9.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Section 19(1)(h) of CEAA, 2012 requires consideration of "any change to the designated project that may be caused by the environment". This section considers how local environmental conditions and natural hazards (*e.g.*, extreme weather) could adversely affect the Project and thus result in impacts to the environment (*e.g.*, accidental events). Potential effects of the environment on a project are typically a function of project design and environmental conditions that could affect the project. These effects are generally mitigated through engineering design, industry standards, and environmental monitoring.

Aspects of the environment that could potentially affect the Project include:

- fog
- sea ice and superstructure icing
- seismic events and tsunamis
- extreme weather conditions
- sediment and seafloor stability

9.1 RESIDUAL ENVIRONMENTAL EFFECTS RATING CRITERIA

A **significant adverse residual environmental effect** of the environment on the Project is defined as one that results in one or more of the following:

- damage to the Project infrastructure resulting in harm to Project workers or the public
- a substantial impact to the Project schedule delaying ongoing Project activities by one season or resulting in a shutdown of drilling operations for three months or more, or
- damage to the Project infrastructure resulting in repairs that cannot be technically or economically implemented

9.2 ENVIRONMENTAL CONSIDERATIONS

9.2.1 Fog

Fog, a major cause of low visibility at sea, is reported on the Scotian Shelf approximately 35% of days (65% of days in July), resulting in a visibility less than 1 km (Hurley 2011). Sea fog or advection fog forms when warm, moist air moves over colder seawater and as the air cools below its saturation point, excess moisture condenses to form fog. Sea fog can cover large areas and persist for long periods as long as a continuous supply of warm moist air is available (DFO 2012c). Sea smoke or evaporation fog forms when cold air moves over warmer seawater (DFO

2012c). Additional climate data is provided in Section 5.1.2, including historical visibility data from the Sable Island Weather Station (refer to Section 5.1.2.5).

Poor visibility most often affects supply and personnel movement to and from the MODU, as OSV transiting and helicopter transportation to the MODU may be hindered in foggy conditions. Based on consideration of historical visibility data from the Sable Island Weather Station (refer to Table 5.1.8), and implementation of standard operating procedures for safe OSV and helicopter operations, fog is not likely to result in a significant effect of the environment on the Project.

9.2.2 Extreme Weather Conditions

Average wind speeds on the Scotia Shelf range from 17.5 to 31.5 km/hour in September and January, respectively, with sustained wind speeds of 130 km/hour during severe storm events (Stantec 2013). In late summer and fall, hurricanes and tropical storms that travel up the eastern coast of North America occasionally reach the Scotian Shelf. Further environmental information, including general and extreme climate and weather data used for the purposes of this analysis, are included in Section 5.1.2 of the EIS. Paths of storms originating in the tropics that have tracked through Atlantic Canada between 2009 and 2011 are illustrated in Figures 5.1.10 to 5.1.12 (Section 5.1.2.4).

In 2012, five tropical cyclones entered the Canadian Hurricane Centre (CHC) Response Zone, with two of those storms staying on the very edge of the zone (Post-tropical Storm Chris, along the southeastern Grand Banks on June 22, 2012, and Post-tropical Storm Rafael, along the southern fringe of the Grand Banks on October 18, 2012) and one (Tropical Storm Michael) transitioning to a post-tropical storm over the extreme southeastern portion of the Response Zone. The CHC issued bulletins on all storms except Michael. Hurricanes Leslie and Sandy made landfall. Hurricane Leslie struck Newfoundland as a post-tropical storm on September 11, 2012. Hurricane Sandy made landfall in New Jersey, with the effects of Post-tropical Storm Sandy affecting southern Ontario and other parts of Eastern Canada on October 29 and 30, 2012 (Environment Canada 2013b). Table 5.1.6 lists all of the tropical cyclones which have entered the Scotian Shelf or Slope region from 2003–2013. Section 5.1.3 provides data on average and extreme wind and waves in the Project Area.

The sea state (high wave conditions) could limit loading and offloading of cargo to the offshore drilling rig. In the unlikely event of a spill, it could also potentially affect spill response operations, including the availability and effectiveness of response methods. Consideration has been given to limitations and delays due to weather and sea state in the estimation of the maximum timeline for response to accidental events (*i.e.*, 21 days) detailed in Section 8.1.

