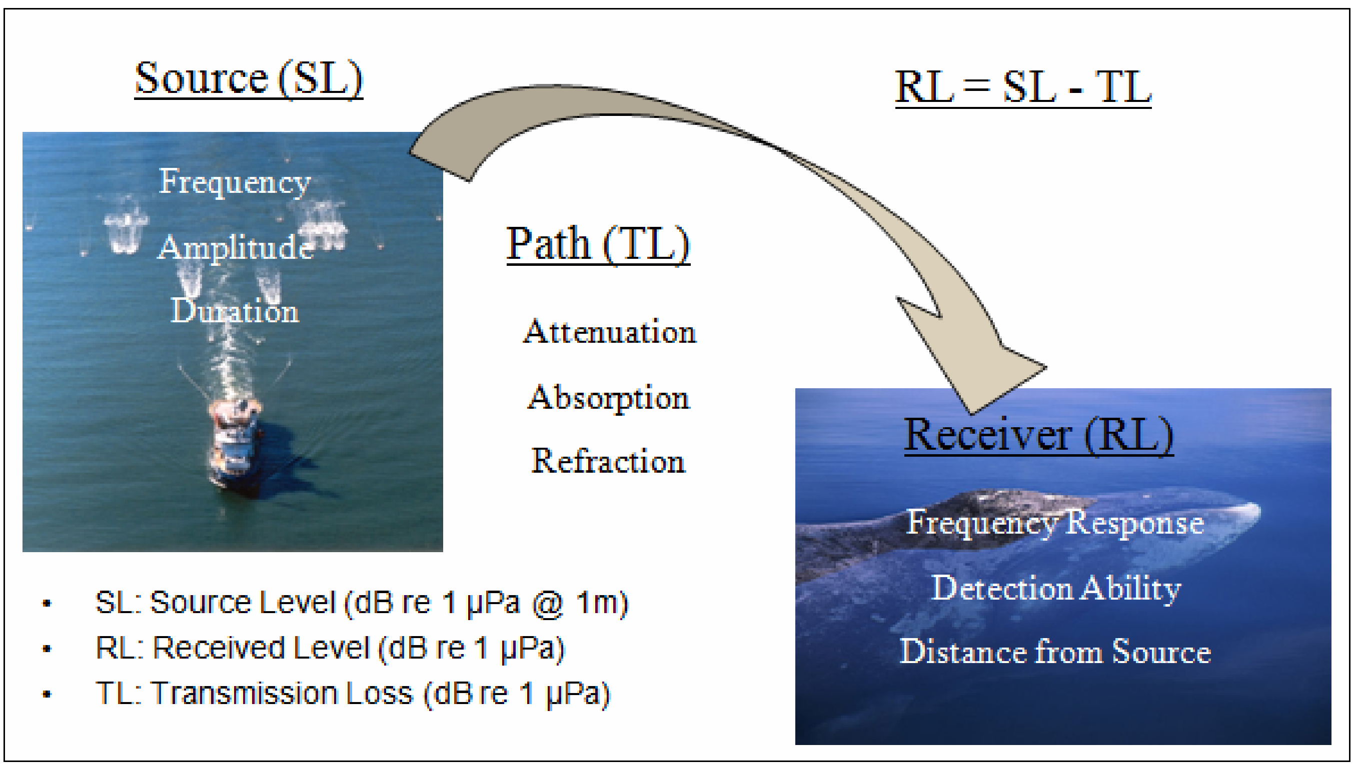
5.0 POTENTIAL ENVIRONMENTAL EFFECTS AND PLANNING IMPLICATIONS FROM EXPLORATION AND PRODUCTION ACTIVITIES

The SEA has focused on potential effects that are associated with exploration and production activities, specifically sounds, drill cuttings, miscellaneous discharges, vessel, traffic, animal attraction and accidental events. Mitigation for potential effects is considered, as are potential cumulative effects. In addition, any planning implications that were noted because of environment descriptions, data constraints and/or environmental effects are also discussed in these sections.

5.1 Sound and Noise Effects

Anthropogenic sound sources have been grouped into six categories: shipping; seismic surveying; sonars; explosions; industrial activity; and miscellaneous (NRC 2003a). Effects of underwater sound are based on the *Source - Path - Receiver* concept. The acoustic energy or sound originates with a source. Sound radiates outward from the source and travels through the water as pressure waves. The sound level decreases with increasing distance from the source. The ability of a marine animal to receive sounds is dependent upon the degree of propagation loss between the source and the receiver the hearing abilities of the animal and the amount of natural ambient or background sound in the surrounding sea (LGL Limited 2005b).

Figure 5.1 Source - Path - Receiver Model



Wind, thermal sound, precipitation, vessel traffic and biological sources all contribute to ambient sound. Ambient sound is highly variable on oceanic continental shelves and this may result in considerable variability in the range at which marine animals can detect anthropogenic sounds.

Communication can also be affected by sound waves produced during seismic surveys. These sound waves also create forces that may cause physiological damage to organisms' internal organs. Organisms with compressible structures such as air bladders are particularly at risk (Parry and Gason 2006).

There are various potential effects of exposure to sound from seismic and other sources that can be characterized as pathological, physiological or behavioural. One data gap is the lack of noise measurement and modelling in the Labrador Shelf SEA Area. Noise measurements and modeling may be useful in impact assessment and in identifying potential mitigations. The following section will provide an overview of the scientific information on the effects of sound to marine organisms.

5.1.1 Species at Risk

The marine mammal species at risk that could occur in the Labrador Shelf SEA Area are listed in Table 4.1. COSEWIC species that are not SARA-listed that could occur in the Labrador Shelf SEA Area are noted in Table 4.2.

5.1.1.1 Marine Fish

The effects of anthropogenic sound on fish are described in detail in Section 5.1.2. These effects are considered the same for SARA-listed fish, and include changes in behaviour and physical damage. The differences when dealing with SARA-listed fish are the potential consequences of these effects at population levels. For vulnerable populations, the loss of an individual or behavioural changes resulting in decreased fitness or reproductive success, may be detrimental to the population. Therefore, detailed knowledge of the effects of anthropogenic sound on SARA-listed fish is critical for their management and protection.

The studies indicate that behavioural effects of seismic activity on SARA-listed fish may include avoidance behaviour, increased swimming speeds, disruption of reproductive behaviour and alteration of migration routes (McCauley et al. 2000a, 2000b). Noise generated by seismic activity may also cause some species to avoid the zone of influence around the seismic vessel.

The direct physical effect of seismic activity on adult and eggs of wolffish will likely be minimal or nonexistent as these life stages are found near the bottom at 100 to 900 m from the surface. The greatest potential for harm is when activity is synchronized with larval hatching periods (Kulka et al. 2007). A recent allowable harm assessment (DFO 2004c) concluded that oil exploration activities were determined to have negligible effects on the ability of both northern and spotted wolffish to survive and recover. Sound from seismic activities would unlikely affect the northern and spotted wolffish.

5.1.1.2 Marine Mammals

The effects of anthropogenic sound on marine mammals are described in detail in Section 5.1.3. These effects are considered the same for SARA-listed marine mammals, and include changes in behaviour, hearing loss and physiological damage. What differs when dealing with SARA-listed species are the potential consequences of these effects at the population level. For vulnerable populations, the loss of a single individual, or even changes in its behaviour that result in decreased fitness, may be detrimental to a population. As such, detailed knowledge of the effects of anthropogenic sound on SARA-listed species is critical for their management and protection.

Most studies indicate that changes in behavioural patterns resulting from anthropogenic sound tend to be short term. These changes may include avoidance, deviation from normal migration routes, interruption of feeding, reduced surface intervals, reduced dive duration, and lower numbers of blows (Richardson 1986; Ljungblad et al. 1988; Richardson and Malme 1993, 1995; Richardson et al. 1999; McCauley et al. 2000a, 2000b; Gordon et al. 2004; LGL Limited 2005). Anthropogenic sounds may also result in an animal being displaced from, or being deprived of access to, critical habitats. All of these effects have the potential to reduce the survivorship of an animal and decrease its reproductive output.

In addition to behavioral modifications, anthropogenic sounds may cause increased levels of physiological stress that result in an individual becoming immune-compromised or having a reduced reproductive output. Knowledge of how short-term stress response may affect the long-term health of marine mammals is unknown (NRC 2003a) and, as such, makes it a matter of concern (Richardson 1986; Ljungblad et al. 1988; Richardson and Malme 1993 and 1995; RIchardson et al. 1999; McCauley et al. 2000a and 2000b; Gordon et al. 2004; LGL Limited 2005), particularly with respect to the SARA-listed species. NRC (2003a) noted that a decrease in feeding rate for marine mammals might potentially equate to a year’s delay in attaining sexual maturity, a small increase in infant mortality, or a slightly shorter life span that may not be important to an individual but could negatively affect the recovery of a SARA-listed population.

The biological implications of signal masking will depend greatly on the function of the signal and the context. In a healthy marine mammal population, the introduction of masking noise might have minimal effect; even if the females’ ability to make a mating choice were diminished, they would still be likely to find a mate. In the case of a severely depleted marine mammal population, the ability of males and females to find each other using acoustic cues could become vital for the well-being of the species (NRC 2003b). Unfortunately, our understanding of the mechanics of signal masking is severely limited, and knowledge of how marine mammals use acoustic cues in the marine environment is even more poorly understood (NRC 2003b). These are important data constraints, particularly in reference to SARA-listed marine mammals.

5.1.1.3 Marine Birds

Bird Species at Risk could interact with oil exploration activities, including sound from seismic airguns. Little is known about the impacts of underwater sound on birds. Only two of the five bird Species at Risk in the Labrador Shelf SEA spend time underwater, the Harlequin Duck and Barrow’s Goldeneye. Both are diving ducks, making short dives for underwater crustaceans and mollusks. These species would only be present during moulting time, but during this time could be distressed by underwater noise from seismic guns, affecting their foraging behaviour. This could cause avoidance of areas of oil exploration.

Oil exploration activities are unlikely to influence Eskimo Curlew, as it would be migrating through terrestrial environments if it were passing through Labrador (assuming the species still exists).

The Ivory Gull is associated with pack ice, so it could be affected by oil exploration activities that influence the formation or persistence of pack ice in the Labrador Shelf SEA like shipping traffic. It could also be disturbed by increased air traffic from helicopters and planes.

The Peregrine Falcon would not be directly affected by exploration activities except perhaps avoidance of areas of high traffic or noise. It feeds on birds that use the marine environment like Guillemots, but does not use the marine environment itself, minimizing the potential for sound transmission or oiling events to affect this species.

Generally, sound from seismic activities is anticipated to have little interaction with marine bird Species at Risk. Oil exploration activities may cause avoidance of some areas by marine birds, and increased aircraft and vessel traffic may affect reproductive success. Oiling events, either chronic or sporadic large-scale events, could have drastic effects on marine bird Species at Risk. Harlequin Duck and Barrow's Goldeneye would be the species that would be most susceptible to effects from the Project, given that they spend the most time in the marine environment.

5.1.2 Marine Fish

5.1.2.1 Invertebrates

The literature covering the effects of seismic sound and noise on invertebrates is limited and incomplete. Much of the existing scientific literature is difficult to compare and draw concrete conclusions because of inadequate documentation on measurement methods and units. The result is that the interpretation of many of the reports with respect to the effects of sounds on invertebrates may be considered subjective.

Field studies of effects of seismic activities are logistically demanding and scarce. Limited studies indicate that most effects on invertebrates without gas-filled cavities are likely too small to be measured in the field (Parry and Gason 2006).

Snow crab eggs were exposed to 221 dB at 2 m in a study and showed possible signs of retarded development (Christian et al. 2004). However, as the eggs are carried by the female and are not pelagic, they are not likely to be exposed at this range or intensity. Pearson et al. (1994) found no statistically significant effects were detected on Dungeness crab (*Cancer majister*) larvae exposed to peak levels of 230 dB re 1 μ Pa at a distance of 1 m. This suggests that crab larvae and perhaps other invertebrates (e.g., shrimp) without air pockets are more resistant to the effect of airguns than are fish eggs and larvae. Rather than being sensitive to pressure changes, invertebrates appear to be more sensitive to particle displacement. Decapods, such as crabs, have an array of hair-like receptors in and on their body surface, which could potentially respond to water or substrate displacements. Crustaceans appear to be most sensitive to low frequency sounds, less than 1,000 Hz (Budelmann 1992; Popper et al. 2001). A number of physiological studies of statocysts of marine crabs suggest that some of these species are potentially capable of sound detection (Popper et al. 2001). There are no indications of acute or mid-term mortality on adult snow crab due to seismic activity, nor does there appear to be any effect on the survival of embryos carried on the female or on the locomotion of the larvae after hatch (DFO 2004d). A follow-up review of this study will focus on crab tissue damage and embryo survivability (SPANS, pers. comm.).

Brown shrimp (*Cragnon cragnon*) in the Wadden Sea were exposed by Webb and Kempf (1998) to a 15 gun array (volume 480 cubic inches with source levels of 190 dB re 1μPa at 1 m depth). There was no evidence of mortality or reduced catch rates for the shrimp. The authors attributed the lack of effects to the absence of gas-filled organs and a rigid exoskeleton.

Bottom trawl yields of a non-selective commercial shrimp fishery in the Camamú Bay, Northeastern Brazil comprising the Southern white shrimp (*Litopenaeus schmitti*), the Southern brown shrimp (*Farfantepenaeus subtilis*) and the Atlantic Seabob (*Xyphopenaeus kroyeri*) were measured before and after (12 to 36 hrs) the use of an array of four synchronized airguns. Each airgun had a total capacity of 635 in^3, 2000 psi, and a peak pressure of 196 dB (re 1µPa at 1 m). No mortality was observed and overall results did not detect significant deleterious impacts on the species (Andriguetto-Filho et al. 2005). Caged shrimp were also exposed to the airguns at very close range; there were no reported mortalities (Andriguetto-Filho et al. 2005).

Behavioural effects of exposure of caged cephalopods (50 squid and two cuttlefish) to sound from a single 20-inch airgun have been reported (McCauley et al. 2000a). The behavioural responses included squid firing their ink sacs and moving away from the airgun, startle responses and increased swimming speeds. No squid or cuttlefish mortalities were reported because of these exposures to the airgun sources.

Guerra et al. (2004) indicated that two incidents of multiple stranding of the giant squid (*Architeuthis dux*) along the north coast of Spain appeared to be linked to geophysical seismic surveys in the Bay of Biscay. Evidence of acute tissue damage was presented and the authors speculated that one female with extensive tissue damage was affected by the impact of acoustic waves. No detail with respect to the seismic sources, locations and durations of seismic exposure were provided, so limited conclusions can be drawn from this study.

Egg-bearing female snow crabs were caught, caged and subsequently exposed to seismic energy released during a commercial seismic survey off Cape Breton, Nova Scotia. Both acute and chronic effects on the adult female crabs, embryos and larvae hatched from the eggs were studied (DFO 2004d). Three definitive observations resulted from this study:

- the seismic survey did not cause any acute or chronic (five months) mortality of the crab, or any changes to the feeding activity of the treated crabs being held in the laboratory;
- neither the survival of embryos being carried by the female crabs during exposure nor the locomotion of the larvae after hatch appeared to be affected; and
- there was acute soiling of gills, antennules and statocysts of the crabs at the exposure site but after five months, all structures had returned to their clean state.

Christian et al. (2004) conducted a behavioural investigation during which caged snow crabs were positioned 50 m below a seven-gun array. Observations on the crabs' responses to seismic shooting were recorded by remote underwater camera. No obvious startle behaviours were observed.

Statistical analysis of seismic survey data and commercial catch rate data (from Victoria, Australia from 1978 to 2004), was used to determine the effects of seismic activity on rock Lobster. Correlations show that there is no evidence to indicate that catch rates were affected by seismic activity (Parry and Gason 2006). Short term changes in catch rates in the study area coincided with changes in adjacent areas not subject to seismic activity (Parry and Gason 2006).

Benthic invertebrates are less likely to be affected by seismic activity because few invertebrates have gas-filled spaces and benthic species are usually more than 20 m away from the seismic source. The resilience of various invertebrates has been tested by exposing them at a short distance to an active airgun (Table 5.1). Lobsters are thought to be resilient to seismic activity because decapods lack the gas-filled voids that would make them sensitive to changes in pressure. Mortality and development rates of Stage II Dungeness crab larvae exposed to single discharges from a seismic array were compared with those of unexposed larvae. No statistically significant differences between the exposed and unexposed larvae were observed with respect to immediate and long-term survival and time to molt, even for those exposed larvae within 1 m of the seismic source (Pearson et al. 1994).

Table 5-1 Observation from Exposures of Marine Macro-invertebrates to Air Sleeves at Close Range

Organism	Exposure Distance from Air Sleeve (m)	Estimated Exposure Level (dB re 1 μ Pa)	Observed Response	Reference
Iceland Scallop	2	217	Shell split in 1 of 3 tested	Matishov 1992
Sea Urchin	2	217	15 percent of spines fell off	Matishov 1992
Mussel	0.5	229	No detectable effect within 30 days	Kosheleva 1992
Periwinkle	0.5	229	No detectable effect within 30 days	Kosheleva 1992
Crustacean	0.5	229	No detectable effect within 30 days	Kosheleva1992
Brown Shrimp	1	190	No mortality	Webb and Kempf 1998

Noise generated during removal of the wellhead and other infrastructure is the primary disturbance associated with decommissioning and abandonment activities. Explosives are sometimes used for difficult wellhead removal (but only if mechanical severance fails). It is a requirement that operators have authorization from C-NLOPB before explosives are used and will be required to implement site-specific mitigations.

5.1.2.2 Fish

There are some data available on the hearing sensitivities of fish (see Popper and Carlson 1998; Popper et al. 2003 for reviews). For example, cod, salmon, America plaice and herring have hearing sensitivities between 80 and 200 Hz, with a sensitivity threshold at 80 to 100 dB rel to 1μPa (Mitson 1995). The frequency of seismic pulses does fall within this range, but responses to these sounds vary according to species. Gadoids have been shown to leave the area during seismic surveys (Skalski et al. 1992; Løkkeborg and Soldal 1993; Engås et al. 1996; Slotte et al. 2004; Parry and Gason 2006), and species such as cod, rockfish and whiting (*Merlangius merlangus*) have been reported to change depth in response to seismic pulses (Pearson et al. 1992; Wardle et al. 2001). In contrast, Wardle et al. (2001) report that neither fish nor invertebrates showed signs of moving away from a reef on the west coast of Scotland after four days of seismic airgun firing. Several studies have shown that exposure to noise such as that produced by seismic airguns can result in temporary hearing loss and physical damage to the ear (Enger 1981; Hastings et al. 1996; Amoser and Ladich 2003; McCauley et al. 2003; Popper et al. 2005). There are, however, substantial differences in the effects of airguns on the hearing thresholds of different species. Popper et al. (2005) showed that fish with poorer hearing, such as pike (*Esox Pucius*), showed little hearing loss in response to seismic airgun activity, while fish with good hearing, such as lake chub (*Couesius plumbeus*), showed the most hearing loss. Periods of hearing loss may affect survival due to the compromised ability to hear biologically relevant sounds. Mortality of fish, fish eggs, and larvae has been observed only within a few metres of airguns (Dalen and Knutsen 1987; Parry and Gason 2006).

While the effects of airguns on fish have been studied for several species, there is much diversity in the structure of the auditory systems of different species (Popper and Carlson 1998; Popper et al. 2003). It is necessary to examine the effects of airguns on all types of hearing specializations. In addition, most studies to date have concentrated on short-term effects. Studies on long-term survival and sublethal effects are needed (Payne 2004).

Behavioural Effects

Behavioural effects of seismic activity on marine fish may include avoidance behaviour, increased swimming speeds, disruption of reproductive behaviour and alteration of migration routes (McCauley et al. 2000a, 2000b). Noise generated by seismic activity may also cause some species to avoid the zone of influence around the seismic vessel.

Many finfish species display an alarm response of tightening schools, increased swimming speed and moving towards the sea floor at levels between 156 to 168 dB re 1 m (McCauley et al. 2000b). McCauley et al. (2000a) studied the responses of fish contained within a 10 m x 6 m x 3 m cage to a nearby operating airgun. These studies indicated that the effects to fish from nearby airgun operations might include:

- a startle response (C-turn) to short-range start-up or high level airgun signals. A greater startle response was observed for smaller fish;
- evidence of alarm responses that were more noticeable for received airgun level above approximately 156 to 161 dB re 1 μPa mean squared pressure;
- a lessening of severity of startle and alarm responses through time (habituation);
- an increased use of the lower portion of cage during airgun operation periods;
- the tendency in some trials for faster swimming and formation of tight groups correlating with periods of high airgun levels;
- a general behavioural response of fish to move to bottom, centre of cage in periods of high airgun exposure (for levels greater than 156 to 161 dB re 1 μPa (rms));
- no significant measured stress increases which could be directly attributed to airgun exposure; and
- evidence of damage to the hearing system of exposed fishes in the form of ablated or damaged hair-cells although an exposure regime required to produce this damage was not established and it is believed such damage would require exposure to high level airgun signals at short range from the source.

McCauley et al (2000b) indicated that a level of 156 dB re 1 m can be detectable between 3 and 5 km from a 3-D array (2,678 cubic inches 100 to 120 m of water). As a result, alarm responses could be expected to occur 3 to 5 km from a seismic vessel, with active avoidance behaviour beginning at distances of 1 to 2 km from a source of this level (McCauley et al. 2000b).

Most schools of fish will not show avoidance if they are not in the path of the approaching seismic vessel (Davis et al. 1998). Observed responses of schooled fish indicate that they are quite variable and depend on species, life history stage, current behaviour, time of day, whether the fish have fed and how the sound propagates in a particular setting. Schools that the vessel passes over may show lateral avoidance or tighten and move towards the bottom. Fish moving towards the seabed appears to be a common response to seismic activity (Davis et al. 1998). Seismic activity has also been shown to reduce the density of demersal species several kilometres from the source, in up to 250 m of water (Engås et al. 1996).

Pearson et al. (1992) studied the effect of sound on rockfish (*Sebastes* spp.) contained in a 4.6 m by 3.6 m cage deployed at the water surface. The fish were exposed to signals produced by a 100 cui (1,639 cm) airgun deployed at 6 m depth and operated at a 10-second rate. The fish began milling in increasingly tighter schools with increasing airgun levels, schools collapsed to the cage bottom when airgun operations commenced, and remained stationary near the bottom or rising in the water column on presentation of airgun signals. The sound levels for which subtle changes in behaviour were observed was at 161 dB re 1 μPa and alarm responses were observed at 180 dB re 1 μPa. The fish behaviours observed in the McCauley et al. (2000a) and Pearson et al. (1992) studies indicated that sound effects result in the fish seeking shelter in tight schools near the bottom. Dalen and Raknes (1985) have also suggested that Atlantic cod may also respond to seismic signals by swimming towards the bottom.

Fish sounds are normally generated in the range of 50 to 3,000 Hz. Fish use sound for communication, navigation and sensing of prey and predators. Sound transmission is thought to play an important role in cod and haddock (*Melanogrammus aegtefinus*) mating (Engen and Folstad 1999; Hawkins and Amorin 2000). Seismic signals are typically in the range of 10 to 200 Hz (Turnpenny and Nedwell 1994) and will therefore overlap slightly with signals produced by fish. However, detecting a signal does not mean the fish will have any measurable reaction to the noise. The hearing ability of fish varies considerably by species, as will the effects of seismic exploration. Variability in effect may also vary within a species because seismic signals have a more pronounced effect on larger fish than of smaller fish of the same species (Engås et al. 1996).

If a seismic survey overlaps with the presence of migrating fish species (such as redfish and cod), startle responses and temporary changes in swimming direction and speed could be expected, but schooling behaviour is not expected to be affected (Blaxter et al. 1981). Any temporary change in behaviour is not expected to interrupt the natural migration instinct to a spawning or feeding area.

Seismic activity can have a greater spatial effect on the behaviour of fish than on the physiology of fish. Most available literature (Blaxter et al. 1981; Dalen and Raknes 1985; Pearson et al. 1992; McCauley et al. 2000a, 2000b; Davis et al. 1998) seems to indicate that the effects of noise on fish are brief and if the effects are short-lived and outside a critical period, they are expected not to translate into biological or physical effects. It appears that behavioural effects on fish as a result of seismic shooting should result in negligible effects on individuals and populations in most cases. The potential for interactions during particularly sensitive periods, such as spawning or migration, are a concern. Two proposed seismic surveys near Cape Breton were evaluated (C-NSOPB 2002) and results seemed to indicate that displacement of marine fish is short-term.

Physical Effects

No mass fish kills associated with the operation of airguns have been recorded (Payne 2004). Since fish are likely to be driven away by approaching seismic shots, mortality of adult fish mortality is not expected (Turnpenny and Nedwell 1994). Depending on source noise level, water depth and distance of the fish relative to the source, injuries (such as eyes and internal organs) would only occur within a few tens of metres (Table 5.2), with lesser symptoms such as hearing damage possible out to several hundred metres (Turnpenny and Nedwell 1994).

Table 5-2 Observations of Exposures of Fish and Shellfish Planktonic Life Stages to Seismic Airguns at Close Range

<table>
<tr><th>Organism</th><th>Life Stage</th><th>Exposure Distance from Air Sleeve (m)</th><th>Estimated Exposure Level (dB re 1 µ pA)</th><th>Observed Response</th><th>Reference</th></tr>
<tr><td>Pollock</td><td>Egg</td><td>0.75</td><td>242</td><td>Some delayed mortality</td><td>Booman et al. 1996</td></tr>
<tr><td rowspan="4">Cod</td><td>Eggs</td><td>1 to 10</td><td>202 to 220</td><td>No signs of injury</td><td>Dalen and Knutsen 1987</td></tr>
<tr><td>Larvae</td><td>5</td><td>220</td><td>Immediate mortality</td><td>Booman et al. 1996</td></tr>
<tr><td>5-day-old larvae</td><td>1</td><td>250</td><td>Delimitation of retina</td><td>Matishov 1992</td></tr>
<tr><td>Fry</td><td>1.3</td><td>234</td><td>Immediate mortality</td><td>Booman et al. 1996</td></tr>
<tr><td rowspan="2">Plaice (Pleuronectes platessa)</td><td rowspan="2">Eggs and larvae</td><td>1</td><td>220</td><td>High mortality (unspecified)</td><td>Kosheleva 1992</td></tr>
<tr><td>2</td><td>214</td><td>No effect</td><td>Kosheleva 1992</td></tr>
<tr><td rowspan="2">Anchovy (Engraulis mordax)</td><td>Eggs</td><td>Unknown</td><td>223</td><td>8.2 percent mortality</td><td>Holiday et al. in Turnpenny and Nedwell 1994</td></tr>
<tr><td>2-day-old larvae</td><td>3</td><td>238</td><td>Swimbladder rupture</td><td>Holiday et al. in Turnpenny and Nedwell 1994</td></tr>
<tr><td rowspan="2">Red Mullet (Mullus surmuletus)</td><td rowspan="2">Eggs</td><td>1</td><td>230</td><td>7.8 percent injured</td><td>Kostyuchenko 1973</td></tr>
<tr><td>10</td><td>210</td><td>No injuries</td><td>Kostyuchenko 1973</td></tr>
<tr><td rowspan="2">Fish (various species)</td><td rowspan="2">Eggs</td><td>0.5</td><td>236</td><td>17 percent dead in 24 hours</td><td>Kostyuchenko 1973</td></tr>
<tr><td>10</td><td>210</td><td>2.1 percent dead in 24 hours</td><td>Kostyuchenko 1973</td></tr>
<tr><td>Dungeness Crab</td><td>Larvae</td><td>1</td><td>231</td><td>No observed effect on time to molt or long-term survival</td><td>Pearson et al. 1994</td></tr>
<tr><td colspan="6">Source: JWL 2006.</td></tr>
</table>

The mortality rate of plankton during seismic surveys has been estimated from several studies. Up to 1 percent of the plankton in the top 50 m of the water column could be killed during 3-D seismic survey off Nova Scotia (Davis et al. 1998). An estimated 0.45 percent of planktonic organisms in the top 10 m of water in a survey area off Norway could be killed (Sætre and Ona 1996). Kenchington et al. (2001) estimated a plankton mortality rate of 6 percent if they were concentrated in the upper 10 m. Given that seismic-related mortality in fish has not been reported beyond 5 m during field and laboratory studies, these estimates are considered conservative and may apply more to phytoplankton and zooplankton than to planktonic life stages of fish and shellfish. Kostyuchenko (1973) reported more than 75 percent survival of fish eggs at 0.5 m from the source (233 db at 1 m) and more than 90 percent survival at 10 m from the source.

Fish with swim bladders and specialized auditory couplings to the inner ear (e.g. herring) are highly sensitive to sound pressure. Fish with a swim bladder but without a specialized auditory coupling (e.g., cod and redfish) are moderately sensitive, while fish with a reduced or absent swim bladder (e.g., mackerel and flounder) have low sensitivity (Fay 1988). Fay (1988) has developed an approximate threshold for each of these three classifications of hearing sensitivity. The highly sensitive group has a hearing threshold of less than 80 dB re 1µPa3. The moderately sensitive threshold is between 80 and 100 dB re 1µPa and those fish with a low threshold have a sensitivity of greater than 100 dB re 1µPa.

These sensitivity thresholds were derived under quiet laboratory conditions, so thresholds to seismic sound pressure in the ocean are thought to be 40 dB higher due to ambient noise and the start and stop nature of the seismic signal. A comparison of moderately sensitive species such as cod, haddock, pollock and redfish determined a measurable behavioural response in the range of 160 to 188 dB re 1μPa (Turnpenny and Nedwell 1994). Source levels during seismic surveys are usually in excess of the noise levels that elicit a response in fish, so the area in which fish react to the noise may extend several kilometres in the open ocean. By comparison, underwater ambient noise in bad weather is in the range of 90 to 100 dB re 1 μPa. As an example, large tankers may have a source noise level of 170 dB re 1 μPa at 1 m.

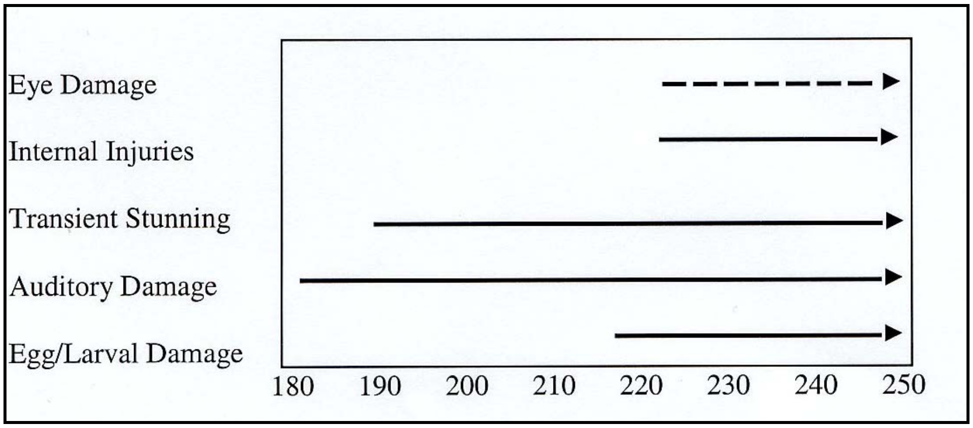
There are well documented observations of fish and invertebrates exhibiting behaviours that appeared to be in response to exposure to seismic activity like a startle response, a change in swimming direction and speed, or a change in vertical distribution (Blaxter et al. 1981; Schwarz and Greer 1984; Pearson et al. 1992; McCauley et al. 2000b; Wardle et al. 2001; Hassel et al. 2003), although the importance of these behaviours is unclear. Some studies indicate that such behavioural changes are temporary (i.e., within minutes (Pearson et al. 1992, in Skalski et al. 1992)), while others imply that marine animals might not resume pre-seismic behaviours and/or distributions for a number of days (Løkkeborg 1991; Engås et al. 1996).

The expected distance for fish to react to a typical peak source level of 250 to 255 dB re 1 μPa is from 3 to 10 km (Engås et al. 1996). A reaction may simply mean a change in swimming direction. The spatial range of response in fish will vary greatly with changes in the physical environment in which the sounds are emitted. In one environment, fish distribution has been shown to change in an area of 74 km x 74 km (40 x 40 nautical miles (nms)) and 250 to 280 m deep for more than five days after shooting ended, with fish larger than 60 cm being affected to a greater extent than smaller fish (Engås et al. 1996). The potential impact of a spatial response of potentially days in fish during sensitive times is unknown, in part due to data constraints associated with life histories of many species and overall lack of knowledge of seismic effects during sensitive periods for most if not all species.

Due to the dampening effects of shallow areas, especially with soft substrates, behavioural responses in shallow waters are less obvious. Two studies in the shallow coastal areas concluded limited changes in fish behaviour in response to seismic noise. In one area with water depths less than 20 m, a seismic signal of 225 dB re 1 μPa at 1 m was emitted and the response of sea bass (*Dicentrarchus labrax*) observed. The study concluded that the bass were not displaced and that they continued to feed (Pickett et al. 1994). In another study, pollock on a shallow coastal reef were observed during a signal of 230 dB re1 μPa (Wardle et al. 2001). Direct visual observations determined that only minor changes in fish behaviour patterns were detectable around the reef. When smaller pollock passed within a few metres of the array and were exposed to approximately 229 dB, they showed a typical "C start" response and moved away only a few metres.

It is assumed that a sound pressure level of 220 dB re 1 μPa0-P is required for egg/larval damage (Figure 5.2). A 'worst-case scenario' mathematical model was applied to investigate the effects of seismic energy on fish eggs and larvae and concluded that mortality rates caused by exposure to seismic were so low compared to natural mortality, the environmental effect of seismic activity on recruitment to a fish stock would be not significant (Sætre and Ona 1996). In addition, mortality of phytoplankton and zooplankton near the seismic vessel should be sufficiently localized as to negligibly affect food availability for fish, shellfish, birds and mammals.

Figure 5.2 Sound Pressure Threshold for the Onset of Fish Injuries



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

The abundance or distribution of any population (including larvae and eggs) will not likely be affected by seismic activity (Sætre and Ona 1996, in Dalen et al. 2007; Dalen et al 1996, in Dalen et al. 2007). Modelling has indicated that a typical seismic survey results in a 0.45 percent mortality of the larvae population (Sætre and Ona 1996, in Dalen et al. 2007). Compared to the natural mortality of cod, herring and capelin larvae or 5 to 15 percent per day, seismic-induced mortality in these species is so low as to have no effect at the population level (Dalen et al 1996, in Dalen et al. 2007). A review of the current scientific literature indicate that egg and larval mortality is limited to within a few metres of the seismic array, physical injury to fish is limited to tens of metres and auditory damage is potentially limited to hundreds of metres (Kostyuchenko 1973; Turnpenny and Nedwell 1994; Sætre and Ona 1996; Kenchington et al. 2001).

The potential effect that seismic activities may have on masking communications by fishes is not well documented. There is overlap in the frequency of seismic signals and the sounds emitted by fish, so there is potential for sound reception and production in fish to be reduced (Myrberg 1980). Recent experiments on goldfish indicate that fish are capable of “auditory scene analysis”, meaning that a sound stream of interest can be “heard out” and analyzed for its informational content independently of simultaneous, potentially interfering sounds (Fay 1988). These studies were carried out using repetitive pulses or clicks as signals and as potentially interfering sounds. These results suggest that the presence of intermittent, audible airgun shots would not necessarily impair fish in receiving and appropriately interpreting other biologically relevant sounds from the environment (MMS 2004).

Studies have shown that exposure to intense sound can affect the auditory thresholds of fish resulting in temporary threshold shifts (TTS) under certain conditions (i.e., Amoser and Ladich 2003; Smith et al. 2004). However, these studies focused on captive fish that were exposed to loud (158 dB re 1 μPa) noise for periods of 10 minutes for 12 or 24 hours. TTS may seldom (or never) occur in the wild unless fish are prevented from fleeing the irritant (LGL Limited 2005b). Threshold shifts affect the fish’s ability to hear its natural full range of sound.

Kosheleva (1992) reports no obvious physiological effects beyond 1 m from a source of 220 to 240 dB re 1 μPa. Hastings (1990) reports the lethal threshold for fish beginning at 229 dB and a stunning effect in the 192 to 198 dB range. Turnpenny and Nedwell (1994) deduce that blindness can be caused in fish exposed to air sleeve blasts approximately 214 dB. A summary of fish injuries caused by exposure to sound pressure is given in Figure 5.2. Auditory damage starts at 180 dB, transient stunning at 192 dB and internal injuries at 220 dB.

Collins et al. (2002) looked at potential effects on fish catches during and after two independent inshore and near-shore seismic surveys undertaken in the Bay St. George and Port au Port areas of western Newfoundland. While not statistically conclusive, their analyses suggested no observable effects on overall fish catches, including snow crab, during or in the years following the seismic surveys. This indicates that fish behaviour was not measurably affected. Turnpenny and Nedwell's (1994) general conclusion is that seismic activity has a reduced affect on fish behaviour inshore, in shallow water because attenuation of the sound is more rapid..

Noise generated during removal of the wellhead and other infrastructure is the primary disturbance associated with decommissioning and abandonment activities. These activities occur directly at the well site and are usually of short duration so short term localized avoidance behaviours may be expected.

5.1.3 Marine Mammals and Sea Turtles

Several offshore oil and gas activities can produce sound (pressure) waves in the marine environment that have the potential to affect marine mammals and sea turtles in the Labrador Shelf SEA Area. The primary sound sources of concern for marine mammals and sea turtles expected from these activities are:

- seismic surveys;
- exploratory and delineation drilling; and
- vessel and aircraft traffic.

Determining the effects of noise on marine mammals and sea turtles is not an easy task. Even though the understanding is increasing, it is still unclear whether or how noise and other anthropogenic factors affect populations (Nowacek et al. 2007).

The following sections describe the acoustic environment in which marine mammals and sea turtles and anthropogenic noise interact, and the background necessary to understand, identify and assess potential offshore oil and gas noise effects on these animals.

5.1.3.1 Acoustic Environment

Use of Noise by Marine Mammals and Sea Turtles

Marine mammals and turtles use sound to communicate and gain information about their environment and as such, sound plays an important role in their daily activities. It is clear from scientific investigations of many marine mammals that the production and reception of certain sounds are critical in various aspects of life history. It is also evident that certain sounds (both natural and anthropogenic) have the potential to interfere with these functions.

The marine environment contains many natural sources of noise (e.g., surf, wind, earthquakes, biological activity) that may impede acoustic communication and other vital functions, but to which marine animals have evolved to accommodate. Anthropogenic sounds have the potential to disturb behavior and/or interfere with important functions (Richardson and Malme 1995; NRC 2003b).

Nowacek et al. (2007) and Richardson et al. (1995) provide good reviews of the current knowledge of anthropogenic noise effects on marine mammals.

Behavioral responses of marine mammals to noise are highly variable and dependent on a suite of internal and external factors (NRC 2003b). Internal factors include:

- individual hearing sensitivity, activity pattern and motivational and behavioural state at time of exposure;
- past exposure of the animal to the noise, which may have led to habituation or sensitization;
- individual noise tolerance; and
- demographic factors such as age, sex and presence of dependent offspring.

External factors include:

- non-acoustic characteristics of the sound source, such as whether it is stationary or moving;
- environmental factors that influence sound transmission;
- habitat characteristics, such as being in a confined area; and
- location, such as proximity to a shoreline.

There are relatively few studies on the effects of sound on sea turtles compared to marine mammals and fish. Studies suggest that sea turtles (specifically loggerhead and green (*Chelonia mydas*) turtles) are able to respond to low frequency sound but their hearing threshold appears to be high (DFO 2004a). It is considered unlikely that they are more sensitive to noise than cetaceans (DFO 2004a).

Underwater sounds produced during offshore oil and gas activities can be divided into two broad categories: continuous and pulsed. Sounds produced for extended periods, such as sounds from ship generators or drilling are classified as "continuous". Sounds of short duration that are produced intermittently or at regular intervals, such as those produced by airguns are classified as "pulsed". Furthermore, sounds can be further classified as either fixed or transient. Those produced by a drilling platform are considered to be fixed or stationary, while those generated by moving sources, such as ships are perceived as transient by animals at a given location (i.e., increasing in level as the ship approaches and then diminishing as it moves away). Studies indicate that marine animals respond somewhat differently to noise from different categories.

5.1.3.2 Sound Types and Potential Effects

This section describes the various sound types potentially produced by offshore oil and gas activities and the level at which they might affect marine mammals and sea turtles.

Canada does not currently have established received-level standards for potential effects of noise on marine mammals but typically uses criteria developed by the US National Marine Fisheries Service (NMFS). Some values of root mean square (rms) sound pressure levels have been estimated and proposed as impact criteria. Impact criteria for potential damage or disturbance to marine mammals have been developed for peak-to-peak and energy flux density values; however, the results of this analysis are not yet publically available (Southall et al. 2007).

For sea turtles, acoustic effects are not well understood but it is considered unlikely that turtles are more sensitive to noise than cetaceans (DFO 2004a). Therefore, criteria and mitigations for marine mammals are generally also applied to sea turtles.

Continuous Sounds

Continuous sounds occur over extended periods of time. Fixed-location continuous sounds are associated with underwater pumps, generators and drilling operations. Transient continuous sounds are produced by moving sources such as ships. These sounds normally increase in level as they approach the receiver (i.e., marine mammal) and then diminish as they move away.

According to the literature and proposed US NMFS standards, whales may be disturbed by continuous noises above a criterion level of 120 dB re 1 µPa (rms) (NMFS 2000). The same criteria are currently used for pinnipeds. Based on the literature reviewed in Richardson et al. (1995), it is apparent that most small and medium-sized toothed whales exposed to prolonged or repeated underwater sounds are unlikely to be displaced unless the overall received level is at least 140 dB re 1 µPa. The US NMFS suggests that levels in excess of 180 dB may induce hearing damage to cetaceans (NMFS 2000).

The measurements of sounds for the purposes of potential effects to marine organisms are currently reported as rms pressures. The size of the averaging window greatly affects the measured rms level by 2 to 12 dB (Madsen 2005). It has been suggested that peak-peak and energy flux density measures are more relevant for transient (pulsive) sounds, since high peak pressures could affect animals and energy flux density measures the energy flow per unit area received by the animal (Madsen 2005). Madsen (2005) showed that several sounds with the same peak-peak values can have very different rms levels and energy flux densities. Marine animals are one of the receivers of sound within the marine environment. Impact criteria for potential damage or disturbance to marine mammals are currently being developed for peak-peak and energy flux density measures of sounds. Impact criteria of rms sound pressure levels have been estimated by the US NMFS.

In shallow waters of continental shelves, the acoustic properties of the seabed may be the dominant with respect to acoustic propagation (Duncan and McCauley 2000). The determination of relevant substrate properties for the Labrador Shelf SEA Area may be a potential data gap with respect to the modelling of seismic activity and its effects on marine mammals.

Pulsed Sounds

Pulsed sounds are typically of short duration and occur intermittently or at regular intervals. Pile driving using an impact hammer and seismic airgun bursts are examples of underwater pulsed sounds. They produce brief noise pulses with peak levels generally much higher than those of most continuous or intermittent noises.

For pulsed sounds, a broadband received sound pressure level of 180 dB re 1 µPa (rms) or greater was proposed as an indication of potential concern about temporary and/or permanent hearing impairment (Level A Harassment in the USA) to cetaceans (NMFS 2003; Madsen 2005). Level A Harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild” (NRC 2003b). The criterion proposed for Level A Harassment to pinnipeds from pulsive sounds is exposure to received levels of 190 dB re 1 µPa (rms) or greater.

A broadband received sound pressure level of 160 dB re 1 µPa (rms) or greater is currently the best estimate available to indicate potential concern to cause disruption of behavioural patterns (Level B Harassment) to marine mammals (NRC 2003). Level B Harassment is defined as “any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild" (NRC 2003b).

Intermittent Noise

Intermittent noise is noise that is discontinuous or widely variable in level, but not pulsive. The 120 dB re 1 μPa (rms) criterion selected for continuous noise is used to evaluate effects of intermittent underwater noise.

5.1.3.3 Sound Exposure Level and Sound Pressure Level

Measurement or modelling of the sound level received by animals is critical to the interpretation of the response (or lack thereof) and to understanding potential effects (Nowacek et al. 2007). Existing safety radii regulations in the US are based on the 90 percent rms sound pressure level metric for pulsive noise sources. Although one can easily measure the 90 percent rms sound pressure level (SPL in situ), this metric is extremely difficult to model in general, since the adaptive integration period, implicit in the definition of the 90 percent rms level, is highly sensitive to the specific multipath arrival pattern from an acoustic source. To accurately predict the 90 percent rms, it is necessary to model acoustic dispersion.

When underwater noise can be assumed to originate from identifiable sources of specified directivity and given transmitted spectral content, high-quality models exist to predict the spectral levels of the received signal. Propagation models use bathymetric databases, geoacoustic information, oceanographic parameters and boundary roughness models to produce estimates of the acoustic field at any point away from the source. The quality of the received level estimate is directly related to the quality of the environmental information used in the model. Sound propagation models coupled with accurate source and receiver models can provide invaluable tools for predicting potential effects, but care must be taken in specifying the environmental parameters for the area under study.

Industry estimates of rms threshold-based safety radii for airgun arrays are generally computed under the simplifying assumption that no acoustic energy is returned to the water column via bottom reflections. In relatively shallow waters where water depth is at most a few hundred metres, safety radius estimates must be considered approximate at best. If multipath reflections were taken into account, the resultant spreading of the seismic pulse would most certainly change the estimates. For in situ measurements, the 90 percent rms SPL can be computed from the sound exposure level (SEL) via a simple relation that depends only on the rms integration period T:

$$\mathrm{SPL}_{\mathrm{RMS90}} = \mathrm{SEL} - 10\log(T) - 0.458,$$

where the last term accounts for the fact that only 90 percent of the acoustic pulse energy is delivered over the standard integration period. However, in the absence of in situ measurements, the integration period is difficult to predict with any reasonable degree of accuracy. It should be noted that the rms level itself has no special biological significance concerning marine mammal hearing.

The draft *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment* (DFO 2007k) provides guidance on how seismic surveys should be conducted, including establishing a safety zone of 500 m around the airgun array to protect marine mammals and turtles. Safety radii used in other countries vary widely from 200 to 3,000 m, depending on the cetacean species and mitigation measure (Weir and Dolman 2007). These seismic survey safety radii are usually intended to satisfy thresholds that have been cast in terms of the rms sound level metric. The only true way to estimate these radii would be through actual field measurements, in situ. Care must be taken in directly comparing SEL and rms SPL estimates, due to the difficulty in accurately estimating the rms sound level a priori. In 2003, measurements of ambient noise prior to seismic operations were conducted in the Sable Island Gully MPA and, specifically, the Gully whale sanctuary (McQuinn 2005). The results of this study indicated that environmental assessment predictions for noise levels were underestimated by 8 dB on average. This finding was considered noteworthy because sound propagation model results are used to define the safety radii for marine mammals around seismic arrays. This study highlights the importance of accurate model inputs such as bathymetric, topographic, geoacoustic and oceanographic data, as well as the necessity to measure variability around mean sound levels.

5.1.3.4 Seismic Surveys

Pulsed sound from seismic exploration has the potential to affect marine mammals. Airguns are used to create a sound wave to obtain information on the seabed geology and potential for oil and gas presence. The airgun arrays used typically produce high amplitude sound with source levels of 220 to 248 dB re 1 µPa at 1 m (Weir and Dolman 2007). The highest energy output is at relatively low frequencies of 10 to 200 Hz. These frequencies overlap with the low frequency sound produced by baleen whales (12 to 500 Hz). The airgun arrays can still produce high frequency sound energy (up to 22 kHz) within a few kilometres of the source. These frequencies overlap with sound frequencies to which small odontocete (toothed whales) species use and are sensitive to in the 0.5 to 20 kHz range (Weir and Dolman 2007). Therefore, both odontocete and mysticete species may potentially be adversely affected by airgun noise.

Several potential effects to marine mammals from seismic airgun sound have been identified. These include physical injury (such as tissue damage, temporary and permanent hearing loss), indirect physical damage (e.g., “the bends”), physiological effects (e.g., stress), masking of echolocation signals, behavioural effects (including displacement from migratory, feeding, and breeding habitat), and indirect effects from displacement of prey species (Weir and Dolman 2007).

5.1.3.5 Exploratory and Delineation Drilling

Noise generated by drilling platforms could result in temporary avoidance of an area by marine mammals. A study showed that humpback whales exposed to simulated semi-submersible and drill platform noises did not exhibit avoidance behaviour (Malme et al. 1985). Based on another study, noise from a drilling platform is detectable no more than 2 km away near a shelf break under typical ambient noise conditions at low frequency (Richardson and Malme 1993). The spatial extent of avoidance behaviour by the most common marine mammal species in SEA Area (i.e., humpback and minke whales) was predicted to be 0.5 to 1 km (JWL 2006) Once the source is removed, marine mammals are expected to return to the avoided area (Davis 1987), thus the effect of noise on marine mammals is considered highly reversible.

Noise generated during removal of the wellhead and other infrastructure is the primary disturbance associated with decommissioning and abandonment activities. Explosives are sometimes used for difficult wellhead removal (but only if mechanical severance fails). It is a requirement that operators have authorization from C-NLOPB before explosives are used. The use of explosives with mitigation measures for marine mammals is not likely to result in injuries or death of marine mammals. These activities occur directly at the well site and are usually of short duration, so short-term localized avoidance behaviour may be expected.

5.1.3.6 Vessel and Aircraft Traffic

Ships and aircrafts used in offshore oil and gas activities produce noise that can potentially affect marine mammals and sea turtles in the SEA Area. The literature suggests that these noises can have various effects ranging from the animal approaching the source (e.g., bowriding) to behavioural disturbance.

Baleen whales have been shown to change their behaviour in response to strong or rapidly changing vessel noise (Watkins 1986; Beach and Weinrich 1989). Behavioural disturbance includes changes in acoustic behavior in response to vessel noise through changes in call type, rates, duration and acoustic call structure (Richardson et al. 1995), course changes, changes in surfacing and respiration patterns, and displays such as breaching, flipper slapping and tail slapping (Wyrick 1954; Edds and Macfarlane 1987; Stone et al. 1992). Changes in acoustic and locomotor behaviour have been positively correlated with the number of vessels present and their proximity, speed and direction changes. Responses typically vary by species, gender and individual (Erbe 2002; Olesiuk et al. 2002; Williams et al. 2002b, 2002c). Humpback whales and other mysticetes have been observed avoiding habitats in shipping areas (Richardson et al. 1995; NRC 2003b). Some bowhead whales have been reported to perform shorter and abrupt dives, away from the noise made by helicopters and Twin Otter planes at predicted received level values between 112 to 120 dB re 1 μPa (Patenaude et al. 2002). These reactions took place primarily when the aircrafts were at altitudes ≤150 m.

Responses of toothed whales to vessels vary within and among species and range from avoidance to approach and bowriding (Baird and Stacey 1991a, 1991b; Stacey and Baird 1991; Mullin et al. 1994a, 1994b).

5.1.3.7 Effects of Noise

The possible effects of offshore oil and gas activities on marine mammals and sea turtles can vary from none to severe. Most effects can be divided into the following three categories:

- masking;
- behavioural disturbance; and
- hearing impairment and other physical effects.

Masking

Underwater ambient sound may prevent an animal from detecting another sound through a process known as masking. Masking can occur because of either natural sounds (e.g., periods of strong winds or heavy rainfall) or anthropogenic sounds (e.g., ship propeller sound). The sea is a naturally noisy environment and even in the absence of anthropogenic sounds, this natural sound can “drown out” or mask weak signals from distant sources.

