estimates included in the revised EA (LGL 2015) are updated below.

- Blue whale (*Balaenoptera musculus*) - it has been estimated that 400-600 blue whales may be found in the western North Atlantic; there are insufficient data to determine population trends for this species (Waring et al. 2011).
- North Atlantic right whale (*Eubalaena glacialis*) - based on a census of individual whales identified using photo-identification, the western North Atlantic right whale population is estimated to be comprised of at least 510 individuals (NARWC 2013).
- Fin whale - the abundance estimate of 3,522 (CV=0.27), considered the best available abundance estimate for the western north Atlantic fin whale stock, was derived from the Canadian Trans-North Atlantic Sighting Survey (TNASS) conducted in July-August 2007 (Waring et al. 2014).
- Minke whale - the abundance estimate of 20,741 (CV = 0.30), considered the best recent abundance estimate for the Canadian East Coast stock of minke whales, was derived from the Canadian Trans-North Atlantic Sighting Survey (TNASS) conducted in July-August 2007 (Waring et al. 2014).
- Sperm whale - there is currently no reliable estimate of sperm whale abundance in the entire western North Atlantic. The best recent abundance estimate of 2,288 (CV = 0.28), based on

aerial and shipboard surveys and uncorrected for dive-time, is likely an underestimate; a trend analysis has not been completed for this stock because the statistical power to detect a trend in abundance is poor due to the relatively imprecise abundance estimates and long survey interval (Waring et al. 2014).

- Northern bottlenose whale (*Hyperoodon ampullatus*) – it is estimated that the Scotian Shelf population of northern bottlenose whales is comprised of 143 individuals (O'Brien and Whitehead 2013). The size of the Davis Strait-Baffin Bay-Labrador Sea population is uncertain, but low sighting rates suggest that it has not recovered from heavy whaling activity (Whitehead and Hooker 2012).
- Killer whale (*Orcinus orca*) – although the number of killer whales in the Northwest Atlantic/Eastern Arctic population is unknown (COSEWIC 2008), at least 67 individuals have been identified in the northwest Atlantic (Lawson and Stevens 2013).
- Long-finned pilot whale (*Globicephala melas*) – estimation of a summer abundance of 6,134 (CV = 0.28) for long-finned pilot whales in the area extending from northern Labrador to the Scotian Shelf. A trend analysis has not been conducted for the western North Atlantic stock of pilot whales; the statistical power to detect a trend in abundance for this stock is poor because of relatively imprecise abundance estimates and a long survey interval (Waring et al. 2014).
- Short-beaked common dolphin - the abundance of short-beaked common dolphins off the U.S. or Canadian Atlantic Coast estimated at 173,486 (CV=0.55) is considered the best current abundance estimate. This estimate was derived from the Canadian Trans-North Atlantic Sighting Survey (TNASS) conducted in July-August 2007 (Waring et al. 2014). Another abundance estimate of 84,000 (CV=0.36) common dolphins was obtained from 10,676 km of trackline data collected during an aerial survey in August 2006. This survey covered the region extending from the 2,000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and the entrance to the Gulf of St. Lawrence. A trend analysis has not been conducted for the western North Atlantic stock of short-beaked common dolphins; the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval (Waring et al. 2014).
- Bottlenose dolphin (*Tursiops truncatus*) - the best available estimate for the offshore stock of bottlenose dolphins in the western North Atlantic is 77,532 (CV=0.40). This estimate is based on 2011 summer surveys covering waters from central Florida to the lower Bay of Fundy. A trend analysis has not been conducted for the western North Atlantic offshore stock of bottlenose dolphins; the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey intervals (Waring et al. 2014).
- Striped dolphin (*Stenella coeruleoalba*) - there are an estimated 46,882 striped dolphins (CV = 0.33) occurring from central Virginia to the lower Bay of Fundy. This estimate is based on shipboard and aerial surveys conducted during June–August 2011 (Waring et al. 2014).
- Harp seal - the total population size for the Northwest Atlantic harp seal population was estimated at 7,411,000 in 2014 (SE = 656,000; Hammill et al. 2014a). Despite highly

variable pup production among years, this population has shown little change in abundance since 2004 and is considered to be relatively stable (Hammill et al. 2014a).

