AMENDMENT OF ENVIRONMENTAL ASSESSMENT OF EXPLORATION SEISMIC SURVEYS FOR EXPLORATION LICENCES 1097, 1098, 1103, AND 1104 WESTERN NEWFOUNDLAND

Prepared For:

Canada-Newfoundland and Labrador Offshore Petroleum Board on behalf of Geophysical Service Inc.

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1.0 INTRODUCTION

This report is an amendment to the environmental assessment (EA) report originally prepared for NWest Energy Inc. (CRA March 2008) in response to a schedule change by the current Operator, Geophysical Service Incorporated (GSI).

The project schedule for the original EA covered the months of April to December. Since submission of the EA report, the spatial and temporal boundaries were modified. Environmental assessment of the spatial changes was addressed in a separate document submitted to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). The survey has been extended to February; therefore, this amendment addresses effects of the Project in January and February.

This amendment addresses sections in the original EA report and the Addendum (CRA July 2008) Report which are affected by the change in temporal boundaries.

1.1 Project Description Changes

GSI proposed to undertake an exploration seismic 2-D and 3-D seismic survey program on NWest's landholdings on the west coast of Newfoundland and Labrador commencing in the third quarter of 2008. There was also the potential for 2-D surveys on the licenses and geohazard surveys in areas of interest. Due to vessel availability that incurred significant schedule delay, GSI will be using a single-streamer vessel, the MV GSI Pacific, instead of a multi-streamer vessel and will be undertaking a 2-D seismic survey program only. The marine seismic air source array has been changed to a volume of 2940 cubic inches from 2620 cubic inches; however, the sound pressure emitted is the same. The program will take 90days to complete.

The survey program changed spatially from a single survey area to three areas. This change in spatial boundary was addressed by GSI to the C-NLOPB. The Project Area was not changed as a result of that Project modification.

2.0 PROJECT DESCRIPTION

2.1 Project Temporal Boundaries

The temporal boundary of the environmental impact assessment (EIA) is eight years, *i.e.*, it assesses potential impacts that could result from the Project occurring between 2008 and 2015. The EIA report assessed potential effects of geophysical operations from May to December. This assessment remains for 2009 to 2015, but the first survey beginning in 2008 has been extended to February 2009. Beyond the first survey, now scheduled for October 2008 to February 2009, subsequent surveys will be determined annually in consultation with stakeholders. The first survey will be completed in 90 days, and is currently underway.

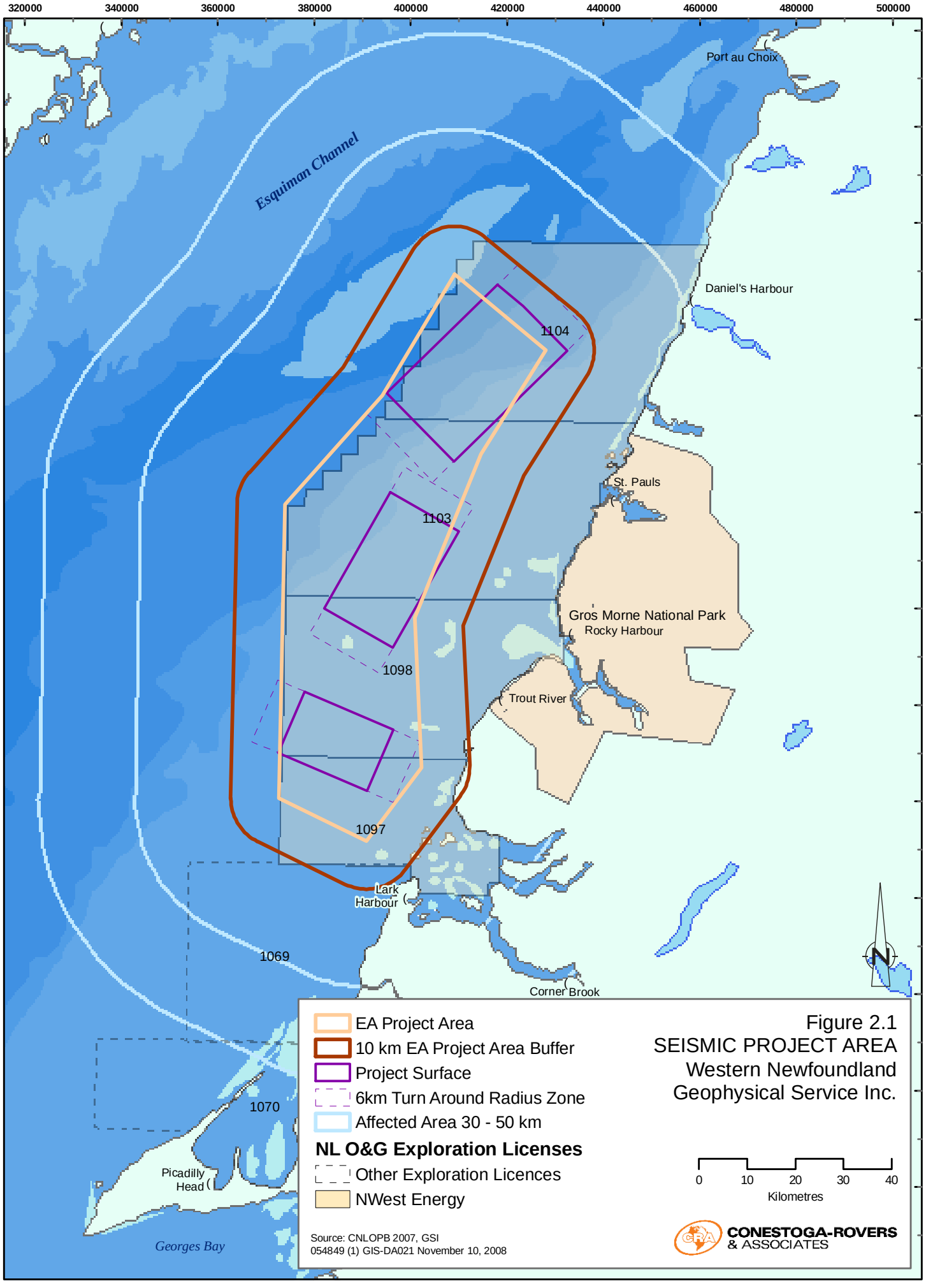
2.2 Project Spatial Boundaries

GSI has modified portions of its 2008 marine seismic survey program. Table 2.1 shows the corner coordinates of the proposed amendments to the survey areas, which are shown in Figure 2.1.

Table 2.1: Corner Coordinates of Revised Survey Area

North Block		**Centre Block**		**South Block**	
UTM E Z21	**UTM N Z21**	**UTM E Z21**	**UTM N Z21**	**UTM E Z21**	**UTM N Z21**
NAD 83	**NAD 83**	**NAD 83**	**NAD 83**	**NAD 83**	**NAD 83**
417992	5567182	395777	5524190	377978	5482871
432428	5553545	410030	5516082	396380	5474876
408917	5530575	396322	5491947	390930	5462208
395008	5544792	382044	5500106	372570	5470149

The spatial boundaries of the modified survey area are shown in Figure 2.1 with the boundaries of the Project Area, Affected Area and the Regional Area.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Esquiman Channel
Port au Choix
Daniel's Harbour
1104
St. Pauls
1103
Gros Morne National Park
Rocky Harbour
1098
Trout River
1097
Lark Harbour
1069
Corner Brook
1070
Picadilly Head
Georges Bay
N
EA Project Area
10 km EA Project Area Buffer
Project Surface
6km Turn Around Radius Zone
Affected Area 30 - 50 km
NL O&G Exploration Licenses
Other Exploration Licences
NWest Energy
Source: CNLOPB 2007, GSI
054849 (1) GIS-DA021 November 10, 2008
Figure 2.1
SEISMIC PROJECT AREA
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES

3.0 ALTERNATIVE TO THE PROJECT & ALTERNATIVES FOR THE PROJECT

There are no changes to this section.

4.0 ENVIRONMENTAL ASSESSMENT METHODLOGY

4.1 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. Boundaries are described generally below, and in further detail as part of the effects analysis sections for each of the VECs.

4.1.1 Temporal Boundaries

This amendment to the EIA report assesses potential effects of geophysical operations in January and February. The 2-D surveys will take 90 days to complete. Beyond the first survey scheduled for October 2008, subsequent surveys will be determined annually in consultation with stakeholders.

Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects, and any sensitive or critical periods of a VEC's life cycle (*e.g.*, spawning, migration), where applicable.

4.2 Cumulative Effects

With freeze up approaching, January and February will likely see a considerable reduction in shipping through the Project Area. No information is available from Transport Canada to describe shipping frequencies.