Marine mammals are highly dependent on sound for communicating, detecting predators, locating prey and, in toothed whales, echolocation (Lawson et al. 2000, in LGL Limited 2005b). Natural ambient noise created by wind, waves, ice and precipitation alone can cause masking or interfere with an animal’s ability to detect a sound. Marine animals themselves also contribute to the level of natural ambient noise. The calls of a blue whale have been recorded for 600 km (Stafford et al. 1998). A sperm whale (*Physeter macrocephalus*) call can be as loud as 232 dB re 1µPa at 1 m (rms) (Møhl et al. 2003) and a species of shrimp has been recorded at 185 to 188 dB re 1µPa at 1 m (Au and Banks 1998). In areas where natural background noise is relatively high, such as near a shelf break or high surf, anthropogenic noise itself can be masked and reduce the area in which it is detectable. Anthropogenic noise is undetectable for marine mammals once it falls below the ambient noise level or the hearing threshold of the animal. Given this and the fact that mammal responses will vary by species and between individuals, the zone of potential influence of noise on marine mammals is highly variable.

Marine mammals have evolved in an environment that contains a variety of natural sounds. As such, marine mammals have evolved systems and behaviour to reduce the impacts of masking (NRC 2003b). Since little is known about the importance of how a temporary interruption in sound detection affects mammals (Richardson and Malme 1995), it is very difficult to assess the effect. In general, the effect of both natural and anthropogenic noise is less severe when it is intermittent rather than continuous (NRC 2003b). The level of masking may be considerably reduced if the anthropogenic noise originates from a direction different from that of the mammal vocalization (NRC 2003b). While marine mammals may adapt behaviour changes to reduce masking, the physiological costs associated with the behavioural changes cannot be estimated at this time (NRC 2003b).

The low frequency spectrum of industrial noise does not typically overlap with the optimal hearing range of belugas, dolphins, or pilot whales. However, industrial noise frequencies do overlap with the sounds of baleen whales and will reduce the area of audible sound for the whale. The impact of such a reduction is unknown (NRC 2003b). Toothed whales have demonstrated the ability to alter their call frequencies and increase the level of transmission when competing with ambient noise (NRC 2003b).

Masking effects from seismic surveys are unlikely to be notable. LGL Limited (2005b) reports that some marine mammals continue calling in the presence of seismic operations, which typically emit a pulse every 11 seconds. It has been postulated that an increase in interval time will enable mammals to receive communications that persist through the survey operation, as reported during other surveys (McDonald et al. 1995, ; Greene and McLennan 2000, ; Madsen et al. 2002, ; Jochens and Biggs 2003). However, other factors may limit the potential effectiveness of increased interval time to mitigate concerns regarding interruptions to marine mammal communications because of seismic activities.

Behavioural Disturbance

Behavioural disturbances observed in marine mammals have included avoidance, deviation from normal migration routes, interruption of feeding, reduced surface intervals, reduced dive duration, and lower numbers of blows (Ljungblad et al. 1988; Richardson and Malme 1993; McDonald et al. 1995; Richardson et al. 1995, 1999; Greene and McLennan 2000; McCauley et al. 2000a, 2000b; Madsen et al. 2002; Jochens and Biggs 2003; Gordon et al. 2004; LGL Limited 2005b). Noise may displace an animal or restrict access to critical habitats.

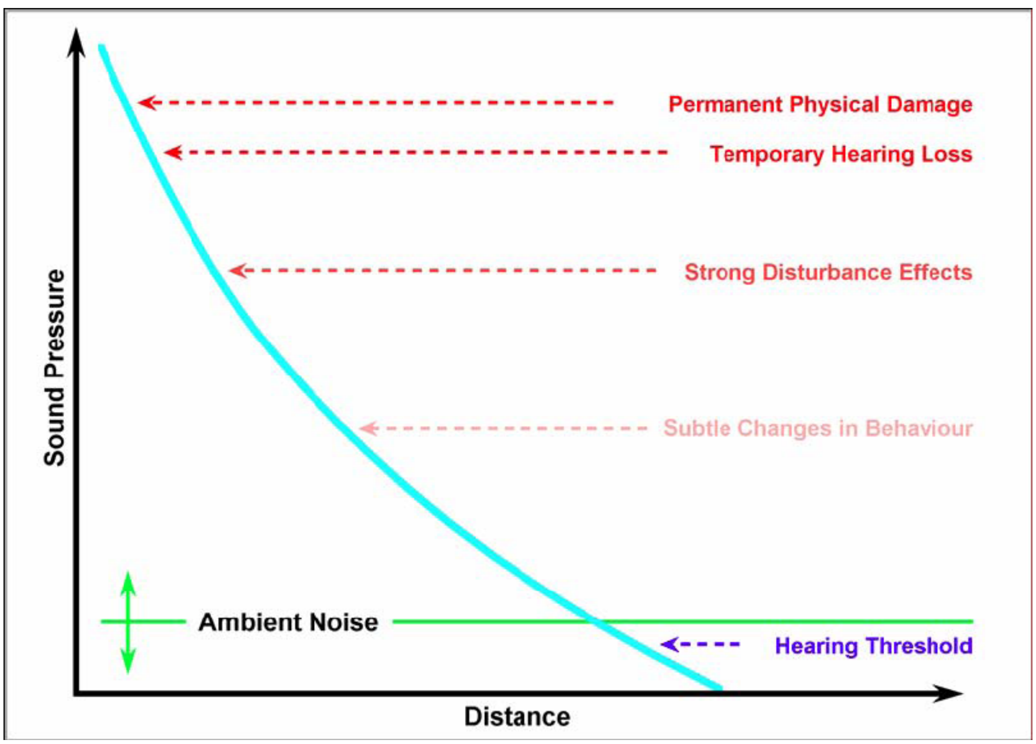
Hearing Impairment and Other Effects

Extended periods of moderate noise levels under water can cause a temporary threshold shift (TTS) in some marine mammals, resulting in a reduction in hearing sensitivity and a small degree of permanent loss (Kastak et al. 2005). At TTS exposure levels, hearing sensitivity is generally restored quickly after the sound dissipates. Noises of greater intensity may result in a permanent threshold shift (PTS), in which hearing loss is not recovered (Finneran et al. 2002). A PTS may be a symptom of physical damage and may alter the functional hearing sensitivity at some or all frequencies. Although there are no data to quantify sound levels required to cause a PTS, it is believed that a source level would have to far exceed the level required for a TTS, the exposure would have to be prolonged, or the rise level would be extremely short (LGL Limited 2005b). Richardson et al. (1995) hypothesized that permanent hearing impairment of marine mammals would not likely occur unless prolonged exposure to continuous anthropogenic sounds exceeding 200 dB re 1 µPa-m was experienced.

Research has shown that marine mammals exposed to intense sounds may exhibit decreased hearing sensitivities (TTS) following cessation of the sound (Au et al. 1999; Kastak et al. 1999; Schlundt et al. 2000). TTS have been observed in captive marine mammals exposed to pulsed sounds in experimental conditions (Finneran et al. 2002), but the likelihood of these effects occurring have not been evaluated under field operating conditions. There is currently no agreement as to what level of TTS and time to recovery would present unacceptable risk to a marine mammal. NMFS policy is under review and currently states that cetaceans and pinnipeds should not be exposed to pulsive sounds exceeding 180 and 190 dB re 1 µPa (rms), respectively (NMFS 2000).

Criteria can be established for zones of influence based on ambient sound levels, absolute hearing thresholds of the species of interest, slight changes in behavior of the species of interest (including habituation), stronger disturbance effects (e.g., avoidance), temporary hearing impairment and permanent hearing or other physical damage, as illustrated in Figure 5.3 (Lawson et al. 2000, in LGL Limited 2005b).

Figure 5.3 Schematic Representation of Zones of Potential Effects Associated with Anthropogenic Sounds on Marine Mammals



Source: Lawson et al. 2000, in LGL Limited 2005b.
Note: Vertical distances between various effects are not drawn to scale.

Exposure to high-intensity pulsed sound such as explosions can cause other, non-auditory physical effects such as stress, neurological effects, bubble formation, resonance effects and other types of organ or tissue damage (NRC 2003b; LGL Limited 2005b). Little is known about the potential for the sounds produced during geophysical surveys to cause auditory threshold shifts or other effects in marine mammals and turtles. Data suggest that if these effects do occur, they would only occur in close proximity to the sound sources. Thus, species that show behavioural avoidance of seismic vessels, including most baleen whales, some toothed whales and some pinnipeds, would not likely experience threshold shifts or other physical effects (LGL Limited 2005b).

5.1.3.8 Effect of Noise on Baleen Whales

Baleen whales predominantly communicate using low frequency sounds (generally between 4 Hz and 25 kHz (RIchardson and Malme 1995)) that can propagate for long distances (Table 5.3). These sounds range in duration from 50 millisecond thumps produced by minke whales (Winn and Perkins 1976; Thompson et al. 1979) to moans produced by blue whales, which can have durations up to 36 seconds (Cummings and Thompson 1971). Acoustic energy in the sound pulses produced by seismic airguns and sub-bottom profilers overlap with frequencies used by baleen whales, but the discontinuous, short duration nature of these pulses is expected to result in limited masking of baleen whale calls. Side-scan sonar and echo-sounder signals do not overlap with the predominant frequencies of baleen whale calls. Several species of baleen whales have been observed to continue calling in the presence of seismic pulses, including bowhead whale, blue whales and fin whales (McDonald et al. 1995).

Table 5-3 Frequency Range and Duration of Sounds Produced by Several Species of Baleen Whales

Species	Frequency range	Duration	Source
Humpback Whales*	<20 Hz - 10 kHz	30 min	Thomson and Richardson 1995; Tyack 1983
Minke Whales	60 Hz - >2 kHz	50 msec - 4 sec	Rankin and Barlow 2005; Schevill and Watkins 1972; Winn and Perkins 1976
Sei Whales	21 Hz - 3.5 kHz	1 - 3 sec	McDonald et al. 2005; Rankin and Barlow 2007; Thompson et al.1979
Blue Whales	9 Hz - 390 Hz	2-36 sec	Cummings and Thompson 1971; Mellinger and Clark 2003
Fin Whales	16 Hz -150 Hz	0.5-1 sec	Thompson et al. 1992
Bowhead Whales	25 Hz - 3.5 kHz	0.4-3.7 sec	Cummings and Holliday 1987; Ljungblad et al. 1982
North Atlantic Right Whales	<400 Hz	0.5-1.5 sec	Richardson et al. 1995; Thompson et al. 1979
* Duration of humpback whale sounds refers to entire songs, not individual sounds.			

While the hearing abilities of baleen whales have not been studied directly, behavioural evidence suggests that these animals hear well at frequencies below 1 kHz (Richardson and Malme 1995). In addition, the anatomy of the baleen whale inner ear seems to be well adapted for low frequency hearing (Ketten 1991, 1992, 1994, 2000). Baleen whales commonly use frequencies below 1 kHz for communication over long distances (Richardson and Malme 1995). It is therefore likely that baleen whales can hear airgun pulses at considerable distances from survey vessels; avoidance behaviour has been documented for several baleen whale species. Strong avoidance behavior may be seen at received levels lower than 160 to 170 dB re 1 μPa (rms) (Gordon et al. 2004). Observers on seismic vessels off the UK from 1997 to 2000 reported that in good sighting conditions, the number of baleen whales seen when airguns were firing was similar to the number seen when airguns were not firing. However, baleen whales remained considerably farther from the airguns and exhibited more frequent alterations in course (usually away from the vessel) when airguns were firing (Stone 2003). Humpback whales, gray whales (*Eschrichtius robustus*) and bowhead whales react to seismic noise pulses by deviating from their normal migration route and/or interrupting feeding and moving away from the sound source (Ljungblad et al. 1988; Richardson and Malme 1993; Richardson et al. 1995, 1999). Fin and blue whales also show some behavioural reactions to airgun noise (McDonald et al. 1995; Stone 2003). Fin whales and sei whales are less likely to remain submerged during periods of shooting (LGL Limited 2005). Bowhead whales migrating off the Alaskan coast have been shown to avoid seismic survey vessels to a distance of more than 24 km (Jasny et al. 2005). Recent satellite tagging studies revealed that one bowhead whale maintained a minimum distance of 9 km from seismic activity, however, it appeared that the seismic survey did not affect overall whale behavior in this case (Citta et al. 2007). Some evidence suggests that baleen whale strandings may be correlated to exposure to seismic sounds. Jasny et al. (2005) report that the stranding of eight humpback whales was correlated with the opening of the area to oil exploration.

McCauley et al. (2000b) examined data from whale observations made from a seismic survey vessel northeast of North West Cape, off Exmouth. They found that there were no discernible differences in the number of whales sighted per observation block (40-minute period) when airguns were on or off. However, further examination of the data showed that sighting rates of whales near to the vessel (within 3 km) were considerably higher when airguns were off. This suggests localized avoidance of the vessel during periods when airguns were on. Richardson et al. (1995) noted that most research indicates that gray and bowhead whales generally avoid seismic vessels where the received sound level is between 150 to 180 dB re 1 µPa (rms). The level at 3 km from the seismic vessel from which the humpback observations were made was in the range 157 to 164 dB re 1 µPa (rms) for a receiver at 32 m depth, which is in agreement with the standoff level provided for gray and bowhead whales (McCauley et al. 2000a).

McCauley et al. (2000b) noted that pod sighting rates observed when the airguns were switched on and off were higher than the sighting rates when airguns were continually on or continually off for distances between 0.75 to 3 km. These higher pod sightings may be explained by a startle response bringing animals to the surface when airguns are turned on after being off for a protracted period. Startle responses by humpback whales to seismic survey sounds have been reported at levels between 150 to 69 dB re 1 µPa (effective pulse pressure, believed equivalent to rms measure) by Malme (2005).

McCauley et al. (2000b) conducted approach trials out in Exmouth Gulf and found that humpback whale pods with females consistently avoided an approaching single operating airgun (Bolt 600B, 20-cubic inch chamber) at a mean range of 1.3 km. Avoidance maneuvers were evident before standoff at ranges from 1.22 to 4.4 km. During the approach trials single, large, mature humpbacks approached the operating airgun to within 100 to 400 m, investigated it, and then swam away (McCauley et al. 2000. These approaches were deliberate, direct and at considerable speed. These whales would have been exposed to airgun signals at 100 m of 179 dB re 1 µPa (rms) (or 195 dB re 1 µPa peak-to-peak). This level is equivalent to the highest peak-to-peak source level (level at 1 m) of song components measured in the 1994 humpback whale song in Hervey Bay by McCauley et al. (1996), or as given by Thompson et al. (1986) for humpback whale sounds in Alaska, of 192 dB re 1µPa peak-to-peak at 1 m.

McCauley et al. (2000b) concluded that it is probable that humpback whales are not at physiological risk unless at short range from a large airgun array. McCauley et al. (2000b) further concluded that displacements to migratory humpback whales were comparatively short in time, involved limited range changes, and a low probability of detrimental physiological effects. Therefore, there appears to be a low risk to migratory humpback whales exposed to seismic activity.

The noise generated due to the presence of a drilling platform could result in the temporary avoidance of an area by marine mammals. Baleen whales have been shown to respond to drillship noises at or above 120 dB (Richardson et al. 1990). Noise from a drilling platform is detectable no more than 2 km away near a shelf break under typical ambient noise conditions (Richardson and Malme 1995). Humpback whales exposed to simulated semi-submersible and drill platform noises did not exhibit avoidance behaviors (Malme et al. 1985). The spatial extent of avoidance behaviour for noise generated by routine exploration and production activities by most common marine mammal species in the area (i.e., humpback and minke whales) is expected to be 0.5 to 1 km (JWL 2006). Once the source is removed, marine mammals are expected to return to the avoided area (Davis 1987).

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

5.1.3.9 Effect of Noise on Toothed Whales

Toothed whales communicate using two types of sounds: 1) continuous, narrowband, frequency-modulated signals that range in duration from several tenths of a second to several seconds and range in frequency from approximately 2 to 25 kHz (Tyack and Clark 2000); and 2) broadband click trains with peak frequencies that vary from tens of kilohertz to well over 100 kHz (Norris and Evans 1966; Au 1980). Click trains contain few to hundreds of clicks and are used for communication, navigation and object detection and discrimination (Au 1993). Because seismic and sub-bottom profiler pulses are intermittent and predominantly low frequency, masking effects are expected to be negligible for toothed whales. However, while Madsen et al. (2002) reported that sperm whales off northern Norway continued calling in the presence of seismic pulses, Bowles et al. (1994) reported that sperm whales ceased calling when exposed to pulses from a distant seismic ship. Some pulses emitted by side-scan sonars and echo-sounders are likely audible to toothed whales, but measureable masking of communication signals is improbable due to the fact that the pulses are short and have narrow beam widths.

The hearing capabilities of several species of toothed whales have been studied directly (Richardson and Malme 1995; Au et al. 2000). The small to medium-sized toothed whale species that have been studied have relatively poor hearing sensitivity below 1 kHz and very good sensitivity above several kHz. The sounds produced by seismic airguns are in the frequency range of low hearing sensitivity for toothed whales. However, they are high intensity sounds and their received levels can sometimes remain above the hearing thresholds of toothed whales for distances out to several tens of kilometres (Richardson and Würsig 1997).

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

A beluga whale exposed to a single peak-to-peak pressure of 226 dB re 1 μPa experienced TTS to within 2 dB for four minutes after exposure (Finneran et al. 2002). A bottlenose dolphin (*Turiops truncatus*) exposed to a single 228 dB re 1 μPa sound did not experience TTS (Finneran et al. 2002). Exposure to several seismic pulses at received levels near 200 to 205 dB (rms), which may be experienced within 100 m of a source vessel, may result in slight TTS in small-toothed marine mammals (LGL Limited 2005).

Dolphins and porpoises are often seen by observers on seismic vessels (Stone 2003). Dramatic avoidance responses at considerable distances from the array have been exhibited by species such as harbour porpoises (Jasny et al. 2005). In addition, Stone (2003) noted localized avoidance of seismic vessels by dolphins off the UK. While the distribution of sperm whales in the northern Gulf of Mexico has been observed to change in response to seismic operations (Mate et al. 1994), other studies report little evidence of reactions by sperm whales to seismic pulses (Madsen et al. 2002; Jochens and Biggs 2003, Stone 2003).

There is increasing evidence that beaked whales may strand after exposure to intense sound from sonars. Sonar surveying is a separate activity from seismic surveying and may be used during geohazard surveys. Several Cuvier's beaked whale (*Ziphius cavirostris*) strandings have been reported coincident with seismic operations (Gentry 2002; Jasny et al. 2005). Cuvier's beaked whale is the most numerous beaked whale species identified during strandings (Culik 2003), with most of those strandings associated with naval maneuvers and sonar (International Ocean Noise Coalition n.d.).

5.1.3.10 Effect of Noise on Pinnipeds

Most pinnipeds produce sounds with dominant frequencies between 0.1 and 3 kHz (RIchardson and Malme 1995). The individual calls of harp seals range from less than 0.1 second to greater than 1 second in duration (Watkins and Schevill 1979). The frequencies contained in seismic and sub-bottom profiler pulses do overlap with some frequencies used by pinnipeds, but the discontinuous, short duration nature of the pulses is expected to result in limited masking of pinniped calls. Side-scan sonar and echo-sounder signals do not overlap with the predominant frequencies of pinniped calls, which avoid measurable masking.

Data on underwater hearing sensitivities are available for three species of phocoenid seals, two species of monachid seals, two species of otariids and the walrus (*Odobenus rosmarus*) (Richardson and Malme 1995; Kastak and Schusterman 1998; Kastak et al. 1999; Kastelein et al. 2002). The hearing sensitivity of most pinniped species that have been tested ranges between 60 and 85 dB re 1 μPa from 1 kHz to 30 to 50 kHz. In the harbour seal, thresholds deteriorate gradually below 1 kHz to approximately 97 dB re 1 μPa at 100 Hz (Kastak and Schusterman 1998). Based on these data, it is likely that airgun pulses are readily audible to pinnipeds. Pinnipeds exposed to 2,500 Hz at 80 and 95 dB for 22, 25 and 50 minutes experienced TTS ranging from 2.9 to 12.2 minutes, but recovered fully within 24 hours of noise exposure (Kastak et al. 2005).

Ringed seals *(Phoca hispida)* near an artificial island drilling site were monitored before and during development of the site. Although air and underwater sound was audible to the seals for up to 5 km, there was no change in their density in that area between breeding seasons before and breeding seasons after development began (Moulton et al. 2003).

Very little information exists on the reactions of pinnipeds to sounds from seismic exploration in open water (Richardson and Malme 1995). Visual monitoring from seismic vessels has shown that pinnipeds frequently do not avoid the area within a few hundred metres of an operating airgun array (Harris 2001). However, the telemetry research of Thompson et al. (1998) suggests that reactions may be stronger than has been evident from visual studies. Based on anecdotal evidence, pinnipeds appear to show little reaction to vessels in open water (Richardson and Malme 1995). However, few studies describe the responses of pinnipeds in the water to vessel traffic.

5.1.3.11 Effect of Noise on Sea Turtles

The frequency range of hearing sensitivity for sea turtles has been reported as 250 to 700 Hz (Ridgeway et al. 1969; Bartol et al. 1999), which is higher than the frequencies where most seismic sounds are produced and lower than side-scan sonar frequencies. However, these frequencies do overlap with those prominent in airgun pulses. It is therefore likely that airguns are audible to sea turtles. The distance over which an airgun array might be audible to a sea turtle is impossible to estimate due to an absence of absolute hearing threshold data. However, because of the high source levels of airgun pulses, this distance is likely to be considerable.

It has been suggested that sound may play a role in sea turtle navigation. However, recent studies suggest that visual, wave and magnetic cues are the principal navigational cues used by hatchling and juvenile sea turtles (Lohmann and Lohmann 1998, ; Lohmann et al. 2001). Still, research has shown that sea turtles modify their behavioral patterns when exposed to high-intensity sound. For example, studies carried out by Lenhardt (1994) showed that sea turtles increase their movements after airgun shots and do not return to the depth where they usually rest.

McCauley et al (2000b) conducted two trials with caged sea turtles and an approaching-departing single airgun (Bolt 600B, 20-cubic inch chamber) to gauge behavioural responses by green and loggerhead turtles. The first trial involved 2:04 hours of airgun exposure and the second 1:01 hour. Each trial used a 10-second repetition rate. The two trials showed that airgun noise levels above 166 dB re 1 µPa (rms), resulted in noticeable increases in the swimming activity of both species of turtles. Airgun noise levels above 175 dB re 1 µPa (rms) resulted in the turtle’s behaviour becoming more erratic, likely indicating that the turtles were in an agitated state (McCauley et al. 2000b). Swimming activity was positively correlated with airgun noise level. The noise level at which the turtles displayed erratic behaviour is expected to approximate the point at which avoidance would occur for unrestrained turtles.

O’Hara and Wilcox (1990) conducted studies on loggerhead turtles in a 300 x 45 m enclosure in a 10 m deep canal. The sound source was a Bolt 600B airgun with 10-cubic inch chamber and two Bolt ‘poppers’, all operating at 2,000 psi (14 MPa), suspended at 2 m depth and operated at a 15 second interval. The turtles maintained a standoff range of approximately 30 m. Although the received airgun levels were not measured, McCauley et al. (2000b) estimated that the level at which O’Hara and Wilcox (1990) observed avoidance behaviour was approximately 175 to 176 dB re 1 µPa (rms).

Moein et al. (1994) studied loggerhead turtles avoidance behaviour, physiological response and electroencephalogram measurements of hearing capability, in response to an operating airgun. The turtles were held in an 18 m x 61 m x 3.6 m netted enclosure in a river. The airguns were deployed and operated from the net ends at 5- to 6-second intervals for five-minute periods. Details of the airgun, its operational pressure, deployment depth and sound levels experienced by the turtles throughout the cage were not given. Avoidance behaviour was observed during the first presentation of the airgun exposure at a mean range of 24 m. Further trials several days afterwards did not elicit statistically significant avoidance behaviour. Physiological measurements showed evidence of increased stress; however, the effect of handling the turtles was not taken into account and, therefore, the increased stress could not be attributed to the airgun operations. A temporary reduction in hearing capability was evident from the neurophysiological measurements but this effect was temporary and the turtles hearing returned to pre-test levels at the end of two weeks. Moein et al. (1994) concluded that this might have been due to either habituation or a temporary shift in the turtles hearing capability. Recent monitoring studies have shown that some sea turtle's show localized movement away from approaching airguns (Holst et al. 2006).

The available evidence from the scientific literature suggests that sea turtles may show behavioural responses to an approaching airgun array at a received level of approximately 166 dB re 1 µPa (rms) and avoidance at approximately 175 dB re 1 µPa (rms). McCauley et al. (2000b) estimated that this corresponds to behavioural changes occurring at approximately 2 km and avoidance at approximately 1 km for seismic vessels operating 3-D airgun arrays in 100 to 120 m water depth. It is necessary to note that important sea turtle habitats mostly occur in shallower water, often less than 20 m deep. The propagation of an airgun array in such water depths may be vastly different from that for the array measured in 120 m water depth.

5.1.4 Marine Birds

5.1.4.1 Seismic Activities

There is limited data available with respect to the effects of underwater sound on birds. The sound created by airguns is focused toward the substrate, below the surface of the water. Above the water, sound is reduced to a muffled noise that should have little or no effect on birds that have their heads above water or are in flight. Most species of seabirds that may be present in the Labrador Shelf SEA Area spend only a few seconds underwater during a foraging dive; therefore, there would be minimal opportunity for exposure to noise associated with seismic shooting.

Only the Alcidae (Dovekie, Common Murre, Thick-billed Murre, Razorbill, Black Guillemot and Atlantic Puffin) spend measureable time underwater during forage dives. They typically spend 25 to 40 seconds underwater during each dive (Gaston and Jones 1998), reaching depths of 20 to 60 m and have the potential to be exposed to the sounds produced by seismic shooting. The effects of seismic noise on Alcids are not well known. Alcids are a vocal species; the call of the Thick-billed Murre covers a frequency range of 1 to 4 kHz (Gaston and Jones 1998), indicating that auditory capabilities play an important role in their activities, particularly during breeding season.

5.1.4.2 Vessel and Air Traffic

Some species are attracted to ships, while some avoid interactions with vessels, so it is possible that traffic could affect foraging birds at sea. It is not anticipated that vessels travelling to and from the Labrador Shelf SEA Area will cause disturbance to seabird colonies.

Aircraft activity near seabird colonies can result in mortality of chicks due to panic responses of adult birds. Helicopters servicing projects in the Labrador Shelf SEA Area will be required to avoid major colonies near the Important Bird Areas and the Gannet Islands Ecological Reserve. Disturbance to marine birds on the water surface will be negligible when aircraft are high above the sea surface.

Marine birds near helicopters taking off and landing on platforms may be disturbed. However, birds that associate with the offshore platforms may become habituated.

Some seabirds (murres, puffins, Razorbill) are flightless during molting of their primaries in winter and would be more vulnerable to disturbance to seismic activities and to vessel and air traffic during this time.

5.1.5 Commercial Fisheries

Potential effects of seismic surveys on reduced fisheries catches are a concern to fishers as a result of physical impacts on eggs, larvae and juvenile fish; potential scaring of fish (reduced catch rates, diverted migrations, and/or interrupting spawning behaviour) as well as potential physical interference with harvesting practices, (i.e., gear conflicts, particularly with fixed gear, that may become entangled with seismic streamers). Engås et al. (1996) found that cod and haddock moved away from a 3 nm x 10 nm region (5.6 km x 18 km) in which seismic operations were carried out over a five-day period. Reductions in fish catches were observed out to their sampling limit of 33 km. They postulated that the fish may have been responding to continuously discharging airguns by swimming through a gradient of exponentially decreasing sound levels and, as such, habituation may have occurred. Therefore, the fish may have terminated their avoidance reaction at different distances depending on their size and swimming speed. Alternatively, the fish may have responded to the airgun discharges by increasing their swimming speed leading to exhaustion. Avoiding the sound source by prolonged swimming speeds (He 1993) may have produced a response pattern of alternating intervals of swimming and resting until habituation terminated the response at different distances for fish of different sizes. Engås et al. (1996) concluded that the effects of seismic had lasted for at least five days.

Løkkeborg (1991) analyzed longline catches of cod in the presence of seismic surveys and concluded a reduction in catch rate had occurred. Løkkeborg and Soldal (1993) examined catch data obtained from commercial vessels operating on fishing grounds where seismic explorations were being conducted. They found a 56 percent reduction in longline catches of cod and 81 percent reduction in the by-catch of cod in shrimp trawling. Skalski et al. (1992) reported that catches of various redfish species (using vertical lines) declined by 50 percent during discharges of a single airgun.

These observations suggested that the fish had responded by either avoiding the sound field of operating seismic vessels or their behavioural state was changed and as such, they were no longer available to the fishing techniques tested. Løkkeborg and Soldal (1993) suggested that behavioural changes that forced fish to the bottom acted to temporarily increase catch rates of cod in the trawls during seismic activities.

The potential seismic effects on fish do not necessarily translate to disruptions to commercial fisheries. For many fish species, any behavioural changes or avoidance effects may involve little if any risk factor.

5.1.6 Sensitive Areas

The effect of sound would be expected to have little or no environmental effect on sensitive areas. The effect of sound from exploration and production activities would be more likely to affect the marine animals (fish, marine birds and marine mammals) that use the sensitive areas as critical habitat and is addressed in the sections specific to each group.

5.1.7 Mitigations

The effects of sound and noise has the potential to affect marine animals and, in particular, marine mammals. There are standard mitigation measures required during geophysical, geotechnical and seismic surveys to assist in the protection of marine animals. The mitigations are detailed in Appendix 2 of the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines, Newfoundland Offshore Area* (C-NLOPB 2008).

Mitigations for noise associated with exploration and production activities, include *but are not limited to*:

- seismic surveys should be implemented in such a manner to use the least amount of energy required to achieve operational goals;
- seismic surveys should be scheduled to avoid sensitive stages (i.e., fish eggs, fish larva, areas of known concentrations of juvenile fish, and shellfish moulting periods);
- seismic surveys should be scheduled to avoid displacing from breeding, feeding or nursing or diverting from a known migration route or corridor an individual migrating marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the SARA;
- seismic surveys should be planned to avoid areas that could raise concerns with respect to gear conflicts;
- seismic surveys should be scheduled to avoid potential impacts on fishing catch rate by avoiding heavily fished areas when these fisheries are active to the greatest extent possible;
- seismic surveys should be scheduled to avoid gear conflicts and fish disruptions during the execution of DFO surveys (DFO recommends a seven to 10 day temporal buffer and a 30 to 40 km spatial buffer between the seismic surveys and DFO surveys in order to reduce the potential for gear conflict and disruption of fish);
- ramp-up procedures as outlined in Geophysical, Geological, Environmental and Geotechnical Program Guidelines, Newfoundland Offshore Area (C-NLOPB 2008);
- airgun shut down (when active and not only during ramp-up procedures) if a SARA-List endangered or threatened marine mammal or sea turtle is sighted within a safety zone of at least 500 m of the array;
- a Marine Mammal and Seabird Observation program;
- the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2008) recommends that the monitoring protocol outlined Recommended Seabird and Marine Mammal Observation Protocols for Atlantic Canada (ESRF 2004) should be implemented for marine mammal monitoring.
- the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2008) recommends that the CWS pelagic seabird monitoring protocol be used for seabird monitoring
- publishing a Canadian Coast Guard "Notice to Mariners" and a "Notice to Fishers" via the CBC Radio program Fisheries Broadcast;
- guidelines established by the CWS require aircraft to remain at least 8 km on the seaward side and 3 km on the landward side away from major seabird colonies between April and November (JWL 2006);
- ship operations will adhere to Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78);

- gear compensation program for gear losses attributed to seismic survey activity;
- using standard pollution prevention policies and procedures;
- avoidance of sensitive times and areas for selected periods and times to minimize potential effects to sensitive species; and
- a Fisheries Liaison Officer (FLO), or similar, to maintain communication with fishers in the area of seismic activity.

5.1.8 Data Constraints Associated with Sound and Noise Effects

Noise effects are probably the best understood for marine mammals there are data constraints for species. There are limited data with respect to plankton, invertebrates and fish species. Ongoing research by various agencies and groups are working to increase the knowledge but there are still data restraints. There are no sound models for the Labrador Shelf Sea Area and as such knowledge regarding the propagation of sound waves within the area is limited. The impact of ice on the effects of sound wave propagation is limited and may have an impact on how sound waves propagate.

While there are data gaps/constraints, their relation to offshore oil and gas is dependent on the nature and timing of the particular activity, and the need to collect additional data will be determined at the project-specific environmental assessment stage.

5.1.9 Planning Considerations for Sound and Noise effects

Project-specific assessments will need to address sound and noise effects on all species including species at risk. Operators may be required to use spatial and temporal mitigations to avoid critical life stages or time periods of species at risk, such as spawning, birthing, pupping, haul out or migrations. While this is critical for SARA-Listed species the potential for restriction due to sensitive life history periods applies to all invertebrates, fishes, birds, marine mammals and sea turtles.

The existing information for the Labrador Shelf SEA Area is insufficient to identify specific areas and times of key importance to marine mammals, which contain a number of species that are SARA-listed. Marine mammal surveys may have to be conducted during exploration and production activities. Operators will have to implement the mitigations outlined in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines, Newfoundland Offshore Area* (C-NLOPB 2004) respecting geophysical programs.

In recent years, operators have undertaken seabird monitoring during exploration drilling programs. It is anticipated that such monitoring may be required for the Labrador Shelf SEA Area. Depending on timing, seabird surveys may be conducted in conjunction with marine mammal surveys during seismic exploration activity.

Information on sound propagation is limited and may be required to full consider the effects of sound and noise on the biological environment.

5.2 Drill Cuttings Discharges Associated with Exploration and Production Activities

Deposition of drill cuttings as well as potential environmental effect should be examined in detail in project-specific environmental assessments. The environmental effects associated with drill cuttings are depositional effects (habitat smothering, creation of piles, extent of disposition); toxicity associated with chemical constituents of the retained and hydrocarbons on cuttings; bioaccumulation (hydrocarbon and metal bioaccumulation by fish and potential of taint); and physical effects related to the effects of fines. Drill cuttings will fall within a few metres with the associated fines being spread over a wider area dependent upon site-specific oceanographic conditions (e.g., currents). Because the drill cuttings fall to the bottom, benthic organisms are primarily the group of organisms impacted.

The composition of cuttings piles is influenced by particle size, organic matter content, the type of benthic fauna, sedimentation rates and biogeochemical pathways (absorption and desorption from oxyhydroxides of iron and manganese, adsorption into organic matter or the assimilation into the gut of benthic flora) (Breuer et al. 2004). Synergistic effects from multiple contaminants should be considered for drill cuttings containing potentially hazardous chemicals.

5.2.1 Offshore Waste Treatment Guidelines Pertaining to Drill Cuttings

Drill cuttings are particles that are generated by drilling into subsurface geological formations and are carried to the surface with drilling muds (OTWG 2002). OWTG (2002) allows for drill cuttings associated with the use of WBMs may be discharged to sea.

Operators planning the use of SBMs in development drilling are required as part of its development application, to examine and report upon the technical and economic feasibility of re-injecting the associated drill cuttings into subsurface formations at its drill site (OWTG 2002). Cuttings may be discharged at the drill site provided they are treated prior to discharge with best available treatment technology. At the time of publication of the OWTG (2002), the best available technology was believed to be capable of achieving a concentration of 6.9 g/100 g or less oil on wet cuttings.

The concentration of oil on discharged drill cuttings from all sources should be measured every 12 hours and a mass-weighted rolling 48-hour average calculated in units of grams oil per 100 grams wet cuttings. The concentrations of specific substances in waste discharges as specified in OWTG (2002) are known to be achievable using proven and practicable, best available waste treatment technology.

It is anticipated that the reoccurring formal review of the OWTG will begin in late 2008. The review is undertaken to ensure that they continue to reflect significant gains in scientific and technical knowledge. Reviews that are more frequent may be considered as the result of specific written requests from government departments, industry or the public.

5.2.2 Newfoundland Experience with Drill Cuttings

The total volume of drill cuttings discharged depends on the depth of hole and drilling conditions encountered. Normally drilling of the upper reaches of holes can be done with WBMs, unless difficult drilling conditions are encountered that require SBMs be used to ensure hole integrity and safety. Deviated and directional drilling situations often require the use of SBMs to ensure hole integrity. Norsk Hydro Canada (2007) indicated that a typical 3,500-m deep hole drilled with WBMs typically produces up to 473 m^3 of cuttings and 3474 m^3 of WBM. Additional examples are provided in Table 5.4 (Norsk Hydro Canada 2007).

Table 5-4 Drill Mud and Cuttings Discharges Associated with Typical Drilling Scenarios

Typical Potential Drilling Scenarios	Hole Sections	Total Cuttings Discharge (M^3)	Total Mud Total Mud Discharge with Synthetic base fluid portion (m^3)
Drilling with Water Based Mud Only			
o 3,500 m Hole	All Sections	473.2	3,474
o 7,000 m Hole	All Sections	1,023.4	8,902
Drilling with Water-based and Synthetic Fluid-based Muds			
o 3,500 m Hole drilled with WBM System except for two lower hole sections (i.e., 311 and 216 mm diameter Sections)	WBM Sections	402.8	2,276
	SBM Sections	109	183.7 **(65.2)**
o 7,000 m Hole drilled with WBM System except for three lower hole sections (i.e., 311 and 216 mm diameter Sections)	WBM Sections	676.4	4,831
	SBM Sections	533	1,165 **(382.7)**
Drilling Options for side track from existing hole			
o 3,500 m Sidetrack hole drilled from existing upper well hole (216 mm section only)	Using SBM	43	199 **(58.3)**
	Using WBM	34	692
o 7,000 m Sidetrack hole drilled from existing upper well hole (311, 216 & 152 mm sections)	Using SBM	181.4	402.6 **(133.4)**
	Using WBM	117.2	2,437

Source: Norsk Hydro Canada 2007.

The drilled cuttings are pumped to surface using SBM or WBM. OWTG (2002) allows for drill cuttings associated with the use of WBM to be discharged to sea. Drill cuttings associated with SBM are removed from the SBM in successive separation stages with shale shakers, hydrocyclones, centrifuges and other specialized separation equipment (Chevron Canada Limited 2005). The drilling fluid is reconditioned and re-used continuously while drilling. Spent SBM (whole muds) will be returned to shore for treatment and disposal. SBM cuttings that meet the OWTG (2002) requirements may be disposed of at sea.

5.2.2.1 Drill Cuttings Models

Drill cuttings depositions are often modeled during study to provide information on the depositional characteristics of cuttings expected to be produced by the undertaking. Results of the White Rose modeling of cuttings deposition indicated that the biological 'zone of influence' (ZOI) is generally confined within approximately 500 m of the drilling area (Husky 2000). The same zone of influence for drill cuttings deposition has also been confirmed by national and international reviews (Hurley and Ellis 2004; Neff 2005).

The Husky Energy model of the White Rose cuttings dispersion indicated that physical or chemical alterations would not occur more than 5 km from source (Husky 2004) and the Husky 2005 EEM concluded that sediment contamination did not extend beyond the zone of influence predicted in the White Rose cuttings model (Husky 2006).

5.2.2.2 Drill cuttings Dispersion and Deposition

Currently all Newfoundland EEM programs have adopted a radial gradient sampling design, where samples were collected or parameters measured at geometrically increasing distances along transects from the center (drill site) with at least one axis placed along the predominant current. Gradient designs have been found to provide the greatest power to detect changes associated with production and drilling activities, and provide information on the scale of disturbance effects (Ellis & Schneider, 1997; Green, 2003). For Newfoundland EEM programs, one or more far-field reference stations are also included in the program with baseline studies having been completed.

The current Newfoundland EEM monitoring programs have utilized the Sediment Quality Triad approach (or modified in case of Hibernia) as the basis to assess impacts of drill cuttings (Chapman et al. 1991; Green & Montagna 1996). The following ecosystem components, benthic habitat and invertebrate communities (Terra Nova and Husky but not Hibernia), body burden, taint, and fish health in commercial fish or shellfish species have been used. The spatial and temporal extent of discharged drill wastes (as indicated by drill cuttings components barium and total petroleum hydrocarbon concentrations in sediments) may be related to differences in the number of wells/volume of discharges, mud types, current speed and direction, water depth or sediment mobility at the drilling location. Large development projects such as Hibernia, Terra Nova and White Rose with several wells at the same location had larger zones than single wells (Hurley and Ellis 2004) at similar water depths (80 m) on the Grand Banks (i.e., White Rose H-20 and N-30). Drill waste signals were detected as far as 3 km (Ba) and 8 km (TPH (0.87 mg per kg)) in sediments (Hibernia) typically along the major current axis (Hurley and Ellis 2004).

Body burden concentrations of TPH (Hurley and Ellis 2004) in sea scallops extended as far as 2,600 m (Terra Nova) but not in American plaice (Terra Nova and Hibernia). Changes in the diversity and abundance of benthic organisms may be detected within 1,000 m of drill sites. These results were consistent for both literature review case studies documenting biological effects around wells discharging SBM and WBM, and from the Newfoundland EEM data (Terra Nova exhibited changes in abundance and density out to 200 m). Evidence suggests that drilling discharges appear to have minor effects on fish health. For the Canadian EEM data, no fish health effects were observed for any of the tested species across all reviewed sites. A number of early warning bioindicators including fish condition indices, skin and organ lesions, liver and gill histopathology and levels of MFO enzymes, were studied in American plaice at the Terra Nova site on the Grand Banks (Mathieu et al. 2004). Similarly, taint was not detected for any of the species tested within the Canadian EEM programs (Hurley and Ellis 2004).

The SERPENT project conducted in the Orphan Basin in 2007 in conjunction with the exploration drilling at Great Barasway F-66 used an ROV to estimate the level of sediment accumulated at marker buoys associated with the project, with the objective of validating the drill cuttings dispersion model and discharge patterns (Gates 2008).

Modelling conducted as part of the exploration drilling environmental assessment predicted that the depth of the well (2,325 m) would result in drill cuttings deposited over a larger area than a well site more than 1,000 m shallower; however, the deposition layer would be thinner (LGL 2005c).

The environmental assessment estimated that the drill cuttings would cover less than 300 m2 to a depth of 1.0 cm (LGL 2005c). Due to limitations in ROV maneuverability, it was not possible to estimate how far the drill cuttings covered the bottom beyond the 15-m limit of the ROV tether (Gates 2005).

However, previous SERPENT studies in the Faroe Shetland Channel and Norwegian Sea have found complete coverage up to 60 m from a well site (with partial coverage up to 205 m, but on average 100 m, from a well site (Jones et al. 2007, in Gates 2008). This is well within the less than 300 m complete coverage predicted in the environmental assessment (LGL 2005c).

5.2.3 Species at Risk

The marine mammal species at risk that could occur in the Labrador Shelf SEA Area are listed in Table 4.1. COSEWIC species that are not SARA-listed that could occur in the Labrador Shelf SEA Area are noted in Table 4.2.

Biological effects associated with drill cuttings are not normally found beyond 500 m from drilling platforms (Hurley and Ellis 2004) and as such, there will be limited interaction between drilling cuttings and marine-associated species at risk.

5.2.4 Invertebrates

The effect of exploratory drilling waste released near the surface upon sensitive species will depend on physical parameters like water depths, currents and particle size. Benthic invertebrates are the primary group of organisms subject to environmental effects associated with drill cuttings.

5.2.4.1 Water-based Muds and Cuttings

Invertebrate smothering is the primary concern associated with the discharge of WBMs and cuttings. While motile fish and shellfish will likely move away from the zone of influence of cuttings deposition, research has indicated that sessile invertebrates are likely to be smothered in areas where the cuttings are greater than 1 cm thick (Bakke et al. 1989). Bryozoans, barnacles, brittlestars, urchins and other sessile epifauna will likely be smothered within 50 m of a well, whereas most polychaetes, amphipods, clams and other burrowing infauna will likely be less affected, as they can resurface from a covering of several centimetres. Since most sessile invertebrate species have short generation times, invertebrate communities are expected to recover within one year after drilling (Hurley and Ellis 2004; Neff 2005).

WBMs may not immediately settle to the substrate bottom but may remain in suspension in the water boundary layer. Any drill cuttings remaining in suspension will likely affect suspension feeders such as scallop. Sea scallop (*Plactopecten magellanicus*) feeding, growth and reproduction may be affected by suspended WBMs at concentrations less than 10 mg/L (Cranford 2004). In addition, the fine particles of bentonite and barite found in drill mud can interfere with digestion and feeding of bivalve species (Barlow and Kingston 2001) such as scallops (Armsworthy et al. 2005).

Changes to water column sediment loading could affect corals through either a reduction in feeding or outright mortality (Cimberg et al. 1981, in Breeze et al. 1997). Increased particle loading could abrade the living coral tissue and kill coral polyps through excessive mucous production (Hecker et al. 1980, in Breeze et al. 1997). It has been found that WBMs may have direct effects on sessile adult organisms typical of hard-bottom communities as indicated by the adult mortality, proportion of individuals showing tissue loss, and reduced relative viability observed in brown cup corals (Raimondi et al. 1997). Raimondi et al. (1997) used environmentally realistic test concentrations (range 0.002 to 200 mg/l) and as such, it is possible that their results are indicatative of the effects found in the laboratory were of the same magnitude as those likely to occur in the field (Holdway 2002). Soft-bottom communities could recolonize from neighbouring substrate in a matter of days up to one year, while a deepwater hard substrate community might never recolonize (Minerals Management Service 2003).

The meiofauna and macrofauna effects studied by Montagna and Harper (1996) indicated that environmental effects were localized within 100 to 200 m from the platforms. The patterns of community change included increases in deposit-feeding polychaetes and nematodes, indicating organic enrichment, while density declines of harpacticoid copepods and amphipods indicated toxicity. Crustaceans (especially amphipods and harpacticoid copepods) and echinoderms are sensitive to toxins, whereas polychaetes, oligochaetes and nematodes (especially nonselective deposit feeders) are enhanced by organic enrichment (from either hydrocarbons or biologically produced materials falling from the platform structure). The percentage of gravid female harpacticoid copepods was greater and the percentage of juveniles was reduced within 50 m of the platforms. In addition, reproductive effort for female harpacticoids carrying eggs was reduced. These responses could be explained as sublethal physiological reactions of these organisms to stress related to exposure to toxins.

Boudreau et al. (1999) conducted a study on the potential sublethal effects of WBM discharge on the Georges Bank. Boudreau et al. (1999) combined bioassay studies and a benthic boundary layer transport model to predict the effects of WBM constituents (bentonite and barite) on adult scallops. Model simulations indicated the potential for a reduction in growing days within the WBM plume. The study concluded that there was a potential for loss of growing days, which could result in reproductive loss. However, the overall effect on scallop populations could not be determined and it must be noted that these conclusions are based in part on model simulations.

Documented data from 20 case studies (Hurley and Ellis 2004) indicate that WBMs have pattern of detectable contaminants and biological effects. Using barium as a tracer, the zone of detection for both single and multiple wells found that background levels for barium were achieved at 1,000 to 3,000 m from the drill source. Increases in other trace metals (specifically arsenic, cadmium, chromium, copper, mercury, lead and zinc) were more spatially limited to 250 to 500 m of the drill site. However, these metals tend not to be in a bioavailable form and thus few biological effects are attributed to increases from metals discharges (CAPP 2001).

Biological effects are routinely detected at distances of 200 to 500 m from the well site and include alterations to benthic community structure, as measured by changes in abundance, species, richness and diversity. The changes to benthic community structures have been primarily attributed to physical alterations in sediment texture, including smothering as opposed to toxic effects (Hurley and Ellis 2004). The effects and area affected will be influenced by environmental variables such as depth, current, wave regimes and substrate type, as well as the nature and volume of the discharges, including cuttings size and location of outfall within the water column. Studies have indicated that benthic communities around single exploration wells returned to baseline conditions within one year after cessation of drilling.

Results of the White Rose Environmental Effects Monitoring Program indicate that maximum concentrations of >C_{10}-C_{21} hydrocarbons were located between 300 and 600 m from drill centres (each containing multiple well slots) and the median concentration of 22 mg/kg (within 1 km of the drill centres) fell to approximately 1 mg/kg within 5 km of the drill centres (Husky 2005). Barium concentrations were also elevated near the drill centres, but levels decreased with distance to a background level of 200 mg/kg within 2 km of the drill centres (Husky 2005).

As WBMs are virtually free of hydrocarbons and metals present are in a form that is not readily bioavailable, contamination is of minimal concern to the environment. The *Offshore Chemical Selection Guidelines* (NEB et al. 1999) control WBM additives by ensuring that the additives have the least risk to the environment. Metals from WBMs and drill cuttings have not been shown to cause biological effects (CAPP 2001; Hurley and Ellis 2004). WBMs do not cause tainting or contamination of fish.

5.2.4.2 Synthetic-based Muds and Cuttings

The increased risk of invertebrate and invertebrate habitat contamination is the primary concern associated with treated SBM deposition. SBMs stay closer to the well site and do not disperse as widely as WBMs. Thus, no additional mortality (smothering) of sessile benthic invertebrates is expected to occur due to the discharge of SBMs, since the area will have been subjected to smothering from previous WBMs deposition.

The primary concern associated with the deposition of treated SBMs is the increased risk of invertebrate and invertebrate habitat contamination. SBMs are essentially non-toxic, require less quantity of mud (compared to WBM) for the same distance drilled, have the potential to biodegrade relatively rapidly and disperse less than WBMs. The C-NLOPB approves any SBM discharge and discharge of whole SBM is not permitted. Changes in species abundance and richness (and other potential biological effects associated with the use of SBMs) are typically within distances of 50 to 500 m from well sites; benthic communities typically recover within one year of well completion. Thus, the risk of invertebrate and invertebrate habitat contamination is likely minimal.

Hurley and Ellis (2004) reviewed 19 studies to assess environmental effects associated with SBM and found that the area of detection and scale of biological effects were more localized than for WBM. Biological effects were generally detected at distances of 50 to 500 m from well sites, with recovery of benthic communities occurring within one year of well completion. While the biological effects of SBM are localized, there is uncertainty regarding degradation processes of SBM (it can produce anoxic conditions in the sediment). Toxic effects on the benthic invertebrate community may include indirect chemical toxicity and toxic effects due to anoxia caused by organic loading and biodegradation (CAPP 2001). In areas with active hydrodynamic conditions, chemical toxicity may play a more important role in SBM effects than biodegradation, as it will be more likely that cuttings will be spread out and will degrade aerobically (not resulting in measurable anoxia). In areas with more quiescent hydrodynamic conditions, biodegradation and subsequent development of anoxic conditions may play more of a role in determining benthic effects than chemical toxicity.

The major conclusions of an examination of Norwegian field studies (Jensen et al. 1999) were:

- results from monitoring studies on fields where only SBMs and WBMs have been used found that discharges of cuttings associated with SBMs and WBMs have little or no effect on benthic fauna outside a radius of 250 m;
- increases in the density of individuals of tolerant indicator species can be found up to 1,000 m from some installations; and
- effects on benthic invertebrate communities from SBM cuttings discharges are rarely seen outside of 250 to 500 m.

Suspension feeders such as scallops are most likely to be affected by SBM discharge. Armsworthy et al. (2005) have demonstrated weight loss of somatic and reproductive scallop tissues when exposed to ParaDrill IA at concentrations of 1.5 mg/L. The fine particles of bentonite and barite in drilling mud are most likely the cause of effects on scallop tissue growth. Hamoutene et al. (2004) exposed lobsters to the SBM (IPAR) over a 20-day period and concluded that there was little or no potential for negative effects. Laboratory studies were conducted to assess effects of synthetic drill mud fluid and drill mud cuttings on a range of marine fish. The laboratory studies found 96 to 100 percent survival for marine copepods and 83 to 100 percent survival for ctenophores (Payne 2001a, 2001b).