Extreme wind and wave conditions could result in accidental spills, suspension/delay of Project activities, evacuation of the MODU, and in extreme cases (such as the 1982 sinking of the Ocean Ranger offshore Newfoundland) loss of life. During a fierce winter storm, the ingress of sea water into the ballast room of the Ocean Ranger platform ultimately led to the evacuation and sinking of the rig and the loss of all 84 crew members. The Ocean Ranger tragedy resulted in significant improvements for the Canadian offshore petroleum industry, including the

establishment of the offshore petroleum boards, and more rigorous requirements around safety training, equipment and inspection.

The local metocean conditions will be a primary consideration when planning drilling activities and supporting logistics (helicopter travel, movement of supplies and personnel), and in the unlikely event of an incident where emergency response or spill response is required.

Mitigation to reduce risks associated with operating in extreme weather is discussed in Section 9.3.

9.2.3 Sea Ice and Superstructure Icing

Sea ice in the offshore Scotian Shelf and Slope area is very rare, and will likely dissipate and melt before reaching the Project Area. Sea ice is therefore not considered to be a factor affecting Project operations. Further information on which this assumption is based, as well as figures depicting the maximum extent of median sea ice coverage from 1981–2010 and the maximum sea ice coverage, are shown in Section 5.1.3.5 (Figures 5.1.26 and 5.1.27).

Although ice is not considered an important factor affecting Project operations, vessels operating in late fall and winter are likely to experience some degree of topside icing. Accumulation of ice on the MODU, sometimes referred to as "superstructure icing" can result from freshwater moisture such as fog, freezing rain, drizzle and wet snow, or from salt water associated with freezing spray or wave wash. Freezing spray is the most common cause of icing and occurs when the air temperature falls below the freezing temperature of sea water and when sea surface temperatures drop below 6 °C (DFO 2012c). Freezing spray is more frequent and severe in coastal waters off eastern Canada. Ice accretion rates from freezing spray can exceed 2 cm/hour and ice build-up of over 25 cm is not uncommon (DFO 2012c).

Smaller vessels (including OSVs) are most at risk from spray icing as they are exposed to more spray and lose stability more rapidly than larger vessels (DFO 2012c). The accumulation of ice on a ship's superstructure can raise the centre of gravity, lower the speed and cause difficulty in maneuvering. It can also create problems with cargo handling equipment (DFO 2012c). Superstructure icing can cause delays while operations are slowed or suspended and ice accumulation is avoided or removed.

Although freezing spray warnings are included in marine forecasts by Environment Canada, these forecasts generally provide a guide to possible icing conditions; ice accumulation rates depend substantially on individual vessel characteristics. Section 9.3 discusses mitigation to reduce effects of sea ice and superstructure icing on OSVs and the MODU.

9.2.4 Seismic Events and Tsunamis

The Scotian Shelf is an area of known seismic activity with recorded earthquakes, and fault zones occurring on the Shelf. While the area is seismically active (Figure 9.2.1), events tend to be of a low magnitude (Table 9.2.1). Given the short duration of exploration activities the probability of a major seismic event occurring during an exploration drilling program is low. There have been seven earthquakes recorded from 1985 to present in the Nova Scotia offshore area. There were two earthquakes within the RAA with a magnitude higher than four occurring on April 12, 2012. One earthquake occurred at 2:30 am with a magnitude of 4.4 ML and the second at 4:30 am with a magnitude of 4.1 ML.