- Loggerhead sea turtle (*Caretta caretta*) - the adult female population in the western North Atlantic is estimated at 38,334 individuals (Richards et al. 2011). There are no current population estimates for loggerhead turtles in Atlantic Canada (DFO 2010).
- Leatherback sea turtle (*Dermochelys coriacea*) - the leatherback sea turtle population is estimated to have declined by more than 70% globally. In the Atlantic, it is impacted by factors including fisheries bycatch, coastal and offshore development, and poaching, and in Canada it is threatened by entanglement in fishing gear (COSEWIC 2012). There are an estimated 34,000–94,000 adult leatherbacks in the North Atlantic (TEWG 2007). Although the size of the seasonal population of foraging leatherbacks in Canada is unknown, it is thought to number in the thousands (COSEWIC 2012). Genetic analysis of leatherback turtles captured off Nova Scotia revealed that the majority originated from natal beaches in Trinidad, followed by beaches in French Guiana, Costa Rica, St. Croix, and Florida (Stewart et al. 2013). While foraging, the leatherback turtle inhabits both shelf and offshore waters in Canada between April and December (COSEWIC 2012). Leatherback sea turtles have been observed foraging on lion's mane and moon jellyfish in Atlantic Canadian waters, and it has been estimated that they consume an average of 330 kg (wet mass) of jellyfish per day (Heaslip et al. 2012). Satellite telemetry data has been used to identify three primary habitats likely used for foraging by leatherback turtles: (1) the area near Georges Bank; (2) southeastern Gulf of St. Lawrence and waters east of Cape Breton; and (3) waters south and east of Burin Peninsula, Newfoundland (DFO 2011). Subsequent research, including satellite telemetry data, will be used to identify critical habitat in a forthcoming amendment to the 2006 recovery strategy (DFO 2013b).

4.4.3 Additional References

Davoren (2013) compared data on previously described annually persistent aggregations of capelin (*Mallotus villosus*) on the northeast Newfoundland coast with data on predator distribution and abundance collected during at-sea surveys repeated over eight years (2000–2003, 2007, and 2009-2011). They found that for all years combined, there was a higher frequency of baleen whales (predominantly humpback whales; also minke and fin whales) associated with three persistent prey hotspots relative to other areas. These hotspots occur a considerable distance west of the Project/Study Area. Baleen whales were associated with both spawning and staging hotspots for capelin. At capelin spawning hotspots, the baleen whales were most frequently present during spawning than before or after spawning.

Kennedy et al. (2014) reported two humpback whales outfitted with satellite transmitters near the Dominican Republic travelled near the Study Area. One whale was recorded on the eastern edge of Cabot Strait in May 2011, and the second whale was recorded on the Grand Banks in June 2012.

In 2008 and 2009, Prieto et al. (2014) deployed satellite tags on sei whales in Portugal, and subsequent analysis of tracking data revealed a well-defined migratory corridor between the Azores and the

Labrador Sea. Tracking data also showed that sei whales in the Labrador Sea spend considerable time foraging, indicating that the Labrador Sea constitutes an important feeding ground for them. Recent satellite telemetry data also suggested a discrete feeding area for sei whales may be present off the Gulf of Maine and Nova Scotia (Prieto et al. 2014). These data support the hypothesis that separate stocks of sei whales exist off the coasts of the U.S. and Canada. Some of the sei whales tracked to the Labrador Sea by Prieto et al. (2014) arrived in the area in mid-May with some remaining there until mid-September, coinciding with the time when sei whales are known to occur in the Gulf of Maine (CETAP 1982; Baumgartner et al. 2011).

Matthews et al. (2011) deployed satellite tags on two killer whales in Admiralty Inlet, Baffin Island in August 2009. The whales were either adult females or juvenile males. The one outfitted with a tag on 15 August 2009 was tracked moving into the North Atlantic in mid-November, traveling just east of the Flemish Cap.

McCordic et al. (2014), using images from the North Atlantic Humpback Whale Catalogue (NAHWC), examined humpback whale flukes for the presence of rake marks from killer whales. They found that within the western North Atlantic, Canada (including the Newfoundland and Labrador region and the Quebec shore of the Gulf of St. Lawrence) humpback whales have a scarring rate that is almost twice that of either the Gulf of Maine or West Greenland. The authors suggested that the Canadian population of killer whales may prey preferentially on marine mammals (McCordic et al. 2014).