Studies on the effects of drill cuttings on tropical corals have shown direct mortality (Thompson et al. 1980), altered feeding behavior (Szmant-Froelich et al. 1981), altered polyp behavior (Thompson and Bright 1980), and effects on coral physiology (Krone and Biggs 1980). A review of these effects concluded that no distinction could be made between the effects of sedimentation and potentially toxic effects of chemical additives or the synergistic effects of both (Dodge and Szmant-Froelich 1985). A major concern relating to oil and gas exploitation is the increased levels of sedimentation that may result from drill cuttings discharged close to a coral reef (Cimberg et al. 1981; Dodge and Szmant-Froelich 1985).

Several reports have examined the discharge of drill cuttings associated with routine drilling on the Grand Banks (where there are multiple drilling activities) (Husky 2000; MMS 2000; CAPP 2001; NEB et al. 2002) and have concluded that single well exploration drilling has no significant environmental effect on the marine environment.

5.2.5 Fish

5.2.5.1 Water-based Muds and Cuttings

Using barium as a tracer, the zone of detection for both single and multiple wells found that background levels for barium were achieved at 1,000 to 3,000 m from the drill source. Increases in other trace metals (specifically arsenic, cadmium, chromium, copper, mercury, lead and zinc) were more spatially limited to 250 to 500 m of the drill site. However, these metals tend not to be in a bioavailable form and thus few biological effects are attributed to increases from metals discharges (CAPP 2001). WBMs have not been shown to cause biological effects (Hurley and Ellis 2004; CAPP 2001). WBMs contain a greater volume of fine-grained material; therefore, it is likely that they will remain in the water column much longer than SBMs. However, concentrations of WBMs in the water column are low, with short exposure times so short, they are not expected to cause any acute or sublethal effects on pelagic species (Neff 1987). Tainting or contamination of fish species is not expected to be associated with WBMs.

5.2.5.2 Synthetic-based Muds and Cuttings

Biological effects were generally detected at distances of 50 to 500 m from well sites; however, the effects were essentially limited to sessile benthic invertebrates. A number of reports have examined the discharge of SBMs and cuttings associated with routine drilling (Husky 2000; MMS 2000; CAPP 2001; NEB et al. 2002) and have concluded that small-scale drilling has no significant environmental effect on the marine environment of the Grand Banks.

Laboratory studies were conducted to assess effects of synthetic drill mud fluid and drill mud cuttings (formulations used for Grand Banks oil and gas operations) on a range of marine fish. The laboratory studies found 88 percent survival rates for capelin larvae and 100 percent survival for yellowtail flounder (Payne 2001a, 2001b). Toxicity studies conducted by Payne et al. (2001a) using American plaice on Hibernia drill cuttings found no acute toxicity in juvenile American plaice exposed for 30 days to Hibernia cuttings, approximating hydrocarbon concentrations typically found 200 to 500 m from rigs in the North Sea.

5.2.6 Commercial Fisheries

The zone of influence for WBMs and SBMs is expected to be within the safety zone around the platform in which fishing activities are prohibited. WBMs have not been shown to cause biological effects (Hurley and Ellis 2004; CAPP 2001). Tainting or contamination of fish species is not expected to be associated with drill cuttings depositions (Husky 2000; CAPP 2001).

5.2.7 Marine Birds

The discharge of drill cuttings will fall to the seafloor and, therefore, there is little chance of interaction with birds on the surface.

5.2.8 Marine Mammals and Sea Turtles

Drilling activities are unlikely to produce concentrations of heavy metals in muds and cuttings that are harmful to marine mammals (Neff et al. 1980, in Hinwood et al. 1994). Biological effects associated with drill cuttings are not normally found beyond 500 m from drilling platforms (Hurley and Ellis 2004) and as such, there will be limited interaction between drilling cuttings and marine mammals and sea turtles.

5.2.9 Sensitive Areas

Drill cuttings and associated muds (both WBMs and SBMs) have the potential to cause localized environmental effects around the well site to approximately 50 to 500 m, depending upon the type of cuttings and associated mud discharged (WBMs or SBMs). There may be sensitive areas that are habitat for species that may be adversely affected by the discharge of drill cuttings such as coral and scallops. It is anticipated that effects to those species may occur within 50 to 500 m of the well site. Special mitigation strategies may be required for such areas.

5.2.10 Mitigations

The mitigation measures to reduce or eliminate potential adverse effects of the drill cuttings include but are not limited to;

- the use of WBMs whenever possible;
- treatment and disposition of drill cuttings (described in Section 5.2.1) as per requirements of the OWTG (NEB et al. 2002);
- SBMs will be recycled, reused and ultimately disposed of on-shore (described in Section 5.2.1);
- Depending upon the timing and nature of the exploration activities, special mitigation strategies may be required to protect areas identified as sensitive habitat;
- screening and selection of chemicals used for drilling;
- waste management plan for the storage, handling and disposal of waste generated offshore;
- use of best available technologies whenever feasible;

- the timing and locations of planned project activities will be provided to fishers who may be operating in the vicinity of the Labrador Shelf SEA Area via a Canadian Coast Guard “Notice to Mariners” and a CBC Radio Fisheries Broadcast “Notice to Fishers”; and
- placement of drilling rigs to avoid settlement of cuttings onto important scallop areas/beds down-current of the drilling rig.

5.2.11 Data Constraints Associated with Drill Cuttings Discharge

The knowledge on drill cuttings and its effects are significant but the knowledge is limited for the most part to temperate and tropical environments. The effects of drill cuttings in subarctic environments are limited and it is not known if the effects signals will be similar as per temperate environment. The effects of drill cuttings on some of the unique assemblages such as epontic communities and phytoplankton have not been examined to any extent. These assemblages are critical in northern altitudes as there is a short primary productivity window for certain species and disruptions to this critical component of the ecosystem may have unforeseen consequences. There is limited knowledge of the effects of drill cuttings on corals.

While there are data gaps/constraints, their relation to offshore oil and gas is dependent on the nature and timing of the particular activity, and the need to collect additional data will be determined at the project-specific environmental assessment stage.

5.2.12 Planning Considerations Associated with Drill Cuttings Discharge

Special mitigations may apply to areas that are considered to be of special concern. The placement of structures may be an important consideration in that Labrador Shelf Sea Area is a rich area for corals and has numerous sensitive areas that are home to a variety of species.

5.3 Routine Discharges

They are a variety of routine discharges associated with offshore exploration and production activities, including cement slurries, BOP fluid, produced water, storage displacement water, bilge and ballast water, deck drainage, cooling water, sewage and food wastes. Produced water discharges are anticipated to be the largest volume of discharges associated with production activities. Produced water tends to be primarily associated with production activities, but it is possible to encountered limited quantities of produced water during exploration activities.

Deck drainage from a seismic vessel or drilling platform would result in the discharge of limited amounts of hydrocarbons; however, they are not generally associated with surface slicks. Bilge water is seawater that may seep or flow into the structure from various points in the offshore installation. Ballast water is water used to maintain the stability of an offshore facility. Vessels will adhere to Annex I of the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78) and drilling platforms treat any oil-containing water prior to discharge in adherence with the OWTG (NEB et al. 2002). The discussion of produced water effects will capture any potential environmental effects that may have been associated with the hydrocarbons entrained with deck drainage, ballast and bilge water.

BOP fluid (routine safety testing) is typically a glycol-water mixture with low toxicity.

Estimates of grey water and black water discharges are associated with the drill platform. Waste water discharge is treated and tested for compliance with OWTG (NEB et al. 2002). Organic matter associated with discharges will disperse quickly in an open ocean environment and be quickly degraded by bacteria.

A low volume of non-chlorinated seawater will be used as cooling water and will result in a small area of thermal effects.

Storage displacement water is used to ensure equilibrium in the oil storage system and is limited to production activities on specific production facilities (i.e., GBS). As oil is produced and flows into the storage cells, storage displacement water is forced out via a buffer system and, as oil is offloaded from the storage cells, storage displacement water flows naturally back into the storage cells. Storage displacement water that is discharged should be treated to reduce its oil concentration to 15 mg/L or less in accordance with OWTG (NEB et al. 2002). The discussion of produced water effects will capture any potential environmental effects that may have been associated with the hydrocarbons entrained with storage displacement water.

Produced water would only be encountered during exploration drilling during well-testing procedures. The amount encountered is very small compared to production activities. If any produced water is encountered, it is typically treated and disposed offshore or atomized in the flare. Produced water will be the main discharge associated with production activities. Produced water must be treated to reduce its oil content to compliance with the current OWTG (NEB et al. 2002), which require produced water to be treated to 30 mg/L oil in discharged produced water. Once produced water is treated to OTWG specifications, the produced water will be discharged overboard. Produced water environmental effects are discussed in detail in the following sections.

The discussion of produced water effects will incorporate any potential effects associated with hydrocarbons (the major contaminant) and other contaminants entrained within deck drainage, ballast, bilge water and storage displacement water as produced water discharges will be significantly larger than the other discharges and the effects the same. There is a lack of information available of the effects of routine discharges other than produced water, and as such will not be discussed further in this section.

Dispersion modelling studies for produced water predict a rapid dilution in the range of 30- to 100-fold within the first tens of metres of the discharge point, followed by slower dilution rates (Terrens and Tait 1993; Brandsma and Smith 1996; Neff 2002). The factors that influence the actual plume dynamics upon discharge are discharge rates, ambient current speed, tidal factors, wind-driven surface current, turbulent mixing regimes, water column stratification, water depth, density of the plume, chemical composition and discharge pipe diameter. Field validation studies of produced water discharge dispersion have verified that dilution is rapid (Neff 2002). A summary of these studies is presented in Table 5.4.

Table 5-5 Produced Water Field Validation Data

Study	Method	Conclusion
Continental Shelf Associates 1993	radium 226	426-fold dilution at 5 m 1,065-fold dilution at 50 m
Smith et al. 1994	dye tracer	100-fold dilution at 10 m 1,000-fold dilution at 103 m
Somerville et al. 1987	dye tracer	100-fold dilution at 50 m 2,800-fold dilution at 1,000 m
Brooks et al. 1980	benzene	150,000-fold dilution at discharge
Terrens and Tait 1996	BTEX/PAHs	Varied depending upon fractions Ranged from 2,000- to 53,000-fold dilution
Holdway and Heggie 1998	benzene and toluene	10,000-fold dilution at 1,000 m
Rabalais et al. 1991; 1992	Barium	Elevated levels found in sediment out to 1,000 m of discharge
US Department of Energy 1997	benzene	Various fields: 41- to 260-fold dilution at 5 m 150- to 3,400-fold dilution at 100 m 4,900- to undetectable at 2,000 m
Source: as reported in Neff 2002.		

5.3.1 Species at Risk

The marine mammal species at risk that could occur in the Labrador Shelf SEA Area are listed in Table 4.1. COSEWIC species that are not SARA-listed that could occur in the Labrador Shelf SEA Area are noted in Table 4.2.

Given the rapid rate of dilution and dispersion of most produced waters upon discharge to the receiving waters, most produced waters effects are extremely localized. Produced water discharges are subject to rapid dilution factors within the 10 m of the discharge point and as such toxic effects are expected to occur only immediately adjacent the discharge point.

The release of petrochemicals, dissolved metals and other solids into the environment associated with oil and gas exploration accidents (oil spill, offshore well blowouts, tanker spills), may result in direct mortality or sublethal impairments (slow growth, decreased resistance to disease) to wolffish. However, if regulations and guidelines are followed, the effects of these events are likely to be negligible (Kulka et al. 2007).

5.3.2 Invertebrates

Research has indicated that crustaceans are usually more sensitive to produced water effects than fish (Neff 1987; Terrens and Tait 1993; Jacobs and Marquenie 1991), with mysiids appearing to be as sensitive as or more sensitive than other species. Given the rapid rate of dilution and dispersion of most produced waters upon discharge to the receiving waters, most produced waters would be expected have a minimal affect on the receiving environment.

Cranford et al. (1998) examined the effect of produced water from Cohasset/Panuke on early life stages of lobster and sea scallop. The lobster larvae data were highly variable, with a 96-hour LC50 of 0.9 percent in experiments conducted with fed larvae. The authors noted cannibalism occurred among the larvae and warned that the resulting data should be interpreted with caution. The 96-hour LC50 for sea scallop larvae was 20.8 percent. Fertilization success of scallop eggs during 48-hour exposures of eggs and sperm to produced water was statistically significantly affected at produced water concentrations greater than 1 percent.

The most sensitive organisms generally do not show effects at concentrations below approximately 1 percent produced water and then only after exposure times of 48 hours or more. Produced water discharges are subject to rapid dilution factors within the 10 m of the discharge point that toxic effects are expected only immediately adjacent the discharge point.

However, in the unlikely scenario that a production platform is situated in estuarine waters with low flows and flushing rates, there is a possibility for produced water effects to occur in near-shore sediments. The effects of produced water discharges in estuarine systems may include toxicity to various organisms, the reduction of invertebrate abundance and diversity (Rabalais et al. 1991).

5.3.3 Fish

The two primary components of produced water that are of environmental concern are the aromatic hydrocarbons (or the BTEX fraction of TPH analyses) and PAHs. BTEX is soluble in seawater and highly toxic to marine organisms. However, there is minimal exposure risk to marine organisms given the rapid loss due to evaporation, adsorption and sedimentation, biodegradation and photolysis (Johnsen et al. 2004). PAHs are less soluble but more persistent in the environment (Holdway and Heggie 2000) and the associated toxicity to marine organisms are primarily related to benzene and naphthalene fractions (Brand et al. 1989, in Holdway and Heggie 2000).

Naphthalene fractions are rapidly degraded in the water column (Johnsen et al. 2004). Low-molecular weight PAHs are the dominant fraction of produced water; these fractions degrade more readily than the high molecular PAH fractions, which generally have a more specific toxicological nature, potentially interacting with cellular protein and DNA (Neff 2002; Johnsen at al. 2004). However, their concentrations in a produced water plume are very low due to the rapid dilution following discharge and are rarely at levels high enough to cause toxic effects in marine plants and animals (Neff 2002; Johnsen et al. 2004).

The produced water will be warmer and less dense than the receiving water. Some zooplankton and fish larvae may experience thermal shock in the immediate vicinity of the outfall. Produced water could affect water quality downstream of the release point and affect plankton.

Laboratory-based studies indicated a correlation between fish reproduction effects, oil dispersed in water above 0.4 mg/L, with DNA adducts, and PAH metabolites (biomarkers) responses observed at 0.1 mg/L oil dispersed in water (Bechmann et al. 2004). Ferraro and Fossi (2004) conducted laboratory experiments using produced water and found a indication of multi-function oxygenase (MFO) activities in relatively low concentrations of PAHs (and their bile metabolites), which suggested a potential role to toxicants other than PAHs. Expanding the study to the field, Ferraro and Fossi (2004) concluded that the studied platform was not particularly affecting biomarker responses, as MFO activities were found at different sites throughout the Labrador Shelf SEA Area. Studies have found that PAHs may cause adverse biological effects due to bioaccumulation in shallow, near shore oil and gas platforms; however, there is little bioaccumulation in marine organisms due to produced water discharged from deepwater offshore oil production platforms (Neff 2002).

Concentrations of phenols (and alkylated phenols) in produced water declines rapidly due to dilution, evaporation and bio- and photo-degradation with distance from a discharge point (Neff 2002). The solubility of phenols is very low in sea water, with concentrations often below detection limits; however, concern remains about their potential to disrupt reproduction when the degree of alkylation is increased (Johnsen et al. 2004). Laboratory-based studies on uptake of alkylated phenols in fish species have indicated that there is uptake in fish within 100 to 1,000 m of a discharge point, located primarily in the gastro-intestinal tract and that the fish excreted the alkylated phenols (and all other associated compounds) via bile to background levels within 24 to 48 hours (Sundt and Baussant 2003).

5.3.4 Marine Mammals and Sea Turtles

Potential effects of routine discharges on marine mammals are the potential contamination of marine mammals and their food sources because of discharges. There are no studies that have analyzed what, if any, effects routine discharges has on marine mammals. Potential effects of routine discharges on marine mammals are the potential contamination of marine mammals and their food sources because of discharges. The results of the White Rose Environmental Effects Monitoring Program (Husky 2005) found that American plaice and snow crab were not contaminated because of project activity. There are no studies that have show effects from routine discharges on marine mammals.

5.3.5 Marine Birds

Seabirds that are attracted to offshore production platforms may be exposed to the intermittent presence of oil sheens in the water. Sheens are thin films of organic materials typically less than 1-mm thick (Taft et al. 1995) that occur when oil droplets trapped in the produced water rise to the surface without breaking up. Oil sheen is defined as a thin film of oil, usually less than 0.002 mm thick on the water surface (Fingas 2001). Sheens contain a small amount of organic material per unit area of surface water. Sheens emanating from weathered crude were sampled in Alaska and were found to contain PAH concentrations ranging from non-detectable to 18.4 µg/L (Neff 1990). Taft et al. (1995) reported that 15 ml of oil could form a rainbow sheen of approximately 50-m^2 surface area.

Factors affecting the concentration of dispersed oil in produced water and the likelihood of sheen occurrence include oil density, interfacial tension between oil and water phases, type and efficiency of chemical treatment and type, size, and efficiency of the physical separation equipment (Ali et al. 1999). Soluble organics and treatment chemicals in produced water decrease the interfacial tension between oil and water.

On calm water, produced water sheen can form at 25 ppm and nearly all offshore installations usually have faint but visible streaks of sheen extending for hundreds of metres downwind of them, even when their water treatment plants are the best available (New Logic Research n.d.; Wills 2000 in Fraser et al. 2006). Sheens are typically short-lived due to natural weathering processes (Neff 1990). The high surface to volume ratios that characterize sheens, contribute to relatively rapid volatilization, dissolution and dispersion of sheen components.

Potential effects to wildlife exposed to sheens are external contamination and irritation of the skin, eyes and gastrointestinal tract, depending upon the nature, thickness and persistence of the sheen. Adverse effects of oil on birds include hypothermia, loss of buoyancy (Neff 1990) and mortality due to loss of thermoregulation in diving birds (Fraser et al. 2006).

5.3.6 Commercial Fisheries

Routine discharges have the potential to affect commercial fisheries because of the potential for physical effects on commercial fisheries, including hydrocarbon and metal bioaccumulation and taint. The results of the 2004 White Rose Environmental Effects Monitoring Program (Husky 2005) concluded that metal and hydrocarbon body burdens for American plaice and snow crab were unaffected by project activity; there was no evidence of taint and health incidences for American plaice were similar between the White Rose Study Area and reference areas. An overview of water column monitoring results in the United Kingdom, Norway and the Netherlands indicated that the hydrocarbon levels and biomarkers in fish and mussels are decreasing as the distance from the discharge point increases; although how specific biomarkers affect the fish at an individual, population or ecosystem level is unknown (OSPAR 2007).

5.3.7 Sensitive Areas

Given the rapid rate of dilution and dispersion of most produced waters upon discharge to the receiving waters, most produced waters effects are extremely localized. Produced water discharges are subject to rapid dilution factors within the 10 m of the discharge point and as such effects are expected to occur immediately adjacent to the discharge point. As noted in Section 5.3.1.2, in the unlikely scenario that a production platform is situated in estuarine waters there is a possibility for produced water effects to occur in near shore sediments resulting in reduced invertebrate abundance and diversity. Although the likelihood of this scenario occurring is remote, it is considered in this section for completeness.

5.3.8 Mitigations

Mitigations for routine discharges associated with exploration and production activities include but are not limited to:

- adherence to OWTG (NEB et al. 2002) limits on discharges;
- screening and selection of chemicals used for drilling;
- sanitary and food waste will be discharged below the water surface once it has been macerated to a particle size of 6 mm or less (NEB et al. 2002);
- design and implementation of a waste management plan that would serves as the controlling document for the storage, handling and disposal of waste generated during the drilling program;
- use of best available technologies and environmental criteria in selecting equipment and chemicals whenever feasible;
- use of Marine Mammal and Seabird Observer program;
- bird salvage permit requirements;
- protection measures for bilge and ballast discharges, deck drainage, drilling discharges, sewage and grey water, hazardous and non-hazardous waste management, handling of helifuel, transfer of fuel, bulk drilling fluids and liquid wastes between vessels and rig, chemical management and spills;
- communication with fishing industry/other marine users regarding drilling activities (e.g., vessel, safety zone);
- gear compensation program; and
- where economically and technically feasible, re-injection of produced water may be undertaken for production activities.

- other seabird colonies in Labrador may warrant Ecological Reserve status or other protective legislation in the future. Herring Islands may be the next candidate site. Future planning will need to consider new seabird reserves.

5.3.9 Data Constraints Associated with Routine Discharges

The knowledge on routine discharges and its effects are significant but the knowledge is limited for the most part to temperate and tropical environments. The effects of routine discharges in subarctic environments are limited and it is not known if the effects signals will be similar as per temperate environment. The effects of routine discharges on some of the unique assemblages such as epontic communities and phytoplankton have not been examined. These assemblages are critical in northern altitudes and disruptions to this critical component of the ecosystem may have unforeseen consequences. Most if not all effects described are with respect to produced water. The effects of other discharges may be equally important for subarctic environments. The effect of ice and cold temperatures on routine discharges is unknown and may change how routine discharges react as compared to the more temperate and tropical environments.

While there are data gaps/constraints, their relation to offshore oil and gas is dependent on the nature and timing of the particular activity, and the need to collect additional data will be determined at the project-specific environmental assessment stage.

5.3.10 Planning Considerations Associated with Routine Discharges

Special mitigations may apply to temporally or spatially for routine discharges for areas that are considered to be of special concern or times of year that are considered especially sensitive. The modeling of routine discharges may be required to consider ice and the effects of ice on their discharges.

5.4 Air Emissions and Climate Change

There is little or no information available on the environmental effects of air emissions directly associated with offshore oil and gas exploration, therefore this is a data gap. Emissions data related to production platforms are provided in Section 2.5.4. Approximately 22 percent of the greenhouse gas generated in Newfoundland and Labrador is generated by the petroleum industries (including offshore production platforms, the refinery in Come By Chance and the transshipment terminal at Whiffen Head) (Government of Newfoundland and Labrador 2008).

It is anticipated that over the next several year's air emissions reduction technologies and strategies (especially those aimed at greenhouse gas reductions) will take on a higher profile and importance. Project-specific environmental assessments conducted within the Labrador Shelf SEA Area may want to consider investigating air emission reduction technologies and strategies on a project specific basis. As a planning strategy, all potential reduction strategies should be investigated and analyzed during the early planning and design stages of a project, when BATEA (best applicable technology economically achievable) options are easier and more economical to address.

5.4.1.1 Climate Change

A brief overview discussion of climate change and its effects on the marine environment are provided in general terms and not by specific VEC in part as it is an evolving area of research and its tie back to air emissions is not fully demonstrated or understood. A majority of the current information is in part with effects on marine mammals and the overview is presented here. However, in reality, climate change is an ecosystem effects and at this time not truly understood because much is based on models and expected environmental effects, coupled with limited data. A majority of the research is based in the western Arctic region with limited data for the Labrador Shelf Sea Area. Nevertheless, the trend is presented and can be expected to be similar for the Labrador Shelf Sea Area.

ArcticNet projects "*Baseline Inventory and Comparative Assessment of Three Northern Labrador Fiord-based Marine Ecosystems*" and "*Understanding and Responding to the Effects of Climate Change and Modernization in Nunatsiavut*" have been conducting marine ecosystem monitoring in four areas within the Inuit Zone (Nachvak, Saglek, Okak and Anaktalak Bays), including bottom-profiling and multi-beam mapping, establishing basic oceanographic conditions (CTD profiles, water chemistry, etc.), nutrient profiling, phytoplankton and zooplankton biomass and production, evaluating paleo-oceanographic conditions and contaminant histories, and assessing contaminant levels in sediments, sculpin, char, and seal. This project is in its third year and publications are forthcoming (M. Biasutti, pers. comm.).

There is a weight of evidence that indicates climate change is tied to air emissions but that is on a more global scale than regional scale, although the effects are and will felt on a regional scale. Air emissions and its relationship to climate change will be an important effect for consideration in future site specific environmental assessments. This is an evolving area of research and will require closer examination as the depth of knowledge increases. Arctic climate has been characterized by tremendous spatial variations, arising from a combination of varying surface types (land, open ocean, sea ice, and ice sheets) and orography (Walsh 2008). The interannual and decadal variations of climate are large in the Arctic (Polyakov et al. 2003). The sensitivity of the Arctic to external forcing variations such as changes in greenhouse gas concentrations is larger than elsewhere in the Northern Hemisphere, resulting in the so-called ‘‘polar amplification’’ of climate change (Walsh 2008).

The Arctic marine environment has shown changes over the past several decades, and these changes are part of a broader global warming that exceeds the range of natural variability over the past 1000 years (Walsh 2008). The recent changes in the atmosphere, sea ice, and ocean appear, as a coordinated response to systematic variations of the large-scale atmospheric circulation, superimposed on a general warming that is likely associated with increasing concentrations of greenhouse gases (Walsh 2008). The possible role of anthropogenic factors in systematic variations of the atmospheric circulation is an active topic of research (Walsh 2008).

The changes have been sufficiently large in some areas of the marine Arctic (e.g., the Bering/Chukchi sector) that consequences for marine ecosystems appear to be underway (Walsh 2008). Projections of 21st-century climate changes by global climate models indicate an additional warming of several degrees Celsius in much of the Arctic marine environment by 2050 (Walsh 2008). Other changes predicted include a general decrease of sea level pressure and increased precipitation. The projected retreat of sea ice is expected to be largest in the summer, resulting in a delayed freeze-up and thinner sea ice during winter relative to the present climate. The changes predicted have implications for biological activity, ecosystems, and human use of the Arctic marine environment, the associated changes in transient climate features, e.g., storms, are more uncertain (Walsh 2008).

The Earth is experiencing a rapid shift in environmental stability (Walsh 2008), which challenges the adaptive capacity of Arctic marine mammals. The polar bear, walrus, bearded seal, and ringed seal may be especially vulnerable due to life histories reliant on sea ice, while the case for the narwhal (Monodon monoceros), beluga, and bowhead whale is less certain (Laidre et al. 2008). Temperate or seasonally migrant species will likely have the capability to extend their geographic range into Arctic marine habitats.

The evolutionary history of Arctic marine mammals has demonstrated their ability to adapt to major climate shifts and ecosystem perturbations (Murray 2008). Nevertheless, the projected course and rate of current climate change (Walsh 2008) may present new challenges to the wellbeing and survival of Arctic marine mammals. These challenges can be considered in four general categories: habitat modification (Laidre et al. 2008); ecosystem alteration (Bluhm and Gradinger 2008), stresses to body condition and health (Burek et al. 2008); and human interactions (Metcalf and Robards 2008). Change in sea ice is the common denominator to all these potential impacts, as direct loss of this habitat is the most prominent threat that Arctic species face.

5.4.1.2 Data Gaps Associated with Air Emissions and Climate Change

The role of air emission in climate change while empirical is not clearly demonstrated. This is a data gap that raise more questions than there are answers. However when one considers climate change in itself, there are data gaps with respect to the effects on all plankton communities, epontic communities, invertebrates, fish, commercial fisheries, marine mammals and sea turtles that include all aspects of their life history. In reality at this time there are signs of potential effects but it is not known what actual effects will occur. This is due in part to data gaps in current knowledge that is compounded by a rapidly changing environment. Data gaps included effects on ecosystems, sea ice, primary productivity, species distributions, migrations, feeding strategies, and competition. Much of the existing and emerging information is from the western arctic and regional information for the Labrador Shelf SEA Area is limited.

While there are data gaps/constraints, their relation to offshore oil and gas is dependent on the nature and timing of the particular activity, and the need to collect additional data will be determined at the project-specific environmental assessment stage.

5.4.1.3 Planning Considerations associated with Air Emissions and Climate Change

Proponents will need to consider the effect of climate change on the environment. Weather patterns could change substantially from the current situation. Climate change will most likely impact the biological environment as it is currently described and understood. Climate change is an avenue of ongoing research and new knowledge will be continually available over the next several years. Some of the expected new information will fill existing knowledge gaps and other information will be build a picture of the impacts of climate change to subarctic environments.

5.5 Existing Anthropogenic Disturbances in the Labrador Shelf Strategic Environmental Assessment Area

The major anthropogenic disturbance to in the Labrador Shelf SEA Area is commercial fishing by trawler. Groundfish are harvested using stern otter trawls. Iceland scallops are harvested with scallop dredges. The severity of the effect of trawling depends on its intensity/frequency, the habitat type and the organisms present (Kulka and Pitcher 2001). These conditions are site-specific and may range from long term alteration of hard coral habitat to temporary disruption of a low-diversity soft bottom habitat. Modelling exercises conducted by Hiddink et al. (2006) showed that the initial effect of the first trawl pass was large. Increasing trawling intensity in areas where trawling activity was already high had a smaller additive effect on benthic biomass (Hiddink et al. 2006).

5.6 Accidental Events

The primary accidental event would be the release of hydrocarbons either in exploration or production phases. They may include crude oil, diesel oil, lubricating oils, other oils and based oil associated with synthetic based muds. Another accidental event would be vessels collisions and this type of accidental event primary effects marine mammals and sea turtles.

5.6.1 Effects of Oil Spills on Shorelines

The main source of hydrocarbons from an accidental event within the Labrador Shelf SEA Area would be because of loss of well control (blowout) and hydrocarbon spills. Hydrocarbon spills may be a result of crude oil releases from drilling equipment, miscellaneous hydrocarbon leaks from a variety of equipment used in the undertaking, diesel fuel releases, drilling fluid and mud releases and/or fuel releases because of vehicle incidents.

Interaction of coastal areas and oil contamination occur where there is direct contact and access with the coastal ocean environment. Within any shoreline type, environmental effects are expected to be proportional to the amount of oil stranded. The level of environmental effects of oil spills on shorelines is closely related to the relative degree of exposure of the affected habitat (Hayes and Gundlach 1975; Gundlach and Hayes 1978; Gundlach et al. 1978; Michel et al. 1978). Two physical factors, wave-energy flux and tidal-energy flux, primarily determine the degree of exposure for shorelines (NOAA 2002).

Shorelines can be classified as high, medium and low energy (NOAA 2002). High-energy shorelines are exposed year-round to large waves and/or strong tidal currents. They occur along the outermost coastline of a region that is subjected to dominant winds causing waves to strike the shoreline directly or by wave refraction. Medium-energy shorelines are subjected to seasonal patterns of influences resulting from storm frequencies and wave size (i.e., they are more sheltered than high-energy shorelines but storm events result in similar patterns as high energy shorelines on a seasonal cycle). Low-energy shorelines are sheltered from wave and tidal energy, except during unusual or infrequent events.

Inherent in the energy classifications are inferences to the persistence of stranded oil. High energy shorelines exhibit rapid natural removal, usually within days to weeks. Low energy shorelines are characterized by slow, natural removal, usually within years. Medium energy shorelines have stranded oil that will be removed when the next high-energy event occurs, which could be days or months after the spill.

The environmental effect of oil spills (NOAA 2002) on the exposed habitats (high-energy and medium-energy shorelines) is reduced because:

- offshore-directed currents generated by waves reflecting off hard surfaces push the oil away from the shore;
- wave-generated currents mix and rework coastal sediments, which are typically coarse-grained in these settings, rapidly removing stranded oil; and
- organisms adapted to living in such a setting are accustomed to short-term perturbations in the environment.

The tidal-energy flux (NOAA 2002) is also important in determining the potential of oil-spill effects on coastal habitats, as strong tidal currents can remove stranded oil as well as build and move inter-tidal sand and/or gravel that bury oil.

Substrate types (NOAA 2002) are important considerations with respect to persistence and effects of oil on shoreline types. The substrate type distinctions of primary importance are between bedrock and unconsolidated sediment, as with unconsolidated sediment there is the potential for penetration and burial of oil. Penetration and burial are different, but these mechanisms lead to the increased persistence of oil and as a result may lead to long-term biological effects, as well as making cleanup more difficult and intrusive. Environmental effects are expected to be greater where the oil penetrates permeable substrates and tends to persist in sheltered habitats. Heavy oils can penetrate up to 1 m on gravel beaches. Mixed sand and gravel beaches usually have oil penetration of less than 50 cm. Beaches may have different permeabilities depending upon grain size; with muddy sediment have the lowest permeability and the least amount of penetration. However, the infaunal burrows provide a mechanism for oil penetration into an often-impermeable substrate.

Biological resources (NOAA 2002) along shorelines are most at risk from oil spills when:

- large numbers of individuals are concentrated in a relatively small area;
- marine or aquatic species come ashore during special life stages or activities, such as nesting, birthing, resting, or moulting;
- early life stages or important reproductive activities occur in sheltered, near-shore environments where oil tends to accumulate;
- a species is threatened, endangered, or rare; or
- a large percentage of the population is likely to be exposed to oil.

In high-energy environments, (NOAA 2000) oil is generally held offshore by wave reflection, and any oil that is deposited is rapidly removed by wave action. Environmental effects to inter-tidal communities are expected be short term. In medium-energy environments, which are essentially an intermediate stage between high-energy and low-energy environments with tide pools, there is usually a small accumulation of soil sediment at high tide mark coexisting with gravel beaches. Depending upon the substrate type and energy/tidal flux, medium-energy environments often have varying species density and diversity. Barnacles, snails, mussels and macro-algae are present and may be dominant species.

The effects of oil in low-energy environments (NOAA 2000) may vary considerably, depending upon substrate type. Beach-type fauna will vary with sand beaches used by birds, turtles, crabs, amphipods and other sediment crustaceans. Tidal flats are often the most diverse productive type of low-energy environments, with large concentrations of bivalves, worms and other invertebrates. They are often critical habitat for feeding birds. If there is the presence of sea grasses, these low-energy environments may be important fish and shellfish nurseries. Under worst-case scenarios, environmental effects in low-energy environments can be severe, with smothering and lethal toxicity associated with interstitial waters. Sea grass communities maybe become defoliated. Temporary declines in infauna may occur, which in turn may affect shorebirds, as low-energy environments are often critical forage habitats.

Many of the early studies related to the effects of oil on the environment focused on the toxicity of individual compounds to marine organisms (Anderson 1979). The results from these types of studies indicated that the acute toxicity of individual hydrocarbons is largely related to their water solubility. The acute toxicity of a specific oil type is the result of the additive toxicity of individual compounds, especially aromatic compounds. Narcotic effects of individual petroleum compounds are an important component of acute toxicity and are related to low molecular weight volatile compounds (Donkin et al. 1990). Sublethal effects following acute or chronic exposure to petroleum hydrocarbons include disruption in energetic processes, interference with biosynthetic processes and structural development and direct toxic effects on developmental and reproductive stages (Capuzzo et al. 1988).

Weathering processes are extremely important in altering the toxicity of an oil spill. Neff et al. (2000) demonstrated rapid loss of monocyclic aromatic hydrocarbons (BTEX compounds) from evaporation and a reduction of acute toxicity of the water-accommodated fraction (WAF) with loss of these compounds. With weathering processes and loss of the monoaromatic compounds, the PAHs become contributors that are more important to the toxicity of weathered oils. Other factors that may contribute to alterations in toxicity include photodegradation and photoactivation (Mallakin et al. 1999; Little et al. 2000).

Data gathered from several oil spills (1970s and 1980s) demonstrated that the medium and higher molecular weight aromatic compounds, such as the alkylated phenanthrenes and alkylated dibenzothiophenes, are among the most persistent compounds in both animal tissues and sediments (Capuzzo 1987). Impairment of feeding mechanisms, growth rates, development rates, energetics, reproductive output, recruitment rates and increased susceptibility to disease and other histopathological disorders are some examples of the types of sublethal effects that may occur with exposure to petroleum hydrocarbons (Capuzzo 1987). Early developmental stages can be especially vulnerable to hydrocarbon exposure, and recruitment failure in chronically contaminated habitats may be related to direct toxic effects of hydrocarbon-contaminated sediments (Krebs and Burns 1977; Sanders et al. 1980; Elmgren et al. 1983).

Generally the rate of recovery from oil spills depends upon the distance from pollution sources, the amount of pollution load, exposure of the shore to wave action, the methods used to remove oil from the environment and the type of ecosystem (Zenetos et. al 2004; Neff and Gilfillian 2004). Rocky shores that are found within the Labrador Shelf SEA Area are continually subjected to natural disturbances and as such are undergoing constant successional changes (Neff and Gilfillan 2004). A review of indirect effects of marine oil spills on rocky shores (Neff and Gifillian 2003) found that shores that were not cleaned or less aggressively cleaned (Torrey Canyon Spill) had many plants and animals surviving on them. These shores quickly returned to normal population fluctuations and small-scale patchiness that are typical of rocky shores in two to three years. The sheltered rocky shores of Brittany were heavily oiled because of the Amoco Cadiz spill with impact considered to minor and of short duration. The most impacted areas were sheltered locations with large amounts of oil resulting in the deaths of large numbers of limpets and periwinkles.

The *Jessica* oil spill in the Galapagos Archipelago (Edgar et al 2003) released 400 tonnes of diesel and 300 tonnes of bunker oil. Weather conditions and favourable ocean currents helped minimize the impacts. Diesel mixed with bunker thereby thinning the bunker resulted in thin strips of oil rather than the typical mouse or thick congealed oil masses coming ashore. The rocky nature of the shores as well as wave action contributed to a lack of detectable effects. All monitoring sites were located on open coasts with small wave action but without full exposure to constant wave action. It was noted that severe shoreline impacts are generally observed only with spills in the thousands rather than the hundreds of tonnes of fuel (Edgar et al. 2003).

In 1989, a diesel fuel release of approximately 600,000 liters occurred at Anvers Island Antarctica. Slicks from this spill spread over 100-km^2 area resulting in an estimated 300 dead oiled seabirds and a reduction in limpet populations by 50 percent (Kennicutt et. al. 1991). The diesel spill caused severe localized short-term effects. Recovery was rapid and no long-term effects were observed. The volatility and the high-energy environment have appeared to reduce the long-term effects with the majority of the diesel fuel evaporated and the remainder diluted and advected from the area.

An accidental spill of diesel fuel (1000 liters) occurred at the Faraday Research Station in Antarctica (Cripps and Shears 1997). The diesel fuel spill was found to have minor, localized and short-term impacts on the environment. The results of diesel fuel spill monitoring found that the fuel had an immediate toxic effect in the intertidal environment, particularly with respect to limpets. However, the fuel dispersed quickly due to evaporation and dispersal.

Nevertheless, diesel is one of the more toxic forms of oil and as such can be lethal to marine organisms at sufficient concentrations (NOAA 2006), may cause tainting of marine resources in shallow nearshore areas and may affect marine birds by direct contact. However, the nature of diesel fuel is such that it evaporates from the surface relatively quickly and does not persist in the environment for any length of time (NOAA 2006). Diesel has a low viscosity and is readily dispersed within the water column when winds reach 5-7 knots or with breaking waves. It is possible for diesel to be dispersed by wave action and may form droplets that are kept in suspension and move with currents. When small spills of diesel are stranded on shorelines, the diesel will penetrate porous sediments but are quickly washed by wave action and tidal flushing. Due to the nature of diesel shoreline cleanup for small diesel spills is usually not needed and the cleanup may cause more of an effect than the spill itself.

Research into biodegradation of petroleum products in Antarctic marine sediments (Powell et. al. 2007) concluded that their research suggested that areas previously exposed to anthropogenic hydrocarbons are better able to cope with subsequent exposures. They concluded that this was because microbial communities are already primed to utilize and degrade hydrocarbons.

A compounding effect in the Labrador Shelf SEA Area will be the physical environment associated with high altitude areas such as degree of ice cover, cold weather, limited daylight and low visibility. The amount of oil that would reach the shoreline would depend upon the results of the model (i.e. would the oil likely reach the shore), time of year, amount ice cover and potential entrapment of oil. Details on oil spill response in subarctic environments are discussed in Section 2.6.15.1.

5.6.1.1 Species at Risk

The marine animal species at risk that could occur in the Labrador Shelf SEA Area are listed in Table 4.1. COSEWIC species that are not SARA-listed that could occur in the Labrador Shelf SEA Area are noted in Table 4.2. The reader should refer to Sections 5.6.1.8, 5.6.1.10 and 5.6.1.11 for discussion of the effect of oil spills on fish, marine birds and marine mammals and sea turtles, respectively, as the same effects wold result on species at risks in those animal groups.

5.6.1.2 Macrophyic Algae

The effects of oil on algal species have received some studies but they have been limited for subarctic environments. Reports on the effects of oil on algae from high latitude have been reviewed by Cross et al. (1987a) with the results ranging from death and disappearance, decreased vertical distribution, and bleaching to no measurable effects. The effects may be species specific and dependent on the spatial and temporal exposure. Fucus sp. have been found to recover slower than mid or intertidal species with population recovery time estimated in the area of 36 months (VanTamelen and Stekoll 1996) for uncleaned shores. It is thought that subtidal algal communities suffer limited direct impacts from oil spills. In an arctic study, it was found that there were no detectable impacts on biomass, density or reproduction for subtidal algae (Cross et al. 1987b) The importance of damage to the algal communities both intertidal and subtidal cannot be understated because of the other biological assemblages associated with these communities including invertebrates and fish species.

5.6.1.3 Phytoplankton

The effects of oil on phytoplankton in nature remain poorly understood (Howarth 1991). Toxicity is closely related to the amount of dissolved, nonvolatile components of the oil (Ostgaard 1994). Howarth (1989) concluded that microcosm experiments provided the most useful information of the ecological effects of oil, particularly for low-level chronic contamination of species composition of plankton communities. Diatoms, one of the dominant phytoplankton algal groups are well reported in laboratory studies. In a review of laboratory studies, it was found that oil could be lethal or reduce photosynthesis and growth in phytoplankton, whereas at low concentrations, it could stimulate phytoplankton growth (Capuzzo 1987). Depending on the amount and type of oil, and the species, effects in experiments vary from death to growth stimulation (Ostgaard et al. 1984; Morales-Loos and Goutx 1990).

Applying Laboratory results to predicting plankton effect to oil in natural environment is problematic as the natural environment has a variety of factors to consider such as season, time of spring blooming, location (near shore, offshore, ice cover), spatial and temporal fluctuations that are not controlled in laboratory studies. Fluctuations in the natural environment make effects of oil of phytoplankton hard to identify (Howarth 1989). There limited evidence of long-term oil effects to phytoplankton in the natural environment (Ostgaard 1994). It more likely that phytoplankton in enclosed near-shore areas are likely more vulnerable to oil.

The spring bloom was the most important biological event occurring after the oil spill ((Prestige oil spill) Varela et al. 2006). The study of the effects during this period is relevant as the recruitment of many important shellfish and pelagic fishes depends on the normal development of this bloom. During the spring bloom, no significant differences in phytoplankton biomass and primary production rates were detected (Varela et al. 2006). Nor were any changes in the dominance of the main phytoplankton groups observed (Varela et al. 2006). It was not possible to demonstrate any major effects on the phytoplankton community after the Torrey Canyon (Nelson-Smith 1970), the Santa Barbara (Straughan 1972), the Argo Merchant (Ku¨hnhold 1978), the Tsesis (Linden et al. 1979; Johansson et al. 1980) or the Aegean Sea (Varela et al. 2006). The results for the Prestige oil spills are comparable with those reported by Reid (1986) in the area of North Sea oil platforms or Batten et al. (1998) after the Empress oil spill, using long data series. Much of existing information is not from high latitude environments and it is unknown if the same lack of effects would be observed in the Labrador Shelf SEA Area.

5.6.1.4 Epontic Communities

There is little or no information available on the effects of oil on epontic communities but living on the underside of ice provides good exposure to sunlight, but also provides a very different exposure route for contaminants than generally occurs for temperate or tropical marine organisms (Chapman 2003). Exposure times to a variety of contaminants may be very much greater than in other marine systems because the ice is protected from wind-driven mixing and as such, contaminants may get trapped. The high transmission of light through the ice and the clear waters could result in phototoxicity of contaminants such as hydrocarbons (PAH) which may be relevant in subarctic environments (Chapman 2003).

5.6.1.5 Microbiota

The low concentrations of hydrocarbons in the water and consequently, their reduced effects may be related to the active role of bacteria in the degradation processes of oil (Varela et al. 2006). Under optimal conditions, bacteria can degrade up to 60 to 80 percent of crude oil (Gutnick and Rosenberg, 1977). No historical data on bacteria were available in the area of the Prestige oil spill (Varel et al. 2006). The role of the microbiota in the high attitude environment is critical and there is limited data on the effects of hydrocarbons on microbiota in high altitude areas. They may be more sensitive or react differently than temperature or tropic microbiota.

5.6.1.6 Zooplankton

There is limited information on the effects of oil on zooplankton communities. The effect of oil is also largely dependent on the structure of planktonic communities. It is a generally held belief that plankton are not likely to suffer long term effects from spilled oil due to rapid dilution and dispersion within the water column (Suchanek 1993). It was found that zooplankton densities declined near a spill but rebounded within five days (Johansson et al. 1980). The data on zooplankton associated with the Prestige oil spill do not reveal any significant shifts in biomass after the spill during the spring bloom (Varela et al. 2006). As in previous years, calanoid copepods were the dominant group of zooplankton in 2003 (Varela et al. 2006).

Several studies carried out over the last few years have demonstrated the existence of an important mechanism involving oil sedimentation on the sea floor by means of planktonic organisms. Zooplankton is able to feed on oil particles (Johansson et al. 1980), which are incorporated to faecal pellets. The high sinking rates of pellets could accelerate sedimentation, especially at low water temperatures (Honjo and Roman, 1978). Up to 30 percent of surface hydrocarbons could be removed from surface waters through zooplankton pellets (Sleeter and Butler, 1982).

The reduced impact on the pelagic system may result from the capability of both phytoplankton and zooplankton to metabolize hydrocarbons (Varela et al. 2006). Many studies have demonstrated limited effects and fast recovery of growth rates after a short lag period following exposition to fuel, even at concentrations of one order of magnitude higher than those reported for the Prestige spill (Herbert and Poulet, 1980; Thomas et al. 1981). This ability of the plankton would result in an additional decrease in the concentration of hydrocarbons in the water.

Much of existing information is not from high latitude environments and it is unknown if the same lack of effects would be observed in the Labrador Shelf SEA Area.

5.6.1.7 Invertebrates

The effects of a fuel spill on invertebrate and invertebrate habitat will be determined by factors such as weather, time of year, type of habitat, species and life history stage. Hydrocarbons will be longest lasting in near-shore sheltered habitats of fine-grained substrates if the spill reaches the shoreline. Concentrations of hydrocarbons can be detectable for several years in the sediments if they are not physically or biologically disturbed (Sanders et al. 1980). Low levels of hydrocarbons in the substrate can have sublethal effects on nearby invertebrates. Oil spilled in near shore waters can become incorporated into near-shore and intertidal sediments, where it can remain toxic and may affect benthic animals for years after the spill (Sanders et al. 1980).

Chronic toxicity of petroleum hydrocarbons after an oil spill is associated with the persistent fractions of oil and individual responses of different species to specific compounds. Alterations in bioenergetics and growth of bivalve molluscs following exposure to petroleum hydrocarbons appear to be related to tissue burdens of specific aromatic compounds (Gilfillan et al. 1977; Widdows et al. 1982, 1987; Donkin et al. 1990). Widdows et al. (1982) demonstrated a negative correlation between cellular and physiological stress indices (lysosomal properties and scope for growth) and tissue concentrations of aromatic hydrocarbons with long-term exposure of *Mytilus edulis* to low concentrations of North Sea crude oil. Recovery of mussels following long-term exposure to low concentrations of diesel oil coincided with depuration of aromatic hydrocarbons (Widdows et al. 1987). Donkin et al. (1990) suggested that reductions in scope for growth in *Mytilus edulis* were related to the accumulation of two- and three-ring aromatic hydrocarbons, as these compounds induced a narcotizing effect on ciliary feeding mechanisms.

Krebs and Burns (1977) observed long-term reductions in recruitment and over-wintering mortality in the fiddler crab (*Uca pugnax)* for seven years following the spill of No. 2 fuel oil from the barge *Florida*. Recovery of crab populations correlated with the disappearance of naphthalenes and alkylated naphthalenes from contaminated sediments. Ho et al. (1999) compared the toxicity to the amphipod *Ampelisca abdita* and chemistry of spilled No. 2 fuel oil in subtidal sediment samples for nine months following the spill from the barge *North Cape*. Toxicity to the amphipods decreased as the PAH concentration in sediments decreased over the first six months post-spill.

In addition to possible histopathological damage, sublethal toxic effects of contaminants in marine organisms include impairment of physiological processes and as such, may alter the energy available for growth and reproduction (Capuzzo 1987; Capuzzo et al. 1988). Chronic exposure to chemical contaminants can result in alterations in reproductive and developmental potential of populations of marine organisms, resulting in possible changes in population structure and dynamics.

Spills that reach the shallow subtidal and intertidal environments may result in the mortality of sessile invertebrates or they may suffer sublethal effects. Eggs and larvae are more subject to harmful physiological effects from a fuel spill because they cannot actively avoid the spill and they have not developed any detoxification mechanisms. Effects can include morphological malfunctions, genetic damage, reduced growth or localized mortality of eggs and larvae (LGL Limited 2005b).

American lobster larvae had a 24-h LC50 of 0.1 ppm to Venezuelan crude oil (Wells 1972). Larvae exposed to 0.1 ppm of South Louisiana crude oil swam and fed actively while those exposed to 1 ppm were lethargic (Forns 1977). Anderson et al. (1974) tested a variety of crude and refined oils and found that post-larval brown shrimp (*Penaeus aztecus*) were less sensitive than adult invertebrate species. Moulting larvae appear to be more sensitive to oil than intermoult larvae (Mecklenburg et al. 1977).

Oil weathers, loses buoyancy and eventually sinks. It can associate with particulate matter suspended in the water and eventually sink, thereby affecting the benthic invertebrate community (Elmgren et al. 1983). A second route of oil to the benthic communities is the transport of oil or contaminated particles from nearby oiled beaches. The most sensitive organisms in the benthic communities appear to be the crustaceans. Major effects on the crustacean fauna have been documented with most oil spills (Elmgren et al. 1980; Sanders et al. 1980; Dauvin and Gentil 1990; Jewett et al. 1999). Because of the 1996 *North Cape* oil spill, (over 800,000 gallons of home heating oil) millions of American lobsters were killed and their death were attributed to the toxic effects of oil (McCay 2001).

5.6.1.8 Fish

A hydrocarbon spill can affect local abundance and availability of phytoplankton and zooplankton to fish but fish are not expected to remain within the area affected by the spill. If zooplankton survives exposure, accumulated hydrocarbons would be depurated within a few days after exposure has ended (Trudel 1985). If fish eat contaminated zooplankton they will accumulate, hydrocarbons themselves, but fish are also able to metabolize hydrocarbons and there is no potential for biomagnification.

All fish and shellfish past the egg and larval stage should likely actively avoid a hydrocarbon spill by swimming away (Irwin 1998). The effect of a localized spill on egg and larval survival would be undetectable from the high rate of natural mortality. Recruitment to a population would not be affected unless more than 50 percent of the larvae in a large portion of the spawning area were lost (Rice 1985). When the survival of herring larvae was reduced by 58 percent because of the *Exxon Valdez* spill, no effect was detected at the population level (Hose et al. 1996).