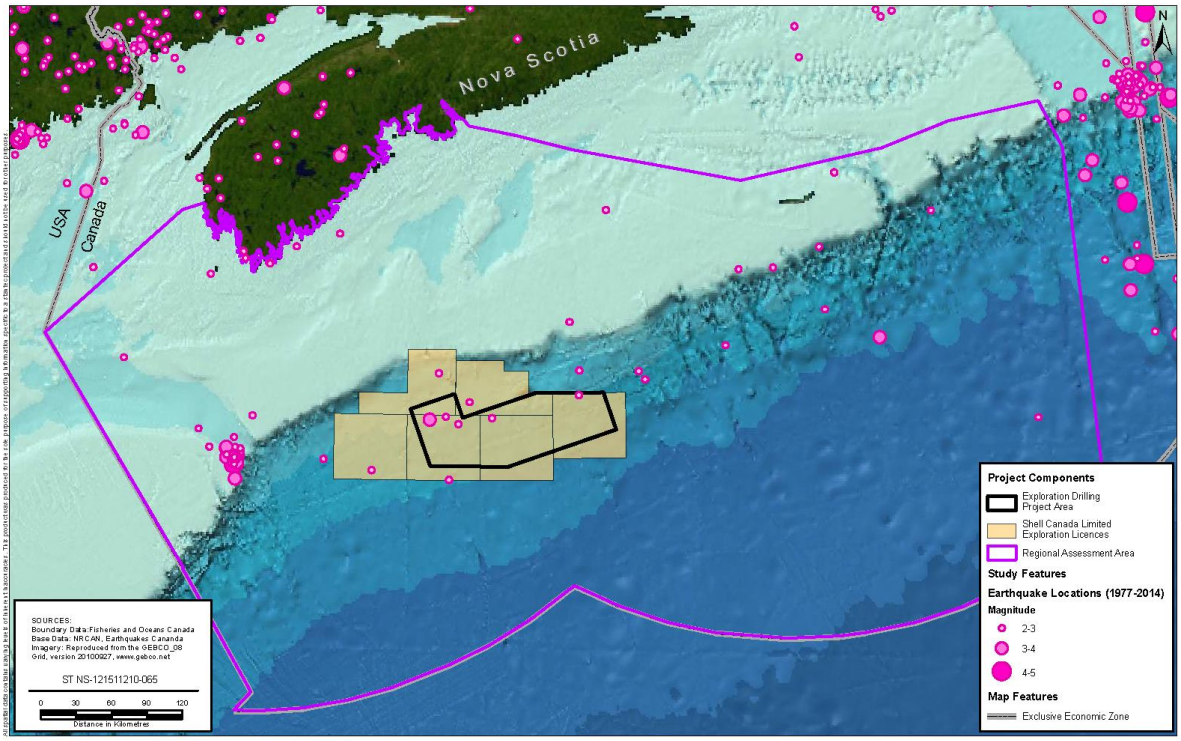

Figure 9.2.1 Earthquakes in or near Nova Scotia, Canada 1977–2013

Table 9.2.1 Earthquakes Recorded within the Project Area, 1985 to Present

Date	Time (UTC)	Latitude	Longitude	Depth	Magnitude	Region
2011/11/16	23:53:35	42.315000	-63.597000	18.0 g	2.1 ML	Offshore Nova Scotia
2010/12/10	00:23:20	42.293000	-63.762000	18.0 g	3.2 MN	Offshore Nova Scotia
2009/10/01	03:20:49	42.306000	-63.121000	18.0 g	2.2 ML	Offshore Nova Scotia
2008/11/03	15:34:35	42.261000	-63.470000	18.0 g	2.9 ML	Offshore Nova Scotia
1992/08/27	01:47:37	42.479000	-62.225000	18.0 g	2.6 MN	Offshore Nova Scotia

g = depth fixed by seismologist
MN = Nuttli magnitude (developed to measure seisms of Eastern Canada)
ML = Local magnitude (associated with the Richter scale)

Source: Earthquakes Canada 2013

There is a low likelihood of tsunamis occurring on the Scotian Slope and, as a result of the relatively short period of the exploration drilling program, it is unlikely that a tsunami would occur during the life of the Project.

Tsunamis are produced by earthquakes, volcanic island explosions and submarine landslides (as well as explosions or the impact of cosmic bodies such as meteorites). They are long, surface gravity waves with amplitudes usually less than 2 m in height in the open ocean. Tsunamis can travel at speeds of approximately 750 km/hour in the open ocean (4500 m deep), slowing down (approximately 350 km/hour in 1000 m water depth) and gaining wave height as it travels into shallower water (NOAA 2009). With the small wave height in the open ocean, and long period of the waves, tsunamis would not be expected to be an issue for an offshore drilling operation.