Matthews and Ferguson (2014) analyzed stable isotopes in the tooth collagen of killer whales from the Eastern Canadian Arctic (ECA) and the north-west Atlantic (NWA; samples from Newfoundland). Significant differences in stable nitrogen isotope values between killer whales from the two areas support the hypothesis that ECA and NWA killer whales are from largely non-overlapping populations. Despite these inter-area differences, ECA and NWA killer whales were found to forage at similar trophic levels.

Andersen et al. (2013) deployed satellite tags on 65 hooded seals during five field seasons (2004–2008) and analyzed tracking data in conjunction with a variety of environmental parameters. Male and female hooded seals were found to prefer similar habitat conditions, but were separated temporally and spatially (geographically and by depth). Males were more localized in their habitat use patterns, and search effort was focused in areas of complex seabed relief (e.g., Baffin Bay, Davis Strait, and the Flemish Cap). Females concentrated their search effort along shelf areas (e.g., the Labrador shelf) and were found to use the Labrador shelf more intensively than males, especially in the autumn/winter season after moulting and prior to breeding.

4.5 Species at Risk

This section includes updates to the description of the Species at Risk VEC in Section 4.6 of HMDC's revised EA (LGL 2015). The new background information presented in this section does not change the effects predictions made in the revised EA (LGL 2015).

Table 4.5 (revision of Table 4.13 in revised EA) summarizes species at risk with reasonable likelihood of occurrence within the Project/Study Area, based on current information (as of February 2015) from the websites for *SARA* and COSEWIC. Updates to species designations included in the revised EA are the additions detailed below and indicated in Table 4.5 with red font and light grey shading. All animal scientific names are included in Table 4.5.

- Killer whale (Northwest Atlantic/Eastern Arctic population), assessed as *special concern* by COSEWIC;
- Atlantic bluefin tuna, assessed as *endangered* by COSEWIC;
- American eel, assessed as *threatened* by COSEWIC; and
- White hake (Atlantic population), assessed as *threatened* by COSEWIC.

As of February 2015, no additional species of special status that could potentially occur within the Project/Study Area have been added to Schedule 1 of *SARA*. A final recovery strategy has been prepared for the *endangered* Ivory Gull (EC 2014), and the recovery strategy for the *endangered* North Atlantic right whale (Brown et al. 2009) has been amended to incorporate changes made pertaining to the critical habitat of the population (DFO 2014b).

HMDC will monitor *SARA* issues through the law gazettes, the Internet, and communication with DFO and Environment Canada, and will adaptively manage any issues that may arise in the future. HMDC will comply with relevant regulations pertaining to *SARA* Recovery Strategies and Action Plans. HMDC will continue to exercise due caution to minimize impacts on species at risk during all of its operations. HMDC also understands that other marine species may be designated as *endangered* or *threatened* on Schedule 1 during the course of the Project and will continue to monitor any status change.

4.6 Potentially Sensitive Areas

This section includes updates to the description of the Potentially Sensitive Areas VEC in Section 4.7 of HMDC's revised EA (LGL 2015).

No additional potentially sensitive areas have been identified in the Project/Study Area since the completion of the revised EA (LGL 2015). Figure 4.3 shows updated coral/sponge closure areas, none of which occur in the Project/Study Area.

Table 4.5 *SARA*-Listed and COSEWIC-Assessed Marine Species that Potentially Occur in the Project/Study Area.

SPECIES		*SARA*[a]			COSEWIC[b]		
Common Name	**Scientific Name**	**Endangered**	**Threatened**	**Special Concern**	**Endangered**	**Threatened**	**Special Concern**
Marine Mammals							
Blue whale (Atlantic population)	*Balaenoptera musculus*	Schedule 1			X		
North Atlantic right whale	*Eubalaena glacialis*	Schedule 1			X		
Fin whale (Atlantic population)	*Balaenoptera physalus*			Schedule 1			X
Sowerby's beaked whale	*Mesoplodon bidens*			Schedule 1			X
Harbour porpoise (Northwest Atlantic population)	*Phocoena phocoena*		Schedule 2				X
Humpback whale (Western North Atlantic population)	*Megaptera novaeangliae*			Schedule 3			
Killer whale (Northwest Atlantic/ Eastern Arctic population)	*Orcinus orca*						X
Sea Turtles							
Leatherback sea turtle	*Dermochelys coriacea*	Schedule 1			X		
Loggerhead sea turtle	*Caretta caretta*				X		
Fishes							
White shark (Atlantic population)	*Carcharodon carcharias*	Schedule 1			X		
Northern wolffish	*Anarhichas denticulatus*		Schedule 1			X	
Spotted wolffish	*Anarhichas minor*		Schedule 1			X	
Atlantic wolffish	*Anarhichas lupus*			Schedule 1			X
Atlantic cod	*Gadus morhua*			Schedule 3			
Atlantic cod (Newfoundland and Labrador population)	*Gadus morhua*				X		
Cusk	*Brosme brosme*				X		
Porbeagle shark	*Lamna nasus*				X		
Roundnose grenadier	*Coryphaenoides rupestris*				X		
Atlantic bluefin tuna	*Thunnus thynnus*				X		
Shortfin mako shark (Atlantic population)	*Isurus oxyrinchus*					X	
Atlantic salmon (South Newfoundland population)	*Salmo salar*					X	
American plaice (Newfoundland and	*Hippoglossoides*					X	