Reported physiological effects of oil on fish have included abnormal gill function (Sanders et al. 1981), increased liver enzyme activity (Koning 1987; Payne et al. 1987), decreased growth (Moles and Norcross 1998), organ damage (Rice 1985) and increased disease or parasites loads (Brown et al. 1973; Carls et al. 1998; Marty et al. 1999). Fish may suffer effects that range from direct physical effects (e.g., coating of gills and suffocation) to more subtle physiological and behavioural effects when exposed to oil. Actual effects depend on a variety of factors such as the amount and type of oil, environmental conditions, species and life stage, lifestyle, fish condition, degree of confinement of experimental subjects and others. Laboratory toxicity studies found that pelagic fish are more sensitive (LC50s of 1 to 3 ppm) than either benthic (LC50s of 3 to 8 ppm) or intertidal fish species (LC50s of >8 ppm) (Rice et al. 1979).

Juvenile and adult fish in shallow/enclosed areas could be more susceptible to effects from oil spills in that the oil might be more persistent in these areas. Therefore, exposure of the fish to the oil could potentially be of longer duration. At the same time, juvenile and adult finfish are mobile and can avoid the contaminated areas. Less mobile invertebrates could not so easily avoid the oil. Contamination of shoreline habitats that are particularly important to fish with specific habitat requirements could potentially result in more adverse effects on the fish.

Several studies have demonstrated the potential for oil residuals on beach sediments to have considerable toxic effects on fish eggs and embryos. Heintz et al. (1999) reported embryo mortality of pink salmon with laboratory exposure to aqueous total PAH concentrations as low as 1 ppb total PAH derived from artificially weathered Alaska North Slope crude oil. This is consistent with the field observations of Bue et al. (1998) of embryo mortality of pink salmon in streams traversing oiled beaches following the spill from the *Exxon Valdez*. Generally, fish eggs appear to be highly sensitive at certain stages and then become less sensitive just prior to larval hatching (Kühnhold 1978; Rice 1985). Larval sensitivity varies with yolk sac stage and feeding conditions (Rice et al. 1986), with eggs and larvae exposed to high concentrations of oil may exhibit morphological malformations, genetic damage and reduced growth. Damage to embryos may not be apparent until the larvae hatch. For example, although Atlantic cod eggs were observed to survive oiling, the hatched larvae were deformed and unable to swim (Kühnhold 1974). Atlantic herring larvae exposed to oil have exhibited behavioural abnormalities such as initial increased swimming activity followed by low activity, narcosis and death (Kühnhold 1972).

5.6.1.9 Commercial Fisheries

While the physical effects on fish from a spill may not necessarily be significant, the economic affects resulting from the prevention or impediment of a fisher's ability to access fishing grounds (because of areas temporarily excluded during the spill or spill clean-up), damage to fishing gear (through oiling) or resulted in a negative effect on the marketability of fish products (because of market perception resulting in lower prices, even without organic or organoleptic evidence of tainting) may be considerable. An interruption could result in an economic effect because of reduced catches, or extra costs associated with having to relocate harvesting effort. Effects due to market perceptions of poor product quality are more difficult to predict, since the actual (physical) effects of the spill might have little to do with these perceptions, thus the perceived taint of fish has had negative effects on economic returns from fisheries. Areas around oil spills and blowouts have been closed without any evidence of taint. For example, during the 1984 blowout at the *Uniacke* well site near Sable Island, a no-fishing zone was established. Taste tests on cod, halibut (*Hippoglossus hippoglossus*) and haddock sampled in the area did not indicate taint (Zitko et al. 1984). Similarly, during the *Kurdistan* oil spill in 1979, inspection officers rejected lobster with any traces of external oil and no proof of internal contamination (Tidmarsh et al. 1986). After the *Torry Canyon* spill in 1967, shellfish prices and sales declined dramatically, even though much of the shellfish catch was from other waters (LGL Limited et al. 2000).

Damage to fishing vessels and gear can also result from small spills (less than 50 bbl) and materials lost from seismic vessels or drill units. Damages are expected to occur infrequently, as the C-NLOPB reported that on average, there are two fishing gear conflicts per year from seismic activities in the Newfoundland and Labrador Offshore Area (JWEL 2003).

5.6.1.10 Marine Birds

The detrimental impacts of oil pollution on seabirds have been clearly demonstrated in the past (Camphuysen and Heubeck 2001). Major accidents still lead to mortality of seabirds, as was demonstrated by the *Treasure* off Africa in 2001, the *Erika* off the coast of France in 1999 (Cadiou et al. 2004; Riffault et al. 2005), the *Prestige* off France and Spain in 2002 (Camphuysen et al. 2002).

Birds are affected by direct contact with oil and most birds that are exposed to an oil spill subsequently die (Frink and White 1990; Fry 1990). From the data, it appears that there are considerable numbers and concentrations of birds within the Labrador Shelf SEA Area. Therefore, any oil spill or blowout could cause at least some and, at worst, extensive bird mortality. There is no clear correlation between the size of an oil spill and numbers of seabirds killed (Burger 1993). Timing and spill location, not spill volume, are the primary factors that influence bird mortality rates (Wiese et al. 2001). The density of birds in a spill area, wind velocity and direction, wave action and distance to shore may also have a greater bearing on mortality than size of the spill (Burger 1993). The type of oil spilled is also a factor in mortality rates. If birds are near an oil spill, then the potential effect could be considerable. One critical factor is the likelihood of oil reaching the coastline, especially areas used by shorebirds or colony-nesting seabirds. There seems to be differing scientific evidence whether oil pollution has major long-term effects on bird productivity or population dynamics. Some studies have suggested that oil pollution is unlikely to have major long-term effects on bird productivity or population dynamics (Clark 1984; Boersma et al. 1995; Wiens 1995; Butler et al. 1998) while others suggest the opposite (Piatt et al. 1990; Walton et al. 1997).

However, it is clear that aquatic and marine species of birds are extremely vulnerable and most often detrimentally affected by exposure to marine oil spills. Terns are less vulnerable to oil than many bird species, but spill clean-up activities may disturb nesting terns and cause nesting failure (Lock et al. 1994). Diving species such as Black Guillemots, murres, Atlantic Puffins, Dovekies, eiders, Long-tailed Ducks, scoters, Red-breasted Mergansers and loons are considered the most susceptible to the immediate effects of surface slicks (Leighton et al. 1985; Chardine 1995; Wiese and Ryan 1999, 2003). Alcids often have the highest oiling rate of seabirds recovered from beaches along the south and east coasts of the Avalon Peninsula, Newfoundland, showing an annual increase over a 13-year period (2.7 percent) in the proportion of oiled birds (Wiese and Ryan 1999, 2003). The Alcid family is known to be extremely vulnerable to small increases in adult mortality.

Seabirds spend most of their lives at the air-water or land-water interfaces where floating oil accumulates (Wiens 1995), increasing their chances of becoming oiled. Marine birds must frequently pass through the water's surface and, as such, when oil is present, they may become fouled. Some species are especially susceptible to oil because of their ecological niches. Birds that spend a lot of time on the water would be at highest risk. The presence of oil on the feathers of a seabird can destroy the waterproofing and insulating characteristics of the feathers and lead to death from hypothermia. Birds living in coldwater environments are most likely to succumb to hypothermia (Hartung 1995).The external exposure results in matting of the feathers, which effectively destroys the thermal insulation and buoyancy provided by the air trapped by the feathers. Consequently, oiled birds are likely to suffer from hypothermia and/or drown (Clark 1984; Hartung 1995). Most seabird losses occur during the initial phase of oil spills, when large numbers of birds are exposed to floating oil (Hartung 1995). From the *Exxon Valdez* spill in 1989, it was estimated that the total kill from oil pollution was 100,000 to 300,000 marine birds (Piatt et al. 1990). Of the birds retrieved, 74 percent were murres, and it was assumed that the colony of 129,000 murres at the Barren Islands was devastated (Piatt et al. 1990).

Oiled birds that escape death from hypothermia and/or drowning often seek refuge ashore, where they engage in abnormally excessive preening in an attempt to rid their feathers of the oil (Hunt 1957, in Hartung 1995). The preening leads to the ingestion of considerable quantities of oil that, although partially absorbed (McEwan and Whitehead 1980) can cause lethal effects. Noted effects on Common Murres and Thick-billed Murres oiled off Newfoundland's south coast include emaciation, renal tubular degeneration, necrosis of the duodenum and liver, anemia and electrolytic imbalance (Khan and Ryan 1991).

Nesting seabirds may transfer oil from their plumage and feet to their eggs (Albers and Szaro 1978). It has been demonstrated that small quantities of oil (1 to 20 μL) on eggs produce developmental defects and mortality in avian embryos of many species (Albers 1977; Albers and Szaro 1978; Hoffmann 1978, 1979a; Macko and King 1980; Parnell et al. 1984; Harfenist et al. 1990). The resultant hatching and fledging success of young appears to be related to the type of oil (Hoffman 1979b; Albers and Gay 1982; Stubblefield et al. 1995) and the timing of exposure during incubation. Embryos are most sensitive to oil during the first half of incubation (Albers 1977; Leighton 1995).

Breeding birds that ingest oil generally exhibit a decrease in fertilization (Holmes et al. 1978), egg laying and hatching (Hartung 1965; Ainley et al. 1981), chick growth (Szaro et al. 1978) and survival (Vangilder and Peterle 1980; Trivelpiece et al. 1984). Similar effects on ducklings occur when they ingest oil directly (Miller et al. 1978; Peakall et al. 1980; Szaro et al. 1981). Oil spills can also cause indirect reproductive failure. Abandonment of nesting burrows by oiled adult Leach's Storm-Petrels may have contributed to reproductive failure in that population (Butler et al. 1998).

Seabirds that ingest oil or oil-contaminated prey may lead to immuno-suppression and Heinz-body hemolytic anemia, which compromises the ability of the blood to carry oxygen (Leighton et al. 1983; Fry and Addiego 1987). This effect persists long after the birds appear to have recovered from exposure (Fry and Addiego 1987). Diminished oxygen transport capacity in the blood is a particular problem for species of birds that obtain their food by pursuing prey underwater. Effects may be exacerbated by stress resulting from handling during cleaning (Briggs et al. 1996). Sublethal effects of oil on seabirds include reduced reproductive success and physiological impairment, including increased vulnerability to stress (Briggs et al. 1996).

Common Eiders are extremely sensitive to relatively small increases in adult mortality (Goudie et al. 2000). Like the Harlequin Duck, a spill could affect the Common Eider, which may be subjected to effects at any time of year (Common Eider breeds and winters in the Labrador Shelf SEA Area). Disturbances, such as oil spills to eiders during breeding season can affect breeding success.

Birds exposed to oil are also at risk of starvation (Hartung 1995). Oiled Common Eiders deplete all of their fat reserves and much of their muscle protein (Gorman and Milne 1970). The energy demands tend to be higher because of the fact that the metabolic rate of oiled birds increases to compensate for the heat loss caused by the reduced insulating capacity of their plumage. This can expedite starvation (Hartung 1967; McEwan and Koelink 1973).

However, an oil spill could impact shorebirds, by direct mortality to some species' birds and eggs, and by destroying their invertebrate prey base, an important food supply for migrating shorebirds.

Oil spill modelling (for surface and subsurface spills during drilling) will need to be conducted for each proposed exploration project to determine the trajectories of lost product during winter and summer. However, simple hypothetical spill scenarios indicate that product may reach shore from a near-shore location within 0.5 days under strong gale or storm force wind conditions to perhaps 24 to 36 hours for a range of wind and current conditions. For locations farther afield, spilled oil is anticipated to reach shore within four days or longer.

If the spill occurs when birds are aggregated during breeding or migration, the environmental effect will be much greater than if they are widely dispersed at sea. It is likely that the cumulative effect of numerous "small" spills and chronic pollution has had a greater effect on seabird populations than the rarer large spills. A small spill around seabird habitat with large breeding populations may have a disproportionately large effect. An example of this occurred when an estimated 30,000 oiled seabirds washed up along the coasts of the Skagerrak following a small release of oil from one or two ships (Mead and Baillie 1981). At the other extreme, the wreck of the *Amoco Cadiz* off the coast of Brittany, France, resulted in the release of 230,000 tonnes of crude oil into coastal waters and the death of less than 5,000 birds (Hope-Jones et al. 1978).

The most traditional method of estimating mortality of seabirds is with beached bird surveys. Camphuysen and Heubeck (2001) concluded that the sources of pollution in chronically polluted areas could be studied with beached bird surveys, including the waters off of Newfoundland and Labrador.

Beached bird surveys were not an option for monitoring the impacts of the Terra Nova spill in 2004. The Terra Nova FPSO spill released 1000 barrels of crude oil 340 km offshore from St. John's, NL. There were no direct data available on seabird mortality given that the winds were blowing westward so carcasses would not drift to shore, and live birds would have to fly such a long distance with a headwind. However, an estimate was prepared by Wilhelm *et al.* (2007) using event probabilities, typical seabird densities for the area, and published mortality estimates from oiling. They estimated that up to 10,000 murres and dovekies might have died because of the spill. Together with the other population stressors (i.e., chronic oil pollution, hunting, and fishery bycatch) this event was concluded to potentially further stress populations of seabirds (Wilhelm et al. 2007).

After the *Prestige* oil spill off France and Spain in 2002, a different method than Wilhelm et al. (2007) was used to estimate mortality using capture-recapture methods. Seabird mortality was estimated to be eleven times the amount of beached birds collected on the coasts. Guillemots were the most affected species. Alonso-Alvarez et al. (2007) studied the nonlethal effects of the *Prestige* spill on Yellow-legged Gulls (*Larus michahellis*) and concluded that ingestion of polycyclic aromatic hydrocarbons from oil spills can negatively alter the physiology of seabirds.

Following an earlier spill off the coast of France, the *Erika* in 1999, 80,000 seabirds washed ashore (Cadiou et al. 2004; Riffault et al. 2005). Again, Guillemots were the most affected species. Castege et al. (2004) concluded that a redistribution of seabirds has occurred within the Bay of Biscay where the spill occurred, depending on the extent of environmental damage.

Some areas, like those along major shipping routes are more likely to experience accidents than others. For both the *Prestige* and the *Erika* spills, authorities were not prepared to deal with the environmental effects (Heubeck et al. 2003).

5.6.1.11 Marine Mammals and Sea Turtles

Whales are not considered at high risk to the effects of oil exposure. However, whales present in the area could suffer sublethal effects through oiling of mucous membranes or the eyes if they swim through a slick (Geraci 1990). These effects are reversible and would not cause permanent damage to the animals. There is a possibility that the baleen of whales could be contaminated with oil, thereby reducing filtration efficiency (Geraci 1990).

Any accidental spills of diesel fuel or lube oil from seismic vessels or other vessels associated with exploratory activities could, depending on the timing, location, and environmental conditions of such an event, result in oiling of marine mammals and sea turtles. However, the nature of diesel fuel is such that it evaporates relatively quickly from the surface and does not persist in the environment for any length of time and the likelihood of such an event is extremely low (JWL 2006).

Marine mammals and sea turtles can be affected by an oil spill if they come in direct contact with oil, but most marine mammals have been observed avoiding or attempting to avoid spill areas. Oil slicks will disperse more slowly in winter that in summer. However, the process would still be relatively slow in summer due to emulsion formation and high viscosities. Oil will settle on the sea surface in the unlikely event of a spill from above or below the sea's surface, where it could potentially be exposed to marine mammals in the area. Direct exposure of marine mammals and sea turtle to oil should be brief, if it occurs at all.

Lutcavage et al. (1995) studied the effect of oil on loggerheads in a controlled setting. They suggest that all post-hatch life stages are vulnerable to oil affects and tar ingestion because sea turtles show no avoidance behavior when they encounter an oil slick. Turtles indiscriminately eat anything that registers as being an appropriate size for food, including tar balls. Such was the case with a juvenile loggerhead stranded in Gran Canaria, Spain, which had an esophageal defect that trapped tar balls, plastics, and fishing line in its digestive system (National Oceanic and Atmospheric Administration (NOAA) 2003). Oil spills could also indirectly affect the health of marine mammals through ingestion, ingestion of contaminated prey, or by a reduction in available prey resulting from prey mortality. For example, this may be the cause of the decline of the Alaskan killer whale population following the

Exxon Valdez oil spill, where up to 22 individuals dies, including a high number of females (with calves) (*Exxon Valdez* Oil Spill Trustees 1992; Miller 1999).

Seals are also at risk from oil spills. Approximately 300 harbour seals died as a result of the *Exxon Valdez* oil spill, most of those were exposed at contaminated haul outs, and the population declined 35 percent between 1989 and 1997 (compared to 13 percent at uncontaminated sites), with a continuing downward trend (*Exxon Valdez* Oil Spill Trustees 1992; Miller 1999). Physiological changes included lesions in the thalamus of the brain and concentrations of petroleum hydrocarbons in bile that were up to six times higher than in seals from uncontaminated sites (*Exxon Valdez* Oil Spill Trustees 1992).

Lutcavage et al. (1995) studied the physiological and clinic pathological effects of oil on loggerhead sea turtles approximately 15 to 18 months old. They showed that the turtles' major physiological systems are adversely affected by both chronic and acute exposures (96-hour exposure to a 0.05-cm layer of South Louisiana crude oil versus 0.5 cm for 48 hours). The skin of exposed turtles, particularly the soft pliable areas of the neck and flippers, sloughed off in layers. This continued for one to two weeks into the recovery period. Histological examination of the damaged skin showed proliferation of inflamed, abnormal, and dead cells. Recovery from the sloughing skin and mucosa took up to 21 days, increasing the turtle's susceptibility to infection.

Frazier (1980, in NOAA 2003) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell plays an important role in navigation and orientation. Frazier (1980, in NOAA 2003) noted that masking olfactory cues may not harm a turtle outright, but impairing its ability to properly orient itself can result in a population effect (NOAA 2003).

The Lutcavage et al. (1995) study provided qualitative evidence that oil exposure affects the balancing of salt and water. Extended salt gland dysfunction would affect the turtle's health by altering internal salt and water homeostasis. In two experimentally oiled turtles, the salt glands effectively shut down for several days, although the turtles eventually recovered after the exposure was discontinued. The salt glands did not appear to be blocked so it appeared that the impact was toxic, rather than physical.

Kemp's ridley and loggerhead turtles feed primarily on crustaceans and mollusks, which bioaccumulate petroleum hydrocarbons (NOAA 2003). Thus, Kemp's ridley and loggerhead turtles may be at greater risk of exposure by ingesting food than leatherback turtles that feed primarily on coelenterates.

Although not marine mammal, polar bears are a mammal that uses the marine environment for feeding and migration. Oil and oil products pose serious health risks to polar bears (Øritsland et al. 1981; Hurst and Øritsland 1982; Griffiths et al. 1987). Oil reduces the insulating effect of the bears' fur, resulting an increased energy demand to maintain body temperatures. Polar bears must compensate for this energy loss by increasing its caloric intake. Given that polar bears may have limited access to food for long periods, an increased demand for food may result in starvation. Polar bears may ingest oil after an oil spill because of grooming contaminated pelts, and through scavenging and preying on contaminated seals, seabirds, or other food items. The ingested oil causes liver and kidney damage, as well as general physiological impairment, and it has long-term toxicity (Hurst and Øritsland 1982; Hurst, et al. 1991). Griffiths et al. (1987) concluded that even a brief oiling of the fur of a polar bear can kill it, primarily by poisoning through grooming, and that a large number of affected polar bears would likely die if an oil spill were to occur in prime polar bear habitat.

5.6.1.12 Sensitive Areas

The coastal bird habitats located within the Labrador Shelf SEA Area are sensitive areas that may be affected in the event of an oil spill or blowout. Studies of oil effects on sea grass (e.g., *Thalassia* sp., *Halophila* sp., *Zostera* sp.) are limited to short- and long-term effects from particular oil spills. Little evaluation of chronic or acute damage from laboratory studies exists. Eelgrass meadows in the tidal zone are generally directly exposed to oil and die-off in the first year of an oil spill. After the initial mortality in the first year, long-term effects of eelgrass are mixed. Long term (greater than 5 years) effects at the *Exxon Valdez* spill were inferred by decreased mean density of shoots and flowering shoots in the oiled area. However, biomass was the same between oiled and non-oiled areas (Dean et al. 1998).

Oil spills are known to cause potential long-term damage to salt marsh ecosystems (Duke et al. 1997; Mille et al. 1998). The vegetation and the structure that salt marshes provide may be affected, sediments may be contaminated and ecosystem functions may be impaired with regard to use by organisms, including important fisheries species, and stabilization of sediments. The rate of degradation of the oil in the sediments is influenced by the sediment type, oxygen content and bacterial community of the sediment, availability and level of nutrients in the sediments and at the oil/sediment interface and the depth to which the oil has penetrated. Oiling effects may be limited when the oil exposure is minimal, the vegetative structure is not affected and residual oil levels are minimal or rapidly weathered. Oiling effects are particularly great when oil coats the vegetation or is incorporated deeply in the sediments beneath the vegetation.

Densities of animals in salt marshes may be reduced by acute, short-term toxic effects of crude oil that sharply increase mortality rates (McDonald et al. 1991; Nance 1991; Widbom and Oviatt 1994), or cause avoidance by mobile organisms (Moles et al. 1994). Oil may persist in marsh sediments for many years (DeLaune et al. 1990; Teal et al. 1992) and may continue to affect habitat use.

Although not considered a sensitive habitat, the common organisms found on rocky intertidal shores (F*ucus*, mussels, periwinkles, starfish and barnacle) are also susceptible to the toxic effects of oil (Chan 1977; Stekoll et al. 1993). Recovery of these components can be quite substantial within a year or two, or nearly complete. However, in the *Exxon Valdez* spill, the aggressive washing of the intertidal rock shores resulted in loss of a considerable amount of silt from the rock interstices and the bivalve fauna has not been fully re-established and may not be until these sediments have been replenished by natural processes (Driskell et al. 1996).

The spatial scale of the affected sand or mud shoreline area will determine the rebound of the affected area. An example of this is the effect of the *Amoco Cadiz* oil spill on benthic crustaceans. Failure to recover in some subtidal habitats was due to the fractionated distribution pattern of favoured habitat by some species of amphipods (Dauvin and Gentil 1990). The populations were able to recover; densities on the affected site returned to pre-spill levels within 15 years (Dauvin 1998).

Oil production may adversely affect the tourism/recreational potential of the Labrador region, primarily in the event of an accidental spill. The degree that tourism and recreation in the Labrador region could be adversely affected by a fuel or oil spill is dependent upon the severity of the incident. If a spill were to occur, marine mammals, fish and birds could be negatively affected. This would have negative consequences for whale-watching, recreational fishing, traditional resource use by Aboriginal peoples and bird-watching in the area. Activities such as kayaking and diving would also be affected by any degradation of the area's marine environment and may represent public safety concerns. Any perceived degradation, real or imagined, would lessen the appeal of the region as a destination for eco-travelers.

5.6.2 Collisions

The most substantive threats to fin whales are vessel collision and fishery gear entanglement. The potential effects of known vessel traffic routes in the Labrador Shelf SEA Area to species at risk will be addressed at the project-specific environmental assessment stage.

Marine mammals are vulnerable to vessel collisions. For small marine mammal populations, vessel collisions may pose a substantial threat (Laist et al. 2001). A common denominator is most of marine mammal-vessel collisions occur near the surface where acoustical reflection and propagation can limit the ability of marine mammals to hear and locate approaching vessels (Gerstein et al. 2005). Injuries on stranded ship-struck marine mammals suggest that large vessels are the principal source of injury with most marine mammals not observed prior to the collision or at the last moment. Their collision avoidance strategies may be ineffective for large vessels with limited maneuver ability. Laist et al. (2001) data suggest that vessel speed reduction in areas of high use marine mammal habitat may reduce the impact on vessel collisions. However, Gerstein et al. (2005) indicate that vessel speed reduction without compensating for acoustical consequences may in actuality increase risk of collisions suggesting that "blanket reduction" of vessel speed may be counter-productive to marine mammal protection. Of the 11 species known to have been subject to vessel collision, fin whales (a Species of Special Concern) are struck the most frequently (Laist et al. 2001).

Information on vessel traffic within the Labrador Shelf SEA Area is provided within Section 5.8.1. In areas of special concern, measures to reduce vessel speed below 26 km/hr (14 knots) may be beneficial (Laist et al. 2001); seismic vessels typically travel at speeds of 7.4 to 9.3 km/h (4 to 5 knots), emitting seismic shots during operation.

5.6.3 Mitigations

Whales and other marine mammals are vulnerable to ship collisions. A common denominator is most of marine mammal-vessel collisions occur near the surface where acoustical reflection and propagation can limit the ability of marine mammals to hear and locate approaching vessels (Gerstein et al. 2005). Marine mammal abilities to detect and locate approaching ships may be affected by downward refraction in negative temperature gradients; Lloyd mirror effect; spreading less from stern to bow for large ships; acoustical shadowing and masking of approaching vessel noise from ambient noise; and other anthropogenic noise sources. Thus, the confluence of a variety of acoustical factors poses considerable challenges for marine mammals to detect and locate approaching vessels. Of the 11 species known to have been subject to vessel collision, fin whales are struck the most frequently; humpback whales, sperm whales and gray whales are also commonly struck (Laist et al. 2001). The most severe and lethal injuries are caused by ships 80 m or larger and vessels travelling 26 km/hr (14 knots) or greater.

Information on vessel traffic within the Labrador Shelf SEA Area is provided within Section 5.8.1. Bowhead whales, gray whales, humpback whales and sperm whales are the slowest swimming whales and as such, may render them more vulnerable to vessel collisions. In areas of special concern, measures to reduce vessel speed below 26 km/hr (14 knots) may be beneficial (Laist et al. 2001), as data would suggest the most severe and lethal injuries are caused by vessels travelling at greater than

26 km/hr (14 knots). Seismic vessels typically travel at speeds of 7.4 to 9.3 km/h (4 to 5 knots), emitting seismic shots during operation.

5.6.3.1 Oil Spills

Oil spill response capabilities will be critical given the number of potential sensitive areas, remoteness of the locale and nature of the environment. The most effective planning tool for minimizing the effects of oil spills is oil spill prevention and preparedness. Spill response capabilities and containment equipment may not be readily available in many remote areas associated with Labrador Shelf areas, therefore oil spill contingency planning and mitigations will be very important. In addition, operators may be required to maintain some degree of spill response capabilities on site.

Mitigations in the event of an oil spill include but are not limited to:

- design and Implementation of an Oil Spill Response Plan that is part of an overall Environmental Protection Plan to be approved by the C-NLOPB;
- emphasis on spill prevention through a combination of education, procedures and policies;
- maintenance of spill response capabilities (trained personnel, absorbents, containment and cleanup systems) on the drill units and/or supply vessels;
- preparation to implement shoreline protection measures and clean-up in event of an accidental event;
- fishery compensation programs for damaged gear and market losses, associated with damage; and
- training and education of personnel.

5.6.3.2 Vessel Collisions

Although there is a conflict in opinions regarding the effectiveness of speed reduction and marine mammal vessel collisions (Section 5.5.6.2), the limited data suggest that vessels speeds below 26 km/hr (14 knots) may be beneficial in reducing marine mammal vessel collisions (Laist et al. 2001). The speed of typical seismic vessel (7.4 to 9.3 km/h, or 4 to 5 knots) operation may assist in the avoidance of marine mammal collisions.

Kraus (1990) provides evidence that ship collisions are a significant source of mortality for North Atlantic right whales. It was estimated that 5 of 25 (20 percent) dead-stranded right whales, in which the cause of death was determined, succumbed to ship collisions (Kraus 1990). It was also estimated that approximately one-fifth of ship collisions with right whales are fatal (Kraus 1990). It has observed that right whales are oblivious to approaching ships during surface social activity and suggested “misses by ships became merely random events. (Goodyear 1989).

The general lack of basic information regarding types of ships involved with marine mammal collisions, speed during collision, collision location, marine mammal behaviour prior to collision, and other factors have hampered the development of mitigation factors and must be considered a data gap.

5.6.4 Data Constraints Associated with Accidental Events

The major data constraint is the overall lack of studies on the effects of oil spills in the high attitude regions. While there is information available and indeed some from northern studies, there is an overall lack of basic of toxicity information for polar marine species (Chapman and Riddle, 2003, 2004; Riddle and Chapman, 2004) and much of the effects is based upon data for temperate and tropical climates. There are some data for invertebrates, less for macroalgae and microbial communities; there are no data for vertebrates including fish, mammals, and birds (Chapman and Riddle, 2005). There is sound theoretical reasons for thinking that polar ecosystem may be sensitive to some contaminant stressors, particularly in combination with other stressors (Chapman and Riddle 2005).

Birds are known to particularly vulnerable to oil spills and there is limited data on the effects of oil on birds at high altitudes, which is a data constraint. Much of what is known has come from the Exxon Valdez spill. Effects on oil on macrophytic algae communities is limited and primarily based on temperate and tropical regions. Effects of on phytoplankton are poorly understood and due to the short growth season in subarctic environments, this is a critical constraint. There is essentially no information on the effects of oil on epontic communities and given their importance to the subarctic environment, this information may be critical. The information on the effects of oil on zooplankton is primarily from temperate and trophic regions and is limited. Information on the effects of oil spills on benthic communities, fish, and commercial fisheries for high altitude areas is limited. The impact of ice in high altitude areas on the effects of oil spills is largely unknown.

The general lack of basic information regarding types of ships is related data involved with marine mammal collisions is a data constraint.

While there are data gaps/constraints, their relation to offshore oil and gas is dependent on the nature and timing of the particular activity, and the need to collect additional data will be determined at the project-specific environmental assessment stage.

5.6.5 Planning Implications for Accidental Events

The remote locale of the Labrador Shelf Offshore SEA Area and unpredictable climate present a unique set of challenges with respect to dealing with accidental events. Because of the unique characteristics of the Labrador Shelf Offshore Area, operators may be required to provide for on-site spill response equipment and training. The specific spill response capability will be determined during the review of the project-specific environmental assessment and the Drilling Program Application.

5.7 Attraction to Lights/Flares

Storm-petrels and other night flying birds could be attracted to vessel lighting or flares, which could potentially result in disorientation (especially during periods of drizzle and fog (Wiese et al. 2001)) and collision with the vessel lights, flares or infrastructure. Attraction could also result in continuous circling around the lights, using energy and delaying foraging or migration (Avery et al. 1978, in Husky Oil 2000; Bourne 1979, in Husky Oil 2000; Sage 1979, in Husky Oil 2000; Wood 1999, in Husky Oil 2000) or being burned in flares (Wiese et al. 2001). Vessel lighting is essential since operations occur on a 24-hour basis and flaring should be limited to a short period during well testing.

Storm-Petrels (with nocturnal feeding habits) and night-flying migrants could also be attracted to lighting or flares on a drilling platform (which is also a 24-hour operation), as the platform would likely be the largest and more intensely lit structure in the area. Proponents should comply with protocols outlined in Williams and Chardine's brochure "*The Leach's Storm Petrel: General Information and Handling Instructions*". Permits are required from the CWS for implementation of these protocols.

5.8 Cumulative Environmental Effects

Individual exploration projects and related activities can result in environmental effects that are not necessarily mutually exclusive of each other, but can act cumulatively. An early analysis of the environmental effects of policies, plans and programs is facilitated by an SEA, resulting in the identification of cumulative environmental effects that could occur (Bonnell and Storey 2000). The overall environmental consequences of exploration and production activities that result from policies, plans and programs (FEARO 1992) can often only be identified at the strategic level.

An important step in undertaking a cumulative effects assessment is the identification of other actions whose effects will likely act in combination with those of the proposed activities under review to bring about cumulative effects. CEAA requires that only activities that have been or will be conducted be considered. The degree of certainty that the activity will proceed must therefore be considered (CEA Agency 1999). The other activities considered for offshore exploration and production activities included those that are ongoing or likely to proceed (as specified by CEA Agency 1994). The cumulative effects of the proposed offshore exploration and production activities within the Labrador Shelf SEA Area may include cumulative effects in combination with:

- marine transportation;
- fishing activities;
- traditional resource use by Aboriginal people;
- tourism and recreation activities; and
- other proposed exploration and production activities (as per C-NLOPB registry) within the Labrador Shelf SEA Area.

5.8.1 Marine Transportation

Shipping activity in the Labrador Sea involves vessels travelling to, from Labrador ports, and to other ports in the province and vessels that are travelling through the zone mostly to and from ports in the Canadian High Arctic. Shipping is mostly seasonal, beginning in June when ice conditions permit and ending in November at the onset of winter. There are exceptions, for example, the offshore fishing activities and freighters travelling between Greenland and eastern North American ports continue throughout the year. The shipping of concentrated ore from the mining operations in Voisey's Bay also continues during the winter months at the rate of one vessel trip every three weeks on average.

The Canadian Coast Guard operates Marine Communications and Traffic Services centres in St. Anthony and Happy Valley-Goose Bay. It records the activities of vessels that are 500 gross tonnage and greater. In 2006, it recorded 624 vessel trips in the area and in 2007 recorded 608 vessel trips to November 2007. According to the Canadian Coast Guard, this may not necessarily a complete listing especially for vessels that travel non-stop through the zone.

5.8.1.1 Labrador Ferry Services

The Labrador traffic during the shipping season involves scheduled ferry and freight services as follows:

- Ferry service between Lewisporte, Cartwright and Happy Valley-Goose Bay. The *MV Sir Robert* Bond normally begins operations in early June and ends by mid-November. Services include vehicle, passengers and freight. The schedule is on a six-day cycle.
- Ferry services from Happy Valley-Goose Bay to Black Tickle and northern Labrador communities to Nain. The *MV Northern Ranger* begins operations in early June and ends by mid-November. Services include passengers and freight. The schedule is on a five-day cycle to the northern ports.
- Ferry services between Charlottetown, Norman Bay, Pinsent's Arm, William's Harbour and Port Hope Simpson. The *MV Challenge 1* begins operations in early June and ends by mid-November. Services include passengers and freight. It alternates between ports on a daily operation except Sunday. The ferry routes between communities in the SEA Area and the ferry connection from the SEA Area to Lewisporte in Newfoundland are shown in Figure 5.4.
- Freight service from Lewisporte to mostly the north coast ports with freight as required. The *MV Astron* begins operations in early June and ends by mid to late November. The schedule is usually a 10- to 14-day cycle.

5.8.1.2 Fuel Transportation

Oil tankers operate regularly during the shipping season, delivering fuel to ports along the Labrador coast. Oil companies such as Imperial Oil Ltd., Ultramar, Irving and Petro-Nav supply various types of fuels to Labrador and the far north. Tankers operated by several companies transport these fuels. Coastal Shipping Ltd., a subsidiary of the Woodward Group, operates four tankers, with two of these dedicated to supplying fuel to Labrador communities and two supplying the Canadian Arctic (P. Martin, pers. comm.). Groupe Desgagnes in Quebec, Algoma Tankers in Ontario and Rigel Shipping in New Brunswick are tanker-operating companies that transport fuel to Labrador and ports in the far north. General routing to the Arctic through the Labrador Sea is shown in Figure 5.5.

5.8.1.3 General Cargo and Barge Towing

Other vessels transport cargo to various community and industry projects in Labrador and further north. These shipping companies include Miller's Shipping in St. John's, Berkshire Shipping in Arnold's Cove, Davis Shipping in Wesleyville, McKeils Shipping in Hamilton, Ontario, and Groupe Ocean in Quebec. These companies also provide barge towing services that carry heavy construction equipment and supplies to remote areas.

Figure 5.4 Ferry Routes Between Communities in the Labrador Shelf Strategic Environmental Assessment Area and the Ferry Route from the Area to Lewisporte in Newfoundland

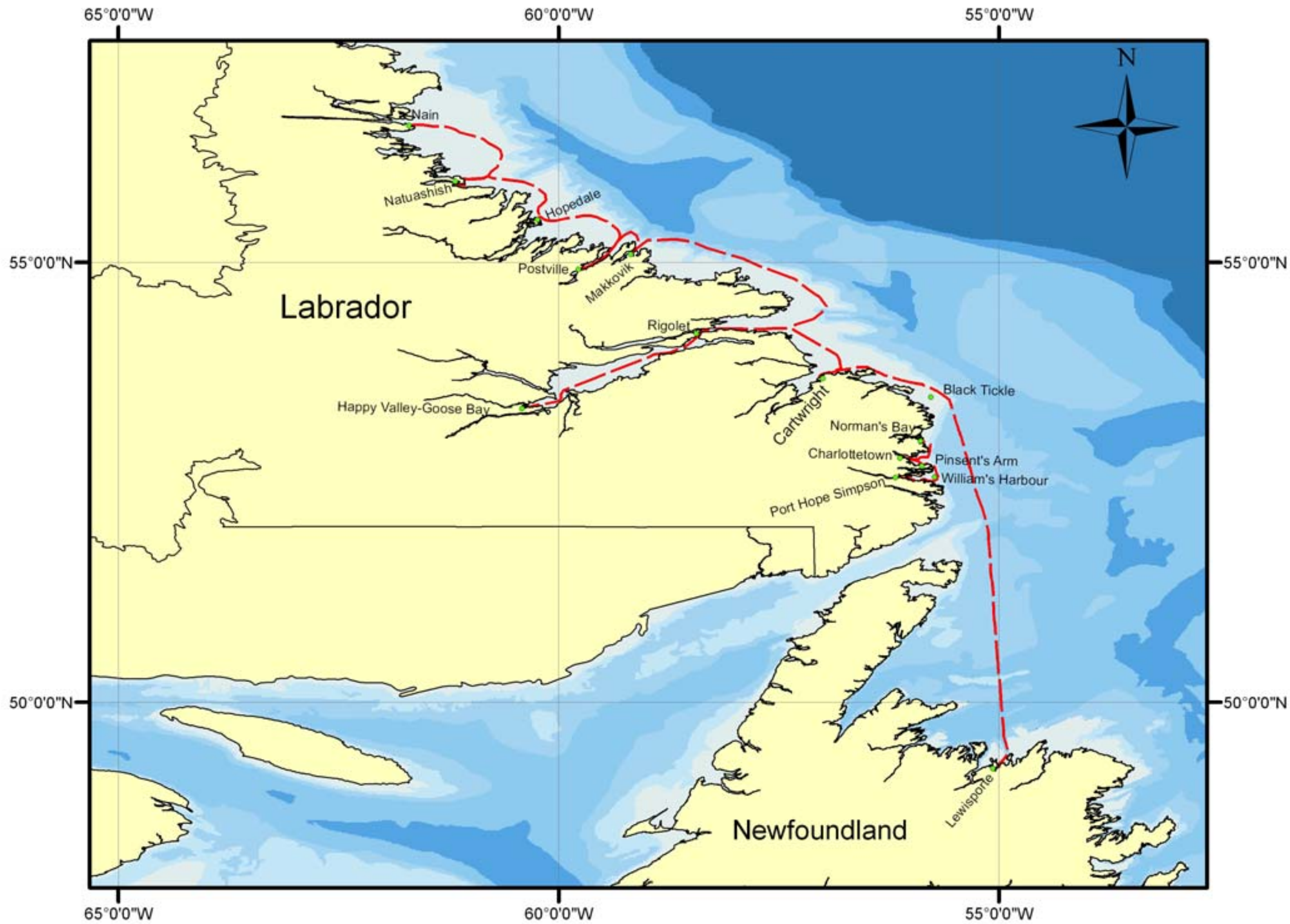
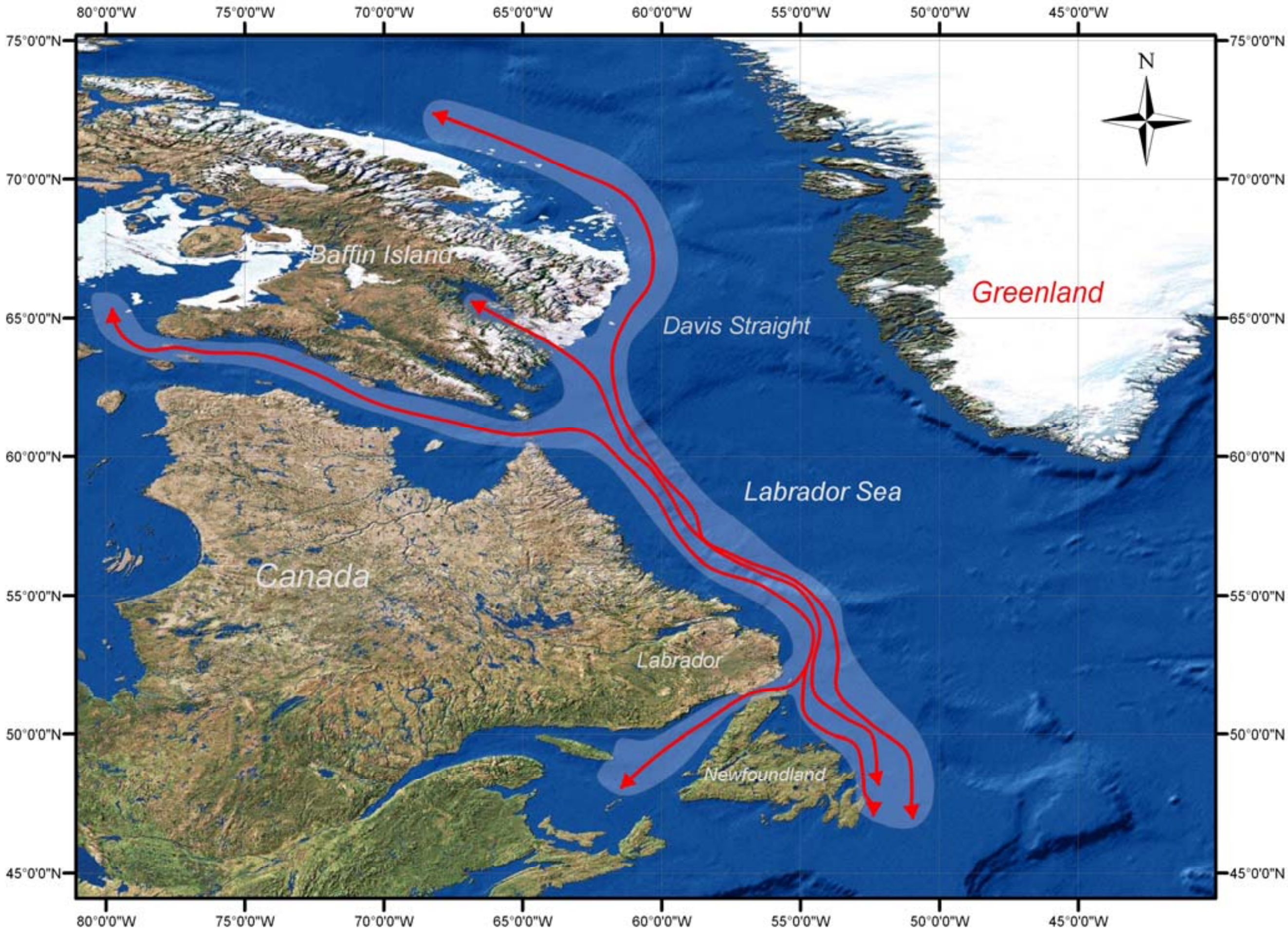


Figure 5.5 Shipping Transportation to the Canadian Arctic Through the Labrador Sea



5.8.1.4 Mining

The mining operations in Voisey's Bay have approximately 20 vessel trips per year to the mine wharf site in Edward's Cove, Anaktalak Bay. It involves the transport of ore to other processing plants in Canada and the supply of fuel and general freight to the site.

The Labrador Inuit Development Corporation (LIDC) operates an Anorthrosite mine in Ten Mile Bay near Nain. A portion of the ore is shipped to Hopedale by Barge while the larger amount is exported directly to Italy by cargo ship, which is usually one vessel trip per year.

5.8.2 Commercial Fisheries

The SEA Area lies within the NAFO fisheries management areas 2GHJ. These areas contain commercial quotas of finfish and shellfish species. Vessels licensed to fish these quotas are in various size classes based on length of the vessel. The size of the vessels up to >65 feet overall length are known as the inshore fleet, although many of these vessels, especially those in the larger size range, fish offshore throughout the 200 mile economic zone.

The inshore vessels fish the Labrador Sea from June, ice permitting, up to October when quotas are caught and/or stormy fall weather reduces operations to the level that it is not practical or economically feasible to fish.

The offshore fleet that includes the larger freezer trawler fleet is capable of fishing year around in the north and conduct fishing operations for shrimp in the SEA Area.

5.8.3 Traditional Resource Use by Aboriginal People

The Labrador Shelf SEA area is used extensively by local aboriginal peoples for traditional hunting and fishing. The activities are spread widely throughout the region and vary by season. The aboriginal people consider these activities as part of their culture and history and concerns were expressed in the public consultation sessions and through the process of collecting traditional knowledge over the impact that operations and/or accidental events may have on them. Some of the activities and issues that were highlighted for the SEA Area are:

- Fishing: the area is used extensively for fishing. Species noted were: crab; rock cod; cod; arctic char; sculpins; mussels; clams; wrinkles; and sea urchins.
- Traditional uses such as egging and berry picking are conducted on the islands in the area.
- Harlequin ducks, a threatened species migrate through the area.
- Ducks and geese are also hunted in the area.
- Traditional activities are well dispersed throughout the Labrador Shelf SEA Area.

5.8.4 Tourism and Recreation

In 2006 there were an estimated 494,400 non-resident visits to Newfoundland and Labrador (an increase of 5.1 percent over 2005). These visits equated to tourism expenditures estimated at $365 million (an increase of 8.3 percent over 2005) (Newfoundland and Labrador Department of Tourism, Culture and Recreation (NLDTCR 2007). Despite the general increase in non-resident visits and expenditures, some regions reported lower than expected tourist visitation. These regional disparities have been attributed to a slow resident travel market, a decline in non-resident auto traffic and a recognized Canada-wide trend of increased travel to urban centers (NLDTCR 2007). All are attributable, in whole or in part, to rising fuel prices.

This being said, the tourism industry is increasing in Labrador and is playing a more important role in rural economies than it has before. Each area along the Labrador coast has its own strengths and amenities. Strategies have been developed by the Nunatsiavut government (northern areas) and the Southeastern Aurora Development Corporation (southern areas) to capitalize these strengths and to accommodate new and growing businesses. Scenic, natural and cultural attractions translate into economic opportunities for the resident population and provide domestic, national and international travelers with world-class outdoor recreation activities. These activities include bird watching, whale watching, kayaking, boat tours, hiking, fishing and camping, as well as activities associated with cruise ship and private vessel (sailing) visitation and the area's cultural and historical attractions.\

5.8.4.1 Cruise Tourism

The province is internationally renowned as an adventure cruise ship destination and of the 22 cruise ships that visited the province in 2006, the majority were from adventure/exploration cruise lines (NL Government news release July 9, 2007). The cruise ship industry is promoted by a tourist industry association (Cruise Association of Newfoundland and Labrador (CANAL)) and supported by both the federal and provincial governments. The cruise routing in Labrador is mainly from south to north and return; however, the east to west routing from Europe ports via Iceland, Greenland, Baffin and south to Labrador is being developed. Developments in Labrador such as the Torngat National Park Reserve will increase tourist interest and cruise ships is considered one of the most convenient means of visiting such areas.

Despite the decline (5 percent) (NLDTCR 2007) in cruise passenger visits from 2005 to 2006, cruise tourism is viewed as a high priority, positive development. A total of 105 port calls were recorded for 2006 for Newfoundland and Labrador, up from the 97 recorded during the 2005 season (NLDTCR 2007). Cruise ship statistics for Labrador Ports (Table 5.6) indicate that the number of port calls have increased from 30 to 36 for 2005 and 2006 and dropped to 16 in 2007. Based on the 2006 numbers (NLDTCR 2007), 75 percent of the additional port calls in 2006 were in Labrador. The annual growth rate for the cruise ship industry as a whole from 1980 to 2004 was 8.2 percent (Partnerships and Planning for Tourism in Nunatsiavut 2006). It was reported that most of these schedules were completed except in 2007, when some destinations were cancelled due to weather conditions. The locations and ports visited by cruise ships in 2006 and 2007 are indicated in Figure 5.6.

Table 5-6 Labrador Cruise Newfoundland and Labrador Ports of Call

Port	2005	2006	2007
	# of Port Calls	# of Port Calls	# of Port Calls
Wunderstrands	1		1
Voisey's Bay	1		
Man of War Point	1	1	
Indian Harbour	1		
White Bear Islands	1		
Nachvak Bay	2		4 (3 completed)
Seven Islands Bay	2		
Cape Chidley	1		
Williams Harbour	1		
Davis Inlet		2	
Saglek Bay		1	1
Cape St. Charles		1	3
Pinsent Arm		2	
Gannet Arm		2	
Makkovik		2	2 (1 completed)
Red Bay	3	2	
Battle Harbour	2	7	8 (7 completed)
Cartwright	1	2	
Hopedale	2	4	4 (3 completed)
Happy Valley - Goose Bay	2		4
Cape Harrison	1		
Nain	1	3	2 (1 completed)

Port	2005	2006	2007
	# of Port Calls	# of Port Calls	# of Port Calls
Button Island	2	1	
Rigolet		2	2
Hebron	3	2	2
Grey River	1	2	
Cape Mugford	1		
St. Lewis			1
Batteau			1
Black Tickle			1
North West River			1
Eclipse Harbour			4 (3 completed)
Source: NLDTRC 2007; CANAL 2007.			

Cruise Association of Newfoundland and Labrador (CANAL) and Interval Associates (consulting team with expertise in Tourism) launched a project in 2005 (Port Readiness Program) that focuses on the development of the cruise ship industry (Partnerships and Planning for Tourism in Nunatsiavut 2006). The goal of this program is to inform key ports of opportunities such as excursion planning. Cruise industry surveys (2004) indicate the important factors to consider when adding ports to itineraries are local activities and attractions, logistics (port/community infrastructure), scenery and wildlife, history and culture (Partnerships and Planning for Tourism in Nunatsiavut 2006). Thus, the Labrador Coast has great potential as a cruise destination. CANAL (2007) specifies10 ports of call in Labrador (Saglek Fjord, Nain, Hebron, Hopedale, Rigolet, Northwest River, Happy Valley Goose Bay, Cartwright, Battle Harbour and Red Bay).

5.8.4.2 Tour Boats

The developing tourist industry in Coastal Labrador has created activity for tour boats during the summer season. For example, in Makkovik an operator provides tours north to the Torngat mountains area; in Cartwright, boat tours of the local area is offered, and daily tour services to the historic site in Battle Harbour are provided from Mary's Harbour.