9.2.5 Sediment and Seafloor Stability

Sediment scour, liquefaction of sediments from seismic events, and slope failure on the seafloor are geohazards that could adversely affect exploration drilling activities (Stantec 2014). The Northeast Channel west of the Project Area is considered to be a route of active sediment transport, feeding a shelf-break sediment fan onto the Western Scotian Slope (WWF 2009); however, this is not expected to affect the Project Area. The peak ground acceleration for the Study Area is estimated to be approximately 0.2 g to 0.3 g based on the Geological Survey of Canada (GSC), for a probability of exceedance of 2% in 50 years (GSC 2010). Canyons (*e.g.*, Dawson and Verrill Canyons east of the Project Area) present along the shelf break represent possible areas of slope instability as they create steep banks, and provide avenues for sediment transport between the Shelf and the Slope into the deep ocean (Stantec 2013). Avoidance of geohazards associated with sediment and seafloor instability is critical to the success of drilling programs and to reduce the risk of accidental events. Sediment and seafloor stability are not expected to result in significant adverse effects on the Project, particularly since the MODU will use a DP system for positioning rather than footings on the seafloor. Shell will conduct a seabed survey in the Project Area in 2014 and any evidence of sediment scour or seafloor instability will be noted and incorporated into Project planning and design as appropriate.

9.3 MITIGATION

The primary means of mitigating effects of the environment on the Project is through detailed engineering, design, compliance with industry codes of practice, and avoidance of environmental hazards where possible.

Fog, Extreme Weather Conditions and Superstructure Icing

The implementation of standard operating procedures, such as reducing vessel or helicopter speed and/or adjusting flight altitude, using appropriate sound and/or light signals, and relying on radar and navigation equipment as appropriate, will help OSVs and helicopters to navigate safely during foggy conditions.

Engineering design for the Project will adhere to national/international standards, which document the proper engineering design for site-specific normal and extreme physical environmental conditions. Such standards are expected to mitigate potential impacts from extreme weather conditions and superstructure icing.

The MODU selected for this Project will be an all-weather drill ship or semi-submersible that is designed to operate in harsh, deepwater environments. Some of these engineered designs include cranes which can operate to -30 °C, anti-icing anchors, deck piping, lifeboats, rafts, escape exits, and drains. De-icing systems on open decks, gangways, stairs, hand railing, and piping have also been designed to allow for work in cold environments. The MODU will also be designed to have additional insulation for bulkheads and deck areas exposed to weather. Steam heating coils will be placed in ballast and drill water tanks to prevent freezing. Enhanced environmental protection for workers from wind, sea spray, and precipitation are also installed in the form of wind walls and cladding around the drill floor and other areas of intense work.

Modern drill ships and rigs have the capability to operate in sea states of 6–7 m and have the capability to disconnect the riser from the well in very short periods of should sea heights pose dangers to the stability of the stringer or wellhead.

As part of the CNSOPB authorizations required to conduct the drilling program, Shell will obtain a Certificate of Fitness from an independent third party Certifying Authority for the MODU prior to commencement of drilling operations in accordance with the *Nova Scotia Offshore Certificate of Fitness Regulations*. The Certifying Authority reviews installations to ensure they are fit for purpose, function as intended and meet the requirements of the regulations.

The OSVs selected for this Project will similarly be equipped for safe all-weather operations. Measures to reduce icing hazards on OSVs may include (DFO 2012c):

- slowing down in heavy seas to reduce bow pounding
- placing gear below deck and covering deck machinery, if possible
- moving objects to prevent water drainage from the deck
- making the ship as watertight as possible
- manual removal of ice if required under severe icing conditions

OSVs will undergo Shell's internal audit process as well as additional external inspections/audits inclusive of the CNSOPB pre-authorization inspection process in preparation for the Project.