SPECIES		*SARA*[a]			COSEWIC[b]		
Common Name	**Scientific Name**	**Endangered**	**Threatened**	**Special Concern**	**Endangered**	**Threatened**	**Special Concern**
Labrador population)	*platessoides*						
Acadian redfish (Atlantic population)	*Sebastes fasciatus*					X	
Deepwater redfish (Northern population)	*Sebastes mentella*					X	
American eel	*Anguilla rostrata*					X	
White hake (Atlantic population)	*Urophycis tenuis*					X	
Blue shark (Atlantic population)	*Prionace glauca*						X
Basking shark (Atlantic population)	*Cetorhinus maximus*						X
Roughhead grenadier	*Macrourus berglax*						X
Spiny dogfish (Atlantic population)	*Squalus acanthias*						X
Thorny skate	*Amblyraja radiata*						X
Birds							
Ivory Gull	*Pagophila eburnea*	Schedule 1			X		

Sources: [a]*SARA* website (http://www.sararegistry.gc.ca/species/default_e.cfm), accessed February 2015; [b]COSEWIC website (http://www.cosewic.gc.ca/index.htm); accessed February 2015; COSEWIC candidate species not included.

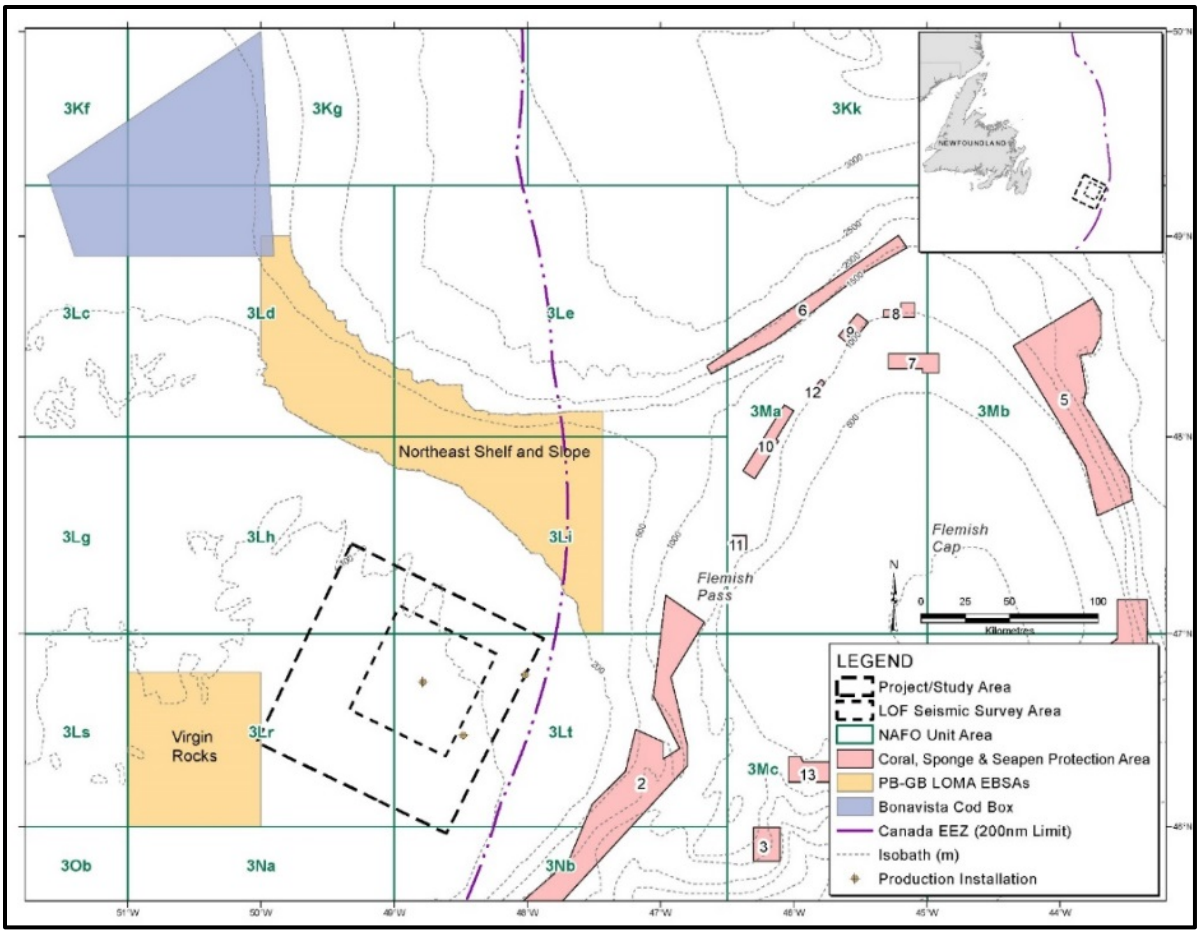


Figure 4.3 Project/Study Area in Relation to Proximate Coral/Sponge Areas, Ecologically and Biologically Sensitive Areas, and the Bonavista Cod Box.

5.0 Consultations

A consultation meeting with fishery stakeholders was held at the HMDC office on 18 March 2015. Attending the meeting for the fishery stakeholders was Johan Joensen, Petroleum Industry Liaison for the FFAW/Unifor and Maureen Murphy, Director of Operations at One Ocean. Derek Butler, Executive Director of the Association of Seafood Producers (ASP) had intended to attend the meeting but could not. The information presented at the consultation meeting was provided to Derek Butler as well as to Rick Ellis of Ocean Choice International. Attending the meeting on behalf of HMDC were Kent Slaney, Mike Hildreth, John Zevenhuizen. John Christian of LGL Limited, consultant for HMDC, also attended the meeting.

John Christian made a presentation related to the Update of the HMDC EA of 2D/3D/4D Seismic projects 2013-Life of Field Newfoundland Offshore Area. Questions and comments resulting from the presentation included the following:

- Add “One Ocean Protocol for Seismic Survey Programs in Newfoundland and Labrador” to the list of mitigations associated with the fisheries;
- Add the initial EA Project Area, Study Area and LOF Seismic Survey Area boundaries to the figures to provide contrast with revised Project/Study Area and Acquisition Area;
- Provide a clear definition of the Project/Study Area and LOF Seismic Survey Area;
- Request for further details on timing of 2015 4D M1 seismic program;
- Request for further details on two vessel undershoot operations; and
- Request for further details on the seismic line orientation.

All questions and comments listed above have been considered in this Update document. Inclusion of the original EA’s boundaries for the Project, Study and LOF Seismic Survey Areas in figures has not been done since these changes have already been reviewed by stakeholders in previous documents associated with this program.

The document One Ocean Protocol for Consultation Meetings: Recommendations for the Fishing and Petroleum Industries in Newfoundland and Labrador (One Ocean 2013b) outlines recommendations for preparing, convening and following up on consultation meetings.

6.0 Environmental Assessment

6.1 Mitigation Measures

The mitigation measures described in the revised EA (see Section 5.8 *in* LGL 2015) remain applicable to the seismic survey activities planned for 2015.

6.2 Validity of Significance Determinations

Based on careful consideration of newly available information presented in Section 5 and consultations with stakeholders, the determinations of significance of the residual effects of seismic survey activities on VECs presented in the revised EA (LGL 2015) remain valid for the 2015 seismic survey activities planned by HMDC.

7.0 Concluding Statement

The seismic survey activities that HMDC plans to conduct in 2015 have been reviewed and assessed, and are within the scope of the revised EA.

The environmental effects predicted in the revised EA are still valid. HMDC reaffirms its commitment to implement the mitigation measures proposed in the revised EA.

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