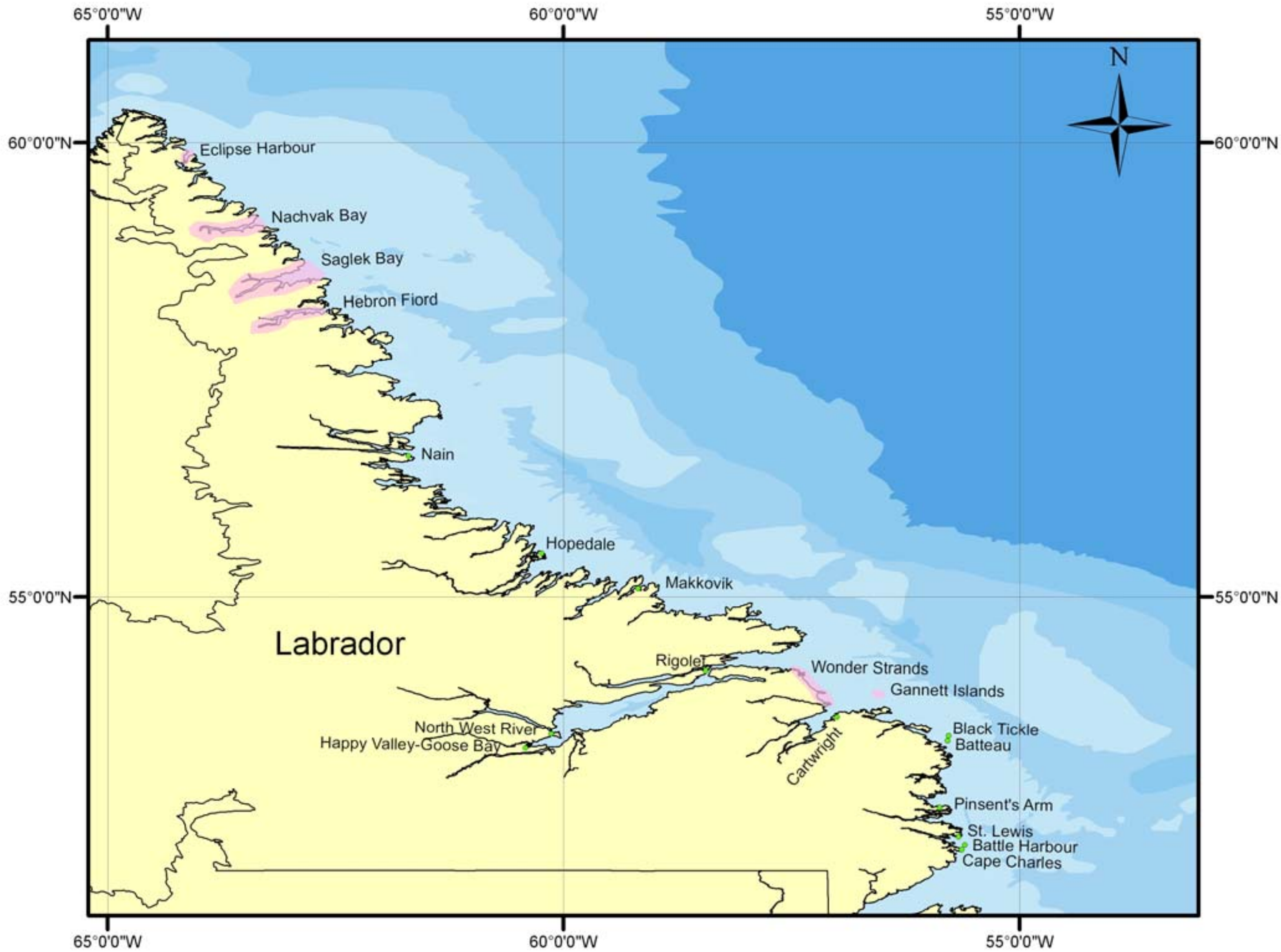
5.8.4.3 Local Personal Boating

Boats are used by local residents for transportation and fishing and hunting. They are mostly in the 6 to 8 m (20 to 30 feet) long category and powered by outboard motor. These are prevalent in every community.

5.8.4.4 Visitor Personal Boating

Recreational sailing and powerboats of various sizes visit the coast each year during the summer season, mainly from various locations along the eastern seaboard and the Great Lakes regions. According to local residents, this activity is on the increase.

Figure 5.6 Locations and Ports Visited by Cruise Ships in 2006 and 2007 in the Labrador Shelf Environmental Assessment Area



Source: CANAL 2007.

5.8.4.5 Ecotourism

The Labrador coast is experiencing a growing movement in ecotourism. The area has a diverse natural environment with potential for new developments and growth. Coastal Labrador provides optimum areas for viewing whales, birds, icebergs and unique scenery, which are visible along coastal hiking trails, boat tours (including sea kayaking) and from various established lookout points. The diversity of the environment is also ideal for Adventure touring opportunities. Public consultations undertaken as part of the Labrador Shelf SEA indicate that the development of the Torngat National Park will assist in attracting tourism interest in the area.

5.8.4.6 Prehistoric and Historic Resources

This section provides an overview of prehistoric and historic resources. Currently most of these resources are land based and as such would not be impacted by offshore oil and gas activities, rather they are included for completeness and reference.

Archaeological sites contain valuable information on past lifeways, cultural identity and relationships, and interactions within and between cultures and the land, sea, plants, and animals. Pre-contact archaeological sites are particularly valued by the aboriginal peoples of Labrador (VBNC 1997). Many archaeological and cultural sites, including burial sites in particular, have a spiritual importance for Labrador's aboriginal populations. The coast of Labrador has a long and complex cultural history, dating from about 7,500 years ago (VBNC 1997). Several cultural traditions of Indian and Inuit ancestry lived in Labrador where they have harvested the resources of the land. Sites that may be associated with European settlement and those of the aboriginal peoples who preceded them, including the Maritime Archaic, Intermediate Indian, Dorset Paleo-Eskimo, Groswater Palaeo-Eskimo, Dorset Palaeo-Eskimo, Thule Eskimo Labrador Inuit, Labrador Innu, Settlers and Recent Indian (VBNC 1997).

There are several sites that are currently recognized for their tourism and recreation potential as they provide a glimpse into the culture and history of Labrador. These include

- Battle Harbour Heritage Properties in Battle Harbour;
- Agvituk Historical Society Museum located in the Moravian Mission House in Hopedale;
- Labrador Heritage Museum in North West River;
- Labrador Straits Museum in St. Modeste;
- Loders Point Premises Museum in St. Lewis;
- Net Loft Museum in Rigolet; and
- the White Elephant Museum in Makkovik (Museum Association of Newfoundland and Labrador 2007 http://www.manl.nf.ca/).

Other sites (known and unknown) of cultural and archaeological significance may come to be recognized for their tourism and recreation potential in the future.

5.8.5 Exploration and Production Activities

Over the past 5 years there have been approximately 36,000 km of seismic data collected in the Labrador Shelf area. There is the possibility for exploration and production activities to occur concurrently or sequentially within parcels adjacent to each other within the Labrador Shelf Area. With worldwide focus shifting to some degree from oil to gas and encouraging gas, finds in the past on the Labrador Shelf could lead to increased activity in this area in the near future.

5.9 Cumulative Environmental Effects Interactions

5.9.1 Exploration and Production Activities

At current time, there is a seismic program underway on the Labrador Shelf; no production or drilling exploration activities are occurring within the Labrador Shelf SEA Area. The actual potential for cumulative effects associated with drilling exploration and production activities will be based on a variety of factors, including but not necessarily limited to the location of the exploration and/or production activities, number, type and durations of seismic surveys; number, type and duration of exploratory and/or production drilling activities; type of exploration and/or production platform and other factors intrinsic to the region, and will be examined in detail in project-specific environmental assessments.

There is currently a call for bids for four parcels in the Labrador Shelf SEA Area. Typical exploration activities associated with an Exploration License include a seismic survey, geohazard survey (in advance of setting a drilling platform) and exploration and/or delineation drilling. Specific details on the nature, spatial and temporal distribution of potential exploration and production activities in the Labrador Shelf SEA Area are not currently available. In the future, additional parcels may become available within the Labrador Shelf SEA Area, thereby adding additional potential exploration and production activities within the Labrador Shelf SEA Area.

Geophysical (seismic, including 2-D, 3-D and VSP) activities will not overlap spatially, as this may interfere with data collection. It is possible that geophysical activities could occur temporally (with appropriate distances between geophysical locations) as well they may occur sequentially. This could result in an additive effect to marine mammals and fish species that may be sensitive to noise generated during the seismic surveys and other geophysical programs.

However, based on the current demand and related availability of seismic vessels, it is unlikely that more than one seismic vessel would be available at any given time. Therefore, it is possible that seismic surveys could be conducted consecutively on the four licenses (currently in the bid process), rather than not concurrently. In addition, the demand and availability of drill units is such that it is possible that wells could be drilled sequentially in the parcels.

Individual seismic programs will require a site-specific environmental assessment pursuant to CEAA that will examine cumulative effects in detail, including background noise levels. Mitigations such as ramp-ups and avoidance of sensitive areas and times and following the C-NLOPB's *Geophysical, Geological, Environmental and Geotechnical Program Guidelines, Newfoundland Offshore Area* (C-NLOPB) ramp-up procedures should be implemented as appropriate. Any proposed seismic program would require an authorization issued by the C-NLOPB and, as such, are subject to an environmental assessment (C-NLOPB 2004) to address the potential environmental effects of seismic surveys in the Labrador Shelf SEA Area.

Based on historical activity, if the 2007 Call for Bids were successful and all parcels were successfully bid, then four exploration licences would be awarded. Considering the historic activity on the Jeanne d'arc Basin it can be assumed that there will be at least one exploration well and potentially two to three delineation wells drilled per license (parcel), resulting in approximately 16 wells drilled on the four parcels over the nine-year lease period.

Exploration/delineation drilling activities may overlap temporally or spatially between licenses. In addition, there will likely be support vessels and air support for exploration/delineation activities in the Labrador Shelf SEA Area at any given time. The increased amount of vessel traffic as a result of exploration/delineation activities in the Labrador Shelf SEA Area could add to existing vessel traffic in the Labrador Shelf SEA Area. The actual potential for cumulative effects associated with exploration/delineation activities will be based on a variety of factors, including the location of the delineation/exploration wells, type of delineation platform used and other factors intrinsic to the region that will be examined in detail in project-specific environmental assessments.

The offshore exploration and production activities will incrementally add to the underwater ambient noise levels in the Labrador Shelf SEA Area. The lack of noise measurement and modelling for the area is an existing data gap. The cumulative effects associated with incremental increases of underwater noise will be examined in project-specific environmental assessments for which there will be more information regarding other activities within and adjacent to the Labrador Shelf SEA Area.

Marine bird distribution and abundance may be influenced by natural processes such as weather, food availability and oceanographic variation, as well as by human activities such as fishing, vessel traffic, large offshore structures and pollution (Wiese and Montevecchi 2000). Exploration and production activities, commercial fishing and marine transportation could result in cumulative effects on seabirds. Seabirds may also be affected by offshore exploration and production activities that occur outside the Labrador Shelf SEA Area, but within their migratory ranges. As well, changes in prey and predator populations may affect marine bird populations.

In addition, during certain periods and activities associated with exploration and production activities support vessels may be operating in the Labrador Shelf SEA Area. Vessel traffic may affect marine birds through vessel lighting, oily discharges and noise. Chronic routine discharges, such as deck drainage and ballast and accidental releases of hydrocarbons, can expose birds to oil. Chronic releases (including those from non-exploration and production activities) may be equally or more important to long-term population dynamics of seabirds. All routine drilling platform discharges will comply with the OWTG (NEB et al. 2002).

Offshore exploration and production activities have the potential to affect habitat for benthic invertebrates within approximately 50 m of the drill centre due to deposition of cuttings. Filter feeding organisms could be affected (reduction in somatic and gonad tissue growth) by fine particles associated with drill cuttings and related mud compounds suspended in the benthic boundary layer up to 20 km from the drill centre. Behavioural effects induced by noise associated with the exploration and production activities (drilling, well abandonment and supply vessel support) could result.

5.9.2 Exploration and Production Activities in Greenland

There is the potential for cumulative effects to occur for migratory species that migrate between the Labrador Shelf SEA area and Greenland. Greenland has eight parcels that are currently or will be potentially available for exploration and production activities.

Marine bird species known to occur within the Labrador Shelf SEA area migrate between the waters off Labrador and other sites in southern areas or eastern areas, including Greenland, where there are other Blocks. A study by Brodeur et al. (2002) determined that tagged Harlequin Ducks from northern Labrador and northern Quebec migrated to southwest Greenland to moult and overwinter. Four males migrated to distinct locations along the west coast of Greenland. They migrated to Ydre Kitsissut Islands, near Nanortalik, Buksefjord and Arsuk and probably moulted there (Brodeur et al. 2002). Post-breeding staging areas were identified in northern Labrador prior to migration to Greenland. It is known that Harlequin Ducks from Hudson Bay, Ungava Bay and northern Labrador all use the Labrador coast before heading to Greenland, making the Labrador coast an important staging area. Ducks in southern Labrador migrate south to the wintering grounds off Newfoundland, the Maritime Provinces, and the northeastern US and likely moult prior to migration at the Gannet Islands and Tumbledowndick Islands, Labrador.

The Common Eider, an important species to Labrador hunters, is one species that may use both the Labrador Shelf SEA Area and the Greenland parcels and could be subject to cumulative effects. A study on the year-round movements of Common Eiders by Mosbech *et al.* (2006) determined that some breeders from Arctic Canada wintered in Atlantic Canada with a migration route along Labrador and Newfoundland coasts. Others crossed the Davis Strait to winter in southwest Greenland and returned to Arctic Canada in spring to breed.

Canada Geese that were collared during fall migration in Greenland have been traced back to breeding populations in Labrador that migrate along the Atlantic coastal zone (Fox *et al.* 1996). These individuals could use both Labrador Shelf SEA area and the Greenland areas, and as such, potential effects of the projects could be cumulative.

Dovekies form breeding colonies of thousands of birds in northern Greenland and winter off the coast of eastern Canada. The normal winter range extends from Labrador south to the Grand Banks of Newfoundland (Brown 1988). Therefore, this species may exist in both areas and could be subject to cumulative effects from the projects in the Labrador Shelf SEA Area and Greenland.

Marine Mammals from the area may also be subject to cumulative effects from potential exploration and production activities that may occur within the Labrador Shelf SEA Area and Greenland. The most likely cumulative effect to marine mammals is related to noise impacts.

It must be kept in mind that the distance between the current Labrador Shelf SEA Area 2007 Call for Bid Parcels and the Greenland Areas is approximately 1200 Km. However, in future there is the possibility that additional parcels within the Labrador Shelf SEA area may be bid and these could potentially be closer than the 2007 Call for Bid parcels for those in Greenland. Therefore, cumulative effects between areas within the Labrador Shelf SEA and Greenland may be required to be examined in project specific environmental assessments.

5.9.3 Commercial Fisheries

The potential exists for exploration and production activities to result in cumulative environmental effects with existing commercial fisheries activities. The establishment of safety zones around drilling platforms would be implemented as a mitigation measure. These effects would be addressed in project-specific environmental assessments.

Mitigative measures that could be applied during seismic operations include an FLO, a Single Point of Contact and an exclusion zone around the seismic vessel and airgun streamer. These would be addressed in more detail in a project-specific environmental assessment.

5.9.4 Marine Transportation

The potential exist for vessels associated with exploration and production activities to result in cumulative effects with existing marine transportation in the Labrador Shelf SEA Area. These effects would be addressed in project-specific environmental assessments.

5.9.5 Tourism, Recreation and Traditional Resource Use

Exploration and production activities may result in cumulative environmental effects with tourism and recreation activities in the Labrador Shelf SEA Area, including activities such as traditional resources use by aboriginal people. The specifics of these activities and potential effects will be considered during any project-specific environmental assessments.

5.10 Effects of the Environment on the Project

The types of environmental activities that could have an effect on the Project include the following:

- Metaocean conditions;
- Geology; and
- Ice and icebergs.

5.10.1 Metaocean Conditions

Severe weather includes low temperatures, snow, sleet, rain and high sea-states all of which can be expected in subarctic environments. Extreme low temperatures have the potential to reduce the ductility of components and increase susceptibility to brittle fracture. The materials specified for the projects undertaken will be required to comply with all applicable codes and standards and are expected to maintain structural integrity at the anticipated minimum ambient temperatures in the Labrador Shelf SEA Area.

Wind, snow, sleet, high sea-states and ice have the potential to increase structural loadings of the components associated with exploratory and production platforms. The design of the exploratory and production structures is such that they must be able to withstand extreme wind, ocean waves, snow, sleet and ice events.

The effect of forecasted severe weather is generally to limit operations or activities offshore. Depending on the rig or vessel, nature of activities or operations and of course the weather itself, the effect may be significant or not. Clearly, having appropriate forecasting and monitoring programs in place goes a long way to mitigating this type of risk. A careful review of expected normal and extreme conditions is a prerequisite for any vessel operating offshore. Extended periods of reduced visibility may be such that helicopter or other logistics activities are disrupted. Any activities sensitive to large currents may need to be supported by in situ current monitoring and current or tide prediction.

Vessel icing due to freezing spray accompanied by strong winds, low temperatures and high seas is a winter hazard. For freezing spray to occur air temperatures must be 2°C or colder and sea temperatures less than 5°C. Ice accretion is also directly proportional to the wind speed and sea state. A monogram depending on these factors can be used to predict icing potential. Ice accretion due to freezing precipitation and ice fog is also possible but generally, these are less of a contributor than freezing spray.

Operating threshold for a drillship and semi-submersible are such that they can stay drilling up to an approximately 2.5 m heave, with some pitch/roll limits. Beyond that point, up to 6 m heave, the rig can stay on location and stay connected but will be unable to drill. At approximately 6 m heave, the rig will need to disconnect and move off location. Both types of hulls would have generally same limits in terms of heave, different limits in terms of pitch and roll, with a drillship having less tolerance for pitch/roll. This will be an important consideration as waves have been recorded up to the 100-year maximum of 13.2 m.

Historical data from offshore Labrador for wells drilled with semi-submersibles or drillships indicate that the earliest a well can begin is June and the well must end by October if using a drillship but can go into November if using a semi-submersible.

5.10.2 Geology

The geology of the Labrador Shelf SEA Area is, of course, of paramount interest to the oil industry as it determines the oil and gas potential and will be critical in that trenching will be necessary to protection from iceberg scour, which is a potential hazard in water depths of less than 250 m. The ability to prepare trench is very dependent upon the equipment and the geology, thus the geology of a locale will dictate the trench equipment required. Boulders will be an impediment to trenching activities.

5.10.3 Ice Conditions

The presence of snow (icing events are frequently accompanied by flurries or snow squalls) can add to the ice loading although it does not affect the spray itself. Ice fog or arctic sea smoke occurs when cold air is blown over relatively warmer waters. This fog is composed of tiny super-cooled water droplets, which freeze on contact with a structure. Ice fog poses a serious icing risk only when atmospheric conditions are just right. Factors such as the size, weight, hull design, and amount of equipment and superstructure exposed to the elements, and the vessel's speed and heading into the wind will determine the amount of icing experienced.

Operators are typically required to submit an ice management plan as per the Guidelines Respecting Physical Environmental Programs during Petroleum Drilling and Production Activities on Frontier Lands (which are currently being revised) (NEB et al. in press). The guidelines clearly indicate all reporting requirements associated with the plan.

One hazard to platforms and personnel will be icebergs. The Terra Nova FPSO was designed to withstand the impact of a 100,000 t iceberg, and has the capability to move off station in the event that an iceberg of greater size threatens the platform. This will be a consideration in the Labrador Shelf SEA Area. Ice management systems have been established to ensure that any iceberg within radar range is tracked to determine its proper path. There are fly-overs, which can be put into practice to ensure that new icebergs are tracked.

If an iceberg is on a collision course, the ice management vessels will attempt to deflect the iceberg by towing, water jetting or pushing the iceberg to alter its course. As several hours, warning will be available and only a moderate deflection is required to avoid a collision then this strategy is quite feasible. Tests have shown that there is an 86 percent success rate for such attempts, however these are based on temperate locales and it is unknown how subarctic environments will affect these procedures, particularly with the high probability of severe weather (Husky Energy 2000).

Sea ice will play a dominant role in the Labrador Shelf SEA Area and is a factor in the shaping of shallow water plant and animal communities. It affects oil and gas industry-related issues that include underwater sound transmission, spill behaviour, and spill remediation.

5.10.4 Planning Implications from Effects of the Environment on the Project

The physical environment on the Labrador Shelf presents a unique set of challenges for hydrocarbon extraction. These can be broken down into geology, metocean and ice conditions. Each has its own considerations, but to date, it is the ice environment that has been considered the most difficult to deal with.

5.10.4.1 Geology

In the present context, geology refers to sediments and general subsea conditions that influence exploration and development infrastructure, rather than subsurface and reservoir geology. Associated issues include pipeline routing and protection, subsea facilities protection and stability of production platforms.

Subsea pipelines are trenched for a number of reasons, but on the Labrador Shelf, the primary concern is protection from iceberg scour, which is a potential hazard in water depths of less than 250 m. Certain types of trenching systems (i.e., jets, ploughs, mechanical trenchers) tend to operate best in specific soil types or strengths, and the selection of a trenching system varies accordingly. The presence of boulders can pose a major impediment to pipeline trenching operations. In some locations, particularly along the inner shelf, much of the seabed is exposed bedrock and conventional trenching for offshore pipelines is not possible. The preferred option with bedrock is to make use of existing channels through the inner shelf that provide shelter from icebergs. Other geological considerations include slope stability and the potential for shallow gas. While most of these issues can be resolved through appropriate surveys, reliable detection of boulders is a significant issue.

Barring the development of alternative approaches or technologies, subsea facilities in locations prone to iceberg scour on the Labrador Shelf may be protected with glory holes. Issues associated with glory hole excavation are familiar through experience gained on the Grand Banks, and issues are similar to those associated with pipeline trenching. Success with glory hole excavation has been variable, and many locations of interest on the Labrador Shelf are in water depths that are beyond the current capabilities of some systems employed on the Grand Banks (i.e., trailing suction hopper dredges).

Seabed conditions will also be an important consideration. The ability of a fixed structure such as a GBS to resist wave or iceberg impact loading is dependent on the ability of the capacity of the foundation, which is in turn a function of the soil strengths at the site. The capacity of mooring piles for a FPSO installation is a function of soil strength, and the presence of boulders can cause considerable difficulty in the installation of such mooring piles. Foundations used to support subsea production systems, such as templates and manifolds, will have similar installation issues. Collection of additional data (i.e., core samples) is required to supplement the limited existing dataset in the region.

5.10.4.2 Metocean Conditions

Metocean issues include items such as wind, wave, temperature, icing and visibility conditions. In general, metocean conditions do not differ considerably from other regions off Canada's east coast. Operators will be required to collect metocean data to support operations.

The general sea state is dictated by wind and wave conditions. Severe sea states can pose an impediment to exploration, shipping, construction and floating production systems. The end of the drilling season during exploration activities in the 1970s and 1980s was generally dictated by the sea state in late fall. A comparison of available data indicates that metocean conditions on the Grand Banks are generally more severe than those on the Labrador Shelf, thus metocean conditions on the Labrador Shelf are not likely to pose any unusual challenges compared to those already experienced on the Grand Banks.

Visibility is dictated by precipitation in the form of fog, rain or snow. Visibility can influence aviation and navigation and, at times, may delay or prevent helicopter support for offshore operations. Available data indicate that visibility on the Labrador Shelf is less of an issue than on the Grand Banks.

Air temperatures on the Labrador Shelf can be considerably lower than on the Grand Banks, and will primarily be a concern with respect to icing. Icing is a consideration for operations during certain periods of the year as the excessive accumulation of ice on the superstructure of ships or other surface facilities may cause instability and impedes other aspects of operations. Available data indicate that severe icing tends to be limited to the months of December to February. Risks associated with icing can be mitigated by limiting activities during this period or implementing a program to monitor and control the excessive accumulation of superstructure ice.

Current data has been identified as a data gap. Operators are required to collect certain metocean data during drilling and production activities. The requirements for this data collection are contained in the *Guidelines Respecting Physical Environmental Programs during Petroleum Drilling and Production Activities on Frontier Lands* (C-NLOPB 1994). Therefore, metocean data must also be collected during site-specific programs.

A planning consideration would be operating thresholds for drillships and semi-submersibles. Monthly frequency analyses for those particular thresholds would be useful for assessment of the effects of the environment on the project.

5.10.4.3 Ice Conditions

Ice conditions on the Labrador Shelf pose an important challenge for exploration and development activities. The ice environment in combination with water depth is the primary consideration that distinguishes the Labrador Shelf from existing cold climate oil and gas developments.

Pack ice is an important constraint for ships and floating structures. The beginning of the drilling season during exploration activities in the 1970s and 1980s was dictated by the end of the pack ice season. Future exploration, shipping, construction and production will likely be affected in a similar manner, unless special measures are in place to deal with pack ice. Pack ice loads will affect vessel station-keeping ability and may result in excessive forces on moorings and risers. Fixed structures, which would be designed for iceberg impact loads, would not be influenced to the same extent, but would face issues related to re-supply and evacuation in pack ice.

The presence of icebergs represents an important hazard for offshore activities, both for surface and subsea structures. Icebergs can be present on a year-round basis, and the frequency of icebergs is such that, without effective ice management, impacts with surface structures would be an annual event. Iceberg impact loads, both in terms of global loads and local ice pressures, represent an important design consideration for surface structures. Iceberg interaction with the seabed poses a hazard to pipelines and subsea structures, requiring measures such as pipeline burial, glory holes or other approaches to reduce risk to acceptable levels.

Ice management techniques can be used to break up pack ice floes and tow icebergs when they threaten installations. However, ice management is not 100 percent effective and therefore, the result of ice management is to reduce, rather than eliminate, ice loads and the associated risk. At present, it is not possible to quantify the magnitude of this reduction, in particular for icebergs, since the ability to detect and manage icebergs in heavy pack ice conditions is uncertain.

6.0 SUMMARY AND CONCLUSIONS

This SEA has been completed in relation to potential offshore oil and gas exploration in the Labrador Shelf SEA Area, including potential seismic surveys (2-D, 3-D, geohazard and VSP) and exploration and delineation drilling programs. The C-NLOPB will use the information presented in this SEA in decision-making for offshore exploration activities for the Labrador Shelf SEA Area. The SEA provides an overview of the existing environment of the Labrador Shelf SEA Area, discusses in broad terms the potential environmental effects which may be associated with offshore oil and gas exploration and production in the Labrador Shelf SEA Area, identifies knowledge and data constraints, highlights any key issues of concern and makes recommendations for mitigation and planning. Information from the SEA will assist the C-NLOPB in determining whether exploration rights should be offered in whole or in part for the Labrador Shelf SEA Area and may identify general restrictive or mitigative measures that may be considered for application to seismic and/or drilling activities.

6.1 Applicable Legislation

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) is responsible, on behalf of the Government of Canada and the Government of Newfoundland and Labrador, for petroleum resource management in the Newfoundland and Labrador Offshore Area. The *Canada-Newfoundland Atlantic Accord Implementation Act* (S.C. 1987, c.3) and the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (R.S.N.L. 1990, c. C-2) collective known as the Accord Acts, administered by the C-NLOPB govern all petroleum operations in the Newfoundland and Labrador offshore area. In addition to the governing acts noted above regulations and guidelines have been established to assist with the governance of the noted above acts. Operators would be required to comply with the Accord Acts and noted applicable legislation and guidelines including the following:

- Newfoundland Offshore Petroleum Drilling Regulations;
- Newfoundland and Labrador Offshore Area Petroleum Geophysical Operations Regulations;
- Geophysical, Geological, Environmental and Geotechnical Program Guidelines, Newfoundland Offshore Area, April 2004;
- Newfoundland Offshore Petroleum Installations Regulation;
- Canada-Newfoundland Oil and Gas Spills and Debris Liability Regulations;
- Newfoundland Offshore Petroleum Drilling Regulation;
- Newfoundland Offshore Certificate of Fitness Regulation;
- Offshore Waste Treatment Guidelines, August 2002;
- Guidelines Respecting the Selection of Chemicals Intended to be Used in Conjunction with Offshore Drilling and Production Activities on Frontier Lands (January 1999); and
- Guidelines Respecting Drilling Programs in the Newfoundland Offshore Area.

6.2 Sensitive Areas

The Labrador Shelf SEA Area is an unique subarctic environment that has a number of areas and places that are described in the SEA report as **sensitive areas**. For the purposes of the Labrador Shelf SEA, the term **sensitive area** is defined as follows:

- an area that is afforded some level of protection under federal or provincial legislation (i.e., National Parks, ecological reserves, Oceans Act Marine Protected Areas (MPAs), National Marine Conservation Areas (NMCAs), National Historic Sites, fishery management areas)
- an area that may be under consideration for such legislative protection,
- an area that is known to have particular ecological or cultural importance and is not captured under federal or provincial regulatory framework (e.g., corals; spawning, nursery, rearing, or migratory areas; areas of high productivity, IBAs, areas of traditional harvesting activities).

The description of an area as a **sensitive area** within the Labrador Shelf SEA, in itself, does not automatically imply that this area will require the application of non-typical mitigations or restriction on activities. The timing, spatial extent, and nature of proposed oil and gas activities, in addition to mitigations prescribed by legislation, will determine the level of restriction or mitigation that will be required.

Sensitive areas that have been identified with the Labrador Shelf SEA include:

- Proposed National Marine Conservation Area (Nain Bight and Hamilton Inlet);
- Battle Harbour, a Canadian National Historict District);
- Gilbert Bay, a marine protected area;
- Hamilton Bank- Hawke Channel;
- Other Labrador Shelf SEA Area banks, specifically Saglek and Nain Banks;
- Torngat Mountain National Park;
- Proposed Mealy Mountain National Park;
- Coral Conservation Priority Area near Cape Chidley;
- Gannett Islands Ecological Reserve; and
- 14 Important Bird Areas(in additional to Gannett Islands) located at
  - Galvano Island;
  - Seven Island Bay;
  - Nain Coastline;
  - Offshore Island Southeast of Nain;
  - Quaker Hat Island;
  - Northeast Groswater Bay;
  - Goose Brook (just outside SEA Area);
  - The Backway (just outside SEA Area);
  - South Groswater Bay Coastline;
  - Tubledown Dick and Stag Islands;
  - Cape Porcupine;
  - Table Islands;

- Bird Islands; and
- St. Peter Bay (just outside SEA Area)

6.3 Potential Issues

While they are a variety of potential issues that are generally applicable to offshore oil and gas exploration, the Labrador Shelf Sea Area is a subarctic environment that has its own unique set of issues that may not be found in more temperate environments. Issues are not considered in isolation although they are provided below in a list for ease of identification. Associated with potential issues are data constraints that may in part be why an item is considered an issue in the first place. Issues and related data constraints result in the need for potential mitigations and having planning implications to address or mitigate the issue. Potential issues that are associated with offshore oil and gas activities, regardless of the locale include:

- effects of sounds associated with industrial activities, including seismic surveys, on marine mammals including polar bears, sea turtles, seabirds, invertebrates, fish and species at risk;
- attraction of seabirds, particularly petrels, to drill units and survey and supply vessels;
- fishery exclusion/safety zones;
- potential sensitivity of suspension and filter feeding benthic invertebrates, including hard corals, to drilling discharges;
- potential collision between surveys and support vessels and marine mammals (including species at risk);
- disturbance to sensitive areas and life histories such as migration routes, spawning areas and nurseries;
- potential cumulative environmental effects from offshore oil and gas exploration activities and effects from other users in the same vicinity (e.g., commercial fishing, vessel traffic, traditional land and resource use by Aboriginal peoples, tourism and recreation-related activities);
- effects of routine discharges (produced water, storage displacement water, bilge and ballast water, deck drainage, cooling water, cement slurries, BOP fluid, sewage and food wastes) on birds, marine mammals, sea turtles, invertebrates, fish and related habitat, commercial fisheries and species at risk; and
- effects of accidental events on birds, marine mammals, sea turtles, invertebrates, fish and related habitat, commercial fisheries and species at risk.

There are several potential issues that are specific to the Labrador Shelf SEA Area because of its unique environment. These include:

- potential sensitivity of eelgrass beds, shallow subtidal and intertidal areas to accidental events, as they are host to a variety of migratory birds (including species at risk);
- important habitat within the Labrador Shelf SEA Area used by birds for breeding, nesting and overwintering, which includes the Harlequin Duck (listed as Species of Concern under SARA);
- the presence of a coral conservation area, Cape Chidley near the northern edge of the Labrador Shelf SEA Area;
- potential sensitivity of key fish spawning and nursery areas within the Labrador Shelf SEA Area, in particular the Hamilton Bank-Hawkes Channel and Gilbert Bay;

- ice conditions (including pack ice, icebergs and iceberg scour) and related ice management issues that are unique to the Labrador Shelf SEA Area and would greatly influence timing and type of exploration and drillings activities;
- two potential National Marine Conservations Areas that have been identified in Nain Bight and Hamilton Inlet;
- potential effects of climate change on the subarctic environments such as the Labrador Shelf SEA Area ecosystem and in particular species that are closely associated with or require ice environment for life history activities;
- challenges associated with accidental events (oil spill) in subarctic environment with ice interactions;
- presence of all three species of wolffish, in particular the northern and spotted wolffish, which are protected under SARA, throughout the Labrador Shelf SEA Area; and
- the presence of 14 IBAs within the Labrador Shelf SEA Area.

6.4 Data Constraints

The availability of information varies considerably among the various components of the Labrador Shelf SEA Area. While there is data available for all VECs and issues identified and discussed throughout the Labrador Shelf SEA, there are a variety of data constraints associated with the existing data. These data constraints range from “limited or aged” data sets with respect to populations estimates, limited knowledge on the ecology of a species or species ecology for a species.

The key data constraints identified below are an overview of the data constraints that have been identified throughout the Labrador Shelf SEA report. The applicable data constraints sections provide greater details with respect to species specific constraints. It must be recognized while at the time of this report these data constraints existed, studies and research are ongoing filling many existing data constraints on one hand and often identifying new constraints on the other hand. A review of data constraints will be required during project specific environmental assessments to ensure that the data constraints noted below and throughout the report are still valid.

- There is a limited database of current measurements for the Labrador Shelf Sea Area.
- Geological information is limited to certain areas and further detailed geological information will be required. Boulder fields have been recorded but there is no detailed mapping.
- There is insufficient data to determine the frequency of ice island occurrence and this will be important as they are difficult to detect and track.
- The exact trajectory (where, when and how much will reach shore) from an oil spill in the Labrador Shelf SEA Area is unknown; and is a data gap for this SEA. However, spill trajectory modelling and fate and effect of spills is a requirement for site-specific drilling and production environmental assessments.
- The present inability to reliably detect and map oil trapped in, under, on, or among ice is a critical deficiency, affecting all aspects of response to spills in ice.
- The current ability to clean up oil spills in the presence of sea ice is extremely limited (DeCola et al. 2006). Ice conditions present the significant challenges to on-water spill response as there is very little commercially available equipment appropriate for use offshore in ice-infested waters.

- Much of the basic biological and ecological information related to species at risk, COSEWIC species and marine mammals in general is lacking, such as identification of critical habitat, migration patterns, behaviour of critical life stages, effects of ongoing human activities on species and their habitat, effects of events outside *SARA*'s geographical jurisdiction and inter-relationships with other species.
- The migration routes, breeding grounds and feeding areas are known for relatively few of the marine mammals and sea turtles. In order to predict the importance of noise effects on marine mammal behaviour, the seasonal and geographic distribution of the marine mammals and sea turtles must be better known.
- There is a paucity of life history data for species in the Labrador Shelf SEA Area based on studies conducted within the Labrador Shelf SEA Area. Much of the information on life histories and ecology is inferred from research on these species in other locales including temperate locations and the western arctic.
- Current distribution and abundance of Ivory Gulls within the Labrador Shelf Sea Area is unknown and the Labrador Shelf Sea Area could be the most important wintering area for this SARA-listed species.
- Very little is known about the Eskimo Curlew's basic biology, breeding biology, or migration and it is unlikely that much will be known about Eskimo Curlew unless the species status can be confirmed.
- An emerging data constraint is the understanding climate variations play in species and ecosystem interactions. This is very relevant for species that are at their ecological limits because their distribution and abundance will change depending upon the ecological regime of the time. Current research efforts are being undertaken to fill data constraints in this area. A significant amount of the current research on climate change is being conducted in the western arctic and equivalent information for the Labrador Shelf SEA area is limited, although it is recognized that this is a new and evolving focus area.
- Plankton are the keystone to the marine ecosystem as they transfer energy up to higher trophic levels. While there are data available on plankton in general, it is limited in the Labrador Shelf SEA Area. The understanding of the contribution of epontic communities to the overall primary productivity of the Labrador Shelf SEA Area is limited.
- The role and importance of sea ice dynamics for ecosystem component interaction and health is limited.
- The data constraints associates with benthic invertebrate communities including basic biology and ecology, including the ability of benthic species to adapt to cold and subarctic environment is poorly understood. The processes controlling distribution, abundance and production is limited with the role of the benthic communities and seabed to the marine ecosystem in high-altitudes being poorly understood.
- There are data constraints with respect to detailed distribution and general life history dynamics of corals and sponges.
- Many scientific assessments for commercial species are dated; therefore, it is difficult to accurately describe and assess the population size and structure for several species.
- The distribution of fish and shellfish eggs and larvae within the Labrador Shelf SEA Area is not well documented and understood, including spatial and temporal variability.
- While there is information on all fish and invertebrate species, there are a variety of uncertainties including basic life history information. The role of environmental variations on

natural mortality, production and recruitment is poorly understood. Non commercial species have more data constraints than commercial species with respect to life history and ecology in the Labrador Shelf SEA Area, in particular with respect to spawning locations, abundance and distribution. The information on the biology, life history and ecology is often inferred from research conducted in other areas. The location of spawning areas and other critical habitat for invertebrates and fish species is often unknown.

- Detailed information on locations of enhanced productivity for fish species, including areas of concentrations of feeding seabirds and marine mammals (e.g., Hawkes Channel), is limited and vague.
- The at-sea distribution of seabirds within the Labrador Shelf SEA Area is poorly understood. An example is that the existing data for pelagic distributions and abundances is dated with most data over 30 years old.
- The focus of noise and vessel interactions has been marine mammals and sea turtles for obvious reasons, in reality there still is an overall lack of data with respect to noise and vessel interactions. A complicating factor for the Labrador Shelf SEA Area will be noise and vessel interactions coupled with sea-ice dynamics. There is limited data for noise with respect to plankton, invertebrates and fish species.
- There are no sound models for the Labrador Shelf Sea Area and as such knowledge regarding the propagation of sound waves within the area is limited. The impact of ice on the effects of sound wave propagation is limited and may have an impact on how sound waves propagate.
- The effects of drill cuttings and routine in subarctic environments are limited and it is not known if the effects signals will be similar as per temperate environment. The effects of drill cuttings and routine discharges on some of the unique assemblages such as epontic communities and phytoplankton have not been examined to any extent.
- The overall lack of studies on the effects of oil spills in the high attitude regions is an obvious data constraint. Experience in responding to oil spills in subarctic environments is limited and as such so is the corresponding literature.
- There is an overall lack of basic of toxicity information for polar marine species (Chapman and Riddle, 2003, 2004; Riddle and Chapman, 2004) and much of the effects is based upon data for temperate and tropical climates. There are some data for invertebrates, less for microalgae and microbial communities; there are no data for vertebrates including fish, mammals, and birds (Chapman and Riddle, 2005).
- There are 14 IBAs within the Labrador Shelf Sea Area and many have not been assessed since 1978, most notably Herring Islands, Bird Islands and outer Islands off Nain. The Important Bird Area require updated population estimates and based on current estimates, some areas may warrant protective area status.
- Population trends for all marine bird species in the Labrador Shelf SEA Area are sketchy and long-term surveys are lacking.

6.5 Addressing Data Constraints

Some of the data constraints noted above can be addressed by government departments under their respective mandates, through collaborative efforts between industry and government, as part of site-specific environmental assessments and through site-specific monitoring programs associated with oil and gas activities. Some activities that could assist in addressing identified data constraints are described in the following.

- The collection of spatial and temporal data on fish spawning, distribution of fish and shellfish eggs and larvae would be valuable for use in environmental effects assessments, as well as fisheries management.
- The collection of data and information with respect to SARA-listed species, including wolffish, leatherback sea turtles and various whale species, would be beneficial for fisheries and resource management.
- Verification of Aboriginal traditional knowledge would enhance existing scientific knowledge.
- Project-specific environmental assessments may identify the need to collect baseline data or undertake modelling or monitoring programs. Depending on the timing of exploration project activities, collection of data may be undertaken opportunistically or there may be a requirement to collect data prior to the commencement of activities.
- Marine mammal and seabird observation programs during exploration and production programs will add to the existing knowledge.
- The Canadian-Newfoundland and Labrador Offshore Petroleum Board will promote research through the Environmental Studies Research Fund, Petroleum Research Atlantic Canada, Memorial University of Newfoundland, to address data constraints identified in the Strategic Environmental Assessment Report.
- The requirement for site-specific oil spill and cuttings deposition modelling as part of the environmental assessment process.
- The requirement for site-specific oil spill modelling as part of the environmental process.
- Community based training in oil spill response capabilities.
- As per the *Guidelines Respecting Physical Environmental Programs during Petroleum Drilling and Production Activities on Frontier Lands* (NEB et al. in press), various metocean data, including current mooring data, will be collected during drilling and production operations.

6.6 Planning Considerations

A number of key environmental planning and management considerations related to future offshore exploration in the Labrador Shelf SEA Area are summarized below. The potential sensitive areas within the Labrador Shelf SEA Area, including, sensitive bird areas and sensitive fish and fish habitat, are identified in Figure 6.1.

- Several species at risk are known or likely to occur in or adjacent to the Labrador Shelf SEA Area. Mitigating potential effects to species and habitats protected by the SARA will be an important consideration in decisions related to future offshore exploration.
- A number of areas and times are particularly important to fish and fish habitat (including benthic invertebrates) in the region (e.g., spawning areas and periods, migration routes, areas of high productivity). Individual seismic programs should, where possible, be planned so as to reduce potential interactions during particularly sensitive times.
- The coastal areas (including islands) within the Labrador Shelf Sea Area are used by the Aboriginal peoples for traditional food gathering (including the harvest of most fish species, hunting of marine mammals (including polar bears) and birds, egging and berry gathering). Mitigating potential effects to traditional resource usage within the Labrador Shelf SEA Area will be an important consideration in decisions related to future offshore exploration.
- Ice conditions and ice management strategies will be a major planning consideration.

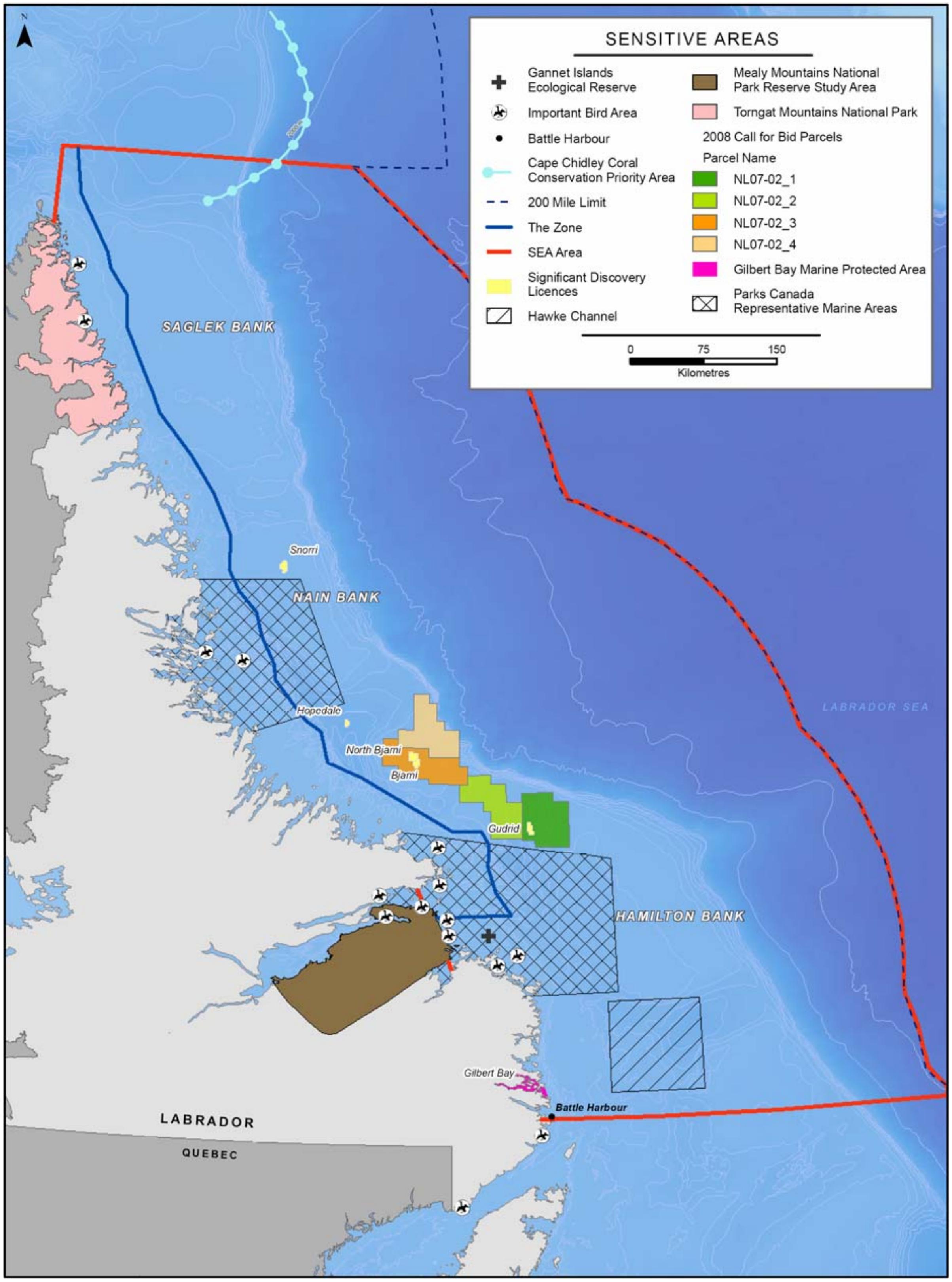
- The remote locale of the Labrador Shelf SEA Area is such that timeliness of any emergency response will be crucial. One planning consideration will be to assess and upgrade spill response capabilities within the Labrador Shelf SEA Area to support offshore oil and gas activities for that area. The appropriate equipment combined with locally trained people to conduct emergency response operations should be in place for activities planned within the Labrador Shelf SEA Area.
- Seismic surveys are, where possible, planned to coordinate program activities with the fishing industry to reduce potential conflict with commercial fishing activity during peak fishing times.
- Pre-spud ROV surveys could be a potential requirement to collect data regarding corals/benthic communities.
- Cumulative effects will need to be included at the project-specific environmental assessment stage and should consider activities occulting within the Greenland Offshore.
- The current fishery within the Labrador Shelf SEA Area is dominated by shellfish, particularly shrimp and crab. Historically the groundfish fishery played a vital role to the area. Future environmental assessments should consider appropriate mitigations for historical groundfish species as it is possible these fisheries could return to the could return to prominence in the future.

6.7 Mitigation Measures

The following sections provide a summary of mitigation measures that were identified in various sections of the Labrador Shelf SEA Area; these are not all inclusive. Project-specific environmental assessments will determine the nature and extent of restrictions or mitigation measures for each activity proposed during projects undertaken within the Labrador Shelf SEA Area. Many of the mitigation measures identified below have been previously implemented for projects, depending upon the specific situation and in some cases may be considered best industry practices.

Mitigation measures may employ spatial or temporal considerations and restrictions when planning operational activities. Many mitigation measures considered and implemented are put into place to avoid critical life stages and/or habitat. Depending on the nature and timing of the oil and gas activity, additional mitigation measures may be required to prevent environmental effects and will be determined at the project-specific environmental assessment stage.

Figure 6.1 Sensitive Areas within the Strategic Environmental Assessment Area



6.7.1 Seismic Surveys

The following mitigation measures (as per C-NLOPB 2008) that may be employed by operators for activities undertaken during seismic operations (including vertical seismic profiling or VSP) include:

- Design and/or select energy source to use the least amount of energy required to achieve operational goals;
- minimize the proportion of the energy that propagates horizontally;
- minimize the amount of energy at frequencies above those necessary for the purpose of the survey;
- schedule seismic surveys to avoid sensitive stages (i.e., fish eggs, fish larva, areas of known concentrations of juvenile fish, and shellfish moulting periods);
- plan to avoid areas that could raise concerns with respect to gear conflicts;
- schedule seismic surveys to avoid potential impacts on fishing catch rate by avoiding heavily fished areas when these fisheries are active to the greatest extent possible;
- schedule seismic surveys to avoid displacing an individual marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *SARA* from breeding, feeding or nursing;
- schedule seismic surveys to avoid diverting an individual migrating marine mammal or sea turtle of a species listed as endangered or threatened on Schedule 1 of the *SARA* from a known migration route or corridor;
- schedule seismic surveys to avoid displacing a group of breeding, feeding or nursing marine mammals, if it is known there are no alternate areas available to those marine mammals for those activities, or that if by using those alternate areas, those marine mammals would incur significant adverse effects;
- schedule seismic surveys to avoid diverting aggregations of fish or groups of marine mammals from known migration routes or corridors if it is known there are no alternate migration routes or corridors, or that if by using those alternate migration routes or corridors, the group of marine mammals or aggregations of fish would incur significant adverse effects;
- schedule seismic surveys to avoid gear conflicts and fish disruptions during the execution of DFO surveys;
- establish a safety zone which is a circle with a radius of at least 500 m as measured from the centre of the air source array;
- ramp-up procedures as outlined in *Geophysical, Geological, Environmental and Geotechnical Program Guidelines*, Newfoundland Offshore Area (C-NLOPB 2008);
- airgun shut downs must be instituted (when active and not only during ramp-up procedures) if a *SARA*-List endangered or threatened marine mammal or sea turtle is sighted within 500 m of the array;
- seismic surveys must ensure that there are no cetaceans or sea turtles or SARA-List marine mammals listed were observed within the safety before starting or restarting an air source array after they have been shut-down for more than 30 minutes;

- seismic surveys must implement a Marine Mammal Program (30 minutes prior to start up procedures and maintain watch at all other times if the proposed seismic survey is of a power that it would meet a threshold requirement for an assessment under the *CEAA)*;
- publish a Canadian Coast Guard “Notice to Mariners” and a “Notice to Fishers” via the CBC Radio program Fisheries Broadcast;
- compensate for gear losses attributed to seismic survey activity;
- use standard pollution prevention policies and procedures;
- avoid sensitive times and areas for selected periods and times to minimize potential effects to sensitive species; and
- maintain communication with fishers in the area of seismic surveys.

6.7.2 Drilling Programs

The following mitigation measures that may be employed by operators for activities undertaken during drilling programs (exploration and/or production) include:

- the use of WBMs whenever possible;
- treatment and disposition of drill cuttings (described in Section 5.2.1) as per requirements of the OWTG (NEB et al. 2002);
- recycled, reused and ultimately disposed of SBMs on-shore (described in Section 5.2.1);
- adherence to OWTG (NEB et al. 2002) limits on all discharges;
- screening and selection of chemicals used for drilling;
- waste management plans for the storage, handling and disposal of waste generated offshore;
- well abandonment procedures to be approved by C-NLOPB;
- selection of supply vessel and aircraft routing to avoid sensitive areas and/or times;
- compensation in the event that gear is damaged;
- use of best available technologies and environmental criteria for equipment and chemical selection whenever feasible; and
- communication with fishers via a Canadian Coast Guard “Notice to Mariners” and a CBC Radio Fisheries Broadcast “Notice to Fishers”.

6.7.3 Accidental Events

The following mitigation measures that may be employed by operators in the event of an accidental event (oil spills and vessel collisions) include:

- design and implement an Oil Spill Response Plan (part of an Environmental Protection Plan) to be approved by the C-NLOPB;
- emphasize oil spill prevention through a combination of education, procedures and policies;
- maintain oil spill response capabilities (trained personnel, absorbents, containment and cleanup systems) on the drill units and/or supply vessels that is appropriate to the environment and potential type of produced under exploration or production;

- preventive equipment should be put into place and be appropriate to mitigate future damages after the causative factor of a spill has been established to minimize the reoccurrence;
- exercise oil spill response plans on a regular basis;
- prepare to implement shoreline protection measures and clean-up in event of an oil spill;
- compensation for damaged gear and market losses, associated with damage due to an oil spill;
- training and education of personnel to handle oil spills; and
- reduced speeds (vessel collision reduction) in areas known to be frequented by marine mammals or areas of know marine mammal concentrations.