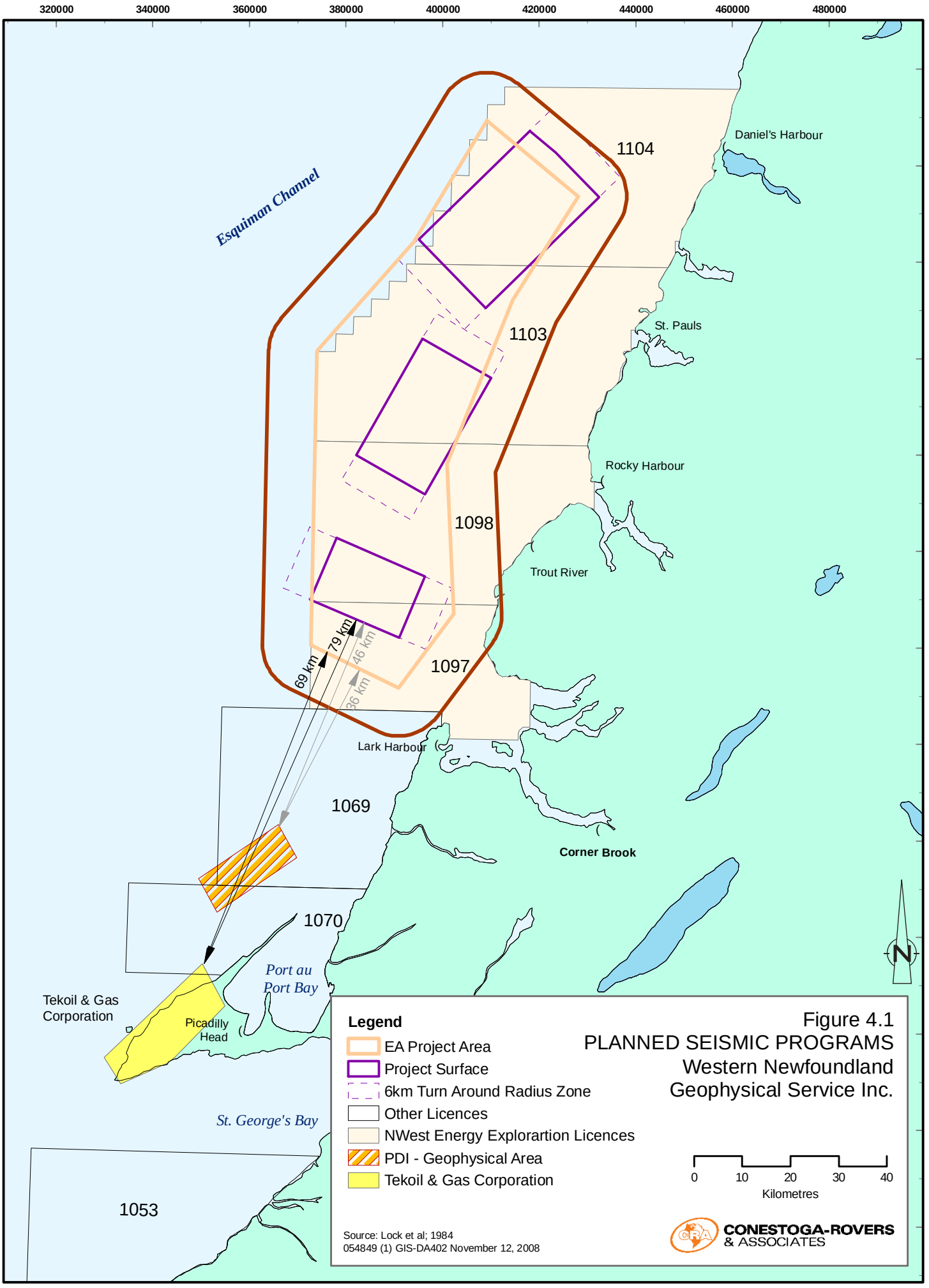
Fish harvesting is not pursued in January and February. Government research vessels are not in the Project Area in January or February.

There are two C-NLOPB approved seismic exploration projects in the Port au Port area. These two surveys are in the same location and are now 70 km south of the most southern boundary of the Project Area and 46 km from the southern boundary of the south block of the seismic survey area (Figure 4.1).

PDI Production Inc. (PDI) submitted a screening level EA as defined by the *Canadian Environmental Assessment Act* (*CEAA*) for a multiyear (2009-2014) ocean bottom cable (OBC) seismic/vertical seismic profiling (VSP) program proposed for marine areas near

the Port-au-Port Peninsula, Newfoundland and Labrador. Initially, PDI was planning a 3-D seismic survey over the Garden Hill South (GHS) area and a 2-D seismic survey over the Shoal Point area. Both proposed marine seismic operations will tie into land-based seismic components on the Port-au-Port Peninsula.

Tekoil and Gas Corp. stated in their EA that they were to commence their seismic survey from October 2008 to April 2009.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Daniel's Harbour
St. Pauls
Rocky Harbour
Trout River
Lark Harbour
Corner Brook
79 km
69 km
46 km
36 km
Port au Port Bay
Tekoil & Gas Corporation
Picadilly Head
St. George's Bay
N
Legend
EA Project Area
Project Surface
6km Turn Around Radius Zone
Other Licences
NWest Energy Explorartion Licences
PDI - Geophysical Area
Tekoil & Gas Corporation
Source: Lock et al; 1984
054849 (1) GIS-DA402 November 12, 2008
Figure 4.1
PLANNED SEISMIC PROGRAMS
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS & ASSOCIATES

5.0 ENVIRONMENTAL BASELINE

5.1 Marine Physical Setting

5.1.1 Chemical and Physical Oceanography Setting

5.1.1.1 Ice

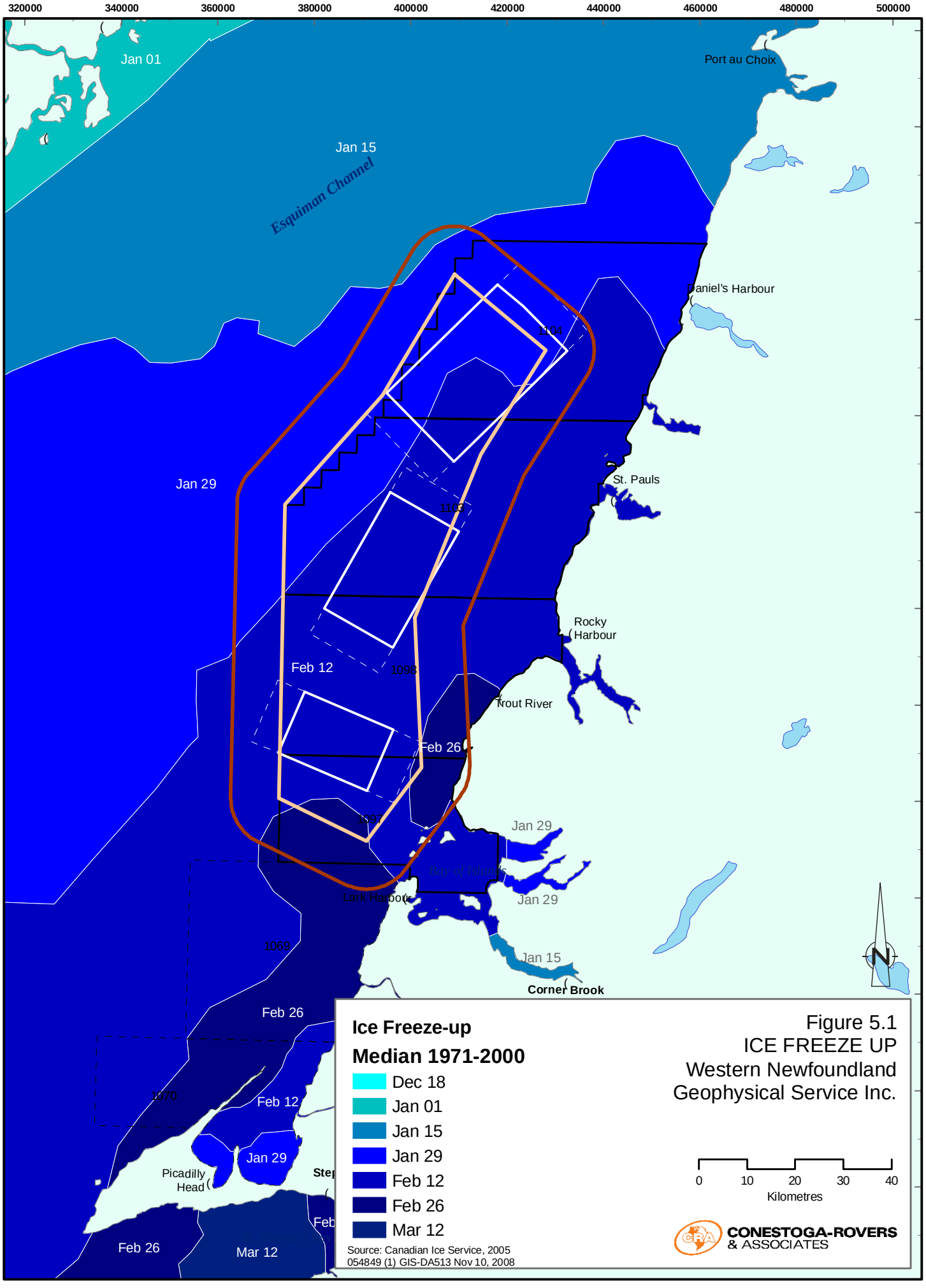
Floating ice is present in two forms in the marine environment: sea ice and icebergs. Both types pose a potential hazard to vessels. Seismic surveys conducted in this area between January 1 and April 30 have the potential of encountering ice.
Ice comes from three sources:

- Labrador ice from the north drifting through the Strait of Belle Isle;
- Ice from the St. Lawrence River and Estuary; and
- Ice formed in the Gulf of St. Lawrence.

The severity of ice varies relatively, depending on the strength and the vector of direction of the wind and the coldness from the air. Over the Gulf, the greatest average ice thickness is 16 cm in February and can vary up to one metre in the Esquiman Channel. In a common year, sea ice enters the Strait of Belle Isle by the start of January. The ice edge usually reaches Notre Dame Bay by the end of the month and Cape Freels in the middle of February. The ice edge is at its maximum southern extent by mid March, and fills the several bays and coves. By April, the rate of melting overtakes the southward ice drift and the pack slowly recedes. Usually by mid-April, navigation via the Strait of Belle Isle is possible, though in extreme years, ice can linger south of Belle Isle after Canada Day.

The freeze-up times discussed herein are based on a 30 year median, 1971 to 2000 (Figure 5.1). A review of weekly ice data for January and February 1970 through 2007 has shown that ice generally makes its first appearance in the northernmost portion of the Project Area by the middle of January. By the end of January, the most northerly and westerly third of the Project Area is ice covered. Usually by February 12, the majority of the Project Area, with the exception of some small near shore areas in the south, is ice-covered. The entire Project Area is generally ice covered by the end of February (Environment Canada 2005).