Icing conditions and accumulation rates on OSVs, helicopters, and the MODU will be monitored during fall and winter operations, particularly when gale-force winds may be combined with air temperatures below -2 °C (DFO 2012c). In addition, the observation, forecasting and reporting of physical environment data will be conducted in accordance with the *Offshore Physical Environment Guidelines* (NEB *et al.* 2008) to promote the safe and prudent conduct of routine operations and emergency response. Marine weather forecasts and warnings are issued for

Canadian marine areas by Environment Canada from regional Storm Prediction Centres. For waters off Nova Scotia, 24-hour services in the form of forecasts, consultation and warnings are provided by the Maritimes Storm Prediction Centre. Storm Prediction Centres generally issue four scheduled forecasts each day for their area of responsibility (DFO 2012c). As such, OSVs, helicopters, and the MODU will be forewarned of inclement weather before it poses a risk to their activities and operations. Extreme weather conditions that are outside the operating envelope of OSVs or helicopters will be avoided if necessary. Pilots will have the authority and obligation to suspend or modify operations in case of adverse weather that compromises the safety of OSV, helicopter, or MODU operations.

Sediment and Seafloor Stability

A seabed survey will be conducted in the Project Area in 2014 to identify potential geohazards (*e.g.*, sediment scour, liquefaction of sediments from seismic events, shallow gas pockets, and slope failure) that could be present in the vicinity of proposed drilling sites and therefore require avoidance and/or special consideration in Project planning.

9.4 RESIDUAL EFFECTS SUMMARY

The key environmental factors that may affect the Project include reduced visibility and high winds and waves. However, engineering design, operational procedures, and other mitigation measures discussed above will reduce the potential effects on and risks to the Project. Potential effects from sea ice, seismic activity and tsunamis, and sediment and seafloor stability are unlikely given their low probabilities of occurrence, the distance offshore and water depths at which Project activities and components will be located, the limited duration of offshore activities (*i.e.*, approximately 130 days to drill each individual well over the four-year period), and the absence of fixed offshore infrastructure. Extreme weather conditions and superstructure icing are also unlikely to adversely affect the Project given that the MODU is designed for harsh weather conditions, meteorological conditions will be monitored, and stop-work procedures would be implemented should conditions become unsafe.

In consideration of the implementation of appropriate engineering design standards, operational procedures, and adherence to the *Offshore Physical Environment Guidelines*, the effects of the physical environment on the Project are predicted to be not significant.

10.0 CUMULATIVE ENVIRONMENTAL EFFECTS

In addition to assessing Project-specific environmental effects, section 19(1)(a) of CEAA, 2012 requires that the EA of a designated project consider "any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out".

This chapter of the EIS identifies past, present, and certain or reasonably foreseeable future physical activities (*i.e.*, projects or activities) with residual environmental effects that could interact cumulatively with the residual environmental effects of the Project, and assesses the significance of the associated potential cumulative environmental effects on the affected VCs.

10.1 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT SCOPE AND METHODS

The CEA Agency's (2013b) Operational Policy Statement (OPS), *Assessing Cumulative Environmental Effects Under the Canadian Environmental Assessment Act, 2012* and the guidance document entitled *Cumulative Effects Assessment Practitioners' Guide* (Hegmann *et al*. 1999) were taken into consideration during development of the cumulative environmental effects assessment scope and methods for this EIS.

10.1.1 Scoping the Assessment

Scoping the assessment of cumulative environmental effects involves selecting the VCs on which to focus the assessment; defining the spatial and temporal boundaries of the assessment; identifying other past, present, and future (*i.e.*, certain or reasonably foreseeable) physical activities in the RAA where residual environmental effects have potential to overlap spatially and temporally with those of the Project; and establishing criteria for determining the significance of residual cumulative environmental effects.

10.1.1.1 Valued Components

The assessment of cumulative environmental effects considers all six of the VCs for which Project-related environmental effects were assessed, as residual environmental effects were predicted for each VC (refer to Section 7). These six VCs are:

- Fish and Fish Habitat
- Marine Mammals and Sea Turtles
- Marine Birds
- Special Areas
- Commercial Fisheries
- Current Aboriginal Use of Lands and Resources for Traditional Purposes

10.1.1.2 Spatial and Temporal Boundaries

The OPS (CEA Agency 2013b) requires determination of spatial and temporal boundaries for the assessment of cumulative environmental effects. In particular, the OPS suggests that spatial boundaries encompass potential environmental effects on the selected VC of the designated project in combination with other physical activities that have been or will be carried out. Temporal boundaries should take into account future physical activities that are certain or reasonably foreseeable, and the degree to which the environmental effects of these physical activities will overlap those predicted from the designated project.