6.8 Conclusion

The Labrador Shelf Offshore Area SEA report provides a general overview of the physical and biological environment for the Labrador Shelf SEA Area. Data constraints and gaps are highlighted for certain environmental descriptors within the SEA Area, including oceanographic, benthic invertebrates, marine mammals, commercial fisheries data, and traditional knowledge within the Nunatsiavut Zone. Within the SEA Area there are a number of sensitive areas. There are two potential candidate areas for a NMCA, sensitive fish habitat (Hawke Channel-Hamilton Bank area, Saglek and Nain Banks), the Gannet Island Ecological Bird Sanctuary, 14 IBAs, the Torngat Mountains National Park, the proposed Mealy Mountains National Park, as well as traditional hunting and harvesting areas within The Zone. Coral communities can be found in numerous locations throughout the Labrador Shelf SEA Area.

The SEA report discusses a number of data gaps. As the SEA Area is very large and diverse, these data gaps are described for the entire SEA Area rather than for specific locations within the Area. For some areas, in particular the Nunatsiavut Zone, the extent of the data gaps is unknown. The C-NLOPB, through its membership in the ESRF Management Board will advocate the allocation of research funds to undertake a gap analysis for the Zone.

For the identified data gaps within the Labrador SEA Area, the C-NLOPB will work with the Nunatsiavut Government to develop a work plan to address these gaps. The C-NLOPB will also promote the undertaking of research within the Labrador SEA Area through research organizations such as ESRF, the PERD, PRAC, and researchers at Memorial University. The C-NLOPB will enter into discussions with the DFO to identify fisheries research needs and priorities for Labrador. In addition, operators may be required to collect data as part of their program operations either opportunistically during program operations or prior to the start of program activities. The requirement and nature of the data collection will be determined during the project-specific environmental assessment stage.

The identification of an area as 'sensitive' in the SEA report does not, in itself, automatically imply that it will require the application of special or non-typical mitigations or restrictions. Within some sensitive areas, there may be a requirement for non-typical mitigations or restrictions on offshore oil and gas activities in order to prevent potential environmental effects. The timing, spatial extent, and nature of proposed oil and gas activities, in addition to mitigations prescribed by legislation, will determine the level of restriction or mitigation that will be required. The timing of these restrictions and/or the application of special mitigation measures are either highlighted below or will be determined during C-NLOPB's project-specific environmental assessment regulatory approval processes.

The SEA report identifies a number of sensitive areas adjacent to the 2007 Labrador Call for Bids parcels. For these areas, the following conclusions apply.

- The Hawke Channel is a designated fishery management closure area. The timing of offshore oil and gas activities in areas adjacent to this area will be restricted to protect fish spawning.
- Parks Canada has identified two potential candidate areas for a National Marine Conservation Area: Nain Bight and Hamilton Inlet. While Hamilton Inlet is the preferred candidate area, in keeping with the Parks Canada process for designation of NMCAs, the C-NLOPB will work cooperatively with Parks Canada as it finalizes its selection and determines the study area for the proposed NMCA. The C-NLOPB is cognizant of the Parks Canada NMCA process and will consider this in future rights issuance for the Labrador Shelf SEA Area.
- For areas that are identified as highly ecologically productive, such as the Hamilton Bank, the conduct of offshore oil and gas activities may require non-typical mitigations or restrictions on activities to prevent effects during sensitive life cycle times. Details regarding this will be determined at the project-specific environmental assessment stage. During the project-specific environmental assessment stage, the C-NLOPB will discuss with DFO, the Nunatisavut Government and the fishing industry the potential requirement for non-typical or site-specific mitigation measures for offshore oil and gas activities.
- Portions of the Labrador SEA Area have been identified as high in coral abundance and diversity. To prevent impacts to coral communities, prior to the commencement of drilling activities, the C-NLOPB will require operators to undertake sea-bottom surveys to determine presence of corals. Mitigations will be required to prevent impacts to sensitive coral communities that are identified.
- Offshore oil and gas activities in or adjacent to the Gilbert Bay MPA, the Gannet Island Ecological Reserve, and future protected areas will be bound by the protection measures defined in the appropriate legislative framework for these areas. Additional mitigation, if required, will be determined at the project-specific environmental assessment stage.

With the exception of the foregoing, the SEA indicates that petroleum exploration activities can be undertaken in the Labrador Shelf area using the mitigations described in the document. A project-specific environmental assessment will be required for each proposed activity and this may identify additional mitigation measures in some cases. If it is determined during an assessment process that baseline information is required in order to assess effect predictions, the operator may then be required to undertake data collection. It is likely that during the early exploration phase, such data collection can be conducted opportunistically as part of an ongoing industry activity. In the event that petroleum resources with development potential are discovered, the C-NLOPB will discuss with the operator, the Nunatsiavut Government, federal and provincial government agencies and interested parties in the public the additional data collection that will be required to support a future development application.

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7.2 Traditional Knowledge Interviews and Public Consultations

7.2.1 Traditional Knowledge Interviews

Postville 2007. Traditional Knowledge Interviews in Postville – November 14, 2007

Makkovik 2007. Traditional Knowledge Interviews in Makkovik – November 15, 2007

Nain 2007 Traditional Knowledge Interviews in Nain – November 20-21, 2007

Natuashish 2007 Traditional Knowledge Interviews in Natuashish – December 5, 2007

Rigolet 2007 Traditional Knowledge Interviews in Rigolet – December 10, 2007

7.2.2 Public Consultations – Round One

Nain 2007	Public Consultation in Nain – October 29, 2007
Natuashish 2007	Public Consultation in Natuashish – October 30, 2007
Hopedale 2007	Public Consultation in Hopedale – November 1, 2007
Postville 2007.	Public Consultation in Postville – November 1, 2007
Makkovik 2007.	Public Consultation in Makkovik – November 2, 2007
Happy Valley-Goose Bay 2007	Public Consultation in Happy Valley-Goose Bay – November 5, 2007
Mary's Harbour 2007	Public Consultation in Mary's Harbour – November 13, 2007
Port Hope Simpson 2007	Public Consultation in Port Hope Simpson – November 14, 2007
Cartwright 2007	Public Consultation in Cartwright – November 15, 2007
Rigolet 2007	Public Consultation in Rigolet – December 5, 2007

7.2.3 Public Consultations – Round Two

Happy Valley-Goose Bay 2008	Public Consultation in Happy Valley-Goose Bay – May 4, 208
Hopedale 2008	Public Consultation in Hopedale – May 5, 2008
Natuashish 2008	Public Consultation in Natuashish – May 6, 2008
Makkovik 2008.	Public Consultation in Makkovik – May 6, 2008
Postville 2008.	Public Consultation in Postville – May 7, 2008
Nain 2008	Public Consultation in Nain – May 8, 2008
Mary's Harbour 2008	Public Consultation in Mary's Harbour – May 12, 2008
Port Hope Simpson 2008	Public Consultation in Port Hope Simpson – May 12, 2008
Cartwright 2008	Public Consultation in Cartwright – May 13, 2008
Rigolet 2008	Public Consultation in Rigolet – May 20, 2008

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APPENDIX A

Strategic Environmental Assessment LabradorOffshore Area Scoping Document (C-NLOPB 2006e).

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

Strategic Environmental Assessment

Labrador Shelf

Newfoundland and Labrador Offshore Area

Scoping Document

Canada-Newfoundland and Labrador

Offshore Petroleum Board

June 2007

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1.0 Introduction

This document describes a scope for a Strategic Environmental Assessment (SEA) of petroleum exploration activities in the Labrador Shelf area of the Newfoundland and Labrador Offshore Area. It outlines the factors to be considered in the SEA, the scope of those factors, and guidelines for preparing the SEA report.

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) has the responsibility pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Act* and the *Canada- Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* (Accord Acts) to ensure that offshore oil and gas activities proceed in an environmentally responsible manner. The C-NLOPB decided in 2002 to conduct a SEA of portions of the Newfoundland and Labrador Offshore Area that may have the potential for offshore oil and gas exploration activity but that were not subject to recent SEA nor to recent and substantial site-specific assessments.

The C-NLOPB has decided to undertake a SEA for the Labrador Shelf portion of the Newfoundland and Labrador Offshore Area.

2.0 Background

Strategic environmental assessment is defined as “the systematic and comprehensive process of evaluating the environmental effects of a policy plan or program, and its alternatives” (Government of Canada Cabinet Directive, 1999). SEA incorporates a broad-based approach to environmental assessment that examines the environmental effects which may be associated with a plan, program or policy proposal and that allows for the incorporation of environmental considerations at the earliest stages of program planning. The Cabinet Directive was updated in 2004 to strengthen the role of SEA at a strategic decision-making level, by clarifying obligations of department and agencies and linking environmental assessment to the Implementation of Sustainable Development Strategies.

SEA typically involves a broader-scale environmental assessment (EA) that considers the larger ecological setting, rather than a project-specific environmental assessment that focuses on site-specific issues with defined boundaries. Additional information regarding SEA may be found on the Canadian Environmental Assessment Agency web site at http://www.ceaa-acee.gc.ca.

In this particular case, information from the SEA will assist the Board in determining whether exploration rights should be offered in whole or in part within the Labrador Shelf area and may identify general restrictive or mitigative measures that should be considered for application to exploration activities. The strategic decision of the SEA is used by the Board in the potential future issuance of one or more exploration licences pursuant to the Accord Acts, in the Labrador Shelf area, and consequent petroleum-related activities that may occur offshore. An exploration licence confers:

1. The right to explore for, and the exclusive right to drill and test for, petroleum
2. The exclusive right to develop those portions of the offshore area in order to produce petroleum
3. The exclusive right, subject to compliance with the other provisions of the Accord Act, to apply for a production licence

Activities associated with exploration licences may include: conduct of seismic surveys, other geophysical surveys, geotechnical surveys; drilling of wells (either exploration or delineation); and well abandonment. If one or more exploratory drilling programs successfully identify petroleum deposits with commercial potential, production activities may follow. Production activities may involve: drilling of wells (delineation, development/production, and injection wells); installation and operation of subsea equipment; installation and operation of production facilities; and production abandonment activities. However, the nature and scale of potential production activities is usually very difficult to predict in any but the most general of terms in the early stages of exploration in an area.

Each of these activities requires the specific approval of the Board, including a project-specific assessment of its associated environmental effects in accordance with the *Canadian Environmental Assessment Act* (CEA Act). The SEA does not replace this requirement for a project-specific EA. However, the SEA will: provide an overview of the existing environment; discuss in broader terms the potential environmental effects associated with offshore oil and gas activities in the Labrador Shelf SEA Are; identify knowledge and data gaps; highlight issues of concern; and make recommendations for mitigation and planning.

3.0 Area of Focus

Within Labrador Shelf offshore area, the Nunatsiavut Government has certain duties and powers, as defined by the *Labrador Inuit Land Claims Agreement* (the Agreement), in The Zone and in the Area Adjacent to the Zone[1]. The chosen area of focus, the Labrador Shelf SEA Area, as identified in Figure 1, will include all marine waters east of the low water mark out to the 200 nMi Exclusive Economic Zone under the jurisdiction of the C-NLOPB. Those areas of the Zone and the Area Adjacent to the Zone that fall

[1] The Zone and Area Adjacent to the Zone are defined in the Agreement.

within this area are captured in the Labrador Shelf SEA Area. For clarity, the area commonly referred to as the Lake Melville Area will only include those marine waters that are eastward of the low water mark.

The terms ‘offshore’ or ‘offshore area’ refer to the jurisdictional area of the C-NLOPB. The Accord Acts define ‘offshore area’ as: *“those submarine areas lying seaward of the low water mark of the Province and extending, at any location as far as (a) any prescribed line, or (b) where no line is prescribed at that location, the outer edge of the continental margin or a distance of two hundred nautical miles from the baselines from which the breadth of the territorial sea of Canada is measures, whichever is greater.”*

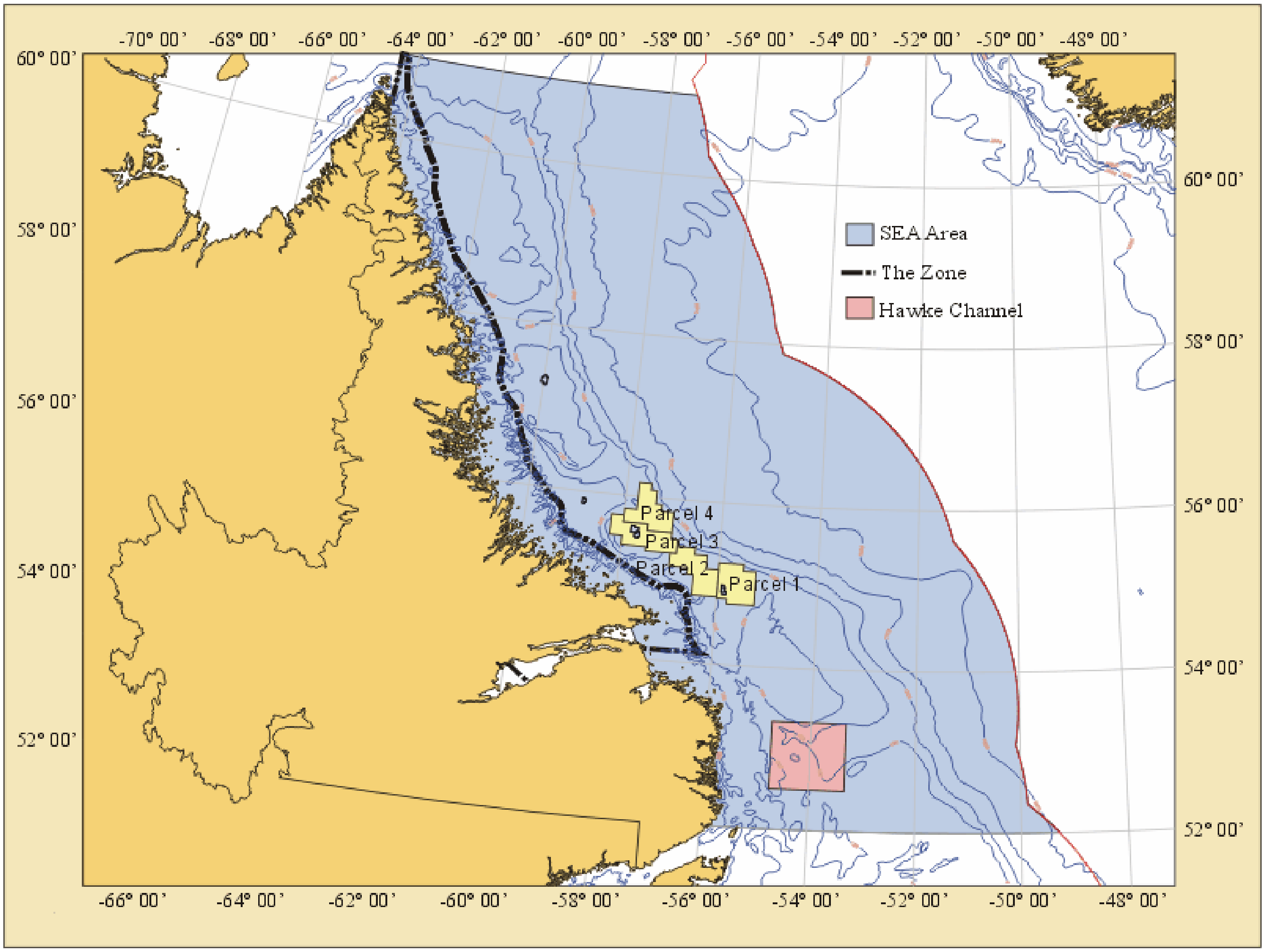


Figure 1 – Labrador Shelf SEA Area

4.0 Working Group

This draft scoping document was drafted by C-NLOPB staff with the assistance of a Working Group. The Working Group is co-chaired by the C-NLOPB and the Nunatsiavut Government and consists of members of the Nunatsiavut Government, federal and provincial government agencies, local Regional Economic Development Boards, the fishing industry, and non-governmental organizations. The purpose of the Working Group is to assist the C-NLOPB in the development of the SEA through the provision of technical advice regarding scope and content of the SEA, and public consultations.

5.0 Objectives

Within the Labrador Shelf SEA Area, the SEA will:

- Provide an overview of the existing environment
- Generally describe typical offshore oil and gas exploration activities
- Generally describe typical offshore oil and gas production activities
- Describe and evaluate potential environmental effects associated with offshore oil and gas exploration activities
- Identify knowledge and data gaps
- Highlight issues that may be of concern
- Identify areas of interest or sensitive areas
- Make recommendations for general mitigative measures that should be employed during offshore petroleum activities
- Identify, where appropriate, areas requiring enhanced levels of mitigation; identify, if feasible, the level of enhanced mitigation required
- Identify general restrictive, or monitoring, measures, as appropriate, that may be required for future offshore petroleum activities
- Assist the Board in determining whether exploration rights should be issued in whole or in part in the Labrador Shelf SEA Area

6.0 Past and Present Oil and Gas Activities

Past exploration activity in the Labrador Shelf SEA Area has consisted of the collection of approximately 149,233 line km of 2D seismic data from 1968 to 2005. The most recent seismic program undertaken in the area was in 2006, whereby approximately 10 844 km of seismic data was acquired. Exploration drilling commenced in the 1970’s. Between 1971 and 1985, 26 exploration wells and 2 delineation wells were drilled on the Labrador Shelf. With the discovery of natural gas at a number of these exploration wells, five significant discoveries licences (SDLs) were granted by the Board. The five SDLs represent a total of 4.244 trillion cubic feet (TCF) of natural gas reserves. There are no Exploration Licences (ELs) or production licences within the Labrador Shelf SEA Area (see Figure 1).

On May 18, 2007, the Board announced a Call for Bids (NL07-02) for the Labrador Offshore Region. The parcels included in the NL07-02 Call for Bids are shown in Figure 1 (Parcels 1 – 4), and are included in the Labrador Shelf SEA Area. The Call for Bids closes on August 1, 2008. This is the first Call for Bids in the Labrador Shelf area in the history of the Call for Bids cycles.

7.0 Scope of SEA

The SEA will describe all foreseeable offshore oil and gas exploration activities in the Labrador Shelf SEA Area. It will examine the project-environment interactions associated with these petroleum exploration activities. Exploration activities to be considered in the SEA include exploratory and delineation drilling, seismic survey activities (2D, 3D, vertical seismic profiling, geohazard surveys), geotechnical surveys, and wellsite abandonment. The focus of the SEA will be on activity and interactions of those activities in the Newfoundland and Labrador offshore area. However, where information exists, the coastal environment will be described and the project-environment interactions identified and discussed.

The extent of exploration activity will be estimated based on historical activity in the area and the potential for future exploration activity, to the degree that this can be foreseen.

Generic types of production facilities that could be employed in the Labrador Shelf SEA Area will be identified and their potential project-environment interactions briefly discussed. Predictions concerning types and quantity of likely production facilities will be undertaken in general terms. The discussion will focus on existing Significant Discover Licences in the area, and known and feasible production scenarios.

7.1 Spatial and Temporal Boundaries

The spatial boundary for petroleum related activities to be considered in the SEA is shown in Figure 1. The Labrador Shelf SEA Area is bounded in the south by the Orphan Basin SEA area. The eastern extent is bounded by the 200 nmi Exclusive Economic Zone and the western boundary ceases at the coast of Labrador to the low water mark.

The SEA will include the offshore petroleum exploration activities, as described in the preceding section, which may occur in the Labrador Shelf SEA Area within the next ten years. The SEA will be reviewed in at least five years to determine whether an update is required.

7.2 Factors and Issues to be Considered

The focus of the SEA will be a “Valued Ecosystem Component” (VEC) approach. Each VEC (including components or subsets thereof) will be identified and the rationale for its selection provided. VECs will be determined based on consultations with interested stakeholders, the public, and regulatory agencies. At a minimum, VECs will include: fish and fish habitat (including benthic habitat); commercial fisheries, traditional Aboriginal fisheries, marine mammals and sea turtles; waterbirds (including seabirds, waterfowl, shorebirds); species at risk; and sensitive/special areas. Traditional Knowledge will be incorporated, where appropriate. Within each of these general categories, species of importance to the Labrador Shelf SEA Area (e.g., species-specific commercial/aboriginal fisheries, species of ecological importance) will be emphasized.

The SEA report will include the following:

- Historical overview of offshore petroleum exploration activity in the Labrador Shelf SEA Area and a discussion of regional offshore oil and gas activities in the NL offshore area
- Overview of typical offshore petroleum exploration activities (well site surveys, vertical seismic profiling, 2D/3D seismic, geotechnical programs, exploration drilling (including onshore to offshore drilling),well abandonment) and methods to carry out these activities
- Brief discussion of production alternatives that could be employed in the Labrador Shelf SEA Area
- Description of the physical and biological environments in the Labrador Shelf SEA Area based on existing information and data, and Traditional Knowledge. Data gaps will be highlighted. Factors to be included are outlined in the Sections 5.2.1 and 5.2.2
- Description of other marine activities in the Labrador Shelf SEA Area (e.g. fisheries, aquaculture, marine transportation)
- Project-environment interactions of the VECs in the Labrador Shelf SEA Area will be identified and qualitatively assessed

- Identification of general mitigative measures and monitoring measures that might be considered for offshore activities. Specific or 'non-typical' mitigations that may be required to address specific concerns will be highlighted
- Identification of areas requiring enhanced, or 'non-typical' mitigation measures
- General discussion of effects and mitigation of potential accidental events, as well as malfunctions associated with offshore oil and gas exploration activity
- General discussion of potential cumulative effects associated with multiple offshore oil and gas activities in the Labrador Shelf SEA Area based on an estimate of potential exploration activity derived from historical offshore petroleum activities in the area, and in consideration of offshore oil and gas activities within the NL offshore area
- For each factor identified below, discuss potential planning implications/considerations which may have to be considered in site-specific EAs (i.e., need for additional data, special mitigations)

Detailed 'effects assessment analyses', including determination of significance pursuant to the *CEA Act*, will not be undertaken in the SEA. A determination of significance can only be undertaken at the project specific stage where detailed information respecting project activities and scheduling are known.

Mitigation measures currently in practice to reduce or eliminate potential effects will be described for activities that may affect the physical and biological environments and VECs. Specific or 'non-typical' mitigations that may be required to address specific concerns will be highlighted, in particular, specific mitigations proposed for any special/sensitive areas identified within the Labrador Shelf SEA Area. Residual effects remaining after the application of routine mitigations will also be described.

The SEA will consider the following environmental factors and issues, as a minimum, with emphasis upon factors unique to the Labrador Shelf SEA Area. Sufficient supporting information will be provided, or referenced and summarized if it already exists in publicly available publications. Substantive uncertainties or information gaps will be identified.

7.2.1 Physical Environment

A general description of physical environmental factors in the Labrador Shelf SEA Area will be presented, with emphasis upon the following:

- Meteorology and climatology (extreme events, means and seasonal variations)

- Geology, including a discussion of the potential for seismicity/geohazard events and their impacts on slope stability in the Labrador Shelf SEA Area
- Oceanography (current regime, wind, waves, extreme events)
- Sea ice and iceberg conditions (historical overview, seasonal variability and current trends)

7.2.2 Biological Environment

An overview of the biological environment in the Labrador Shelf SEA Area will be presented, with emphasis upon identified VECs. For each of the following, the biological descriptions should be consistent with the level of detail presented for each species. Overviews of species (distributions, critical life stages, and important areas) should be presented in the context of their relevance to the Labrador Shelf SEA Area and of the potential for interaction with offshore oil and gas activities. This description will be based on available information and will include, but not be limited to:

- Finfish and Invertebrate species – for those species identified in Labrador Shelf SEA Area; focus on commercially important and emerging fisheries
- Plankton
- Fish habitat (including benthic habitat) for those species identified in LSSA
- Commercial fish species
- Traditional Aboriginal fisheries
- Marine mammals and sea turtles
- Waterbirds (including seabirds, waterfowl, and shorebirds)
- “Species at Risk”
- Sensitive/Special areas

The following provides a detailed listing of information that will be captured within the SEA.

- Coastal/Shoreline Environment
    - An overview of the coastal/shoreline environment in the Labrador Shelf SEA Area with specific emphasis on special or unique habitats or places (e.g., parks, protected areas, fish spawning habitat, important bird areas, shoreline sensitivity information)
- Plankton

- Benthic Invertebrates (including commercial shellfish species)
- Finfish and Marine Invertebrates:
  - Overview of finfish and marine invertebrates in Labrador Shelf SEA Area, with focus on commercially important and emerging fisheries; information will include a summary of critical life stages; and locations of habitat supporting these life stages, if applicable to the Labrador Shelf SEA Area
  - The identification of known spawning, feeding, migratory and essential habitats, including coastal areas (where information exists) within the Labrador Shelf SEA Area, for the species described above
  - Summaries of finfish and marine invertebrate habitat in the LSSA particularly those supporting fisheries

- Commercial, Recreational and Aboriginal Fisheries
  - Overview of Historical, present and potential future commercial fisheries within the Labrador Shelf SEA Area, including species under moratoria
  - Description of commercial, recreational and aboriginal fisheries in Labrador Shelf SEA Area. This description should include a summary of historical fisheries
  - General description of fishery activity including species, location, vessel size, gear type, timing
  - Aquaculture activities, if present, should be described

- Waterbirds
  - Overview of species present in the Labrador Shelf SEA Area and their distribution, including seabirds, waterfowl, and shorebirds.
  - Description of critical life stages, lifestyles, life histories, and important areas within the Labrador Shelf SEA Area.

- Marine Mammals and Sea Turtles
  - General description of marine mammals and sea turtles that may be present in the Labrador Shelf SEA Area
  - Distribution of species, including lifestyles, life histories and important areas within the Labrador Shelf SEA Area

- Species at Risk
  - Description of Species at Risk, and critical habitat, as described in the *Species at Risk Act*, COSEWIC, and by the Government of

Newfoundland and Labrador that have been identified, or are believed likely to be present, in the Labrador Shelf SEA Area
    - Monitoring and mitigation, consistent with recovery strategies/action plans (endangered/threatened) and management plans (special concern) for species or critical habitat identified in the SEA Area as indicated above

- Sensitive/Special Areas
    - Description of sensitive or special areas in the Labrador Shelf SEA Area. These can include, but are not limited to:
        - rare or unique habitats
        - important bird areas
        - Provincial ecological reserves
        - fish spawning habitat/migration routes
        - marine mammal migration routes
        - rare or unique plant species
        - areas of high productivity
        - Torngat Mountains National Park Study Area
        - National Parks
        - Marine Protected Area designations
        - two Areas of interest under the National Marine Conservation Area (Nain Bight and Hamilton Inlet)

- Human Use
    - Description of traditional and cultural activities in the Labrador Shelf SEA Area. These include but are not limited to: travel routes, hunting, gathering and other domestic harvesting activities
    - General overview of marine recreational and tourism activities in Labrador Shelf SEA Area

- Marine Commercial Traffic
    - Overview of commercial traffic activity within, and through the Labrador Shelf SEA Area

7.2.3 Project-Environment Interactions

For each of the identified VECs, a description of the interactions of petroleum exploration activity with the environment will be presented. Proposed activities include:

- Seismic data collection

- Exploratory/delineation drilling (e.g., mobile offshore drilling unit (semi-submersible or jack-up rig), and ancillary activities
- Production activities (based on information provided as per Section 7.2 above)
- Vessel traffic (e.g., supply vessels, seismic vessels, helicopters)
- Well abandonment operations

Typical project-environment interactions associated with generic petroleum production activities will be briefly discussed for completeness.

Potential project interactions include, but are not limited to the following:

- Noise/disturbance (e.g., seismic survey activities, noise from drilling installations) issues on marine mammals, sea turtles, seabirds, and sensitive life stages of commercial fish/shellfish species
- Benthic habitat disturbance
- Coastal interactions (including fish/bird habitats, sensitive areas)
- Air quality issues (may include a discussion of typical greenhouse gas emissions associated with typical drilling and production operations)
- Operational discharges and the effects on water and sediment quality
- Accidental events – including offshore and coastal interactions, sensitive/special places, mitigations
- Conflict with commercial fisheries, aboriginal fisheries, commercial traffic (e.g. ferry service), and recreational/tourism use of area and loss of access
- Attraction of seabirds to lights/flares on structures or vessels
- Consideration of potential conflict with project activities (including light and noise generated) with tourism operations and the aesthetic and cultural landscape

7.2.4 Cumulative Project-Environment Interactions

Cumulative effects will be examined in consideration of the estimate of potential exploration activity in the Labrador Shelf SEA Area and mitigation measures identified. Planned and reasonably foreseeable exploration activities will be included in the cumulative effects and will also consider other non-petroleum activities ongoing in the Labrador Shelf SEA Area such as commercial fishing, Aboriginal fishing activities, hunting, marine traffic, tourism operations, and fisheries research surveys. Consideration of marine activities in adjacent areas will be included.

7.2.5 Environment-Project Interactions

For exploration activities identified, the SEA will include a discussion of the effects of the environment on project activities within the Labrador Shelf SEA Area. These environmental factors may include:

- The occurrence of sea ice and icebergs
- Temperature, currents, storm events
- Severe winds and waves (extreme events)

8.0 Conclusions and Recommendations

Based on the information presented in the physical and biological environment overview, the description of project-environment interactions and the application of mitigation measures, conclusions will be presented and planning approaches recommended for the Board to consider in the issuance of exploration licences in the Labrador Shelf SEA Area. Data gaps with potential to affect the validity of these conclusions will be highlighted. Sensitive areas or areas of concern identified during the SEA process will also be highlighted.

9.0 Consultations

Throughout the development of the SEA, the C-NLOPB and its contractor(s), with assistance by the Working Group, will consult with the Nunatsiavut, provincial, and federal government departments, Aboriginal Groups, and Labrador communities, the fishing industry and local non-governmental organizations. Information on the SEA process will be provided and people will be encouraged to discuss issues and concerns that are relevant to the Labrador SEA Shelf Area and SEA objectives.

APPENDIX B

Letter of Introduction to the Labrador Shelf SEA Process to Aboriginal Groups and Regulatory Agencies

CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

FAXED 09/10/07

October 9, 2007

Honourable William Barbour
Minister of Lands and Natural Resources
Nunatsiavut Government
1A Hillcrest Road
PO Box 909, Stn. B
Happy Valley-Goose Bay NL A0P 1E0

Dear Mr. Barbour:

Re: Canada-Newfoundland and Labrador Offshore Petroleum Board Labrador Shelf Strategic Environmental Assessment

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) is in the process of preparing a Strategic Environmental Assessment (SEA) for the Labrador Shelf area. We have commissioned Sikumiut Environmental Management Ltd. (Sikumiut) in cooperation with Minaskuat Limited Partnership (Minaskuat) to prepare this document on our behalf.

The area to be covered in this study is shown on the attached map, and includes the coastal areas immediately adjacent to the Labrador SEA Area. We anticipate that the work will begin immediately on this project and will conclude in June 2008.

The purpose of the SEA is several fold:

- To assist the C-NLOPB in the issuance of land rights, in whole or in part, in the Newfoundland and Labrador Offshore Area
- To provide an overview of the existing physical, biological and socio-economic environment in the Labrador SEA Area
- To discuss, in broad terms, the potential environmental effects associated with offshore oil and gas exploration activities in the Labrador SEA Area
- To identify existing knowledge and data gaps about the components of the environment and interactions with offshore oil and gas activities in the Labrador SEA Area
- To highlight issues of concern associated with offshore oil and gas exploration in the Labrador SEA Area

- To provide mitigation and planning recommendations for future offshore oil and gas exploration activities in the Labrador SEA Area

While the SEA will assist the C-NLOPB and oil and gas operators in planning work plans for future activities in the Study Area, it will not replace any detailed environmental assessment requirements for any specific projects that may arise in the future. The results of the SEA will assist the C-NLOPB in focusing the project-specific environmental assessments on those issues and concerns identified.

As part of our work in preparing the SEA report, the C-NLOPB have requested our consultant, Sikumiut, to gather local and traditional knowledge on a variety of issues that need to be considered.

Sikumiut is developing a detailed plan regarding the information to be collected and the process for its collection. We understand and respect the sensitivity associated with the collection of traditional knowledge, and will ensure that a due process of informed consent is followed. During our consultations and discussion, each participant will be made aware that the information they provide may be presented in the Strategic Environmental Assessment report, however, their identity will not be disclosed.

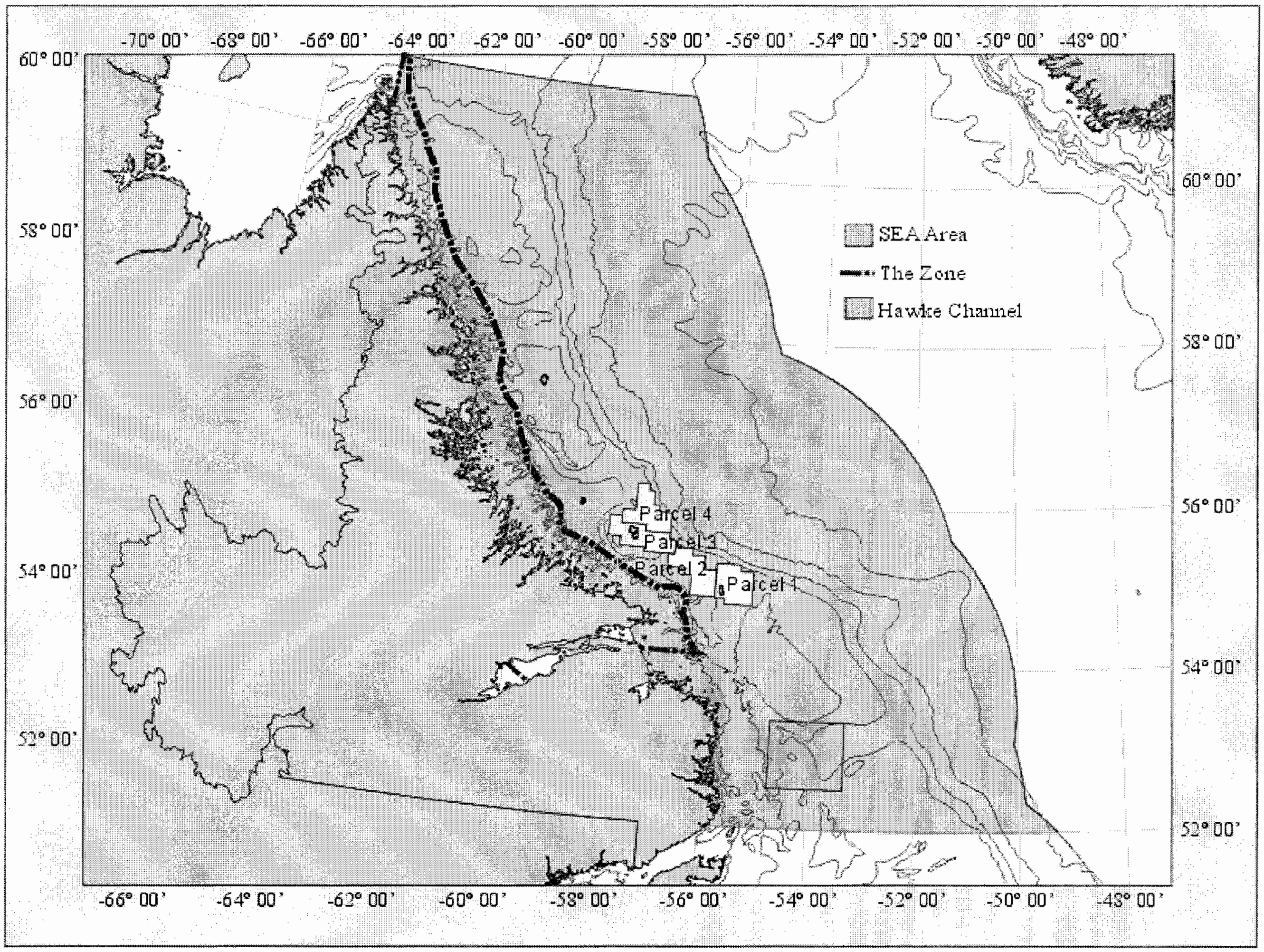
We look forward to your participation in this project and to your support in garnering local knowledge required for its successful completion.

Yours truly,

Max Ruelokke, P. Eng.
Chairman and CEO

Enclosure

cc K. Coady
K. Dominie (Sikumiut)
S. Whiteway (Minaskuat)



Labrador Shelf SEA Area

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CANADA-NEWFOUNDLAND
and LABRADOR
OFFSHORE
PETROLEUM
BOARD

FAXED 09/10/07

October 9, 2007

Mr. Mark Nui
President
Innu Nation
PO Box 13
Natuashish NL A0P 1A0

Dear Mr. Nui:

Re: Canada-Newfoundland and Labrador Offshore Petroleum Board Labrador Shelf Strategic Environmental Assessment

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) is in the process of preparing a Strategic Environmental Assessment (SEA) for the Labrador Shelf area. We have commissioned Sikumiut Environmental Management Ltd. (Sikumiut) in cooperation with Minaskuat Limited Partnership (Minaskuat) to prepare this document on our behalf.

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- To highlight issues of concern associated with offshore oil and gas exploration in the Labrador SEA Area

- To provide mitigation and planning recommendations for future offshore oil and gas exploration activities in the Labrador SEA Area

While the SEA will assist the C-NLOPB and oil and gas operators in planning work plans for future activities in the Study Area, it will not replace any detailed environmental assessment requirements for any specific projects that may arise in the future. The results of the SEA will assist the C-NLOPB in focusing the project-specific environmental assessments on those issues and concerns identified.

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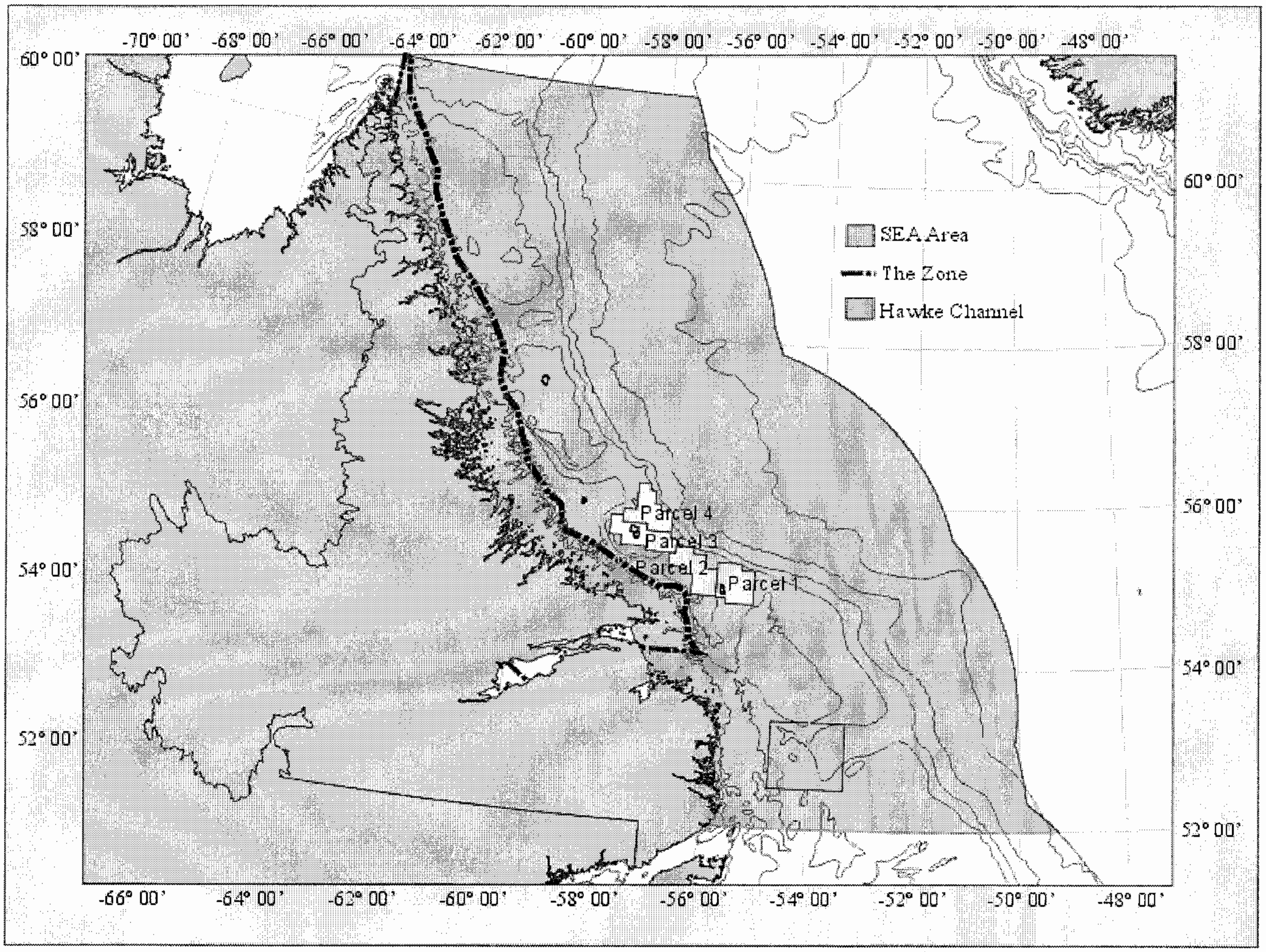
Yours truly,

Max Ruelokke, P. Eng.
Chairman and CEO

Enclosure

cc K. Coady
K. Dominie (Sikumiut)
S. Whiteway (Minaskuat)



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CANADA-NEWFOUNDLAND and LABRADOR OFFSHORE PETROLEUM BOARD

FAXED 09/10/07

October 9, 2007

Mr. Chris Montague
President
Labrador Metis Nation
PO Box 460,Stn C
Happy Valley-Goose Bay NL A0P 1C0

Dear Mr. Montague:

Re: Canada-Newfoundland and Labrador Offshore Petroleum Board Labrador Shelf Strategic Environmental Assessment

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) is in the process of preparing a Strategic Environmental Assessment (SEA) for the Labrador Shelf area. We have commissioned Sikumiut Environmental Management Ltd. (Sikumiut) in cooperation with Minaskuat Limited Partnership (Minaskuat) to prepare this document on our behalf.

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Yours truly,

Max Ruelokke, P. Eng.
Chairman and CEO

Enclosure

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K. Dominie (Sikumiut)
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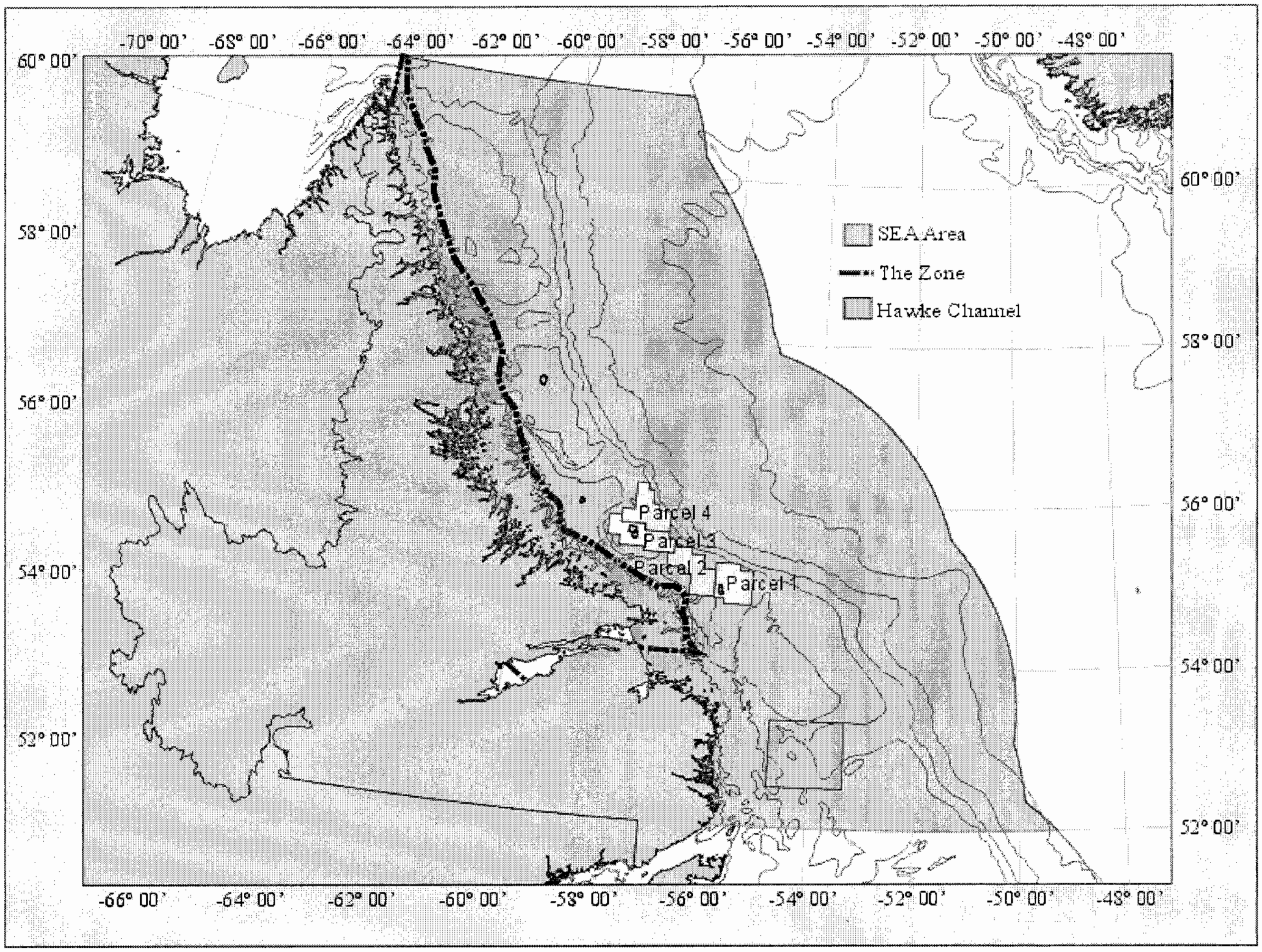

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CANADA-NEWFOUNDLAND
and LABRADOR
OFFSHORE
PETROLEUM
BOARD

FAXED 09/10/07

October 9, 2007

Distribution:

Re: Canada-Newfoundland and Labrador Offshore Petroleum Board
Labrador Shelf Strategic Environmental Assessment

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- To provide mitigation and planning recommendations for future offshore oil and gas exploration activities in the Labrador SEA Area

While the SEA will assist the C-NLOPB and potential contractors in planning work plans for future activities in the Study Area, it will not replace any detailed environmental assessment requirements for any specific projects that may arise in the future. The results of the SEA will assist the C-NLOPB in focusing the project-specific environmental assessments on those issues and concerns identified.

As part of the work in preparing the SEA report, consultation sessions will be undertaken with government departments and agencies that may be involved in the Labrador Shelf SEA Area. The purpose of the consultation sessions is to gather information and knowledge regarding the coastal areas of Labrador as it may relate to offshore oil and gas development. Over the next few weeks, our Consultants, Sikumiut, will be contacting your department to arrange a meeting.

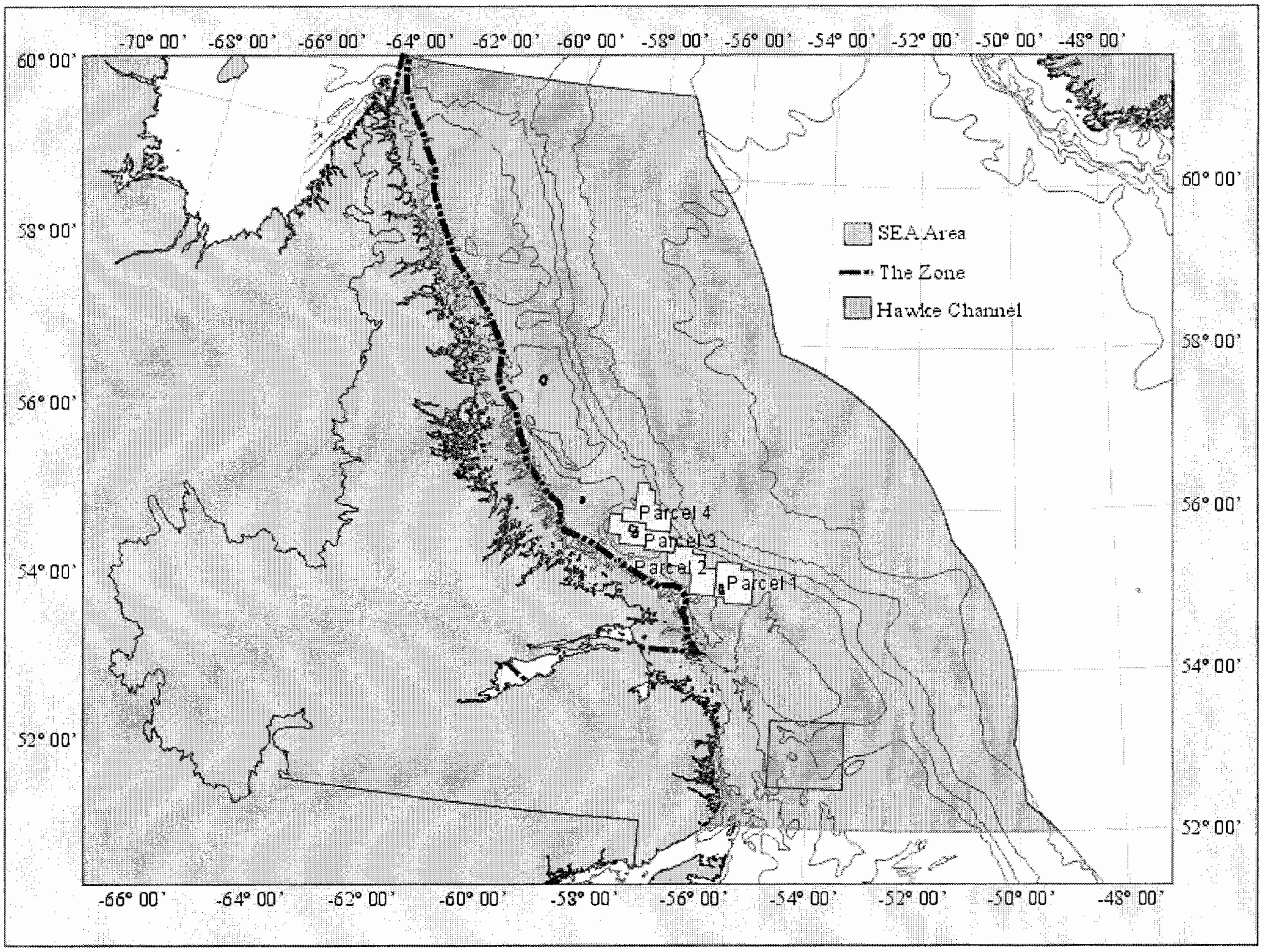
We look forward to your participation in this project.