The ice concentration is the ratio expressed in tenths describing the area of the water surface covered by ice as a fraction of the whole area. Based on the 30-year median, there is generally less than 1/10 ice concentration in the Project Area on January 29. By February 6, the Project Area varies from 4-6/10 ice concentration in nearshore waters to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Port au Choix
Jan 15
Esquiman Channel
Daniel's Harbour
1104
Jan 29
St. Pauls
1103
Rocky Harbour
Feb 12
1098
Trout River
Feb 26
1093
Jan 29
Bay of Islands
Lark Harbour
Jan 29
1069
Jan 15
Corner Brook
Feb 26
1070
Feb 12
Jan 29
Picadilly Head
Feb 26
Mar 12
Ice Freeze-up
Median 1971-2000
Dec 18
Jan 01
Jan 15
Jan 29
Feb 12
Feb 26
Mar 12
Source: Canadian Ice Service, 2005
054849 (1) GIS-DA513 Nov 10, 2008
Figure 5.1
ICE FREEZE UP
Western Newfoundland
Geophysical Service Inc.
0
10
20
30
40
Kilometres
CONESTOGA-ROVERS
& ASSOCIATES

over 9/10 ice concentration in deeper waters. In late February, the Project Area is 10/10 ice concentration, based on the 30-year median.

Ice coverage in the Gulf of Saint Lawrence as a whole was lower than average in the 2005-2006 season, and considerably lower than average in the 2006-2007 season (Environment Canada 2006, 2007). (Data are not yet available for the 2007-2008 season). It is possible a similar situation may occur in the 2008-2009 season. Environment Canada's annual report entitled *Seasonal Outlook for Gulf of St. Lawrence and East Newfoundland Waters* for the 2008-2009 season should be available in early December 2008 and will provide further details on predicted ice coverage in the Project Area during the proposed survey timeframe.

Most icebergs enter the coastal and offshore waters of eastern Newfoundland. During late winter and early spring icebergs may occasionally enter the Gulf of St. Lawrence through old ice floes entering the Gulf from the Labrador Sea. About 10% enter the Strait of Belle Isle and drift into the Gulf of St. Lawrence towards Anticosti Island (Woodworth-Lynas *et al*. 1992).

5.2 Marine Resources

5.2.1 Marine and Migratory Birds

Figure 5.2 shows the distribution of vulnerable pelagic seabirds over the year. The period between January and March is zero to moderate in vulnerability to oil pollution (in terms of concentrations) for seabirds in the Affected Area. Most of the Project Area shows that no seabird surveys were undertaken and that may have been due to ice conditions. The highest abundance of seabirds, less than one bird per kilometre, occurs between January and March in the southern part of the Affected Area, particularly in the vicinity of EL 1097. An area of between 10 and 100 birds/km were present on the periphery of ELs 1103 and 1104 during this same period.

5.2.2 Marine Fish and Shellfish

Information on fish and shellfish is the same as provided in the original EA report. Based on the Strategic Environmental Assessment for Western Newfoundland and Labrador Offshore Area (LGL Ltd. 2005), halibut are the only fish spawning in the winter in the Gulf of St. Lawrence.

Greenland halibut (turbot) (*Reinhardtius hippoglossoides*) is a deepwater flatfish species that occurs in water temperatures ranging between –0.5 to 6.0°C but appears to have a preference for temperatures of 0 to 4.5°C. In the northwest Atlantic off northeastern Newfoundland and southern Labrador, these fish are normally caught at depths exceeding 450 m. Reported depths of capture range from 90 to 1,600 m.

These halibut are believed to spawn in Davis Strait during the winter and early spring at depths ranging from 650 to 1,000 m. They are also thought to spawn in the Laurentian Channel and the Gulf of St. Lawrence during the winter. The large fertilized eggs of this species (4 to 5 mm diameter) are benthic but the hatched young move upwards in the water column and remain at about 30 m below surface until they attain an approximate length of 70 mm. As they grow, the young fish move downward in the water column and are transported by the currents in the Davis Strait southward to the continental shelf and slopes of Labrador and Newfoundland (Scott and Scott 1988).

Atlantic halibut (*Hippoglossus hippoglossus*) in the northern Gulf of St. Lawrence are most abundant in the Esquiman, Laurentian and Anticosti Channels at depths >200 m. Based on observations made during scientific trawl surveys, these halibut are able to spawn in January and May (timing of surveys). Tagging studies have indicated that Atlantic halibut of this stock do not move far from their home range (DFO 2005). Most of the Atlantic halibut caught within the Study Area and landed at Newfoundland ports in 2004 were taken in the offshore areas of 4Rb, primarily beyond the 200 m isobath.

5.3 Other Ocean Users

5.3.1 Commercial Fisheries

Project Area Fisheries (4Rb, c)

Table 5.6 of the original EA showed the landed weight of domestic harvest within NAFO UA 4Rb, c within the entire Project Area and within the single Survey Area. Based on the Fisheries and Oceans Canada database, there were no landed catches in January and February 2004 to 2007 within the three new Survey Areas or within the Project Area (including the 10 km buffer).

Figure 5.3 shows shrimp fishing areas from January to February from 2004 to 2007. No shrimp fishing occurred in the Project Area during these months.

There was no snow crab harvest during January to February from 2004 to 2007 in the Project Area (Figure 5.4).

Figures 5.5 and 5.6 show a lack of seine fishing for mackerel, herring or capelin during January and February from 2004 to 2007. Seine fishing did not occur in the Project Area during these months.

Gillnet fishing for plaice, cod, halibut, redfish, skate or turbot was not undertaken in the Project Area between January and February from 2004 to 2007 (Figure 5.7).

There was no longline fishery in the Project Area during January and February from 2004 to 2007 (Figure 5.8).

5.3.2 Research Vessel Surveys

Figure 5.9 shows the locations of DFO research vessel surveys conducted in January and February, based on the DFO databases. Discussions with DFO representatives stated that the majority of stock surveys are undertaken in the summer months. None of the research surveys are within the Project Area over those winter months.

6.0 ENVIRONMENTAL EFFECTS OF PROJECT ACTIVITIES

6.1 Marine and Migratory Birds

The Gulf of St. Lawrence is occupied by numerous seabird species throughout the ice-free period and as expected, there is low abundance in the frozen ice period. Bird populations that may occur from January to February include Northern Fulmars, Black-legged Kittiwakes, Dovekies and murres. Harlequin Ducks and Common Eiders will be over-wintering along the coast (Figure 6.1).

6.1.1 Boundaries

With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January and February in 2009 for the first seismic survey. The ecological spatial boundary for marine bird species includes only foraging habitats.

6.1.2 Potential Interactions and Issues

There are no data suggesting that seismic surveys have adverse impacts on birds (MMS 2004). Potential impact mechanisms are noise impacts from seismic surveys and disturbance from vessels. Noise produced from these geophysical surveys might only impacts those offshore bird species that spend a considerable amount of time underwater, swimming or plunge diving for food. Noise from the surveys could adversely affect surface-feeding and diving seabirds near the air source array. A possible mechanism for indirect effects is alteration of prey concentration. However, persistent and widespread alterations in abundance of fishes are not expected.

Regulators have expressed concern on effects from attraction of birds to vessel lighting.

Coastal and marine birds could be affected by a spill due to an accident involving the survey vessel.

6.1.3 Significance Criteria and Evaluation

A significant adverse effect on coastal, marine and migratory birds is one likely to cause:

- A death or life-threatening injury of one or more individual of a listed species; and or
- Death or life-threatening injury of non-listed species in sufficient numbers to affect the population adversely; and or
- Long-term or permanent displacement of any species from preferred feeding, breeding or nursery habitats; and or
- Destruction or adverse effects of critical habitat for any listed species.

6.1.4 Effects Assessment and Mitigation

6.1.4.1 Seismic Source Emission

Many species of marine birds utilize habitats within the Affected Area; however, little information on the effects of seismic exploration surveys on these species exists in the scientific literature. Davis *et al.* (1998) suggested the lack of data regarding seabirds and seismic surveys reflects the minimal evidence that any effects occur.

Stemp (1985) found no evidence of seismic effects on marine bird mortality or distributional effects in Davis Strait and Parsons (in Stemp 1985) reported shearwaters did not respond to seismic sources when in close proximity (30 m) to high frequency sounds. Additionally, Turnpenny and Nedwell (1994) found no ill effects of air source seismic surveys on guillemots, fulmars, and kittiwakes. Research in the Irish Sea also indicated no evidence seabirds were attracted or repelled by seismic activity (Evans *et al.* 1993).

Because seismic pulses are directed downward and highly attenuated at the surface, near surface feeding and diving marine birds would not likely be exposed to sound levels that would result in significant adverse effects on hearing or be life threatening. Above the water, the sound from the air source array 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. It is possible birds on the water at close range would be startled by the sound; however, the presence of the vessel and associated gear dragging in the water should have already warned the bird of unnatural visual and auditory stimuli.

Stemp (1985) found no evidence that a seismic program in the Davis Strait area had resulted in distributional effects on marine birds. 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. Turnpenny and Nedwell (1994) refer to data in which trained observers reported no behavioural effects on guillemot, fulmar and kittiwake species that were monitored during air source seismic surveys. Thus, behavioural changes will likely not be evident for the bird species at risk in the Affected Area.

6.1.4.2 Vessel Presence

Seismic survey vessel traffic will be limited to routes to the Survey Areas and within the Survey Areas, including the turn around area.

Avifauna species that occupy the Affected Area will likely not be disturbed by vessel activity due to its transitory nature. The area of interest for seismic surveys is offshore and, therefore, is not expected to impact coastal breeding colonies as birds in this region are not breeding in January and February.