The specific spatial and temporal boundaries that are presented for each VC in the respective VC analysis chapter in Section 7 have also been applied to the assessment of cumulative environmental effects for each VC in Section 10.2, including the Project Area, LAA and RAA as illustrated on Figure 10.1.1. The definition of the RAA is particularly relevant with respect to the assessment of cumulative environmental effects and is therefore repeated here for ease of reference. The RAA is larger than the spatial boundaries for Project-related effects in order to encompass the other physical activities outside of the Project Area and LAA that have potential to interact cumulatively with the Project (refer to Section 10.1.1.3).

Regional Assessment Area (RAA): The RAA is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present, and future (*i.e.*, certain or reasonably foreseeable) physical activities. The RAA is restricted to the 200 nautical mile limit of Canada's EEZ, including offshore marine waters of the Scotian Shelf and Slope within Canadian jurisdiction. The western extent of the RAA encompasses the Georges Bank Oil and Gas Moratorium Area and terminates at the international maritime boundary between Canada and the United States. The eastern extent of the RAA encompasses the Gully MPA and terminates at the eastern edge of Banquereau Bank. A portion of the Scotian Shelf and the Nova Scotia coastline to the Bay of Fundy is also included as part of the RAA boundary. The RAA is consistent for all VCs and is depicted on Figure 10.1.1.