Yours truly,

Max Ruelokke, P. Eng
Chairman and CEO

Enclosure

cc K. Coady
K. Dominie (Sikumiut)
S. Whiteway (Minaskuat)



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Distribution

Randy Power A/Section Head Marine Environment & Habitat Management Fax No: 709-772-5562	Kyle Penney Staff Officer Environmental Impact Management Maritime Forces Atlantic Fax No. 902-721-5417
Jason Simms DFO-Oceans Fax No - (709) 772-3578	Ms. Kim Mahwinney Canadian Wildlife Service Fax No. - (709) 772-5097
Mr. Glenn Worthman Environment Canada Fax No. - (709) 772-5097	Mr. Fred Allen Director, Regulatory Affairs Petroleum Resource Development Fax No - (709) 729-2508
Mr. Bill Parrott Assistant Deputy Minister Department of Environment and Conservation FAX 709-729-7413	Tom Dooley Director, Resource Policy Department of Fisheries & Aquaculture Fax No. - (709) 729-6082
Mr. Gary Pittman Parks Canada Fax No. - (709) 869-5768	Mr. David Hughes ADM (A) Policy & Planning Labrador and Aboriginal Affairs Fax No. (709) 729-4900
Ms. Judy Rowell Parks Canada Torngat Mountains National Park Reserve Fax No. - (709) 922-1294	Gary Sonnichsen A/Subdivision Head Natural Resources Canada Marine Environmental Geoscience Fax No - (902) 426-4104

APPENDIX C

Notice of Public Consultation Meetings and List of Stakeholders

NOTICE

Public Consultation Meetings

will be held in the communities in Labrador regarding a Strategic Environmental Assessment on the Labrador Shelf Offshore Area for future potential Oil and Gas Developments

The consultations will be conducted by
Sikumiut Environmental Management Ltd.
for the
Canada-Newfoundland and Labrador Offshore Petroleum Board (CNLOPB)

The following table lists the meeting schedule:

Community	Meeting Place	Date 2007	Day	Start Time
Nain	Nunatsiavut Government Bldg.	October 29	Monday	7:00 PM
Natuashish	Innu Nation Office	Oct 30	Tuesday	7:00 PM
Hopedale	Town Council Office	Nov 1	Thursday	10:30 AM
Postville	Recreation Center	Nov 1	Thursday	7:00 PM
Makkovik	Town Council Office	Nov 2	Friday	10:30 AM
Rigolet	Town Council Office	Nov 4	Sunday	7:00 PM
Happy Valley - Goose Bay	Labrador Friendship Center	Nov 5	Monday	7:00 PM

For further information please contact:

Harold Murphy, Telephone (709) 722-1059, Cell: (709) 689-1941, E-mail: hmurphy@nf.sympatico.ca.

Charlotte Wolfrey, Telephone (709) 947-3597, E-mail: charlotte.wolfrey@sikumiut.ca

NOTICE

Public Consultation Meetings

will be held in the communities in Southern Labrador regarding a Strategic Environmental Assessment on the Labrador Shelf Offshore Area for future potential Oil and Gas Developments

The consultations will be conducted by
Sikumiut Environmental Management Ltd.
for the
Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB)

The following table lists the meeting schedule:

Community	Meeting Place	Date 2007	Day	Start Time
Happy Valley - Goose Bay	Labrador Friendship Center	Nov 5	Monday	7:00 PM
Mary's Harbour	Riverlodge Hotel	Nov 13	Tuesday	7:00 PM
Port Hope Simpson	Alexis Hotel	Nov 14	Wednesday	7:00 PM
Cartwright	Parish Hall	Nov 15	Thursday	7:00 PM

For further information please contact:

Harold Murphy, Telephone (709) 722-1059, Cell: (709) 689-1941, E-mail: hmurphy@nf.sympatico.ca.

Charlotte Wolfrey, Telephone (709) 947-3597, E-mail: charlotte.wolfrey@sikumiut.ca

Judy Pardy

Appendix 1. List of Stakeholders

List of Stakeholders …. September 2007 ---by Sector

Aboriginal

Agency	Community	Contact Person (s); Affiliation/ Title (s)	Addresses	Tel/Fax
Innu Nation	Natuashish	Mark Nui, President	P.O. Box 13 Natuashish, NL AOP 1AO	Tel: Fax: 709-478-8833
Labrador Metis Nation	Happy Valley-Goose Bay	Chris Montague, President	P.O. Box 460,Stn. C Happy Valley-Goose Bay,NL AOP 1CO	Tel: Fax: 709-896-0594
Nunatsiavut Government	Happy Valley-Goose Bay	Honourable William Barbour Minister of Lands and Natural Resources	1A Hillcrest Road P.O. Box 909,Stn.B Happy Valley-Goose Bay AOP 1EO	Tel: Fax: (709) 922-2931

Federal and Provincial Governments

Agency	Community	Contact Person (s); Affiliation / Title (s)	Addresses	Tel/Fax Numbers
Department of Fisheries and Oceans	St. John's	**Randy Power** A/Section Head, Habitat Evaluation Marine Environment and Habitat Management	P.O. Box 5667 St. John's NL A1C 5X1	Tel: (709) 772-8888 Fax: 709-772-5562 Email:
Department of Fisheries and Aquaculture	St. John's	**Tom Dooley,** Director, Resource Policy	P.O. Box 8700 St. John's, NL, A1B 4J6	Tel: 709-729-0335 Fax: 709-729-6082 Email:

Agency	Community	Contact Person (s); Affiliation / Title (s)	Addresses	Tel/Fax Numbers
Department of Natural Resources	St. John's	**Fred Allen** Manager, Regulatory Affairs Petroleum Resource Development Energy Branch	P.O. Box 8700 St. John's NL A1B 4J6	Tel: (709) 729-2778 Fax: (709) 729-2508
Department of Environment and Conservation	St. John's	**Bill Parrott** ADM	PO Box 8700 St. John's NL A1B 4J6	Tel: 709-729-2559 Fax: (709) 729-7413
Parks Canada	Nain	**Ms. Judy Rowell**	Box 471 Nain NL A0P 1LO	Fax: (709) 922-1294
Parks Canada	Goose Bay	**Mr. Garry Pittman**		Fax: (709) 869-5768
Environment Canada	St. John's	**Glenn Worthman**	6 Bruce Street Mount Pearl NL A1N 4T3	Tel: Fax: (709) 772-5097
Canadian Wildlife Service	St. John's	**Kim Mawhinney**	6 Bruce Street Mount Pearl NL A1N 4T3	Tel: Fax: (709) 772-5097
Department of National Defence	Halifax	**Kyle Penney**		Tel: Fax: 902-721-5417
Natural Resources Canada	Halifax	**Mr. Gary Sonnichsen**		Tel: Fax: (902) 426-4104

Municipal Government

Agency	Community	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax / Email
Town Council	St. Lewis	Mayor Annie Rumbolt Loraine Poole, Clerk	P.O. Box 106 St. Lewis, Labrador, NL, A0K 4W0	Tel: (709) 939-2282 Fax: (709) 939-2210 Email
Town Council	Mary's Harbour	**Mayor Ford Rumbolt** Glenys Rumbolt, Town Clerk/Manager	P.O. Box 134 Mary's Harbour, Labrador, NL, A0K 3P0	Tel: (709) 921 6281 Fax: (709) 921 6255 Email: maryshbr@nf.aibn.com
Town Council	Port Hope Simpson	**Mayor Margaret Burden** Betty Sampson, Town Clerk	Port Hope Simpson, Labrador, NL, A0K	Tel; (709) 960-0236 Fax: (709) 960-0387 Email: phscouncil@nf.sympatico.ca
Town Council	Pinsent's Arm	**Harrison Campbell**, Chairperson	Community of Pinsent's Arm General Delivery, Pinsent's Arm, NL A0K 5Y0	Tel; (709) 951-2212 Fax: (709) 951-2211 Email
Town Council	Charlottetown	**Mayor Philip Snow** Zillah Kippenhuck, Town Clerk	P.O. Box 151 Charlottetown, Labrador A0K 5Y0	Tel; (709) 949-0299 Fax: (709) 949-0377 Email: ctown@nf.sympatico.ca
Town Council	Williams Harbour	Chairperson George Russell	Community of Williams Harbour General Delivery, Williams Harbour, NL, A0K 5V0	Tel; (709) 924-0287 Fax: (709) 924-0212 Email
Town Council	Norman Bay	Chairperson George Roberts	General Delivery, Norman Bay , NL A0K 5Y0	Tel; (709) 988-4218 Fax: 709) 988-4218

Agency	Community	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax / Email
				Email
Town Council	Black Tickle	Lavinda Turnbull	Community of Black Tickle General Delivery Black Tickle, NL A0K 1N0	Tel; (709) 471-8902 Fax: (709) 471-8904 Email
Town Council	Cartwright	Mayor Rosetta Holwell Shirley Hopkins, Town Manager/Clerk	P.O. Box 129 Cartwright, Labrador, NL, AOK 1VO	Tel; (709) 938-7259 Fax: (709) 938-7454 Email
Town Council	Rigolet	**Richard Rich - Mayor** Harry Shiwak, Town Manager Georgina Allen, Community Development Officer	PO Box 69 Rigolet, Labrador, NL, A0P 1P0	Tel; (709) 947-3382 Fax: (709) 947-3360 Email
Town Council	Postville	Mayor Glen Sheppard Diane Gear, Town Manager	P.O.Box 74 Postville, Labrador, NL, A0P 1N0	Tel; (709) 479 9830/9831 Fax: (709) 479 9888 Email
Town Council	Makkovik	AngajukKak **Herb Jacque**. Terry Rice, Town Manager	Makkovik Inuit Community Government P.O. Box 85 16 Andersen Street Makkovik, NL A0P 1J0	Tel: (709) 923-2221 (main) (709) 923-2299 (Town Mgr) (709) 923-2455 (H. Jacque) Fax: (709) 923-2126 Email townclerkmakkovik@nf.aibn.com townmanager@makkovik.ca herbert.jacque@nunatsiavut.com
Town Council	Hopedale	AngajukKâk Judy Dicker Kitora Abel, Town Manager	Hopedale Inuit Community Government PO Box 189 Hopedale, Labrador, NL, A0P 1G0	Tel: (709) 933-3864 Fax: (709) 933-3800

Agency	Community	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax / Email
				Email towncouncilhopedale@nf.aibn.com
Town Council	Natuashish		Mushuau Innu Band Council PO Box 107, Natuashish, Labrador, NL, A0P 1A0	Tel: : (709) 478-8827 Fax: (709) 478-8936 Email
Town Council	Nain	AngajukKâk Sarah Erickson Dasi Ikkusek Town Manager	Nain Inuit Community Government 2 Anaktalâk Street, P.O. Box 400 Nain, Labrador, NL AOP 1L0	Tel: (709) 922-2842 Fax: (709) 922-2295 Email nainicg@nf.aibn.com
Local Service District	Lodge Bay	Gerald Pye	General Delivery, Lodge Bay	Tel: (709) 921-6328 Fax: Email

Associations/Non-Government Organizations

Agency	Main Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Combined Councils of Labrador	North West River	**Stanley Oliver** President	Executive Director Combined Councils of Labrador PO Box 479 North West River NL A0P 1M0	Tel: (709) 497-3512 Fax(709) 497-3613 Toll Free: 866-895-8989 Email:

Agency	Main Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Southeastern Aurora Development Corporation	Cartwright	Judy E. Pardy Executive Director	P.O. Box 239 Cartwright, Labrador, NL, A0k 1V0	Tel: (709) 938-7000 Fax: (709) 938- 7030 Email: jpardy@nf.aibn.com
Inukshuk Economic Development Corporation	Makkovik	Chairperson Wilfred Lane **Note:** Each Inuit Community has an Economic Development Officer as follows:	P.O. Box 128, 13 Seaview Makkovik, NL A0P 1J0	Tel: (709) 923-2161/2165 Fax: 709-923-2186 Email:
Inukshuk Economic Development Corporation	Makkovik	Denise Lane Strategic Opportunities Officer	P.O. Box 128 Makkovik, NL A0P 1J0	Tel: 709-923-2161 Fax: 709-923-2186 Email:deniselane@nf.aibn.com
Inukshuk Economic Development Corporation	Rigolet	Georgina Allen, Community Development Officer	Town Council of Rigolet P.O. Box 69 Rigolet, NL A0P 1P0	Tel: (709) 947-3560 Fax: (709) 947-3561 Email: galleninukshuk@yahoo.com
Inukshuk Economic Development Corporation	Postville	Cora Edmunds Community Development Officer	Town Council of Postville P.O. Box 74 Postville, NL A0P 1N0	Tel: (709) 479-9714 Fax: (709) 479-9888 Email: coraedmunds@nf.aibn.com
Inukshuk Economic Development Corporation	Hopedale	Julianna Flowers Community Development Officer	Town Council of Hopedale P.O. Box 189 Hopedale, Labrador, NL A0P 1G0	Tel: (709) 933-3490 Fax: (709) 933-3800 Email: inukshuk@nf.aibn.com

Agency	Main Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Inukshuk Economic Development Corporation	Nain	Molly Shiwak Community Development Officer	Town Council of Nain P.O. Box 59 Nain, NL, A0P 1L0	Tel: (709) 922-2842 Fax: (709) 922-2295 Email:mollyshiwak@hotmail.com
Battle Harbour Reg. Dev. Association	Mary's Harbour	Marilyn Rumboldt President	P.O. Box 131 Mary's Harbour, Labrador, A0K 3P0	Tel: (709) 921-6957 Fax: (709) 921-6993 Email:
Gilbert Bay Marine Protected Area	Port Hope Simpson	Margaret Burden	Box 10 Port Hope Simpson,NL AOK 4EO	Tel: Fax: Email:
Labrador Southeast Coastal Action Program	Port Hope Simpson	Wayne Russell Executive Director	Box 180 Port Hope Simpson,NL AOK 4EO	Tel: Fax: Email:
Upper Lake Melville Environmental Society	Happy Valley-Goose Bay	Wayne Russell Executive Director	P.O. Box 2143, Stn.B 169 Hamilton River Road Happy Valley-Goose Bay NL AOP 1EO	
One Ocean	St. John's	Maureen Murphy	P.O. Box 4920 St. John's, NL A1R 5R3	Tel: (709) 778-0511 Fax: Email: marueen.murphy@mi.mun.ca
Association of Seafood Producers	St. John's	E. Derek Butler, Executive Director Sherry Day, Executive Secretary	Fort William Place Suite 103, Baine Johnston Centre St. John's, NL A1C 1K4	Tel: : (709) 726-3730 Fax: (709) 726-3731 Email:

Agency	Main Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
				info@seafoodproducers.org
Fish, Food and Allied Workers Union	St. John's	Jamie Coady	PO Box 10, Stn. C St. John's, NL A1C 5H5	Tel: (709) 576-7276 Fax: (709) 576-1521 Email: jcoady@ffaw.nfld.net
Canadian Association of Prawn Producers	St.John's	Bruce Chapman Director		Tel: Fax: Email:

Fish Processors:

Agency	Head Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Labrador Fishermen's Union Shrimp Company Ltd.	L'Anse au Loup	Gilbert Linstead General Manager Ken Fowler, Assistant Manager	P.O. Box 130, L'Anse Au Loup, Labrador, NL, A0K 3L0	Tel: (709) 927-5816 Fax: (709) 927-5555 Email: generalmanager@lfuscl.com agm@lfuscl.com
Torngat Fish Producers Co-operative Society Ltd.	Happy Valley – Goose Bay	Keith Watts General Manager	P.O. Box 839 Station B Happy Valley-Goose Bay, Labrador, NL, A0P 1E0 Email:	Tel: (709) 896-3992 Fax: (709) 896-3336 Email: gm@torngatfishcoop.com

Agency	Head Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Quinlan Brothers Ltd.	Bay De Verde	Patrick Quinlan, President Robin Quinlan, Manager Processes Crab in Black Tickle	P.O. Box 40 Bay De Verde, Trinity Bay, NL, A0A 1E0	Tel: (709) 739-6960 Fax: (709) 739- 0586 Email: rquinlan@quinlanbros.ca
Coastal Labrador Fisheries Ltd.- St.Lewis	Hants Harbour	Randy Janes General Manager	Box 10 Hants Harbour,NL AOB 1YO	Tel: Fax: Email:
Labrador Sea Products	St.John's	David Earle Chief Financial Officer	Suite 302, 215 Water St. St.John's,NL A1C 6C9	Tel: Fax: Email:
Labrador Inuit Development Corporation	Happy Valley-Goose Bay	Mike Voisey, General Manager	P.O. Box 1000, Stn.B Happy Valley-Goose Bay,NL AOP 1EO	Tel: Fax: Email:

Fisher's Committees [as provided by the Department of Fisheries and Aquaculture Happy Valley – Goose Bay]

Agency	Head Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Fisher's Committee	L'anse au Clair	Kevin Letto; local Chair Person		Tel: (709) 931-2081
Fisher's Committee	Forteau	Andrew Saulter		Tel: (709) 931-2804
Fisher's Committee	L'anse au Loup	Eric O'Brien Chester Davis; FFAWU Council Member		Tel: (709) 927-5685 Tel: (709) 927-5515
Fisher's Committee	West St. Modeste	Randy O'Dell		Tel: (709) 927-5890
Fisher's Committee	Pinware	David Butt		Tel: (709) 927-5287
Fisher's Committee	Red Bay	Mervin Layden; Local Chair Person		Tel: (709) 920-2184
Fisher's Committee	Capstan Island	Reg Fowler		Tel: (709) 927-5771
Fisher's Committee	St. Lewis	John Chubbs Roy Mangrove; Shrimp Committee Member		Tel: (709) 939-2234 Tel: (709) 939-2229
Fisher's Committee	Mary's Harbour	Allister Russell Alton Rumbolt; FFAWU Council Memeber Aubrey Russell; Chair Shrimp & Crab offshore		Tel: (709) 921-6302 Tel: (709) 921-6301 Tel: (709) 921-6253

Agency	Head Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
		Committee		
Fisher's Committee	Port Hope Simpson	Andrew Strugnell Lloyd Hicks; Shrimp & Crab Harvester		Tel: (709) 960-0258 Tel: (709) 960-0334
Fisher's Committee	Pinsent's Arm	Harrison Campbell; Shrimp & Crab Harvester		Tel: (709) 951-2212
Fisher's Committee	Charlottetown	Donald Kippenhuck; Local Chair person		Tel: (709) 949-0230
Fisher's Committee	William's Harbour	Cliff Russell Trevor Larkam; Shrimp & Crab Harvester		Tel: (709) 924-0222 Tel: (709) 924-0277
Fisher's Committee	Norman Bay	George Roberts		Tel: (709) 988-4218
Fisher's Committee	Black Tickle	Mike Dyson		Tel: (709) 471-8834
Fisher's Committee	Cartwright	Wade Dyson Alexander Dyson; Local Chair Person		Tel: (709) 938-7580 Tel: (709) 938-7432
Fisher's Committee	Rigolet	Richard Rich		Tel: (709) 947-3312
Fisher's Committee	Postville	Wilfred Lane		Tel: (709) 479-9897

Agency	Head Office	Contact Person (s); Affiliation / Title (s)	Addresses	Tel Fax/Email
Fisher's Committee	Makkovik	Lester Mitchell		Tel: (709) 923-2222
Fisher's Committee	Hopedale	Ross Flowers		Tel: (709) 933-3789
Fisher's Committee	Nain	Joey Angatok		Tel: (709) 922-1013

APPENDIX D

Labrador Shelf SEA Information Brochure

The results of this strategic environmental assessment will be used by the C-NLOPB as part of their planning and decision-making related to the conversion of federal exploratory permits for the Labrador Shelf Offshore Area into exploration licenses.

The main issues that have been identified to date for consideration by the SEA are:

- Fish and fish habitat (focusing on commercial species and including benthic habitat and macroinvertebrates);
- Commercial fisheries;
- Marine mammals and sea turtles;
- Water birds including seabirds, waterfowl and shorebirds;
- Species at risk; and
- Sensitive and special areas.

Other issues may be included based on consultations with various stakeholders including the public, other resource users and regulatory authorities.

You are invited to provide information on these and any other factors that you feel may be impacted by offshore oil and gas activities in the Labrador Shelf Area. You can provide your comments to the Study Team that will visit your area or alternatively you can send comments to:

Mr. Harold Murphy

Sikumiut Environmental Management Ltd.

80 Elizabeth Avenue, Suite 200

St. John’s, NL

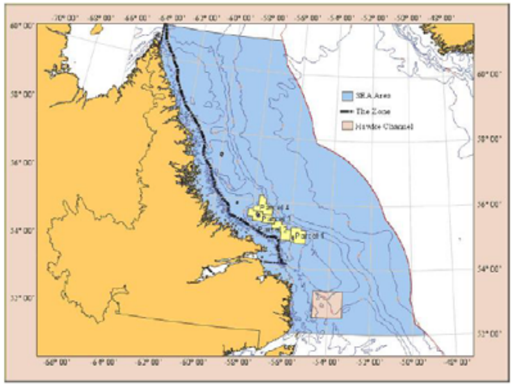
A1A 1W7

Email: hmurphy@nf.sympatico.ca

Sikumiut Environmental Management Ltd.

80 Elizabeth Ave. Suite 200
St. John’s, NL
Phone (709) 754-0499
Fax (709) 754-1445

Sikumiut Environmental Management Ltd.



GENERAL

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) is undertaking a Strategic Environmental Assessment (SEA) of the Labrador Shelf Area. The Study Area is shown in the map below.

A SEA represents a broader, more proactive approach to assessing and managing environmental effects than traditional project-specific EAs. A SEA:

- Allows environmental issues to be identified and addressed at the earliest stages of planning, and typically focuses on "regional-scale" environmental concerns.
- Can facilitate the consideration of stakeholder issues and concerns early in the planning process, and demonstrates accountability and due diligence in decision-making.
- Can also help to define the environmental components and potential effects which may require consideration in subsequent project-specific environmental assessments by identifying the key environmental issues associated with a particular sector and/or region.

In this particular case, information from the SEA will assist the C-NLOPB to:

- Determine whether or not an exploration license should be offered in whole or in part within the Study Area;
- Determine what mitigative measures or restrictions should be applied of offshore oil and gas exploration activities in the Study Area; and
- Determine whether or not to issue an Exploration License (EL) (pursuant to the Accord Acts) within the Study Area.

For the purposes of this proposal, the SEA will consider petroleum related activities that may occur in the Labrador Shelf Offshore Area, if one or more exploration licenses are issued. An exploration license confers:

- The right to explore for, and the exclusive right to drill and test for, petroleum;
- The exclusive right to develop those portions of the offshore area in order to produce petroleum; and
- The exclusive right, subject to compliance with the other provisions of the Accord Act, to apply for a production license.

The SEA will:

- Provide an overview of the existing physical, biological and socio-economic environment;
- Discuss the potential environmental effects associated with offshore oil and gas exploration activities in the Study Area in broad terms;
- Identify existing knowledge and data gaps about the components of the environment and interactions with offshore oil and gas exploration activities in the Study Area;
- Highlight issues of concern associated with offshore oil and gas exploration in the Study Area; and
- Provide mitigation and planning recommendations for potential future offshore oil and gas exploration activities in the Study Area.

The C-NLOPB established a Working Group in January 2007 to assist them in conducting an SEA for the Labrador Shelf Offshore Area, including the preparation of Scoping Document. The Working Group is co-chaired by the C-NLOPB and the Nunatsiavut Government and consists of members representing federal and provincial government agencies, local Regional Economic Development Boards and non-governmental organizations. The names of the Working Group members are noted on the back of this pamphlet. The Study Team will work in close association with the C-NLOPB and the Working Group during the preparation of the SEA.

OBJECTIVE OF THE WORK

The objective of this study is to complete an SEA of offshore oil and gas activities in the Labrador Shelf Offshore Area , which may include the drilling of wells (exploration, delineation or production), seismic and other geophysical surveys. These activities require review and approval by the C-NLOPB and are subject to project-specific environmental assessments. The Labrador Shelf SEA will specifically:

- Provide an overview of the existing environment of the Labrador Shelf, consolidating the most up-to-date region-specific information available and serving as an important reference for future project-specific environmental assessments in the region;
- Discuss in broader terms the potential environmental effects which may be associated with offshore oil and gas exploration activities in the Labrador Shelf and consider the latest information available with respect to the impacts from oil and gas activities on the Labrador Shelf and elsewhere in the world;
- Identify knowledge and data gaps and the need for additional studies;
- Highlight any key issues of concern, incorporating the results of consultation with regulatory agencies, stakeholders and the public and identifying issues and interactions that may require careful and early consideration by future operators in the area;
- Identify areas of interest or sensitive areas in the Labrador Shelf;
- Make recommendations for environmental management, mitigation and planning that should be employed during offshore oil and gas activities in the Labrador Shelf;
- Identify general restrictive or monitoring measures that may be required for future offshore oil and gas activities conducted in the Labrador Shelf; and
- Assist the C-NLOPB in determining whether exploration rights should be issued in whole or in part for the Labrador Shelf Offshore Area.

APPENDIX E

Public Consultation Session Minutes:
Round One – 2007
Round Two – 2008

C-NLOPB - Strategic Environmental Assessment
Labrador Offshore Shelf

Table of Contents

C-NLOPB - Strategic Environmental Assessment
Labrador Offshore Shelf

Summary of Consultations Meetings October 29 to November 15, 2007

During the period October 29 to November 15, 2007, consultation meetings were held in nine (9) communities from Nain to Mary's Harbour. The community of Rigolet was omitted from the schedule due to weather conditions and a meeting for this community is being re-scheduled.
Attendance at the individual meetings ranged from 5 to 12 persons for a total of 78. Those who attended had a high degree of interest, raised important questions and provided pertinent information. They were appreciative of the consultation process and some expressed thanks for the information exchange and indicated that they would look forward to the second round of consultations when a document is completed.

The detail notes from each meeting are contained herein while the following summarizes the main discussions:

1. A C-NLOPB power point presentation was made at each meeting. It involved an overview of the C-NLOPB, oil and gas activity in NL offshore, the regulatory process and the SEA process. This generated a wide range of questions and discussion:
   - Benefits to local communities and community/regional were prevalent topics. Discussions on further input by the communities, mainly in regards to benefits and environment protection, during planning and operations ranged from the possible need to form local committees to Labrador being represented on the C-NLOPB. Questions on receiving follow-up information, further consultations and project specific EAs were frequently explained.
   - The role of the Nunatsiavut government and its authority was queried and was explained at several meetings.
   - It was emphasized by many attendants that the people depend on the sea for their livelihood and any destruction, for example, as may be caused by oil spill, would be devastating. The need for identifying a compensation mechanization in line with gas or oil industry developments was highlighted.
   - Various technical questions about offshore seismic, exploration drilling and production of gas and oil were raised and discussed. The seismic effects on fish species was frequently a question raised.

2. Physical Environment: Attendants advised at all meetings that ice and icebergs in the Labrador Sea will present difficult challenges for any gas and oil exploration and development. The pack/ drift arctic ice and iceberg conditions and the strong Labrador Current are considered to present

more severe conditions compared to those experienced further south on the Grand Banks. Caution was recommended to properly assess and understand these conditions.

Storms during the fall and winter seasons were mentioned and it was questioned if a year around operation could be conducted.

Participants indicated that tide patterns will have to be well known in order to prepare an effective response for any oil spill.

3. Sea Birds: A variety of birds were identified. Most popular were the species that are hunted for food such as geese and turrs. Many of the well-known areas for birds were identified on the charts. A research and tagging project was conducted on scooter/diver species in the Nain area. An ecological reserve on the Gannett Islands off Cartwright was identified. The eider duck concentrations in areas such as Table Bay near Cartwright and St. Peter’s Bay south of Battle Harbour were mentioned. It was mentioned in Makkovik that the C-NLOPB land parcel 1 on the map is in the migration route for sea birds and seals. The Harlequin ducks are in the area as a protected species. Snowy Owls are present and the Golden Eagle [Bald-headed Eagle] are starting to nest here. Tinkers, Pigeons, Shearwaters, Gulls, Scooters and Guillemots are other species noted throughout the meetings.
4. Fish species and the fishery: Fishers were present at all meetings and usually lead the discussions on the fishery. The commercial fish species in the zone are currently crab, shrimp and turbot. Scallop and char are processed in the Nain plant. A relatively small index fishery for cod is conducted. Rock cod is harvested and processed as salted product in Postville. Concern was expressed about protecting the area for the fishery. Fishers on the north coast indicated that the areas parceled for gas and oil exploration lie within their crab fishing grounds. On the south coast fishers, particularly in Mary’s Harbour are adamant about maintaining the protection zone in the Hawke Channel. This designated area is now exclusive to crab pot fishing only. It is showing positive results to the crab resource and consequently there is a strong interest for this exclusion area to continue. .

   Various other finfish and shellfish species were mentioned, i.e., rock cod, salmon, char, mussels, scallops and whelks.

   The need for fishery liaison officers between oil and gas industry and the fishery was recommended at some meetings.

5. Marine mammals: Seals were most frequently discussed. Ring and bearded seals were noted and the harp seal is increasingly plentiful in recent years. Ranger Seals are frequent in Jeanette Bay south of Makkovik. Polar bears frequent the area.

   Whales, porpoise and dolphins are common in season.

6. Species at Risk: Wolffish was the only fish species mentioned throughout the meetings that is known as a species at risk and located in the area. Harlequin Duck and polar bears are in the area.

7. Marine traffic: It was recognized that marine traffic is on the increase. In Nain the ore carrier to Voisey's Bay has experienced difficulty with pack ice. Oil or gas development would increase traffic and this increase would have to be controlled [regulated] to safely interact with other operations such as fishing vessels.

8. Tourism: This industry is on the increase. The Nunatsiavut government has developed a strategy for the northern areas while the Southeastern Aurora Development Corporation had a development strategy for the southern areas.

9. The following areas were referenced as special areas during the meetings:
   - Gilbert Bay is a Marine Protected Area;
   - The Gannet Islands, off Cartwright, is an Ecological reserve;
   - Battle Harbour is a developed historic site and tourist destination;
   - The Torngat Mountain region is designated as a National Park;
   - Government negotiations for a national park in the Mealy mountains area are ongoing.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Nain, Oct 29, 2007

The meeting was attended by 12 persons from Nain as outlined on the attendance sheet in separate file. Also notes from discussion with Ron Webb and Gus Dicker on Oct 30 are included.

Following the C-NLOPB presentation the second part of the meeting dealt with explaining the consultation process and a discussion environmental issues and concerns was held.

Physical Environment: The group indicated that the environment in the Labrador Sea presents some difficult challenges for any gas and oil exploration and development especially during the winter period when ice concentration is at its peak.

Rough multi-year ice causes shipping problems as already experienced by winter shipping to Voisey's Bay.

Shear ice can be prevalent along the coast. This is a condition where drift ice that becomes obstructed will raft and pile up and can create thickness of up to 30 feet or more. Gus Dicker showed us photos of an ore ship encountering shear ice while on route to Voisey's Bay.

It was suggested by some attendants that the shear ice zone be identified.

It was noted that the Inuit are the experts on ice.

The area is known as "iceberg alley", with hundreds of large icebergs drifting south in tides up to an estimated 6 knots. The iceberg conditions in size and numbers were said to be much greater in this area as compared to those on the Flemish Cap and Grand Banks. There was a word of caution to be careful when comparing both the northern and southern regions.

It was suggested that the size and route of these iceberg conditions be investigated.

It was mentioned that climate warming might increase the number of icebergs in this area.

Oil and/or gas activity during the ice season was considered problematic during ice season and it was recommended by one participant that no activity take place during this period.

The occurrence of an under sea mud slide off Hopedale, in 2006, was mentioned as possibly having affects on all marine life, even as far south as the Newfoundland Island. This incident was mentioned generally but no specific information was available.
[To be investigated further in other community consultations.]

Sea Birds: A wide variety of seabirds are present throughout the area. Many species are important sources of food for local residents at various times of the year. There are no sanctuaries or protected areas for birds; however, it was explained that all areas are considered special as far as bird habitat is concerned and there has been no need to establish special conservation areas up to the present time.

Migrating birds are known to follow the edge of the land fast ice in spring and have been important food sources.

An Ecological Reserve on the Gannett Islands off Cartwright was noted.

Conservation and hunting management measures are in place and respected by the bonafide hunters. Migration studies on scooter/diver species are being conducted and status reports are available from Canada wildlife. [Pers. Comm. Gus Dicker]

Marine Mammals: Seals have been an important food supply. Ring Seals and bearded seals were noted, while the harp seals are increasingly plentiful in recent years.

Fish species: The main commercial species in the area are turbot, crab and shrimp and in the inshore areas there are scallop and Arctic char. The inshore species are the main supplier to the processing plant in Nain. There was a limited char and scallop fishery in 2007 resulted in the plant operating for only one month. The low price for scallop was mentioned as the main cause for the low activity.

One fisher in attendance identified the crab fishing ground as being located in the areas as shown by C-NLOPB as areas of significant discovery and asked as to what affect an offshore gas development would have on their operations. He identified his crab fishing grounds on the chart and indicated that a more accurate confirmation could be obtained from the logs submitted to DFO.

Concern was expressed about the affect that an [oil or gas] spill would have on fish species. They noted that the ocean current would cause a southward drift and could have far reaching effects to southern areas.

Species at Risk: Wolffish species is prevalent in the area.

Tourism: Tourism is on the increase in the area and communities are gradually investing in infrastructure to accommodate this type of business, including smaller longliner type tour boats. Cruise ships are visiting and private [sailing] vessel visits are on the increase.
The development of the Torngat National Park will increase tourism interest in the area. However, any increase in marine traffic should be managed in such a way as not to affect the ecological status of the park, and to ensure that it evolves in a way that people are comfortable with.

Marine traffic: Increasing marine traffic includes commercial vessels, e.g., ore ships in Voisey's Bay.

Private sailing vessel traffic is increasing and has potential for further expansion. One example is an interaction with a Greenland-Baffin route to include Labrador.
Marine transportation and freight services in provided during the shipping season and is from late June to November of each year. Both coastal transport vessels and private local vessels were considered as being important.
Oil or gas development would increase traffic and this increase would have to be controlled [regulated] to safely interact with other operations such as fishing vessels.

We were advised by Judy Rowell of Parks Canada that environmental documents relating Labrador that were compiled during a study of the transportation of oil from the Beaufort Sea through the Northwest passage and south through the Labrador sea should be available at Nunatsiavut office.

"Our Foot Prints are Everywhere" is another document mentioned.

Ron Webb and Gus Dicker to provide names to Charlotte for follow-up collection of traditional knowledge.

The participants noted that it is important to consider what is on the beaches and not only at the low water mark.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Natuashish, Oct 30, 2007

The meeting was attended by 10 persons from Natuashish as outlined on the attendance sheet in separate file. Jodi Ashini from Minaskuat Limited Partnership was also in attendance.

Translation services were provided by Etienne Pastiwet and assisted by President Mark Nui.
We offered an apology for not having the agenda and other information documents translated into Innu language and we gave a commitment to have the documents completed and mailed to them.

During the C-NLOPB presentation, the attendants raised several questions and made comments as follows:
1. President Nui requested that, for the 2nd round consultations, measurements be provided in feet [and miles] as well as or in lieu of metric.
2. A question was raised on the authority of Nunatsiavut in the C-NLOPB process in regards to within and outside the zone.
3. The factors that would trigger an Impacts and Benefits Agreement (IBA) were discussed.
4. Benefits such as jobs and a refinery in Labrador were mentioned in IBA discussion.
5. The question was asked as to how Innu Nation can get involved and that the Innu have a right to know what is going on including information on the issuance of [exploration] licenses.
6. It was stated that someone from Innu Nation should be on the board [working group].
7. The rights of the Innu were raised by an attendant and he expressed concern about the Land Claims Agreement and that the Innu will lose in that process.
8. President Nui asked that Peter Penashue be invited to the consultation session in Happy Valley-Goose Bay.

The second part of the meeting involved a discussion on the Innu use of the coastal and referred to the maps and charts provided. They informed that their coastal hunting grounds ranged from Okak Bay in the North to Makkovik Bay in the South.

Physical Environment: There were no comments made on this component.
Birds: Geese were mentioned as being important for hunting for food. Collecting eggs on the outside islands is a seasonal practice. Eider ducks and turrs were also mentioned.

Marine Mammals: Seals were mentioned

Fish Species: Salmon and char are important species. The Innu fish these species as a source of food.
The reasons for the disappearance of the cod in the area was raised as a question.
Rock cod is plentiful in the area.
Innu Nation is involved in the commercial shrimp fishery in partnership with Ocean Choice International.

Sport Fishing: This is an important activity in the area. Several good salmon rivers were pointed out on the map.

Tourism: President Nui stated that there is an interest in development of tourism, but no details were provided.

Other: Arctic hare are present on the coastal islands. Spracklin Island was one island were hare was very plentiful in the past. Caribou is also hunted on the islands as well as the collection of stone for carving.

Traditional Knowledge Contacts:
Names provide by Mark Nui:
Catchatan Riche, Katie Riche, Elders, and for Youth contact Jerry Pastween, Fire Chief.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Hopedale, Nov 1, 2007

The meeting was attended by five (5) persons from Hopedale as outlined on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised several questions and discussion about the gas and oil technology and particularly how it would relate to the fishery. The fisher participants advised that the significant discovery areas are located on the crab fishing grounds and asked that if further exploration or production would allow fishing to continue. There was some concern that the economics of gas and oil may rule despite any opposition or concerns from local communities.
There were questions on employment and job opportunities.

Physical Environment: Participants were asked about the comment made in Nain about an undersea mud slide and it was confirmed that an offshore earth tremor did occur 3 or 4 years ago that broke up the ice in Big Bay.
The factors informed by participants that would affect operations are icebergs. The area is well known as iceberg alley. Pack ice is well known to occur including in the offshore.
The ice season range from December to June. [Pack ice occurs later in this season]
Stormy weather conditions seem to be more prevalent in recent years. Weather patterns seem to be changing with higher wind conditions. An example was given about a storm that occurred in September of this year with very high winds.

Birds: All the islands in the area are bird hunting areas and the most prominent of these areas were identified and marked on the charts provided.
The bird species present in the area [not necessarily in any order of priority] are: Eider Duck; geese; Turrs; tinkers; pigeons; shearwaters; ducks; gulls; scooters; guillemots.
The Harlequin Duck are in the area is a protected species. Snowy Owls are present and the Golden Eagle [Bald-headed Eagle] are starting to nest here.

The wildlife manager for the Nunatsiavut area is Jim Goudie in Postville.

Marine Mammals: Polar bears, whales [for example minke species], jumper and porpoise were mentioned. The polar bear may soon be classified as a species at risk. Seals are common.

Fish Species: Turbot, shrimp and crab are the main commercial species. There is no fish processing done in Hopedale. Smaller inshore boats fish char and salmon for food. Rock cod is also fished for food.
Shellfish in the area are mussels and whelks.

There are shrimp concentrations in the inshore that are not fished. Surveys were conducted in recent years using beam trawls but there has been no follow-up commercial development. Processing facilities is a constraining factor.

Shrimp [and crab] licenses are allocated by the Nunatsiavut Government.

Sport Fishing: This is a salmon and char species sport fishing activity in the area rivers. Several good salmon rivers were pointed out on the map.

Species at Risk: Wolffish; the polar bear may be re-classified soon to an endangered species.

Tourism: This is on the increase. Nutatsiavut Government has developed a strategy and the contact is Kristy Sheppard in Rigolet. The Gateway to the North concept was noted.
Icebergs are becoming an important tourist attraction that provides opportunities for local boat charters.

Other: It was commented that there may be many data gaps that should be investigated.

Traditional Knowledge Contacts:

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Postville, Nov 1, 2007

The meeting was attended by six (6) persons from Postville as outlined on the attendance sheet in separate file.

There were fewer participants at the beginning of the meeting and it was decided that a general discussion would be the best format.

As introduction the C-NLOPB was explained, as well as the SEA process and the rationale for conducting an SEA for the Labrador shelf at this time. The power point presentation and wall map were used for references and examples. Marine charts were used to identify specific area of use and/or concern. It was noted that people depend on the resources and if there were an accident that affected these resources then how can compensation be evaluated? A mechanism for compensation is needed.

Items raised during the meeting are arranged as follows:

Physical Environment: Participants indicated that tide patterns will have to be well known in order to prepare an effective response for any oil spill.
Northern pack ice makes high ridges; ice moves with the tides and there are certain times when [gas or oil] production should stop due to ice conditions. These periods should be identified.

Birds: Ducks come to the islands in spring. There are lots of Eider Duck. A geese hunt is conducted in the spring and fall. An allocation of 4 per family is provided in the spring while the fall is not limited. It was noted that geese taste different in the spring compared to the fall because of their diet, i.e. corn during over wintering in the south versus berries in the north during summer. The outside islands are used for hunting.

Marine Mammals: It was commented that all mammals and ground fish migrate between offshore and inshore.

Fish Species: There is a commercial fishery for rock cod in Postville. Fishing grounds are within Kaipikok Bay. Approximately 140,000 lbs. of salted rock cod is produced at the local plant annually. [Note: Tornagat later advised that this is round weight and would equate to about 45,000 lbs. (33 %) of salt bulk fish]
Rock cod is also caught in winter through the ice, for human consumption as well as dog food.
Caplin is on the increase in recent years.
Salmon and char are in the area.
I was noted that cod are coming back and that Aillik Bank is a cod fishing area. Black and the Turnaviks are good fishing and hunting areas.

Sport Fishing: There is a salmon and char species activity in the area Rivers.

Species at Risk: [not discussed]

Tourism: [none mentioned]

Other: A statement was made that people need [a good] economy; there is a dependency on modern economy but other people depend on the traditional foods.

Traditional Knowledge Contacts:

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Makkovik, Nov 2 2007

There were 2 group meetings held in Makkovik and one discussion/meeting with Mr. Ted Andersen on his invitation to his home in the evening.

The meeting was attended by 7 persons from Makkovik at the 10:30 a.m. meeting and 4 town councillors at the 3:30 meeting. The attendants are listed on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised several questions and discussion about the gas and oil technology.

The town clerk asked for a copy of the power point presentation and she was advised that it would be e-mailed to her office. [This has been done. Nov 6]

One participant asked if it was possible to be informed when licenses are being issued for exploration drilling.

There was a question/statement that the Nunatsiavut lands agreement require consultations on licenses in areas out to 50 miles from the farthest out islands.

There was a detailed statement by one participant about the background of developments in Labrador whereby local communities did not benefit. He raised the question as to what they will now gain from current developments. He also raised the question if there are too much development going on in such a short time and that there should be more time for benefit discussions.

Question raised. Is there anyone on the board from Labrador? [This was a standing question at most meetings.]

It was suggested that a person from each community be appointed to observe on the drill sites; monitors similar to Voisey's Bay.

How high does the sea [state] have to be to prevent drilling?

If drilling causes pull up water with chemicals, how is it treated before it is released in the ocean?
What is the volume of water?   Answer given: approx. 20,000 cubic metres per day. What happens to drill sediment? Answer: It is pumped up to unit and cleaned.
Will it exploration and/or production be a year around operation? Answer: Not known at this point.

Other items raised during the meeting are arranged as follows:

Physical Environment: Ice rafting is a major issue.

Birds: It was noted that Parcel 1 on the map is in the migration for birds [and seals].
Jeannette Bay is a good area where Makkovik residents use for geese hunting.
There was a question as to what happens to Birds on the Grand Banks in regards to the oil industry. ? It was answered in context that there are no major negative impacts.

Marine Mammals: There are seal concentrations south of Makkovik. Sandy Cove near Jeannette Bay is known for a concentration of Ranger seals.

Fish Species: The inshore fishing in Makkovik, range from Kanairitkok Bay in the North to Jeanette Bay in the south. There are 4 crab licenses in Makkovik.
The fish plant in Makkovik is the main source of employment.
Salmon and char are very valuable species. There are no commercial licenses.

Sport Fishing: There is a salmon and char species activity in the area rivers that are owned and operated by outside companies.

Species at Risk: Wolffish was mentioned and it was noted that Turbot is being or should be considered?

Tourism: Cruise ships to the area are a future prospect.
Sailing vessels come to the area and is expected to increase. For example the opening of the N.W. passage route, due to ice being less severe, is gaining interest to sailing vessel operators.

Other: Boom holding and other oil spill response facilities and training are needed.
Other service infrastructure such as hospital facilities will have to be developed.
Scoping for a specific project will be needed.

Traditional Knowledge Contacts:

The 3:30 p.m. meeting with the town councilors involved a series of questions:

What is the depth of water in the drilling areas?
What fish are present?
What is the process to gather information/data?
Any 3-D pictures of the bottom?
What data is available on icebergs?
How soon will development take place?
Can fisheries continue in the area?

It was noted that there are shrimp, scallop, crab in the area. There may be spawning areas present.

Ice is a factor. Cold water current creates fast moving ice.

Natural gas has huge tankers that will operate in this environment. It is very significant technology in a high risk environment. People will have to know the information upfront.

To summarize discussions with Mr. Ted Andersen, he made it clear that such developments take place with the local community benefits as a priority and that proper measures, with the confidence of the community, are in place to protect the environment.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Happy Valley-Goose Bay, November 5, 2007

There was one group meetings held in Happy Valley-Goose Bay and two discussion/meetings: Shawn Melindy at the NL Department of Fisheries and Aquaculture and Keith Watts and Ron Johnson at the Torngat Fish Producers Co-operative Society Ltd.

The group meeting was held at 7:00 PM and was attended by 12 persons. The attendants are listed on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised several questions and discussion about the gas and oil technology.

There was a question about line kilometers of Seismic; what does it mean?

A question was raised about previous discoveries, i.e., gas or oil in the area and they were advised that natural gas has been identified.

A question was raised about the licensing process. When would a license be issued for production?

Does Seismic harm the ground [fish]? And what measures would be in place to protect the crab?

Physical Environment: It was indicated that ice rafting is a major factor and would operations be seasonal or year around?

Birds: Birds were acknowledged but no specific species discussed.

Marine Mammals:

Fish Species: This was the main issues raised at this meeting. There are crab, shrimp and turbot resources in the area. The areas of discoveries are on the crab fishing grounds. It was questioned if seismic and other activities would interfere with crab and shrimp fishing operations and if the seismic operations could be scheduled as to not interfere with the fishery.

It was suggested that fishery liaison officers be deployed to ensure that the exploration do not interfere with fishing gear.

A fisher in attendance indicated that the crab populations are changing. He stated that about 25 years ago there were no crab in that area and now they seem to be moving north. This past year they found good crab fishing about 28 miles off Makkovik. He felt that this northward moving could be due to [ocean] warming.

Sport Fishing:

Species at Risk: Wolffish was mentioned .

Tourism:

Other:

Traditional Knowledge Contacts: Dave Dyson; Sam Morris; Alex Saunders.

A 1:30 p.m. meeting was held with Shawn Melindy, Development Officer with the NL Department of Fisheries and Aquaculture in Happy Valley-Goose Bay:

Shawn made the following points about the fishery on the North coast:

- not too much Turbot landed on the North coast; some landed in Makkovik which fluxuates from year to year;
- scallop landings are important in Nain and these landing fluctuates annually;
- Char is also important to the Nain plant;
- boats from outside the area enter into partnerships with the local fishers to harvest turbot, scallop and crab;
- shrimp is harvested by outside vessels.

The Department is assisting a project in Rigolet involving ring seals and reviving the traditional ways of processing. The concentration of Arctic ice has lessened in the Rigolet area in recent years which has provided for a seal harvest.

In the South Coast areas there are similar fisheries as in the north however there are more locally based enterprises. The Department has been involved in developing a whelk fishery in areas along the north and south coast. Project reports should be available on the Department website.

There are three special /protected areas along the south coast:

1. Gilbert Bay
2. Gannet Islands
3. Battle Harbour

A 2:30 p.m. meeting was held with Keith Watts, General Manager and Ronald Johnson, Assistant General Manager of the Torngat Fish Producers Co-operative Society Ltd. in Happy Valley-Goose Bay: [herein referred to as Torngat fish]

Torngat Fish confirms that the discovery parcels of land outlined on the C-NLOPB maps track across crab fishing grounds. These crab grounds range to 120 miles off Smokey and down [south] to 54'40" Latitude for the northern coast fishers.
Ron Johnson will provide us with the coordinates of the main grounds fished.
The crab fishery last for 4 to 6 weeks for the main quota. The quota is 700,000 lbs plus 400,000 exploratory quota in NAFO area 2H. The fishery starts at the 1^{st} to mid-July.

The plant in Makkovik operates for 12 o 16 weeks and employs 100 to 130 workers.

The plant in Nain process scallop and char from the inshore fishery. In 2006, it processed 1.2 million lbs of shell stock scallop which has been substantially reduced in 2007 due to low market prices.

There has been attempt to process sea cucumber in the area, similar to the operation on Fogo Island however this has not reached commercial levels.

Torngat Fish process approximately 60,000 lbs of salted rock cod in Postville each year.

Torngat Fish requested to be place on the C-NLOPB list to be notified directly of developments in this area. They asked if fishery liaison officers would be hired to avoid users conflicts, i.e., gear conflicts.

The prospect of Torngat fish becoming a member of One Ocean was mentioned in the context that they are not part of the FFAWU that is part of this organization and therefore has no input and receives no information.

They explained that it might be easy to confuse The Torngat fish Co-operative with the Torngat Joint Fisheries Board, the latter being the fisheries agency of the Nunatsaivut Government.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Mary's Harbour, Nov 13, 2007

The meeting was attended by five (5) persons from Mary's Harbour as outlined on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised the following points:

1. There was a strong consensus that the Hawke Channel Conservation or "Cod Box" be closed to drilling. [This is a big issue]. It was explained by the attendants that this area is designated a conservation area for the past 3 years. Fishing is restricted to crab pots only and other industry activity is prohibited.

   It is considered a nursery area for cod and crab, which is documented by scientific research. One example sited was studies conducted by Dr. George Rose of Memorial University.

   Shrimp Companies deploying draggers have stayed away from this area.
   Fishers contend that the crab fishery would be wiped out if drilling is done in the Hawke Channel. Other species such as turbot and cod are also in the area.

   The question was raised as to what would happen if oil or gas is discovered in this area; what would happen to the fishing grounds? It was stated that nothing should be planned for the conservation box without local input particularly the fishing industry. The whole Labrador coast depends on the fishery [particularly the crab fishery] to keep the communities alive.
   Fishers want to continue with this box protection as they see positive results in the crab stocks each year since it was introduced.

Note: An example was provided to the fishers of how oil exploration activity on the west coast of the Island was scheduled around lobster molting season.

2. What effect does seismic have on fish? Examples of research that showed no measurable effect was explained.
3. Is any information released on seismic results?
4. What would be the environmental impact in the event of an accident? The area would also be in the path of any oil spill drift from the north. You would need to be able to determine where the spill would go.

One person at the meeting, Claude Rumbolt advised that he is a consultant who is serving 180 fishers and he asked to be kept informed on this assessment and any other exploration activity.

Other items raised during the meeting are arranged as follows:

Physical Environment: Ice rafting is a factor. It was noted that this past year there was no ice early in the year while in the latter part of the season the most ice ever was reported.

Birds: There is a lot of subsistence bird hunting. Table Bay, towards Cartwright, was mentioned for its Eider Duck populations and St. Peter’s Bay just south of Battle Harbour was also noted. The closure of the cod fishery has reduced activity in many remote areas which has lessened disturbance of birds nesting in the areas.

Marine Mammals: Seals are an important resource in the area.

Fish Species: The importance of the commercial species was discussed throughout the meeting, i.e., crab, shrimp, turbot, cod. It was suggested that there are many unknowns as to what exactly is present, e.g., sited: bottom corals. What are the gaps?

Sport Fishing:

Species at Risk: Wolffish was mentioned as being plentiful.

Tourism: This industry is on the increase with the opening of the road. Battle Harbour is a popular attraction. Whale watching, kayaking, the strand beach area located north of Cartwright are all great potentials. Private yachting is on the increase.
The Aurora Development Corporation has developed a development strategy. [A CD of this study was received from Aurora].

Archeology: There is evidence that the Basque Whaling activity was conducted in Henley Harbour. It was suggested to check with the Labrador Métis Nation for information.

Other:

Traditional Knowledge Contacts:

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Port Hope Simpson, Nov 14, 2007

The meeting was attended by seven (7) persons from Port Hope Simpson as outlined on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised questions and made statements:

1. Are the finds off Labrador gas or oil?
2. Is seismic in 2 dimension (D) or 3-D?
3. Are there any companies interested in the acreage outlined on the wall chart?
4. There was a question on the licensing process.
5. Do Companies know how much gas [or oil] is out there? Ans: 4 trillion cu. ft. of gas; no oil found to date.
6. Can the natural gas be taken out safely? Will it be transported to shore by pipeline?

Note: The safety/environment issue, in relation to gas versus oil, was discussed and an example was sited about a gas blow-out near Sable Island with no environmental impacts.