Birds attracted to vessel lighting at night may experience some disorientation and fly into vessel lights and other equipment. There is one extreme case of bird attraction where lights on a fishing vessel attracted 1.5 tonnes (6,000 birds) of crested auklets which endangered the vessel stability. The presence of the seismic vessel is a negligible addition of night lighting compared to fishing vessels and commercial traffic which transit through in the Project Activity Area year round. Collisions of migrating seabirds (*e.g.,* shearwaters, dovekies, murres and Leach's storm-petrel) is more of an issue with erect structures such as lighthouses, broadcast and communication towers, illuminated office buildings, and offshore platforms and light-induced fisheries (Gauthreaux and Belser 2006, Montevecchi 2006). Lighting is required for nighttime vessel activities; therefore navigation, deck lights and interior lights must be left on for safety. However, effort will be made to minimise operations that require high-intensity work lights. Such lighting may be turned off in inclement weather (low cloud cover, overcast skies, fog and drizzle conditions), if not required. Under foggy conditions, coastal lighting is more of an influence as birds fly closer to land (Chaffey 2003, Weir 1976, Blomquist and Peterz 1984). Other light mitigation measures could include shielding upward projecting lights, turning off unneeded interior and exterior lighting and covering windows at night. Routine checks for and records of bird collisions and stranded birds will be reported and appropriate release of birds affected by light in the Project Area will be conducted.

Procedures for handling stranded birds will follow those outlined in the Storm Petrel Mitigation Program developed by Williams and Chardine (1999) for the Terra Nova Offshore Oil Development (Appendix A). An Environmental Observer will be assigned on the vessel during seismic surveys. All marine observations will be reported and information will be given to appropriate organizations to provide valuable information on the distribution of marine birds off the west coast of Newfoundland. A Live Seabird Salvage permit from CWS may be required for this Project (Appendix B)

6.1.4.3 Vessel Discharge and Accidental Events

Accidental releases of hydrocarbons can expose birds to oil by breathing contaminated air, through skin contact, through eating contaminated prey items (Davies and Bell 1984), or by ingesting contaminants while preening contaminated plumage (Stout 1993). Exposure to hydrocarbons may result in a loss of waterproofing, thermoregulatory capability (hypothermia), and buoyancy (drowning) due to the matting of feathers (Wiese 1999; MMS 2004). Oil ingestion, even in small amounts, may result in lethal and sublethal effects, including starvation due to increased energy needs to compensate for heat loss (MMS 2004). Potential impacts are expected to be limited due to the high volatility and relatively small volume of the spilled oil (diesel or kerosene). If a spill occurred and marine birds were impacted, the Williams and Chardine protocol (entitled "The Leach's Storm Petrel: General Information and Handling Instructions") or protocols recommended by the C-NLOPB for handling oiled or standard birds would be followed. No significant adverse effects are likely to occur as a result of an accidental event associated with this Project.

The impacts of oil on birds have been well documented (*e.g.,* Hartung 1995); however, there will be limited amounts of marine fuel and lube oil onboard that could potentially be spilled into the ocean. No oil from discharge is expected to occur and thus, should not have any severe adverse effects on avifauna. Discharge from vessels will be standard for any marine vessel and will follow Offshore Waste Treatment Guidelines (OWTG) (NEB *et al.* 2002). Potential oil spillage may occur from ballast and bilge water discharge, however, if oil is suspected to be in the water, it will be tested and if necessary, treated using an oil/water separator to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG.

Coastal and marine birds could also be affected by a spill from any vessel (fishing, commercial and DFO research) at sea. The single seismic vessel does not increase the risk to coastal and seabird populations as discussed in the original EA report.

GSI will use non-solid streamers with an Isopar-M fluid. This fluid is kerosene and is used as a dispersant on crude oil spills. GSI has increased the thickness of the streamer skin to further reduce the possibility of a leak or spill, with a wall thickness 12% thicker that that of the original manufacturer. The vessel is required to carry a "Shipboard Oil Pollution Emergency Plan" pursuant to MARPOL 73/78. The Plan contains a description of procedures and checklists, which govern operations involving hydrocarbons. Adherence to this plan should prevent unintended operational releases. Effects due to accidental spills associated with the proposed operation are considered to be detectable if they occur, but to likely have negligible results on fish populations. The streamer will be fluid-filled. Fluids used in streamers (can be light oils or kerosene) are used for floatation purposes only. There are no records of streamer spills in the C-NLOPB files which have been kept since 1997. There were five incidents of streamer spills off Nova Scotia, all in 2003. All spills of streamer fluid were less than 1 m^3 and ranged from 0.02 to 0.57 m^3.

6.1.5 Cumulative Effects

The cumulative effects of anthropogenic disturbance such as seismic surveys, oil and gas exploration, commercial fishing and shipping, along with natural process such as weather and food availability, have potential to change predator and prey abundances inside and outside the Affected Area, thus causing adverse effects on avifauna. However, the minimal increase in vessel traffic from this Project will be minor compared with existing vessel traffic in the area and should not significantly increase disruption to avifauna. Due to the potential for ice coverage in February, marine traffic is likely to be considerably reduced.

PDI and Tekoil stated in their respective EA documents that their surveys could commence in the fall of 2008 and into 2009. These surveys have not commenced; therefore, there will not be any spatial or temporal overlap with other seismic surveys in January and February 2009.

Routine discharges from marine vessels containing petroleum hydrocarbons could cumulatively influence avifauna. The seismic vessel used for this Project will comply with discharge regulations established by OWTG and thus, should not significantly add to short-term or long-term effects of oil spillage on marine avifauna.

Overall, there are no cumulative effects of this seismic exploration Project expected to occur on the distribution, abundance, breeding status and general well-being of marine avifauna inside and outside the Project Area.

6.1.6 Monitoring and Follow-Up

The Fisheries Liaison Observers also act as Environmental Observers onboard to record marine bird (and marine mammal) sightings during the program. The protocol will follow CWS's Standardized Protocols For Pelagic Seabirds Surveys From Moving and Stationary Platforms for the Hydrocarbon Industry: Interim Protocol – June 2006 (Appendix C).

GSI will ensure that CWS is provided field data collection with respect to marine birds at the completion of the seismic survey. These marine bird data reports will be provided following this survey and any other subsequent seismic surveys.

6.1.7 Summary

Table 6.1 provides a summary of the potential for interaction, impact analysis, mitigations and cumulative and residual effects for marine and migratory birds.

Table 6.1 Summary of Environmental Assessment for Marine and Migratory Birds

Interactions and Issues ▪ Direct physical effects associated with seismic noise (*e.g.*, auditory damage) ▪ Decline in prey availability ▪ Disturbance from vessel noise and lights ▪ Accidental spills causing oiling of birds	
Impact Analysis There are no documented adverse effects directly on seabirds as reported by offshore observers. Effects associated with vessel presence and lights will be similar to what marine birds are exposed to now with the considerable commercial and fishing vessel traffic. Harlequin Ducks will not interact with the Project activities spatially, and are only at risk to a spill which would dissipate well within the distance of the Project Area to the coastline. Environmental effects including cumulative effects on marine and migratory birds are considered non-significant.	
Mitigation ▪ A dedicated observer will be on board the seismic vessel to record marine birds and incidents of collisions and strandings ▪ Vessel compliant with audit prior to survey ▪ Maintenance of streamer equipment and responsible management of such equipment ▪ Compliance with OWTG (NEB *et al.* 2002) and MARPOL for all discharges ▪ Avoidance of Gros Morne National Park estuaries by vessel	
Significance	
Likelihood of occurrence	Likely for survey Unlikely for spills
Geographic extent	Immediate, local to vessel
Frequency of occurrence	Intermittent for 90 days for 2-D program

Table 6.1 Summary of Environmental Assessment for Marine and Migratory Birds

Duration of impact	Immediate
Magnitude of impact	Negligible for seismic Low for spills
Reversibility	Reversible
Significance of Effects	Not adversely significant
Confidence • High level of confidence based on previous seismic surveys and research.	

6.2 Marine Fish and Shellfish

This analysis considers Project interactions with commercial pelagic and demersal fish and invertebrates, including egg, larval, juvenile and adult life stages. Fish spawning is of critical importance as survivability of fish at early life stages may be a major limiting factor on adult populations.

6.2.1 Boundaries

With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January to February in 2009 for the three Survey Areas.

The technical boundaries and the information available for this study rely on existing information with regard to marine fish/shellfish distribution, migration and spawning areas. There is a lack of precise spatial information on spawning grounds, particularly as related to non-commercial species. Other uncertainties surround some demersal fish species, which continue to decline despite moratoriums and controls on fishing effort. There are also few specific studies on the physical effects of seismic studies on fish spawning specific to the Affected and Regional Areas.

6.2.2 Potential Interactions and Issues

Potential interactions between the Project and marine fish and shellfish relate primarily to direct physical injury and detrimental behavioural effects as a result of noise from seismic activities. Physical injury may include failure to reach the next development stage, hearing injury and death to:

- fish eggs and larvae;
- juvenile and adult finfish; and

- invertebrates.

Behavioural effects may include:

- avoidance behaviour;
- increased swimming speeds;
- disruption of migration patterns; and
- disruption of reproductive behaviour and success.

Acoustic behaviour and uses of sound by fish are less documented than the physiology of sound detection by fishes. The effects of intense and potential harmful sound on fish hearing and behaviour are poorly understood. Such noise may disturb fish and may produce temporary or permanent hearing impairment in some individuals, but is unlikely to cause death or life-threatening injury.

6.2.3 Significance Criteria and Evaluation

A significant adverse environmental effect is one that is likely to cause one or more of the following:

- mortality or life-threatening injury to individuals of a species at risk;
- the abundance of one or more non-listed species is reduced to a level from which recovery of the population is uncertain;
- long-term or permanent displacement of any species from spawning habitat; or
- destruction or adverse changes to critical or essential fish habitats.

To be considered significant, Project-related mortality would exceed the range of natural mortality by two standard deviations.

A non-significant adverse environmental effect is one that is likely to cause one or more of the following:

- mortality or life-threatening injury of individuals (other than listed species) in small numbers that would not adversely effect the population or the ecological functioning of the fish community; and / or
- short term displacement of individuals from preferred feeding, spawning, nursery grounds or migratory routes (including critical habitat for listed species and essential fish habitat).

6.2.4 Effects Assessment and Mitigation

Effects to fish and shellfish were discussed in detail in the original EA report and those conclusions are summarized in this section. Recognising that the fishers are not actively harvesting in the January to February period and behavioural effects on catch are not an issue, the fish and shellfish are still there and may be affected.