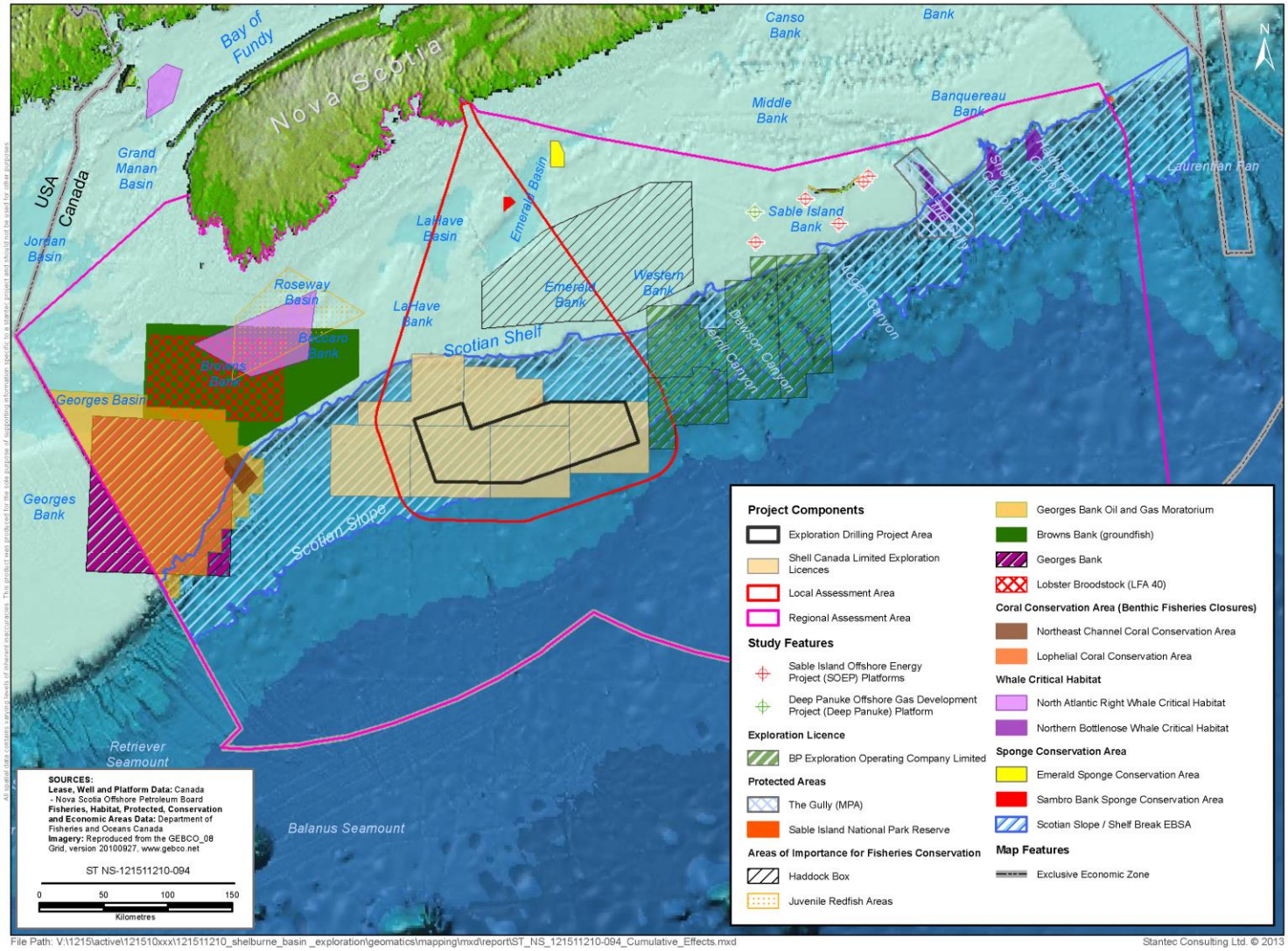

Figure 10.1.1 Assessment Boundaries for Cumulative Environmental Effects

10.1.1.3 Other Physical Activities

In accordance with the OPS (CEA Agency 2013b), the cumulative environmental effects assessment includes consideration of other physical activities that have been, are being, and will be carried out in the RAA. With respect to future physical activities that will be carried out, the assessment considers (CEAA Agency 2013b):

- future physical activities that are certain (*i.e.*, the physical activity will proceed or there is a high probability that the physical activity will proceed – *e.g.*, the proponent has received the necessary authorizations or is in the process of obtaining those authorizations)

- future physical activities that are reasonably foreseeable (*i.e.*, the physical activity is expected to proceed – *e.g.*, the proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed)

Table 10.1.1 identifies the past, present, and future (*i.e.*, certain or reasonably foreseeable) physical activities within the RAA that have potential to cause residual environmental effects that overlap spatially and temporally with the residual environmental effects of the Project. Refer to Section 5.3 of this EIS for descriptions of these physical activities and where they are located within the RAA.

Table 10.1.1 Other Physical Activities

Past and Present Physical Activities	Future Physical Activities
• Offshore gas development projects on the Scotian Shelf (*i.e.*, SOEP and Deep Panuke) • Commercial, Aboriginal and Recreational Fisheries • Other ocean users, such as those conducting shipping, scientific research, and military activities • BP's proposed Tangier 3D Seismic Survey (first phase of seismic program to be carried out April–November 2014)	• BP's proposed Tangier 3D Seismic Survey (second phase of seismic program to be carried out April–November 2015)

The physical activities listed in Table 10.1.1 are included in the scope of the cumulative environmental effects assessment as applicable with respect to each VC (*i.e.*, where there is potential for a residual environmental effect of the Project to interact cumulatively with a residual environmental effect of another physical activity on the VC; refer to Section 10.1.2.2).

Depending on the results of the Tangier 3D Seismic Survey, BP could potentially begin drilling as early as 2017 (Mellor 2014). The potential for drilling and the associated timeline remain highly speculative, however, given that the results of the Tangier 3D Seismic Survey are yet to be determined and BP has not publicly disclosed its intention to seek the necessary EA or other authorizations to proceed with drilling; therefore, the potential BP drilling program does not constitute a "certain" or "reasonably foreseeable" future physical activity as defined in the OPS

(CEA Agency 2013b). Potential BP drilling activities have been excluded from the scope of the cumulative environmental effects assessment, as the limited information that is currently available regarding the timing and details of BP's potential activities is insufficient to support such an assessment. An EA will be required if/when BP seeks the necessary authorizations to proceed with drilling and further information is known about the project. It is expected that the EA conducted at that time would consider potential cumulative environmental interactions with the Shelburne Basin Venture Exploration Drilling Project, if applicable.