7. What about drilling mud? How much is left on the bottom?
8. Is habitat restored elsewhere?
9. What effect does seismic have on fish, seals and whales?
10. How can we find out when they would be conducting seismic? They were informed that this is posted on the C-NLOPB web site as well as any spills. In addition, seismic activity is announced on CBC radio fisheries broadcast.
11. Would production be on a year-around or seasonal schedule?
12. One attendant noted that we do not know what damage may be already done during past drilling.

Physical Environment: Icebergs were mentioned in the context of bottom scouring would be a major pipeline concern. One person mentioned that he had seen one iceberg grounded in 300 fathoms of water. This was questioned; however, he was confident that it was actually grounded at that depth.

The Labrador current would be a factor in the event of an oil spill. For example, a spill in the north could have an impact 100 miles to the south.

Ice cover could cover up an oil spill and could carry it great distances.

Birds: Bird hunting is conducted in the area. Bird concentrations in St. Peter’s Bay was cited.

Marine Mammals: Seals were mentioned.

Fish Species: Shrimp, crab, turbot and scallop were noted. The fishery is a major industry in the area. The impact of gas or oil developments on the fishery was raised as a major question.

Sport Fishing:

Species at Risk:

Tourism: This is important to the area. Destination Labrador was cited as a source of information. On attendant at the meeting, Ms. Margaret is Chairperson of the board and she advised to contact Randy Little at their office in Happy Valley- Goose Bay, Tel: 896-6507

Archeology: Some work is going on. Cape Porcupine was mentioned.

Other: Local benefits were discussed and it was questioned if there are anyone acting on behalf of Labrador outside the Inuit zone. While the meeting was informed that companies are required to do a benefits plan, concern was expressed about local input and questioned if it may be necessary to have a local group formed for this purpose.

There was a discussion on gas versus oil in terms of environmental impacts. It was suggested that gas is less dangerous that oil since gas can dissipate quickly.

There was a question if temperature would have an effect on dissipating?

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Cartwright, Nov 15, 2007

The meeting was attended by five (5) persons from Cartwright as outlined on the attendance sheet in separate file.

During the C-NLOPB presentation the attendants raised questions and made statements:

1. There should be a fisher representative on the [SEA] working Group.
2. When will it be made public as to when drilling will take place?
3. Discussion on the appointments of Directors to the C-NLOPB.
4. How does Seismic affect fish?

Physical Environment: One incident of a large iceberg grounding off Saglek was mentioned. One person noted that icebergs were a little scarce this past year compared to other years.

Birds: One person at the meeting advised that he works seasonally with Ducks Unlimited in the area from Indian Tickle to Cape North, which includes Table Bay. The major research work involves eider ducks.

Marine Mammals: Seals

Fish Species: One fisher raised concern about the effects of seismic in crab molting areas. He informed that there are areas where soft shell crab is prevalent throughout the year. He identified one of these areas on the charts. These should be identified and protected similar to the Hawke Channel.

Species noted: Cod, capelin, rock cod, salmon, char, whelks and mussels. Scallop are harvested by divers for own use. Salmon runs to the rivers may be down in numbers this year. [check with DFO].

Sport Fishing:

Species at Risk: Wolffish

Notes compiled by:

Harold Murphy
Nov 19, 2007

C-NLOPB - Strategic Environmental Assessment
Labrador Offshore Shelf
Consultation Meeting Attendance

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C-NLOPB - Strategic Environmental Assessment, Consultations Meetings.
Attendance, Nain, Oct 29, 2007**.**

Name	Affilation
Sabrina Surman	Arctic Net
John Eikkusek	Torngat Fisheries Co-op Fish Plant Manager
Sarah Erickson	Angajukkak (Mayor)
John Lampe	Nunatsiavut Gov’t. staff
Joey Angnatok	Crab Fisher
Angus Simpson	Parks Canada
Ernie Ford	Nunatsiavut Gov’t. staff
Katie E. Winters	Interpreter and Nunatsiavut Gov’t. staff
Alfred J. Winters	Nain Resident
Judy Rowell	Parks Canada
Gus A. Dicker	Sikumiut Nain Office
Ron Webb	Sikumiut Nain Office
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C-NLOPB, Strategic Environmental Assessment, Consultations Meetings.
Attendance: Natuashish, Oct 29, 2007.

Name	Affiliation
Etienne Pastiwet	Innu Nation
Sebastien Piwas	Innu Nation
Agathe Piwas	
Edonval Piwas	
Joel P. Rich	
Charlie A. Jacobish	
Clarence Franz Nui	
Mark Nui	President Innu Nation
Joachim Nui	
Prote Poker	Chief Band Council
Jodi Ashini	
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C-NLOPB - Strategic Environmental Assessment, Consultations Meeting
Attendance: Hopedale, Nov 1, 2007.

Name	Affiliation
Judy Dicker	Angajukkak (Mayor)
Ian Winters	Conservation officer
Brent Denniston	Nunatsiavut Gov't staff
Juliana Flowers	Community Development Officer
Greg Flowers	Nunatsiavut representative for Hopedale and crab fisher
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C-NLOPB - Strategic Environmental Assessment, Consultations Meeting

Attendance: Postville, Nov 1, 2007.

Name	Affiliation
Keith Decker	Angajukkak (Mayor)
Wilfred Lane	Conservation Coordinator
Videt Flowers	Councillor
Douglas Jacque	Resident -Retired
Shirley Goudie	Town Manager
Bob Edmunds	Resident
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C-NLOPB - Strategic Environmental Assessment, Consultations Meeting

Attendance: Makkovik, Nov 2, 2007.

Name	Affiliation
Meeting at 10:30 A.M.	
Herb Jacque	Angajukkak (Mayor)
Martin Jararuse	Interpreter
Doreen Winters	Town Clerk
Curtis Andersen	Heavy Equipment Operator
Erol Andersen	Nunatsiavut Gov't. Staff
Todd Broomfield	Local Uranium Committee
Ted Andersen	Retired contractor/former member on various community and regional orgs.
Meeting at 3:30 P.M.	
Jackie Penney	Town Councillor
Christine Nochasak	Town Councillor
Mary B. Andersen	Town Councillor
Rick F. Plowman	Town Councillor and School Principal
	11

C-NLOPB, Strategic Environmental Assessment, Consultations Meetings.
Attendance: Happy Valley-Goose Bay, Nov 5, 2007.

Name	Affiliation
Shawn Melindy	NL Dept. of Fisheries & Aquaculture
Joe Goudie	Parks Canada
David Leeder	Minaskuat
Roland Kenuksigak	Labrador Metis Nation
Corinna Freake	Protected Areas of NL
Frank Russell	Upper Lake Melville Environmental Society
Stan Oliver	Combined Councils of Labrador
Ralph Tooktoshina	Fisherman
Kate Kyle	CBC reporter
Peter Penashue	Innu Nation
Paula Reid	Innu Nation
Robyn Montague	NL Dept of Natural resources
	12

C-NLOPB, Strategic Environmental Assessment, Consultations Meetings.
Attendance: Mary’s Harbour, Nov 13, 2007.

Name	Affiliation
Alton Rumboldt	Crab Fisher; FFAWU Inshore Council Member
Willis Rumbolt	Crab Fisher
Wallace Pye	Crab Fisher
Aubrey Russell	Fisher
Ford Rumbolt	Plant supervisor; Mayor of Mary’s Hr.
Claude Rumbolt	Claude’s Fishery Consulting
Dwight Russell	Chairperson 25 crab supplementary fishers
Harold Rumbolt	Dept. of Fisheries & Aquaculture
Larry Rumbolt	Deputy Mayor, Mary’s Harbour
	9

C-NLOPB Strategic Environmental Assessment, Consultations Meetings.
Attendance: Port Hope Simpson, Nov 14, 2007.

Name	Affiliation
Randy Simmons	Environment Canada
Sean Weir	Teacher and Town Councillor
Dennis Burden	Fisher
Wayne Russell	LSCAP Inc.
Lloyd Hicks	Fisher
Roxanne Notley	SADC Zone 4
Margaret Burden	Mayor of PHS Co-chair MPA Gilbert Bay
	7

C-NLOPB Strategic Environmental Assessment, Consultations Meetings.
Attendance: Cartwright, Nov 15, 2007.

Name	Affiliation
Anthony Elson	Ducks Unlimited
Dean Martin	
Wade Dyson	Crab fisher
Simon Williams	
Rev. Graham Hill	Anglican Minister
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C-NLOPB - Strategic Environmental Assessment

Labrador Offshore Shelf

2nd Round of Consultations May 4 - 20, 2008

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C-NLOPB - Strategic Environmental Assessment
Labrador Offshore Shelf

Summary of Consultations Meetings   May 4 – May 20, 2008

The 2nd. Round of consultation meetings were scheduled in ten (10) communities from Nain to Mary's Harbour during May 4 – May 21 2008. These included the same communities that were visited in the fall of 2007 during the initial round of consultations. The meetings were held from May 4 - 20 and were conducted in nine (9) communities. In Natuashish the weather caused a flight arrival delay and a change of meeting location may have been factors for no residents showing up for the meeting on May 6. The change in time of the meeting was advertised on the local community radio however there were no participants and consequently no meeting was held in Natuashish.

Attendance at the individual meetings ranged from 4 – 10 persons for a total of 53. There were 29 of those participants who had attended the initial meetings. This is compared to the initial consultation meeting attendance with a range of 5 – 12 participants for a total of 89.

Each meeting was opened with a brief introduction and explanation that the objective was to present the draft report and invite comments as a follow-up to the initial consultations that were conducted last fall. The report was then presented with a power point visual aid. Discussion was held throughout and after the presentation. The report summary and main report was referred to during some of the discussions. It was made known at all meetings that the report is posted on the C-NLOPB website, copies are available in Community offices and the deadline for comments is May 21.

Those who attended were interested in the draft report and participation varied with questions and comments. However these were not extensive as compared to the initial consultations. At all meetings appreciation was expressed for the overall consultation process and the information exchange.

Notes from each meeting are contained herein while the following summarizes the main discussions:

1. The sensitivity of the area in relation to the fishery resources such as crab and shrimp was raised at several of the meetings.
2. There is concern about the operations and the possibility of pollution from an “oil or gas spill”.
3. Oil spill drift was raised in regards to direction and effects.
4. The effect of seismic on fish populations is a concern.
5. Community benefits particularly in the context of Impacts and Benefits Agreements, compensation for damage to the environment and the fishery were discussed at some meetings.
6. The importance of collecting traditional knowledge was mentioned.
7. Committees to provide a mechanism for community and stakeholder input in development and production phases are considered important.
8. The fish species of Herring, Lumpfish and porcupine Crab are present in the area.
9. The focus in Rigolet was on conservation and local employment opportunities.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Nain May 8, 2008

The meeting was attended by 5 persons as outlined above; 3 of those had attended the initial consultations on Oct 29 2007.

During the presentation of the draft report the attendants made the following comment:

1. The topic of sensitive areas was raised in the context of the crab fishing grounds in the parcel areas. Attendants were advised that the crab fishery was raised throughout the initial consultations and is referenced in the report.

C-NLOPB - Strategic Environmental Assessment

Consultation Meeting notes…. Natuashish May 6, 2008

A meeting was not conducted in Natuashish due to any attendance.

The flight to Natuashish was late in arriving due to foggy weather along the coast. In addition the location of the meeting had to be changed to three different locations.

We arrived in Natuashish at 12:00 noon and left for Makkovik at 2:50 PM.

As follow-up Kim Coady will e-mail President Mark Nui.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Hopedale May 5 2008

The meeting was attended by 10 persons from Hopedale as listed on the attendance sheet in separate file. Only 1 of these persons attended the 1st round of consultations on Nov 1 2007

During the presentation of the draft report the attendants raised questions and discussion as follows:

1. A Question was raised on the timeframe for exploration and if there are any potential this year? Kim explained the process and indicated that it would be unlikely for any activity to take place this year. There was a general feeling or hope that some positive activity would begin to happen. The question was asked as to what may be driving this SEA project?
2. Community benefits were raised as an important issue. It was noted that the parcels of area that are up for bid by the C-NLOPB are out side the Inuit Land Claims agreement and therefore would not be eligible for an Impacts and Benefits agreement unless some activity was within the land claims boundary.

3. This lead to the question as to why the other significant areas on the map outside the parcels are not up for bids.

4. In the event of a specific project the communities would be interested in reviewing as to what happens in the case of an oil spill. E.g. sited "If a blow-out occurs how would it affect the area?"

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Postville May 7, 2008

The meeting was attended by 5 persons as outlined on the attendance sheet in separate file; 3 of those had attended the initial consultations on Nov. 1 2007

During the presentation of the draft report the attendants raised questions and discussion as follows:

1. In regards to potential issues which of those listed in the draft report are more prevalent on the Grand Banks? Each one was reviewed as not being major issues in these operations.
2. How long do wells be monitored after they are closed?
3. There was a discussion on direct benefits [royalties] to Nunatsiavut government and it was noted that any production outside the 12 mile zone would not apply unless, for example, oil or gas was transported via pipe line to shore through the zone.
4. The prospect of compensation programs for any damage caused to the environment or eco-systems. The concept was mentioned of [after the fact] compensation for damage e.g. to fish populations that may be discovered some time after the operations are terminated.
5. Migratory Birds that may be killed on route will have an effect on populations elsewhere.
6. The importance of collecting traditional knowledge of land and sea use is important and an attendant referred to the document “Our Foot Prints are Everywhere” is an important source of information. It was noted that this was an important reference in drafting the report.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Makkovik May 6, 2008 @ 7:00 PM

The meeting was attended by 6 persons from Makkovik and 5 of those attended the initial meeting on Nov 2, 2007.

During and after the presentation of the draft report the attendants raised questions and discussion as follows:

1. A large pod of killer whales were observed some years ago from a small boat off Cape Harrison. Would such migrations be effected?
2. What is the latest on cod fish in the specific local areas that were once good fishing grounds?
3. The exploration activities were discussed and the Geohazards and Geotechnical surveys were explained.
4. A question was raised on what would be the mostly likely rig to be used in production in the area.
5. How much is know about the speed of the Labrador current?
6. The Species at Risk component was explained as to how a species is listed under SARA.
7. What effects would drilling have on Bottom Dwelling Organisms?
8. The species of Porcupine Crab was raised as not being listed.
9. What happens if drilling is conducted in or near a biologically sensitive area?
10. What is the impact of drilling mud during coupling and uncoupling of a rig?
11. What will be the effect of the currents in the event of an oil spill?
12. If drilling causes pull up water with chemicals, how is it treated before it is released in the ocean?
13. How can more information be collected to fill the data gaps?
14. What about community input on committees? For example similar to committees such as One Ocean or the Placentia Bay Traffic Committee.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Rigolet, May 20 , 2008

The meeting was attended by 4 persons from Rigolet and all 4 of those attended the initial meeting on December 5, 2007.

During and after the presentation of the draft report the attendants raised some concerns and questions as follows:

1. There was concern about possible job opportunities, especially if tankers are used instead of pipelines; there is no possibility for Nunatsiavut Government to intervene if the oil is put in tankers outside the 12 mile limit.

2. The group present felt that Nunatsiavut should have a say because no matter where the oil is drilled because if there is an oil spill the birds and fish no matter where they are will be affected and we fish commercially and for food.

3. Communities would like to benefit from the companies drilling offshore, for example jobs in the communities, maybe we could be a supply base here in Rigolet we have a year round ice free port for the most part.

4. There should be training provided now to have people from here work on the oil rigs.

5. Does drilling affect the commercial fishery?

6. There must be effects from Hibernia oil rigs, there must be lots of information now regarding the effects of the drill rigs around Newfoundland, we should be given examples from that drilling, and look at those projects to see where we can be trained.

7. We would like to know the maximum effects drilling have on fish.

8. Will drilling start in September if the bidding closes in August? Charlotte explained that it could take up to three years before drilling would start.

9. What will happen if there is a spill in the areas where there are endangered species?

10. Will the drilling just go on and not care about the endangered animals or birds? Charlotte said the C-NLOPB can impose restrictions (not saying they will) on areas where they know is habitat for endangered species.

Notes compiled by Charlotte Wolfrey

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Happy Valley-Goose Bay, May 4 2008

The meeting was attended by 8 persons listed above and 3 of those attended the initial meeting on Nov 5, 2007.

During and after the presentation of the draft report the attendants raised questions and discussion as follows:

1. Wolfish (3 species) was presented as Species at Risk and is also listed as a commercial species. It was explained by the DFA representative that the fishers are not allowed to keep any wolfish and must release and report any incidental catches to DFO.
2. Spider Crab needs to be clarified as Toad Crab and Porcupine crab is another species that needs to be included.
3. The areas of discoveries are on the crab fishing grounds. It was questioned if seismic and other activities would interfere with crab and shrimp fishing operations and if the seismic operations could be scheduled as to not interfere with the fishery. This was similar to the discussions that held during the November 2007 consultations.
4. It was noted by the fisher representative that the Labrador Current may be faster then the average maximum speed presented in the report.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Mary's Harbour, May 12, 2008

The meeting was attended by 6 persons as outlined above; 5 of those had attended the initial consultations on Nov 13 2007.

During the presentation of the draft report the attendants made the following comments:

1. Fish Species: Herring, Lumpfish and Porcupine Crab are in the area; herring and lumpfish were harvested commercially in the past.
2. Potential Issues: It was questioned if there is any compensation fund in place for damages in the event of an accident such as an oil spill. According to the attendance, this should be listed as a potential issue.
3. There was a question on whether there is any check on the wells that were capped in the area back in the 70 and 80's.
4. It was questioned if the colder water temperatures would have an adverse affect on oil floating to the surface.
5. There was a discussion on bids for the parcels of area shown on the map and mainly in the context of more consultation on the project.
6. It was questioned as to what mechanism is in place for other stakeholders such as the fishing industry to have a say before and during the development of a project.
7. They stress the importance of the fishing enterprises that are currently using the area and the importance of the fishery to the communities in the area. They questioned if seismic has an effect on crab larvae and noted incidence in the past where fishers reported that turbot became scarce when seismic was conducted.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Port Hope Simpson, May 12, 2008

The meeting was attended by 4 persons as outlined on the attendance sheet in separate file; 2 of those had attended the initial consultations on Nov 14, 2007.

During the presentation of the draft report the attendants made the following comments:

1. Sensitive areas. The Southeast Aurora Development Corporation (SADC) is working to have St. Lewis Inlet recognized as a special area.
2. The frequency of seismic sound waves was a question in regards to its effects on fish.
3. The time frame to develop a find was questioned.
4. Oil spill drifting was raised an item of concern.

C-NLOPB - Strategic Environmental Assessment

Consultations Meeting notes…. Cartwright May 13, 2007

The meeting was attended by 5 persons as outlined on the attendance sheet in separate file; 3 of those had attended the initial consultations on Nov 15, 2007.

During the presentation of the draft report the attendants made the following comments:

1. There was considerable discussion about seismic operations and its effects on the environment and fish and shellfish populations. One attendant indicated that while monitoring may be conducted during the operation period, e.g. 3 months, there is no follow-up over the other 9 months.
2. One other attendant commented that jelly fish was not included in the [summary] report.

C-NLOPB - Strategic Environmental Assessment

Labrador Offshore Shelf

Consultations Meeting Attendance

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Consultation Meeting Attendance,

Nain, May 8, 2008

In attendance:

Name	Address	Telephone E-Mail	Affiliation
Sarah Erickson	P.O. Box 470, Nain	922-2842 (W) Sarah.erickson@nunatsiavut.com	Angajukkak (Mayor)
John Lampe	Nunatsiavut Government Nain	922-2942 John-lampe@nunatsiavut.com	Nunatsiavut Gov't. staff
Ron Webb	Sikumiut, Nain	Ron.webb@sikumiut.ca	Sikumiut Nain Office
David Dicker	P.O. Box 183 Nain A0P 1L0	922-2186	Labrador Inuit Dev. Corp.
Wilson Jararuse	P.O. Box 158 Nain A0P 1L0	922-2942 wjararuse@nunatsiavut.com	Interpreter

Consultation Meeting Attendance,

Natuashish, May 6, 2008

No Attendance

Consultation Meeting Attendance,

Hopedale, May 5, 2008

In Attendance:

Name	**Address**	**Telephone E-mail**	**Affiliation**
Hon. Patty Pottle	Hopedale	933-3696 ppottle@nf.aibn.com	Minister of Aboriginal Affairs NL Government
Judy Dicker	Hopedale	933-3864 Judy.dicker@nunatsiavut.com	Angajukkak (Mayor)
David Milli	Hopedale	933-3884	
Katie Pijogge	Hopedale	933-3870	Interpreter
Tom Onalik	Hopedale		
Kitora Abel	Hopedale	933-3698	
Philip Abel	Hopedale	933-3698	
Elizabeth Tuglavina	Hopedale	933-3887 Elizabeth.tuglavina@lghealth.ca	

Jenny Dicker	Hopedale	933-3852 Winnietheppooh117@hotmail.com	
Sukie Aggek	Hopedale	Seagget@hotmail.com	

Consultation Meeting Attendance,

Postville, May 7, 2008

In Attendance:

Name	Address	Telephone /E-Mail	Affiliation
Keith Decker	Postville	479-9830 keith.decker@nunatsiavut.com	Angajukkak (Mayor)
Wilfred Lane	P.0. Box 34 Postville A0P 1N0	479-9897 wlane@nunatsiavut.com	Conservation Coordinator
Shirley Goudie	Postville	479-9830 (w) 479-9865 (h) communitycouncil@nf.aibn.com	Town Manager
Jenelle Gear	P.O. Box 8 Postville A0P 1N0	479-1022 Jen-tmlchick8@hotmail.com	
Betty Vincent	Postville	479-1019 emimo_angel17@hotmail.com	

Consultation Meeting Attendance,

Makkovik, May 6, 2008

In Attendance:

Name	Address	Telephone E-Mail	Affiliation
Herb Jacque	Makkovik	923-2455 Herbert.jacque@nunatsiavut.com	Angajukkak (Mayor)
Curtis Andersen	Makkovik	923-2310	Heavy Equipment Operator
Ted Andersen	Makkovik		Retired contractor and former member on various community and regional orgs.
Christine Nochasak	Makkovik	923-2358 myriansummor@yahoo.ca	Town Councilor
Rick F. Plowman	Makkovik	923-2145 rplowman@lsb.ca	Town Councilor and School Principal
Katie Haye	P.O. Box 37 Makkovik	923-2227 Kakivak34@hotmail.com	Interpreter

Consultation Meeting Attendance,

Rigolet, May 20, 2008

In Attendance:

Name	**Address**	**Telephone E-Mail**	**Affiliation**
Paula MacLean Sheppard		947-3383 pmsheppard@nunatsiavut.com	Community Liaison Nunatsiavut Government
David Wolfrey		947-3542 dwolfrey@nunatsiavut.com	Conservaton Officer Nunatsiavut Government
Daniel Michelin		947-3382	AngajukKak Rigolet
Sarah Blake		townofrigolet@yahoo.com	Town Manager of Rigolet

Consultation Meeting Attendance,

Happy Valley-Goose Bay, May 4, 2008

In Attendance:

Name	**Address**	**Telephone E-mail**	**Affiliation**
Shawn Melindy	P.O. Box 3014, Stn. B Happy Valley- Goose Bay A0P 1E0	896-3412 smelindy@gov.nl.ca	NL Dept. of Fisheries & Aquaculture
Stan Oliver	P.O. Box 1542, Stn. B Happy Valley- Goose Bay A0P 1E0	896-8302 (w) soliver@lfchvgb.ca	Town of HV-GB & Torngat Joint Fisheries Board
Natalie Jette	P.O. Box 474, Stn. C Happy Valley- Goose Bay A0P 1E0	896-5860 njette@hotmail.com	Public
Jennifer Mitchell	P.O. Box1968, Stn. B	896-5860 jennifer.mitchell@jacqueswhitford.com	Jacques Whitford
Ralph Tooktoshina	5 Montagnais St. Happy Valley- Goose Bay	896-9039	Fisherman
Juliana Cofey	P.O. Box 2050, Stn. B Happy Valley- Goose Bay A0P 1E0	896-6780 Juliana.coffey@torngat.coffey@torngatsecretiat.ca	Torngat Joint Fisheries Board
Andrea Procter	Gen. Del. Stn. B Happy Valley- Goose Bay A0P 1E0	896-9268 Andrea.procter@mun.ca	Memorial University
Laurens Bartmann	P.O. Box 477 North West River A0P 1M0	laurensbartmann@hotmail.com	Labrador Innu Helicopters

Consultation Meeting Attendance,

Mary's Harbour, May 12, 2008

In Attendance:

Name	Address	Telephone E-mail	Affiliation
Alton Rumboldt	P.O. Box 21 Mary's Hr	921-6301 alton@nf.sympatico.ca	Crab Fisher; FFAWU Inshore Council Member
Aubrey Russell	P.O. Box 114 Mary's Hr	921-6253	Fisher
Ford Rumbolt	P.O. Box 36 Mary's Hr	921-6218 rumbolt-ford @nf.sympatico.ca	Plant supervisor; Mayor of Mary's Hr.
Larry Rumbolt	P.O. Box 34, Mary's Hr	921-6456 Larry_rumbolt@yahoo.ca	Deputy Mayor, Mary's Harbour
Claude Rumbolt	P.O. Box 29;Mary's Hr	921-6273 rcrumbolt@nf.sympatico.ca	Claude's Fishery Consulting
Gary Bolger	P.O. Box 22 St. Lewis	939-2359 dbolger22@yahoo.ca	REDB SADC

Consultation Meeting Attendance,

Port Hope Simpson, May 12, 2008

In Attendance:

Name	Address	Telephone E-mail	Affiliation
Rex Turnbull	P.O. Box 189 Port Hope Simpson	960-1010 lscap@nf.aibn.com	LSCAP Inc.
Lloyd Hicks	P.O. Box 98 Port Hope Simpson	960-0334	Fisher
Roxanne Notley	P.O. Box 65 Port Hope Simpson A0K 4E0	960-0470 roxanne.notley@nf.aibn.com	Executive Director SADC
Michelle Clarke	Port Hope Simpson A0K 4E0	Porthopesimpson@nf.aibn.com	Town Office

Consultation Meeting Attendance,

Cartwright, May 12, 2008

In Attendance:

Name	Address	Telephone E-mail	Affiliation
Anthony Elson	P.O. Box 119 Cartwright	938-7302	Area Resident
Dean Martin	P.O. Box 152 Cartwright	938-7057 dean.martin@nf.sympatico.ca	
Rev. Graham Hill	P.O. Box 89 Cartwright	938-7224 reverend_grahamhill@hotmail.com	Anglican Minister
Patrick Davis	P.O. Box 167 Cartwright	938-7338 labrador@nf.sympatico.ca	
Dave Gatehouse	P.O. Box 7 Cartwright	938-7268 dgatehouse@cdli.ca	SADC

APPENDIX F

Principle and Process for Traditional Knowledge Collection

Traditional Knowledge

Effective incorporation of Traditional Knowledge (TK) requires a firm understanding of what TK is, how it can be gathered and applied and ensuring the providers of the TK are participating in a manner by which they know what their TK is being used for and why. While there are numerous ways to incorporate TK in the environmental assessment process, there is no template for dealing with the issue. This is due in large part to the dynamic and intangible nature of TK and how it is perceived differently and applied differently by various aboriginal groups and even within a single aboriginal group. Nonetheless, there are appropriate means of incorporating TK for the Labrador SEA and these guiding principles will be applied during the work. In addition, Sikumiut and Minaskuat have a strong history of dealing with the two aboriginal groups in Labrador and work regularly to apply traditional and technical knowledge for a complementary outcome on several projects. While the overview of incorporating TK in an environmental assessment described below is model after the Canadian Environmental Assessment Agency guidelines (http://www.ceaa-acee.gc.ca/012/atk_e.htm), the Labrador SEA team has direct relevant experience with effectively implementing them.

The following outlines the approach and methods to gather TK, demonstrates how this will be incorporated in the Labrador SEA document and outlines some direct relevant experience with similar projects. In order to properly gather and apply TK, there is a need to understand what it is ensure it is gathered and applied appropriately. TK is held by the Aboriginal people who live in the area of a proposed project, and who have a long relationship with the lands, waters and resources likely to be affected. Incorporating TK in the environmental assessment process can:

- provide relevant biophysical information, including historical information, that may otherwise have been unavailable;
- help identify potential environmental effects;
- lead to improved project design;
- strengthen mitigation measures;
- contribute to the building of enhanced long-term relationships between proponents, Aboriginal groups, and/or responsible authorities;
- lead to better decisions; and
- contribute to the building of EA and TK capacity within Aboriginal communities and build an awareness of, and appreciation for, TK in non-Aboriginal communities.

TK can be brought into an EA at any time. For instance, in an EA, TK can assist with:

- scoping the project and the assessment;
- the collection of baseline information;
- consideration of the environmental effects of a project;
- evaluation of environmental effects and the determination of their significance;
- evaluation of any cumulative environmental effects of the project;
- evaluation of the effects of the environment on the project;
- identification or modification of mitigation measures; and
- design and implementation of any follow-up programs.

Application of TK during an environmental assessment will differ from project to project, however, there are guiding principles which will be applied to this project. First and foremost, the project team will work with aboriginal communities in the region. The TK held by each Aboriginal group is unique to that group, so consideration of TK in a particular EA will need to be developed with the holders of the TK. To do so, the project team will ensure:

- The appropriate governing bodies are contacted early in the process and made aware of the project. This will include contacting representatives of the Nunatsiavut Government (for the Inuit communities) and the Natuashish band council for the Innu residing in Natuashish. There may will also be a need to contact the Innu Nation. Upon contact, these groups will be informed of the project and asked to cooperate with the SEA; their input will also be sought to ensure an acceptable approach is employed to gather and use TK for purposes of the project;
- Where groups have already developed consultation and research protocols, the team will attempt to follow the protocols that have been established.
- Following this, the communities will be contacted and provided with the opportunity to determine whether or not they wish to provide TK to the SEA;
- community members are provided with clear and accurate information about the project, the EA, the EA process, which kinds of TK may be sought, and how any TK provided may be incorporated into the EA process;
- it is prepared for unforeseen delays while communities determine their level and nature of involvement;
- translation services be provided where necessary.

The study team will ensure that principles of informed consent are employed. To accomplish this, the team will seek prior written informed consent from the community members that opt to participate in the environmental assessment process. To do so, the team will work closely with the community to:

- clearly set out how the information will be collected and how it will be used;
- clearly set out who owns the knowledge;
- provide community members with clear and accurate information about any relevant access to information legislation;
- identify the proponent of the project and any other key contact persons; and,
- identify potential benefits and possible problems associated with the research;

Access Traditional Knowledge with the support of the community

During the collection and use of TK, the team will need to ensure the community as a whole, as well as the providers of TK, are fully aware of:

- how and by whom the information will be collected;
- how and if specific community members will be paid for the provision of TK related services;
- who owns the TK (intellectual property right issues may need to be addressed);
- how the community will be acknowledged and credited with any TK that is provided to the process;
- how and when the community will be provided with any reports that incorporate their TK so that they can review it; and
- if and how the confidentiality of specific TK can be respected.
- Note: Many Aboriginal groups have developed consultation and research protocols. Where these exist, EA practitioners are encouraged to follow the protocols that have been established, as appropriate.

Collect Traditional Knowledge in collaboration with the community

There are a number of methods and techniques for collecting and documenting TK including interviews, mapping, group discussions, and during consultation efforts. The team will employ a mixture of these methods, but will ensure that they:

- work closely with the community when developing methodologies for collecting TK that respect the cultural identity of the community;
- develop TK research frameworks in collaboration with the holders of the TK;
- get community approval for research plans;
- attempt to collect TK from different segments of the population depending on age, gender, and lifestyle;
- the community should be given the opportunity to review and verify any TK that is collected;
- the community should be given the opportunity to review how TK has been used in the EA, such as in the determination of environmental effects and any proposed mitigation, follow-up and monitoring that is proposed; and
- any TK collected must also stay in the community so that the community can also benefit from the TK research.

Bring Aboriginal traditional knowledge and western knowledge together

How TK is integrated into an EA depends almost entirely on the type of knowledge that is collected. For instance, environmental information (such as TK dealing with wildlife migration patterns) can be readily integrated with other environmental knowledge. Knowledge about, or based on, values and norms is not as readily integrated with scientific data sets. Thus, the team has to collect and organize any TK that is provided, and bring to the attention of decision makers that TK has been considered and how it has been considered. In many situations, western and traditional knowledge systems will be complimentary in the insights that they can provide to the EA team, and thus they can be reconciled with one another in the EA. Where they cannot be reconciled, the team will juxtapose what is suggested by each knowledge system in their EA report, demonstrate how they have considered each in their EA, and how each type of knowledge has been considered in the EA.

The integration of TK and science can also be significantly aided by employing community members to work directly on the TK collection, review and integration. In some cases, there may be individuals who are members of the aboriginal communities and also have a science background. By drawing on the experience of such individuals, the task of collecting and processing TK and integrating it with science becomes easier.

APPENDIX G

Traditional Knowledge Minutes

Nov. 13, 2007

Interview with Inuit participant

Charlotte provided information on C-NLOPB, this SEA, Sikumiut involvement and what we were here to talk to him about. She told Mr. Dyson that during a public consultation in Goose Bay his name was put forward as a person to contact.

Here is an account of what he said:

Communities never gets help from mining, oil especially the south coast, we only go the fishery to rely on, any drilling could wipe out the crab fishery. The shrimp draggers are tearing up the crab grounds and depleting the stocks. Anything to do with oil and gas exploration I am not in favor of. Any fishermen will not be in favor of this.

Crab are a stationary fish, they are at the bottom, any drilling on their beds and they are finished. Even if there are no spills the drill holes will affect the ocean floor, there is pressure and there will be gas or oil escaping whether they are capped or not.

I am really worried about drilling on our crab grounds, also there are turbot and they are a deep water fish and a fish that stays on the bottom of the ocean, I think drilling will also kill this fish.

The area where there may be drilling the area where you are showing me, is in boundaries of where I fish for crab, I fish off Cartwright and Black Tickle, but the bottom of 54˚ 40' is in the northern area where I do fish. There are good crab grounds there. Again I would like to say that the crab lives in the bottom of the ocean**.**

November 13, 2007

Interview with Inuit participant

Charlotte gave the participant information on C-NLOPB, this SEA , Sikumiut involvement and what we were here to talk to him about. She told Mr. Morris that during a public consultation in Goose Bay his name was put forward as a person to contact.

Here is an account of what he said:

The area you are talking about is on the borderline of his fishing grounds, 54 -40 is on the border, he fishes there in different locations, but mostly near there. He fishes in what is called the Cartwright Channel. He fishes for crab, they are in a small area in what we call Parcel 2.

If drilling is done in this area close to the crab fishing , there will be problems. The crab in that area is only now starting to recover. If there is any kind of spill there would be serious consequences.

It took five years for the crab to start to recover, what would happen if there was and oil spill?

He recommends that at the next meeting there should be experts that to answer these kind of questions.

Even a small spill with the moving winds and tides the oil or gas could come to or fishing area.

Also the ice will be very dangerous.

I don’t know the effects of drilling on the environment. Also the seismic tests that are going on we are not informed, we see the ships occasionally but we don’t know what they are doing.

I would like to be informed of the next meeting.

Makkovik Nov. 15, 2007
Inuit Participant

I go north as far as Saglak, Hebron Okak Islands.

South to Tasialuk for a scatter trip. I use Jigger Island, Cape Harrison. Adlavik, down to the cabin on Lillian Islands and also to Island Harbour Bay.

Hunting: Caribou, Artic Hare, Seal, Geese and Black Duck
Fishing: Adlavik and Stag Bay for charr and cod. I also use Turnaviks and Ironbounds
The farthest islands I use Ironbounds, Bears, Ragged Islands, Turnaviks.

We berry pick to Manak's Island and Adlavik Islands

With regard to the tides and winds, when they were doing work out there before they threw cards in the water and they came ashore here so the tides and the wind would bring any oil spilled right here.
One concern I have is that this will be an adjacent resource and again there will be no Benefits to Nunatsiavut.
Another concern I have is what about an underwater blowout, how would they contain that?

Inuit Participant

I am a crab fisherman. I go south to 54-40 and there is no limit on us to go north. Some people go off of Smokey and some go between Makkovik and Hopedale.

There is shrimp off of Hopedale; there is no plant, so we have to run shrimp back to the island.

An oil spill would be my biggest concern, when you come again you should bring an expert to answer our questions, one that could talk about blowouts and oil spills. The place that is proposed for possible drilling looks like to me is right on top of the Crab grounds. There is only a small area of crab around 54-40; I can't see it proper on these maps You need charts from DFO; they have the right charts even the way points where we fish There should be a restriction on drilling where the crab is it is not a big area.

Inuit Participant

North people go up to Hebron and Okak hunting and fishing. On the southern boundary I would say we go to Smokey and Shippuk.

We hunt caribou, partridge, geese, geese and ducks. Seals (rangers) small birds like pigeons, shell birds divers and bully birds. We get eggs of the islands.

The furthest islands out that I use are Dunn's Island, Turnaviks and IronBounds. We don't berry pick so much on the islands. We do use Numuak Island for some bakeapples.

We trap also the shoreline put to the Cape (Makkovik) and up around southward a bit. Some people go north so far as Aillik and Cape Makkovik. We get polar bear on occasion off Cape Makkovik. We get caribou inland in the Burnt Lake area occasionally. We also hunt a few turrs.

Nain – Nov. 20-21, 2007.

Inuit participants (Nov. 20, 2007)

We use all of the islands; we go to House Harbor, Taber Island, and Skull Island in Inuktitut KakkitakKutok, Sandy Island-Siugalialuk, Humbies- Kikittasuak and Nukasusutok.

We hunt caribou, seals ukalik and rabbits.

We go north as far as Hebron and Saglak Bay, south we go as far as Tungajualok.
We use all of the islands for hunting and fishing. There are all kinds of animals; the ice is usually frozen to the islands. In the spring we go to Black Duck Pond. We pick bakeapples on Martin's Island. In Okak Harbor we get rhubarbs. We also go to Napatusuak.

Inuit participants (Nov. 20, 2007).

Our range of territory is north up to Saglak and Hebron and south to Voisey's Bay. We use all of the islands right up to Saglak for:

Eggs
Ducks
Berries
Caribou
Seals

The ice is not like it used to be it only forms on the inside now close to the islands. There is packed rough ice. There are a lot of cabins

We fish for artic charr, rock cod, sculpins, mussels, clams wrinkles we call them suituk, and sea urchins. Cutthroat is Tassiuk.

Our land is good for the future, we don't want no mining up there, no drilling nothing, we will lose our wildlife. We don't want any of that we want to keep our way of life and the land the way it is. Inland we hunt black bears, foxes, otter, artic fox, goose shell birds, divers, black ducks, marten, partridges, spruce partridges.

Inuit participant (Nov 21, 2007)

Our territory is right up to Hebron and Saglak in the north and south we go as far as Big Bay sometimes.

Animals	**Fish**
Fox	ittiks (sea Porcupine)
Polar bear	lake trout
Caribou	charr
Black bear	salmon
Mink	turbot
Otter	sculpins
Marten	rock cod
Partridges	scallops
White owl	clams
Eagles	shrimp
Mice	crab

Muskrat	wrinkes
Porcupine	kelp (used by fish and animals)
Walrus	whales
Shrews (animals feeding)	jumpers
	White whale migrates there
	Harps
	Hoods
	Square flipper
	Jars
	Rangers

The old people used to say there is a breeding place for walrus off the Mugfords and off of Cut Throat. You can get all of that information from "Our Footprints are everywhere" The breeding area for walrus etc. I forgot to mention other animals present:
Sparrows
Robins
Song birds
Pigeons
Bully birds
Turrs
Geese
Black duck
Harlequin ducks, these are endangered, when the migrate south they go outside Marshall Island. Out in the Dog area. There used to be a whole lot of harlequins, they would go right over the offshore area during their migration south. When they come here north they go on the inside lands and islands. You can still see a lot sometimes especially when they are going south.

Inuit participant –Nov 21, 2007

North I go as far as the Mugfords and south to Tungauluk- Spraklins Island. There are scallops around Shoal Tickle.

We go duck hunting in the Spraklin's and House Harbor area. We hunt geese, seal, ukalik, caribou, and partridges. Around the Mugfords we get caribou, ukaliks, ducks we go Tikkatsuk for black ducks.

We get charr, salmon, mussels, clams. We go berry picking for bakeapples on Dog Island.

Postville- Nov. 14, 2007

Inuit Participant

Most people form Postville use the land south as far as Cape Harrison and North as far as Kanitok Bay, some people go further north on skidoo.

There are a lot of icebergs in the summer off of here, there is always ice out there in the winter there is a lot of slob ice.

Patrix is the island that we use furthest out it is used for goose hunting. We use the islands out there for eider ducks and geese. On the shore we get foxes, wolves, caribou and trapping marten, mink and otter.

There are polar bear, ukaliks, seals, trout, divers codfish on the outside islands.

What you need is a marine chart, it would be better. The crab are on the bottom.

We need observers for the drill rigs.

Inuit Participant

We go to the Turnaviks both the east and west Turnaviks. Antone's Island is used for birds. We use the Bays like Island Harbor Bay, Salt Water Pond, Mark's Bight, Kaipakok Bay right to Long Island. Birds include: geese, ducks, black ducks eider ducks turrs (sometimes). We use the Cape outside Kaipokok Bay we hunts right up to the run.

Trapping is in the bay and English River and English River Pond. Animals: marten, otter, lynx, mink ukalik and foxes.

Fishing: cod, rock cod fishing in the bay, charr and salmon around the bay, we go rodding up in the rapids, just behind Postville is Libby's Pond we use that for rodding.

We also get jumpers and go egging on the islands, we get ducks eggs and gulls eggs. Birds includes pigeons, and shell birds around the bay.

We go north from Postville to Tikkeratsuk and south to Cape Makkovik for hunting and fishing.

Kaipakok Bay freezes around New Year's (the upper bay December 1) We can go on skidoo in mid January on the bay. The outside ice is later we don't go anywhere on the outside untl in February., we go across the land say to Hopedale until then.

There are icebergs all along the Northern Labrador coast. In the summertime there are icebergs all summer even outside the Turnaviks. We go to Cape Aillik and North towards Antone's Island.

We hunt seals, bedlamers, jars, harps and in the spring we hunt jars on the ice in April.

Inuit Participant

The northern boundaries here is Tikkeratsuk and south off the Gull or Cape. We go fishing off Makkovik Sisters, Bar Harbor and Aillik. Fishing for cod

Hunting birds. We use the East and West Turnaviks for hunting and fishing

Islands we use: Black Island, Puncheon Island, Pigeon Islands.

We use Aillik and all of the islands for egging, we go north as far as Antone's Island. At Island Harbor Bay we hunt everything, Lillie's Island partridges and birds we go far as Tikkeratsuk.

We go sealing in the spring. The condition of the ice out there is hard to say, not good to go on way out there. There are icebergs off the Turnaviks. Up in the bay we hunts. Patrix Island is the furthest out we go.

Inuit Participant

We for fishing for cod out to Aillik. We go duck hinting in Tikkeratsuk, Horse Rocks past the Turnaviks and up to Cape Makkovik.

I'd rather they drill for oil that mine the uranium, we should go for drilling there may be jobs there.

About 60 miles off shore there is open water, clear of drift ice. I don't think a drill rig would have much trouble with ice out there, shore they goes to Voisey's Bay in the winter.

I don't do any trapping.

Inuit Participant

Around here some of our traditional hunting out around the outer islands is goose hunting, egging, hunting artic hare.   We for seal hunting on the bay in the fall.

We go hunting black ducks, eider ducks, we use the islands for berry picking, black berries red berries and bakeapples.

We use the west Turnaviks, Duck Island, Big Island , any of the bigger islands out there.

We cod fish around the Horse Rocks and the Aillik Banks.

Just like the cod fish is coming back, we even caught cod around up here this summer.

I would be concerned about he spills if there was drilling.

Rigolet

Inuit Participant December 10, 2007

I go north as far as Smokey that is the area I hunt in. To the south is more my traditional territory, we go south as far as Cape Porcupine.

North they used to fish around the islands around Smokey.

We go duck hunting for divers, eider ducks, geese and black ducks that is both north and south, but I go south of Rigolet mostly. I have a cabin in Cuff Harbor.

In the West bay, Fish Cove area we fish for salmon, charr, trout. We pick berries bakeapples mostly in that area.

In what we call George's Bight inside the West Bay area is a breeding area for ducks and geese. In Snook's Cove there are lots of geese and birds and is a good place for seals like rangers, jars, harps, square flipper and uppers. The uppers are on the rocks around Snook's Cove.

We also go seal hunting on Lake Melville in the spring.

The Gannets are an ecological site for birds, this is a bird sanctuary.

We use the East and West Stags, and the Emmett Islands that is about as far out as we go. Tumbledown Dick used to be a fishing place. George's Island has a herd of caribou from the endangered Mealy Mountain Herd. George's Island was once a fishing place, but since the cod left there are not many people using it.

There is a graveyard on Tub Harbor and another one to Fish Cove at Nexus.

We also trap for marten and fox up and down the Strand.

There are cabins at Flat Water Brook. Indian Islands used to be good for fishing now it is a hunting area for ducks and geese.

Broomfield's Head used to be a Military site, around the Sandy Cove area too, you can still see lots of shells and tracks of equipment that used to be there.

Inuit Participant December 11, 2007

We go north as far as Big Brook that is where my mother is from. We go south as far as Flat Waters. I have been as far as Hopedale to hunt caribou, but that was only one year.

The Islands that are the farthest out that we use are Smokey, Cut Throat. We hunt ukaliks, seals. I don't use the area for fishing, once it was the best fishing grounds in Eastern Canada but it got fished out.

Now we go berry picking north and hunting geese and ducks mostly.

We use Lake Melville a lot for fishing, things like trout and smelts and salmon. We seal hunt up there too mostly for jar seals. Valley's Bight on my father's land is where we hunt geese and ducks, do a bit of ice fishing and fishing by nets. Valley's Bight is good for trapping, lynx, fox, marten, otter and seal hunting. Good for partridge hunting, both white and spruce partridge.

On the south side of Groswater Bay we pick bakeapples and fish for charr, we fish for charr around Kunnocks Cove, around the Cranford Head area.

Another area that is used a lot by the Rigolet people in Lake Melville is English River, that area is where there is hunting, fishing and trapping. All kinds of animals native to Labrador.

Back Bay and Double Mer are also areas where there is a lot of use by Rigolet people, there is all the traditional activities taking place there. It is very valuable areas to the Rigolet people. We use these areas more that the outside lands and waters.

Inuit Participant

December 11, 2007

The area I use is as far mostly as Smokey, I do sometimes go to Shippuk, and Big Brook around that area. On the south side I go as far as Indian Islands. On the south side too Plants /bight is good for geese. Broomfield's Head is good bakeapple picking grounds. Goose Brook and Tom Luscombe Brook is a fall staging area for geese. This is where the geese stop and rest on their way south in the fall and on their way north in the spring. Double Mer too is a place where geese stop to rest. Out around Smokey we hunt around Cut Throat, Indian Harbor, Pigeon Islands, out around Holton and Big Island off Winter's Cove, Little Holton is good for rangers. McKenzie's Bight is good for geese, Fox Island has a cabin. Rattler's Bight got cabins, Winter's Cove got cabins and there are more cabins around Smokey.

Valley's Bight up in Lake Melville is good for geese and we trap there. We hunt geese, black ducks, and divers up there.

All around Smokey is good hunting right from Smokey to Shippuk is good for eiders it is an eider nesting area. Also around Mason's Island is a nesting area for eiders, up around Jimmy Gil's Tickle. There is also a nesting area for harlequin ducks around Halfway Brook on the north side.

The animals we hunt are: porcupine, foxes, ukaliks, marten, polar bears, black bears, muskrat, beaver, otter, rabbits, partridges and caribou. The fish we fish for are: trout, cod , capelin, salmon (this is number one for Rigolet) charr, scallop, clams, mussels, rock cod, smelts, seals on the bay in the spring and in the water other times. Seals include jars, rangers, uppers, square flipper, harps and bedlamers. Some people hunt jumpers (dolphins)

The Rigolet people use the area around Smokey, and go right out to Shippuk and Big Brook. I went as far as Nutak and Okak myself hunting caribou. That is not a regular thing but on occasion if there are no caribou around closer I will go north to hunt them. On the south side of things we go as far as West Bay mostly. We also have Lake Melville that is important to us. I would say we the Rigolet Inuit use Lake Melville mostly from Charlie's Point on the north side to Frenchmen's Point on the south side.

We would mostly use the farthest island on the north side of the bay if the codfish ever came back, the islands closer to land around Smokey is used mostly to hunt for geese in the fall and for berry picking in the summer.

Natuashish- December 5th, 2007

Innu Participant

Hunted as far as Nutak and around Okak Islands, hunted caribou, partridge, ducks and seals. Hunted and trapped starting from Okak Bay then following the rivers south like Tassiuyak then along Webb's Bay.

We used this area for fishing cod fish.

Trapped and hunting in land from Okak Islands as far south of Adlatok Bay. We used Mistastin Lake and Border Beacon for hunting caribou twice a year. Used to hunt and trap animals along Naskuapi River, Nipishish Lake, Snegamook Lake, Mistinippi Lake and Shapio Lake. Animals such as Caribou, foxes, otter, marten.

Islands from Voisey's Bay to Big Bay - hunting seals, ducks and gull eggs. A lot of food in this area.

Kaipokok River- alot of Kukumesh. A lot of porcupine in Ashuanipu River.

Harp Lake was never a place for Innu people go hunting or trapping- hills too high and steep. North of Torngat Mountains for caribou hunting. A lot of geese in between Harp Lake and Adlatok River.

Innu Participants

We used Mistatin Lake and Border Beacon for hunting caribou twice a year. A lot of good food in the country.

Still a lot of bakeapples in marshes, can almost find them in any marsh. We go bakeapple picking around Shango Bay. We also picked black berries for jam on "Big Island".

In August month, we go egging to the islands along the coast. We always left a some eggs behind in each nest for the eggs to hatch.

A lot of seals in Davis Inlet, must be a lot of food on the bottom for the seals to be around.

June month- opening of ice, everything starts moving in the shoreline.

A lot of White hare on islands from Nain to Davis Inlet.

Cod fish no longer around all fished out. Fishing boats might be some of the reason for lower numbers

I think the drill rigs will stop the fish so far and then die off. But we don't know what would happen, they (Government?????) told us that they would stop that from happening.

Innu Participant

A lot of Innu people hunted and trapped inland for survival back in the old days. We used to hunt as far as Nain mainly in around Voisey's Bay area. Didn't go as far as Hebron.

Any rivers were used for camping while we hunted for animals, such as caribou, fish.

Never went to Harp Lake for trapping or hunting.

Ice- Ice freezes almost everywhere in the Winter around here. Innu people never lived near salt water, always in wooded areas. Caribou hunting in Border Beacon and Mistastin Lake and sometimes near Fort Chimo. Innuit people also hunted around Voisey's Bay and inland from Natuashish.

Egging on islands on the coast line from Nain to Flowers Bay.

Picked berries such as bakeapples and blackberries anywhere you can find a marsh,

I hope we don't lose any of our traditional foods if this drilling goes ahead

Innu Participants

Hunted inland for caribou, partridges and foxes for food around Torngat Mountain area. Nain to Postville. Not a lot of other animals area. Beavers- we used to trap Beaver, if we seen any signs around.

Nothing is ever wasted. what we hunted, we eat.

Bakeapple picking in marshes anywhere.

Martens are very rare now. Maybe it's from all the forest fires. Porcupines are also starting to be rare.

Fished Tamakat near Shango Bay and also fished in Voisey's Bay.

We also eat Black Bears in the country.

Ice frozen all over inland.