6.2.4.1 Physical Effects

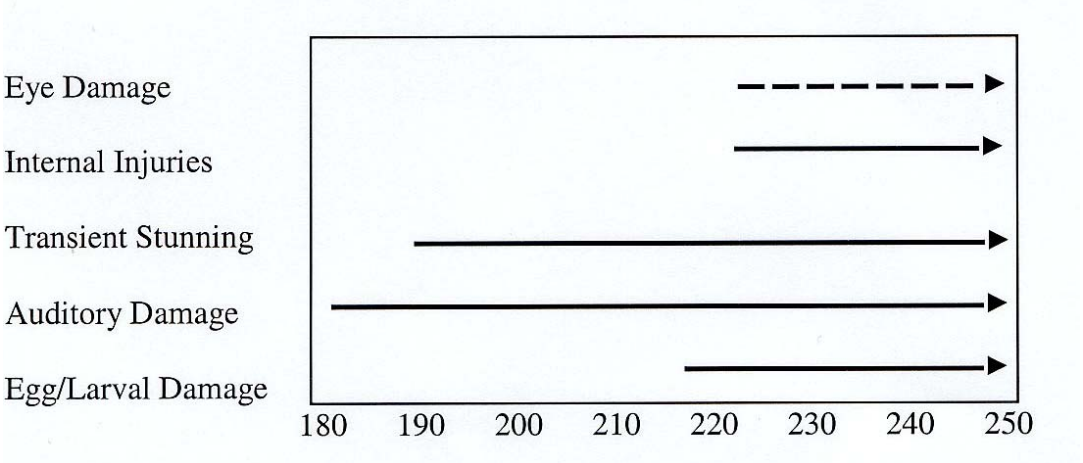
Most studies on the biological effects of seismic sound energy have concentrated on marine mammals and fish, groups which have sensitive hearing organs and which, in many cases, incorporate sound as part of social behaviour. Therefore, this section will discuss effects on physical and anatomical effects, and on spawning fish and eggs and larvae.

Mortality of fish has not occurred in research studies. Rise times are too slow and peak pressures too low to cause serious injury, except perhaps to fish that are within a few metres of an air sleeve at the time of discharge (Turnpenny and Nedwell 1994). DFO (2004) concludes that there are no documented cases of fish mortality upon exposure to seismic sound under field conditions and that exposure to seismic sound is unlikely to result in direct fish mortality. Therefore, spawning fish are not likely to be mortally impacted by the air source array from this Project.

Invertebrates lack swim bladders and hearing organs, two anatomical features where physical damage most likely occurs in aquatic organisms. The Royal Society of Canada (2004) suggests that seismic surveys will have no effect on the marine benthos provided the water depth is greater than 20 m. Kosheleva (1992) reports no obvious physiological effects beyond 1 m from a source of 220 to 240 dB re 1 µPa. He tested external damage and reported no visible signs of damage on crabs exposed to an air source element at 0.5 m.

Hastings (1990) reports the lethal threshold for fish beginning at 229 dB re 1 µPa and a stunning effect in the 192 to 198 dB re 1 µPa range. Turnpenny and Nedwell (1994) deduce that blindness can be caused in fish exposed to air sleeve emissions on the order of 214 dB re 1 µPa, auditory damage starts at 180 dB, transient stunning at 192 dB re 1 µPa and internal injuries at 220 dB re 1 µPa (Figure 6.2).

Figure 6.2 Sound Pressure Threshold (dB re 1 μPa) for the Onset of Fish Injuries



Source: adapted from Turnpenny and Nedwell 1994.
Note: Dotted line indicates an assumed sound level.

Most fish exposed to an air source array at a distance of a few metres could suffer inner ear damage at a source range of 210 and 240 dB. For this Project 2-D array, this sound level is 1 metre or less from the array, depending on angle of emission. The probability of hearing impairment decreases with increased distance between the fish and an air source array as sound attenuates.

Increased stress as a response to external factors is generally difficult to measure in invertebrates. However, changes in relative movement when exposed to a sound field may be a good indicator of stress. Christian *et al.* (2004) discuss the startle responses observed by snow crabs held in a DFO tank and exposed to sounds produced by the clanging of metal bars. Snow crabs were observed immediately drawing in their legs and proceeding to escape the region of the imposing sound. When exposed to a 200-cu. in. array located at a distance of 50 m, caged as well as tagged snow crab demonstrated little to no movement; they did not draw in their legs, and they remained in their original position (Christian *et al.* 2004). Thus, seismic sound fields are not anticipated to cause adverse effects by increasing stress on snow crabs.

In response to concerns for seismic surveys in shallow water on the west coast of Newfoundland, Payne *et al.* (2007) were funded to conduct laboratory and field experimentations on lobsters subject to seismic sources. Over a period of days to several months, there were no effects of delayed mortality or damage to mechanosensory systems associated with animal equilibrium and posture. There was no evidence of leg loss or other appendages. Sublethal effects were observed with feeding (minor) and serum biochemistry and organ stress was apparent in the hepatopancreas.

No significant adverse effects of seismic noise on the behaviour or physiology of fish and shellfish are anticipated from the GSI 2-D seismic surveys.

6.2.4.2 Eggs and Larvae Development

Based on the Strategic Environmental Assessment for Western Newfoundland, the only commercial fish species spawning in the winter are Greenland and Atlantic halibut. These species appear to spawn outside of the Project Area for the most part. There may be spawning of Atlantic halibut in the northern Survey Area which covers water depths >200 m.

While it is recognized that fish eggs, zooplankton (including ichthyoplankton) and larvae could be killed or damaged at distances up to or less than five metres from a large array, various studies have indicated that the impact would be indistinguishable from natural mortality, given the extent of exposure and the numbers of organisms involved.

Reporting on a workshop of oil industry, DFO and fisheries participants from Nova Scotia and Newfoundland sponsored by ESRF in Halifax in 2000, LGL-Griffiths Muecke (Thomson *et al.* 2001) noted that, in light of such information, "The workshop participants concurred that studies of seismic effects on fish eggs and larvae were of low priority and were not considered further" (p. vii).

No significant adverse effects on fish, lobsters, snow crab or eggs and larvae are anticipated as a result of GSI's 2-D seismic program. No specific mitigation is proposed during routine seismic activities.

6.2.4.3 Accidental Events

Oil or kerosene spills may affect water quality, which in turn may affect the health and survival of plankton, fish eggs, and larvae, juvenile and adult fish in the immediate vicinity of the vessel. While risk to adult fish and shellfish is low, pelagic fish eggs and larvae may be affected to different degrees by an accidental spill of hydrocarbons in the water. The nature and degree of such an interaction depends on the severity, timing, and location of the spill. The risk of such vessel accidents is low, and the volumes potentially released are limited. The probability of spills and the research undertaken in spill events to show low effects was discussed in detail in the original EA report.

Therefore, incidents involving survey vessels are not likely to result in significant effects on fish.

6.3 Cumulative Effects

The main projects and activities that may interact cumulatively with fish spawning include oil and gas exploration and production activities, other seismic projects, commercial shipping traffic, commercial fishing, and commercial fishing traffic. Two seismic exploration projects were to be active in the vicinity of the Project Area. PDI Productions Inc. was commencing work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. may be conducting seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. The PDI survey area is 46 km from the GSI southern survey area and Tekoil is 79 km away. Neither survey is being undertaken in January and February 2009, thus there will be no spatial or temporal overlap between these projects and the GSI Project.

In addition to these human activities, marine fish populations in the Affected Area may be affected by natural factors, such as changes in prey and predator populations in areas within their natural range that may occur outside the Affected Area. Certain populations of marine fish are more vulnerable to changes in their environment. This is especially true of species at risk. This seismic program is not changing critical or preferred habitats of marine fish, nor resulting in mass removal of these species. The distribution of most fish species varies seasonally in response to physical or chemical changes in the surrounding environment (*e.g.*, depth, substrate, salinity, temperature) and as a result of seasonal habitat requirements (*e.g.*, spawning, feeding).

Long annual migrations are undertaken by most pelagic species, such as herring and mackerel, and groundfish species, such as cod. The Project will not change the physical or chemical requirements that dictate fish presence, and their ability to reproduce.

Although non-significant, the residual effects of the Project components on fish spawning that may be cumulative with the effects of other human activities in the region are expected to be very limited, consisting primarily of short-term avoidance behaviour. Commercial fishing is not being undertaken in January and February. Seismic surveys produce repetitive, localised and short-term increases in ambient noise levels, with the period between potential exposures ranging from hours to days. Within the near field of an array, about 300 m, received noise levels may reach or exceed 180 dB re 1 µPa.

Beyond this distance, sound from a seismic survey is similar to commercial vessels (MMS 2004).

If another seismic survey was being conducted on the western shelf within the proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical interference. For instance, most survey operators indicate that they aim to maintain a minimum distance of 40 to 50 km from any other survey vessels, and separation for concurrent surveys is typically greater than 50 km. In the normal course of survey operations, seismic vessel operators, working in a similar geographical area, will plan operations to maximize separation and thereby reduce or avoid seismic 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 marine fish and shellfish.

Considering the significance criteria provided for fish and given that impacts from cumulative vessel traffic, individual projects and other activities in the Affected Area are not likely to contribute to significant adverse effects. The Project components are predicted to have minimal interaction with species at risk; the 2-D seismic survey is not anticipated to result in significant cumulative adverse effects to marine fish and shellfish. Seismic surveys (2-D) have been undertaken in the Regional Area in the past with no apparent effects to fish or fisheries success.

6.3.1 Monitoring

Follow-up and monitoring are not recommended for fish and shellfish for routine seismic activities.

6.3.2 Summary

Table 6.3 provides a summary of the potential for interaction, impact analysis, mitigations and cumulative and residual effects for marine fish and shellfish.

Table 6.3 Summary of Environmental Assessment for Marine Fish and Shellfish

Interactions and Issues
▪ Behavioural changes ▪ Physiological changes ▪ Masking of sound ▪ Hearing impairment ▪ Mortality

Table 6.3 Summary of Environmental Assessment for Marine Fish and Shellfish

Impact Analysis Noise levels from geophysical activities and vessel traffic for this Project are predicted to be less than the limits that cause physical effects on fish. Turnpenny and Nedwell (1994) summarized the following physical effects of noise on fish (worse case within 10 m of a 255 db re 1 µPa source): ▪ transient stunning of marine fish occurs at noise levels above 192 dB re 1µPa; ▪ internal injuries at 200 dB re 1µPa; ▪ egg/larval damage due to noise occurs at 220 dB re 1 µPa; and ▪ fish mortality at 230-240 db re 1µPa. McCauley *et al.* (2000a, b) conducted trials with captive fish and found that increases in swimming behaviour occurred when seismic sound levels reached 156 dB re 1 µPa. In the survey proposed by GSI, sound is estimated to attenuate to 156 dB re 1 µPa @ 1 m at a distance of 32 m-500 m at 0° below horizon and 812 m-32 km at 45° emission angle in 40 m of water. In 150 m water depth, the distance to the same attenuation is 32 m-128 m at 0°, 32 m at 10°, and 2-32 km at 45° emission angles. Noise levels should attenuate to ambient levels 30 to 50 km from the survey vessel. To minimise sudden changes in noise levels, GSI will implement a ramp-up procedure. The various components and activities associated with the proposed Project are not predicted to result in significant environmental effects on fish and shellfish because the effects are reversible, of limited duration, magnitude, and geographic extent (Table 5.2). Although there are few studies on the effects of seismic surveys on specific fish species in the Gulf of St. Lawrence, research studies show that mortality or serious injury is unlikely beyond a distance of approximately 2 m from the sound source. Effects of the Project on marine fish and shellfish in the Affected Area are predicted to be non-significant.	
Mitigation ▪ Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment*, to the extent reasonably practical. ▪ To minimize sudden changes in noise levels, a 30 minute ramp up procedure will be implemented. ▪ Avoidance of known spawning areas at times when fish are known to be spawning, where appropriate. ▪ Compliance with OWTG (NEB *et al.* 2002) for all discharges.	
Significance evaluation	
Likelihood of occurrence	Low for shellfish and finfish physical effects.
Geographic extent	Immediate to the air source array for physical effects
Frequency of occurrence	Intermittent during 2-D data acquisition (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible
Significance of effect	Not adversely significant
Confidence	
▪ Understanding the use of sound by fishes is very poor with few relevant published papers. ▪ Lack of specific knowledge about critical fish areas in the Gulf of St. Lawrence.	

6.4 Marine Mammals

Marine mammals are considered a VEC due to their significant role in the offshore ecosystem and because of regulatory protection, and scientific and public concern. This analysis considers cetaceans and pinnipeds that may live and/or migrate through the Project Area.

6.4.1 Boundaries

Temporal boundaries for this analysis are defined by the extended Project schedule into January and February 2009. Temporal ecological boundaries for cetaceans and pinnipeds vary according to species. Most cetaceans are migratory and occur in the Gulf of St. Lawrence predominantly during the summer and fall months (Lesage *et al.* 2007).

Therefore, it is expected that marine mammal presence will range from limited to zero in the Project Area in January and February 2009, and thus not considered further. Mitigation is provided below. The original EA addressed effects on marine mammals for the remaining year.

6.4.3 Mitigation

The Statement of Canadian Practice for Mitigation of Seismic Noise in the Marine Environment (DFO 2008) will also provide guidance to the seismic program. The Statement of Canadian Practice aims to formalise and standardise the mitigation measures used in Canada with respect to the conduct of seismic surveys in the marine environment. It is based on a DFO-sponsored peer review by Canadian and international experts. The following points outline the mitigation measures described in the Statement of Canadian Practice:

- Avoid death, harm, or harassment of individuals of marine mammals and sea turtles listed as endangered or threatened on SARA; and population-level effects for all other marine species.
- Avoid, to the extent reasonably practical, causing a dispersion of an aggregation of spawning finfish.
- from a known spawning area; a displacement of a group of breeding, feeding or nursing, or migrating, marine mammals, if it is known there are no alternate areas available to those marine mammals for those activities.
- Avoid, to the extent reasonably practical, displacing an individual marine mammal listed as endangered or threatened on SARA from breeding, feeding or nursing, or migrating, if it is known there are no alternate areas for those activities that the individual could be expected to use.
- Establish a safety zone of 500 metres from the centre of the seismic source array or arrays.
- Conduct regular on-going visual monitoring of the safety zone by a qualified Environmental Observer, including continuous visual monitoring during a period of at least 30 minutes prior to start-up of the seismic array.
- Delay start up if a whale, other than a dolphin or a porpoise, is seen within the safety zone during the 30 minute visual survey until the sea turtle or whale has not been observed for at least 30 minutes within the safety zone or has been observed leaving the safety zone.
- Shut down seismic array immediately when a whale is observed to be in the safety zone if that whale is listed as endangered or threatened on SARA or is

listed as a species of special concern for which there could be significant adverse effects.

- Operations may re-commence, using ramp-up/soft-start measures if the array has been shut down for more than 30 minutes. This includes commencing the ramp-up by firing a single source, preferably the smallest source in terms of energy output and volume; and continually activating additional sources in ascending order of size over a 20 to 40 minute period until desired operating level is attained.
- Shut down seismic source array(s) or reduce to a single energy source for line changes. If shut down occurs, ramp-up/soft-start procedures will not be required as alternative measures to maintain the safety zone will be used.
- During periods of low visibility and if the seismic program is in an area known to be an area where a vocalizing whale, other than a dolphin, that is listed as endangered or threatened on SARA, is reasonably expected to be encountered, a ramp-up / soft-start will only commence.

GSI will conduct a marine mammal monitoring program for whale species at risk during survey data acquisition. The reporting of marine mammal observations will use the forms developed under the Joint Nature Conservation Committee (JNCC) Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Surveys (April 2004). A trained Environmental Observer will watch for marine mammals from the bridge, forward and aft, of the seismic vessel throughout the survey. GSI will establish a 500 m safety zone for the program and will delay start up of the air source array if a turtle or whale is observed within the safety zone and will shut down the seismic array if a *SARA* listed whale or turtle is observed within the safety zone. Prior to arriving at the start of a line, the air source array will be slowly brought up to maximum power, a procedure referred to as a "soft start" or "ramping up". An approved ramp-up procedure will be followed when air source operations begin or after every shutdown. Vessels towing streamers have limited maneuverability when the equipment is deployed. GSI is including a 10 km vessel turn-around perimeter around the survey area, during which time the array will be powered down to a single air source (likely the smallest) to warn marine mammals of the presence of the seismic vessel. If the air sources are completely shut down due to maintenance or other purposes, the arrays will be ramped up according to C-NLOPB guidelines, regulations or conditions of authorization.

The potential effects from vessels on marine mammals include strikes, temporary behavioural (aversion or attraction) effects, and effects from vessel noise. The physical presence of the vessel during seismic surveys does not typically result in significant adverse effects regarding collisions. Marine species, in particular marine mammals, are

expected to easily avoid the vessel during seismic surveys due to exhibited avoidance behaviour to noise and the slow speed of the ship. The survey vessel will likely travel at an average speed of 4.5 knots when the survey gear is deployed and will increase to approximately 10 knots while in transit. These speeds are within operational activities of fishing and commercial marine traffic. While the potential for collision exists, collision events are predicted to be unlikely. Collision with an endangered species would be considered significant; however, since there are no records of collision between the listed species at risk and seismic vessels, the probability of occurrence is considered low. Bow wave riding delphinids is considered an attraction behaviour response and unavoidable, and is not considered an adverse effect.

6.4.4 Accidental Events

Spilled oil may affect marine mammals through dermal contact, inhalation, ingestion and/or fouling of baleen plates. Potential impacts will be short-lived due to the high volatility and relatively small volume of the spilled oil (diesel or kerosene) and confinement to surface water. No significant adverse effects are anticipated for marine mammals as a result of small volume accidental spills.

6.4.5 Cumulative Effects

In general, because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects will be associated with other concurrent activities (*e.g.*, cargo ships, tankers, oil and gas exploration and production activities, other 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 localised, and therefore, not significant with respect to effects on species at risk.

Two seismic exploration projects may be active in the vicinity of the Project Area. PDI Productions Inc. was to commence work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. was to conduct seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. It appears that neither survey is being undertaken in January and February 2009, therefore there is no temporal overlap. In the event of other seismic surveys being conducted on the Western Shelf within the

proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical 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 species at risk.

In general, the seismic survey vessel activity and noise will constitute a minor percentage 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 impacts on species at risk.

6.4.6 Monitoring and Follow-Up

The Fisheries Liaison Observer acts as the Environmental Observer onboard the seismic vessel. That individual will record sightings of marine mammals on a daily basis, weather permitting. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. This, along with a 30-minute ramp-up procedure will ensure that whale species at risk in the Affected Area are not significantly affected in an adverse manner.

GSI will conduct a periodic review of the EA report to determine the validity of species at risk assessment and acknowledges that additional mitigation may be necessary should new species be added to Schedule 1 over the life of the Project.

6.4.7 Summary

Table 6.4 summarises the environmental effects on marine mammals from the GSI geophysical surveys.

Table 6.4 Summary of Environmental Assessment for Marine Mammals

Interactions and Issues
• Disturbance of marine mammals caused by the presence of vessels, particularly with regard to collisions with species at risk. • Noise from seismic activities leading to masking of cetacean vocalisation; behavioural changes; temporary threshold shift or hearing impairment; or • physical injury.
Impact Analysis
There is lack of published information regarding avoidance thresholds in odontocete whales, however, baleen whales exhibit clear avoidance behaviours at threshold levels of approximately 160 to 170 dB re 1µPa (rms) (Davis *et al*, 1998). NMFS policy regarding exposure of marine mammals to high-level sounds is that whales should not be exposed to impulse sounds exceeding 180 dB re 1µPa (rms), although behavioural

Table 6.4 Summary of Environmental Assessment for Marine Mammals

changes are apparent at 160 dB re 1µPa (rms) (NMFS 2000). Therefore, using 170 dB re 1µPa (rms) (≈160 dB re 1µPa (SEL)) as a received sound level boundary, the minimum and maximum distance from a 242 dB re 1µPa$_{(rms)}$ at 1m broadband source to an attenuation of 170 dB re 1µPa $_{(rms)}$ is 32 km at 0° from horizon and 2 km at 45° in 150 m water depth. Effects from seismic activities may result in physical injury and auditory impairment in cetaceans that are in close proximity to the firing air source array, a distance that should be avoided by marine mammals through ramping-up or when they hear the approaching seismic vessel. Auditory damage and mortality as a result of seismic activities and/or vessel traffic is not considered to be a major concern with respect to the proposed Project. The proposed Project may result in behavioural effects on marine mammals; however, most studies indicate that such behavioural disturbances are likely to be transitory with normal behaviour resuming within an hour or two after vessel passage. Mortality, serious injury or displacement from behavioural patterns that disrupt the ecological functioning of a species are not expected as there is no evidence nor expectation that seismic activities will result in these effects (MMS 2004).	
Mitigation • Collision avoidance practices, including constant speed and course maintained by seismic and support vessels. • Trained observer on the seismic vessel to ensure that air source s are shut down if endangered or threatened cetaceans are present within 500 m of the seismic vessel. • Ramp-up procedure will be implemented, prior to start. Ramp-up will be delayed if a marine mammal is present within 500 m of the seismic vessel.	
Significance evaluation	
Likelihood of occurrence	Medium
Geographic extent	Immediate to Regional for disturbance effects
Frequency of occurrence	Intermittent during 2-D data acquisition (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible, immediate recovery after Project activities cease
Significance of Effect	Not adversely significant
Confidence	
• High level of confidence related to significance rating given international and local industry experience.	

6.5 Sea Turtles

Sea turtles are tropical and sub-tropical animals and will have migrated out of the Gulf of St. Lawrence and are not considered further for this seasonal amendment report.

6.6 Species at Risk

6.6.1 Boundaries

The spatial boundaries of interaction between species at risk and the Project are primarily related to the zone of influence as predicted by modelling of noise attenuation from the seismic array.

Ecological spatial boundaries vary between the various species at risk although it is recognised that most species at risk range beyond the Project Area:

- There are no known spawning areas for fish species at risk within the Regional Area in January and February.

- The ecological temporal boundary for marine bird species at risk includes the overwintering habitat of Harlequin Ducks. This species uses the nearshore coastal waters and watercourses in Gros Morne National Park and has limited potential for interaction with this Project. There are no known nesting grounds for the Ivory Gull in the Affected Area, and any presence in the area is expected to be incidental.
- Data on winter occurrence is poor to non-existent on the four species of marine mammals at risk to occur in the Gulf of St. Lawrence (Lesage *et al.* 2007). They may occur in the Affected Area and can be potentially affected by Project activities.

6.6.2 Potential Issues and Interactions

Potential interactions between routine Project activities and species at risk relate primarily to behavioural and physiological effects associated with air source operations. These disturbances may lead to the following effects:

- direct physical effects associated with seismic noise;
- behavioural effects associated with seismic noise; and
- auditory and communication masking by seismic noise in fish and mammals.

There are also likely interactions associated with operation of the seismic vessel and vessel traffic, particularly for bird species (*e.g.*, attraction noise and lights), and marine mammals (*e.g.*, collisions with vessels).

6.6.3 Significance Criteria and Evaluation

A significant, adverse environmental effect is one that, after application of all feasible mitigation and consideration of all reasonable Project alternatives:

- will prevent the achievement of self-sustaining population objectives or recovery goals;
- will result in exceedance of applicable allowable harm assessments; and or
- for which an incidental harm permit would not likely be issued. Due to the sensitive nature of species at risk, residual adverse effects on one individual may be considered significant.

A non-significant, adverse environmental effect is one that, after application of all feasible mitigation and consideration of all reasonable Project alternatives:

- results in threats to individuals, residences or critical habitat of listed species that does not jeopardize the survival or recovery of the species;
- does not result in exceedance of applicable allowable harm assessments; and or
- for which an incidental harm permit would likely be issued.

6.6.4 Effects Assessment and Mitigation

Potential effects on species at risk are discussed in Section 6.1.4 for marine and migratory birds, and Section 6.3.4 for marine mammals.

Recovery plans for the species at risk that may or do occur in the Affected Area are discussed below with respect to mitigation measures applied to the Project. Recovery plans for blue whales is pending and will be considered over the course of the eight year period, if they become available.

6.6.4.1 Marine and Migratory Bird Species At Risk

Harlequin Ducks

Potential impacts of vessel traffic on Harlequin Ducks have been identified in the 'Management Plan for the Harlequin Duck (*Histrionicus histrionicus*) Eastern Population, in Atlantic Canada and Quebec' (Environment Canada 2007). Vessel traffic will be well offshore and out of range of any direct impact with Harlequin Ducks; however, in the unlikely event of disturbance, mitigation measures are addressed below.

Harlequin Ducks are potentially impacted by vessel activity mainly during the moulting and wintering period. One of the most significant threats to North American moulting and wintering population of Harlequin Ducks is potential for oil contamination. Minimal amounts of oil will be aboard the seismic vessel. Potential oil spillage may occur from ballast and bilge water discharge but will be regulated to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG. Any accidental spills will be reported to the C-NLOPB immediately.

6.6.4.2 Marine Mammal Species at Risk

North Atlantic Right Whale Recovery Plans

Several potential impacts of vessel traffic on North Atlantic right whales have been identified in the 'Canadian North Atlantic Right Whale Recovery Plan' (Fisheries and Oceans Canada 2000. Areas of concern related to vessel traffic and mitigation measures are addressed below.

Vessel collisions, noise disturbance and habitat degradation have been identified as three of the main threats to North Atlantic right whale. To mitigate these potential risks, vessels will gradually increase the intensity of the air source discharge to allow time for whales and turtles to avoid the sound. In addition, a qualified offshore Environmental Observer from the vessel will be assigned to look for evidence of North Atlantic right whales (*i.e.,* whale footprints, surfacing) in the vicinity of the vessel. In the event of whale species presence, the vessel will cease seismic activity and take appropriate measures to avoid collision. Vessel operations will only commence when North Atlantic right whales are outside a 500 m safety radius of the seismic activity.

Petroleum spills are a major threat to North Atlantic right whale recovery. Minimal amounts of oil will be aboard the seismic vessel. Potential oil spillage may occur from ballast and bilge water discharge but will be regulated to ensure that oil concentrations in the discharge do not exceed 15 mg/L as required by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships 1972, and the Protocol of 1978 related thereto), International Maritime Organization and OWTG. GSI will contract a seismic vessel equipped with solid-streamer technology, as this type of streamer is not reliant on floatation fluid to achieve a neutral ballast state, thus reducing the risk of accidental spill. Any accidental spills will be reported to the C-NLOPB immediately.

Marine noise is a highly emotive issue as it affects cetaceans (large marine mammals, such as whales, dolphins and porpoises). Initial studies have established that noise generated from offshore operations present a low risk to marine life, but due to a lack of data for sensitive species, this statement cannot be adequately defined in all cases. There are no documented cases of marine mammal mortality from exposure to seismic sounds and DFO (2004) considers it unlikely that mammal mortality would be caused by seismic sound exposure.

A dedicated Environmental Observer will be onboard the seismic vessel. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. This, along with a 30-minute ramp-up procedure will ensure that whale species at risk in the Affected Area are not significantly affected.

The potential effects from vessels on marine mammals include strikes, temporary behavioural (aversion or attraction) effects, and effects from vessel noise. The physical presence of the vessel during seismic surveys does not typically result in significant adverse effects. Marine species, in particular marine mammals, are expected to easily avoid the vessel during seismic surveys due to exhibited avoidance behaviour to noise and the slow speed of the ship. The survey vessel will likely travel at an average speed of 4.5 kn when the survey gear is deployed and will increase to approximately 10 kn while in transit. While the potential for collision exists, collision events are predicted to be unlikely. Collision with an endangered species would be considered significant; however, since there are no records of collision between the listed species at risk and seismic vessels, the probability of occurrence is considered low.

Physical harm is expected to be mitigated by using ramp-up or soft-start procedures which will encourage whales to move from the area prior to physical effects occurring. The *Statement of Canadian Practice for Mitigation of Seismic Noise in the Marine Environment* (DFO 2008) for ramp-up and shut down of the air sleeves will be closely followed to avoid death, harm or harassment of individuals of marine mammals listed under *SARA*. Specifically, the ramp-up of the air sleeve to seismic survey capacity will occur over a 20- to 40-minute period to initiate a behavioural avoidance response in marine mammals whereby they will leave the Project Affected Area prior to experiencing hearing damage.

GSI will make the necessary arrangements to ensure that a qualified Environmental Observer will be on board the survey vessel at all times during the survey period. The observer will conduct continuous monitoring for marine mammals for 30 minutes prior to start-up of the seismic array.

6.6.5 Follow Up and Monitoring

Monitoring of species at risk is the same as for unlisted species discussed in the appropriate VEC sections above and in the original EA report.

6.6.6 Cumulative Effects

Seismic vessel activity is a minor component of total marine transportation. Two other geophysical surveys are anticipated on the west coast of Newfoundland during Fall 2008 and Winter 2009, compared with the multitude of commercial tanker, cargo ships, in the vicinity of the western coast of Newfoundland. The additional vessel activity from the survey is negligible compared to the other vessels and cumulative impacts on species at risk are not significant.

In general, because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects will be associated with other concurrent activities (*e.g.*, cargo ships, tankers, oil and gas exploration and production activities, other 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 localised, and therefore, not significant with respect to affects on species at risk.

Two seismic exploration projects may be active in the vicinity of the Project Area. PDI Productions Inc. was to commence work in the fall of 2008 in the Port au Port area (EL 1070) but if the Project undergoes unavoidable delays, the seismic work could be undertaken anytime in the next three years. Tekoil and Gas Corp. was to conduct seismic work over part of, and adjacent to, the Port au Port Peninsula (EL 1071) during a six-week period from October 2008 to April 2009. It appears that neither survey is to be undertaken in January and February 2009; thus there will be no temporal overlap. If these other seismic surveys being conducted on the west coast within the proposed timeframe, a significant distance between surveys will be necessary to prevent both operational conflict and acoustical 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 species at risk. The Tekoil survey area is 79 km away from the GSI southern survey area, and PDI is 46 km away.

In general, the seismic survey vessel activity and noise will constitute a minor percentage 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 impacts on species at risk.

6.6.7 Summary

A summary of potential interactions, environmental effects, mitigation, and cumulative and residual environmental effects are provided in Table 6.6.

Table 6.6 Summary of Environmental Assessment for Species at Risk

Interactions ▪ Direct physical effects associated with seismic noise (*e.g.*, auditory damage). ▪ Behavioural effects associated with seismic noise (*e.g.*, avoidance, changes in migration, and feeding). ▪ Communication masking by seismic noise in fish and mammals (*e.g.*, during feeding). ▪ Disturbance from vessel noise and lights.	
Impact Analysis Potential adverse environmental effects on species at risk will be unlikely because of planned monitoring and mitigation measures. In addition, species at risk are expected to show some avoidance of the areas of highest received levels of seismic sounds. Therefore, there is not likely to be a significant adverse environment effect on species at risk.	
Mitigation ▪ Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* to the extent reasonably practical. ▪ A 500 m safety zone monitoring program for whale species at risk during survey data acquisition will be implemented. ▪ A dedicated Environmental Observer will be onboard the seismic vessel. If a concentration of marine mammals is observed in a particular area, the survey can shift to another part of the survey area until the concentration has moved away. ▪ To minimize sudden changes in noise levels, a ramp up procedure will be implemented. ▪ Collision avoidance practices, including constant speed and course maintained by seismic vessels. ▪ Compliance with OWTG (NEB *et al.* 2002) for all discharges. ▪ Avoidance of bird nearshore overwintering Harlequin Ducks in Gros Morne National Park	
Significance	
Likelihood of occurrence	Medium
Geographic extent	Local to Regional for disturbance effects.
Frequency of occurrence	Intermittent for the 2-D program (90 days)
Duration of impact	Immediate
Magnitude of impact	Low
Permanence/reversibility	Reversible, immediate recovery after Project activities cease.
Significance of Effects	Not adversely significant
Confidence	
High level of confidence based on previous seismic surveys.	

6.7 Sensitive Areas

Special Areas include "sensitive areas" such as important or critical habitat that may be affected by the Project, or areas that have special conservation status by law. There are four sensitive areas within and in close proximity to the Project Area: Gros Morne National Park, two lobster nursery areas and the cod spawning area (Figure 6.3). Details of these sites are provided in Section 5.2.8 of the original EA report.

There will be no incursion of the vessel into the cod spawning area and navigation of the seismic vessel for turning purposes will be a minimum of 35 km distance. The Project Area is located 30 km offshore of Gros Morne National Park and will not interact with Harlequin Ducks.

With respect to temporal boundaries, the potential interactions of concern are those related to the seismic activities that could occur in January and February 2009 for the first seismic survey. Surveys between May and December within the next seven-year (2009 to 2015) time period were addressed in the original EA report. There are no anticipated potential interactions between Project activities and sensitive areas because there are no direct effects to lobster larvae nursery areas and cod spawning areas by noise and accidental spill events in January or February as lobster larvae are settled on the seafloor and cod are not spawning; and there are no anticipated direct effects to the coastal environment and ecosystem of Gros Morne National Park from accidental events.

6.8 Commercial Fisheries

Commercial fisheries are important to the economy of Newfoundland and considered a VEC for this assessment due to potential interactions between the seismic vessel and fishing gear and vessels. There is no commercial fish harvesting being undertaken in January or February; therefore, there is no interaction between the GSI Survey over these two months and fish harvesting. This VEC Is not considered further.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

7.1 Meteorology and Oceanography

Extreme conditions may affect schedule and program operations. Seismic surveys (data quality) are limited by waves in excess of three metres. Meteorological and oceanographic monitoring through weather forecasting services will be undertaken to anticipate severe weather conditions. Degradation of data quality due to poor weather conditions is a determinating factor for operations.

7.2 Sea Ice and Icebergs

Icebergs of Newfoundland and Labrador typically do not extend into the Gulf of St; Lawrence as far south as the Affected Area. The seismic surveys will extend into a month where freeze up occurs in the Project Area. GSI will only work with very thin surface ice if it occurs as the vessel is capable of break it up and it would be of no consequence to the vessel. The cables are towed at eight metres below surface and well below any surface ice. If ice conditions were of a thickness to damage the cables, the data collection conditions would be unsuitable. GSI will watch for ice flows and where there is any risk to the vessel or equipment they will avoid the ice flows or cease operations.

8.0 SUMMARIES AND CONCLUSIONS

8.1 Summary of Mitigation and Follow-Up

Table 8.1 summarises mitigating measures and follow-up procedures that are recommended in this Amendment Report.

Table 8.1 VEC-Specific Mitigative Measures and Follow-Up

VEC	Mitigation Measures	Follow up and Monitoring
Marine and Migratory Birds	Compliance with NWest WMP, *Canada Shipping Act,* OWTG and MARPOL for all discharges. A fuel transfer plan will be developed and implemented. Any handling of stranded birds will follow CWS and industry protocols. A dedicated Environmental Observer will be on board the seismic vessel to record marine birds. Vessel compliant with audit prior to survey. Maintenance of streamer equipment and responsible management of such equipment. Avoidance of overwintering Harlequin Ducks in Gros Morne National Park by vessel.	Sightings data for seabirds will be summarised in a monitoring report which will be submitted to C-NLOPB and CWS. Records of bird strandings will be provided to the C-NLOPB for distribution to interested parties. DFO will be contacted on the sighting of dead and or injured seabirds. DFO will be notified if GSI is responsible for the harm to seabirds.
Marine Fish and Shellfish	Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment,* to the extent reasonably practical. To minimize sudden changes in noise levels, a 30 minute ramp up procedure will be implemented.	No follow up or monitoring required for routine activities
Marine Mammals	Before start of the operations, a meeting will be held with GSI representatives and seismic company representatives to review sail lines, scheduling, anticipated fishing vessels and gear types, mitigating measures, expectations of all parties and Emergency Response Plans. An Environmental Observer will be onboard the vessel throughout the duration of the survey. The Fisheries Liaison Observer and Environmental Observer will record sightings of marine mammals on a daily basis as per protocol. A 20 to 40 minute ramp-up procedure will be undertaken. Ramping up will be delayed if a marine mammal is observed in the 500 m safety zone. Air sources will be shut down or reduced to a smaller air source while the vessel is doing turns between survey lines. The Environmental Observer will ensure the delay or shut down of seismic operations if endangered or	A trained observer will record marine mammal and seabird observations. All spills will be reported. DFO will be contacted on the sighting of dead and or injured marine mammals. DFO will be notified if GSI is responsible for the harm to marine mammals.

Table 8.1 VEC-Specific Mitigative Measures and Follow-Up

VEC	Mitigation Measures	Follow up and Monitoring
	threatened whales are present within 500 m. Any re-start of the air source array will follow the ramping up procedure. Collision avoidance practices, including constant speed and course maintained by seismic and support vessels. Vessels will maintain a steady course and speed, and use existing travel routes, where possible.	
Species at Risk	Adherence to the *Statement of Canadian Practice on the Mitigation of Seismic Noise in the Marine Environment* to the extent reasonably practical. Same as above for marine birds and marine mammals	A trained observer will record marine mammal, sea turtles and seabird observations. All spills will be reported.
Sensitive Areas	Dedicated Environmental Observer will be on board the seismic vessel to record marine birds and marine mammals. Vessel compliant with audit prior to survey. Maintenance of streamer equipment and responsible management of such equipment. Compliance with OWTG (NEB *et al.* 2002) for all discharges. Avoidance of overwintering Harlequin Ducks in Gros Morne National Park by vessel.	No follow up or monitoring required for routine activities All spills will be reported.
Commercial Fisheries	A Notice to Mariners on the location and scheduling of seismic activities will be issued. Communication mechanisms will be developed with the fishing industry and DFO research surveys. Environmental Observers on the vessel will monitor fishing activity in the vicinity of the seismic vessel and serve as a liaison between the fishing vessels and the seismic vessel; GSI will comply with C-NLOPB's compensation guidelines.	No follow up or monitoring required for routine activities

8.2 Conclusions

The Project Area is not known to be an important feeding, rearing or mating area for any of the listed species that could occur in the area. Commercial fishing will not occur in January and February. With the use of appropriate mitigation, all Project effects have been rated as not adversely significant. Most of the species that could occur in the Project Area are more vulnerable to direct and indirect fishing activities; entanglement in fishing gear; collisions with ships; and/or pollution. As described in this report, all appropriate mitigation measures and response planning will be in place to limit pollution as a result of the Project; vessel activity will generally be restricted to the immediate Project Area; and noise levels associated with the Project are not predicted to

result in physical harm to marine birds, marine fish/shellfish, or marine mammals. Previous 2-D seismic surveys conducted in this area have not resulted in claims of significant adverse effects to biological or socio-economic VECs of the area. Based on the above, no harm to listed species or their critical habitat is anticipated to occur as a result of the Project in January or February. This is consistent with the recent review by the Mineral Management Service (2004) on environmental effects of seismic activities in the Gulf of Mexico, which have shown that adverse significant effects from a much larger number of seismic programs are not apparent beyond the immediate localised project areas.

The significance of residual environmental effects (*i.e.*, after mitigation has been applied), including cumulative effects, is predicted not likely to be significantly adverse for all VECs. In conclusion, this environmental assessment predicts that GSI's proposed 2-D seismic program surveys can be conducted with no likely significant adverse effects on the biological and socio-economic resources of the west coast of Newfoundland.

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