10.1.1.4 Criteria for Determining Significance of Residual Cumulative Environmental Effects

Rating criteria are specifically defined for each VC to provide the threshold for determining the significance of residual adverse environmental effects.

The specific criteria for determining the significance of residual environmental effects that have been applied to the VCs in Section 7 are also applied to determine the significance of residual cumulative environmental effects for each VC in Section 10.2.

10.1.2 Cumulative Environmental Effects Assessment Methodology

Following the scoping of the assessment, the cumulative environmental effects assessment is carried out in three stages: (1) establishing context for the cumulative effects; (2) determining if Project-specific environmental effects interact in space and time with the environmental effects of other physical activities; and (3) assessing the cumulative environmental effects and the Project's contribution to them.

10.1.2.1 Establishing Context for Cumulative Environmental Effects

Existing environmental conditions for the marine physical environment, marine biological environment, and socio-economic environment in the RAA have been, and continue to be, shaped by the cumulative environmental effects of historical physical activities previously carried out in the RAA and ongoing physical activities currently being carried out in the RAA. Likewise, future physical activities in the RAA will influence future environmental conditions in the RAA. Section 5 describes existing conditions in the RAA to characterize the setting for the Project, support an understanding of the receiving environment, and provide sufficient context to enable an understanding of how current environmental conditions might be affected by the Project in combination with other past, present, and future physical activities within the RAA.

It is assumed that the existing status or conditions of each VC reflect the influence of other past and present physical activities within the RAA. Section 10.2.1 provides a brief overview of how the environmental effects of various physical activities in the RAA have affected, are affecting, or are anticipated to affect each VC, independently of the residual environmental effects that will be contributed by the Project. This information establishes context to support the assessment of cumulative environmental effects.

10.1.2.2 Determination of Potential Cumulative Interactions

The following two considerations with respect to each VC are used as criteria to determine whether the Project has potential to interact with another physical activity in such a way that contributes to a cumulative environmental effect:

1) Whether the Project could result in a demonstrable or measurable residual environmental effect on the VC
2) Whether the residual environmental effect of the Project is likely to act in a cumulative fashion with the residual environmental effect of another past, present, or future physical activity (*e.g.*, whether the residual environmental effects of the Project and the other physical activity are likely to overlap spatially and temporally)

An assessment of cumulative environmental effects is not warranted for any given VC unless both of the above criteria are satisfied.

10.1.2.3 Assessment of Cumulative Environmental Effects

When the two criteria in Section 10.1.2.2 above are met for a VC, the assessment of cumulative environmental effects considers how the residual environmental effects of the Project may contribute to changes to the VC from the residual environmental effects of other past, present, or future physical activities.

The potential for residual environmental effects from the Project to cause a change in cumulative environmental effects that could affect the quality or sustainability of the VC is evaluated. The evaluation considers the context for cumulative environmental effects in the RAA, the nature and extent of the potential cumulative interactions, and the planned implementation of mitigation.

Residual cumulative environmental effects are characterized through application of the specific analysis criteria (*i.e.*, magnitude, geographic extent, duration, frequency, reversibility, and context) defined for each VC in its respective VC analysis chapter in Section 7. The significance of potential cumulative environmental effects is then determined based on the same VC-specific criteria used for the assessment of Project-related environmental effects in Section 7.

Following the determination of significance, follow-up and monitoring programs are recommended, where necessary, to verify cumulative environmental effects predictions or to assess the effectiveness of proposed mitigation measures.

10.2 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

10.2.1 Context for Cumulative Environmental Effects

This section provides a brief overview of how the residual environmental effects associated with other past, present, and future physical activities in the RAA have affected, are affecting, or are

anticipated to affect each VC prior to any residual environmental effects that will be contributed by the Project.

10.2.1.1 Potential Residual Effects of Offshore Gas Development Projects in the RAA

Various offshore oil and gas activities have occurred in the RAA, including production of offshore oil and gas resources since 1992 (refer to Section 5.3.2.1). Encana's SOEP and ExxonMobil's Deep Panuke are the only offshore oil and gas projects presently operating in the RAA. SOEP has been producing natural gas since 1999 and has a total project life expectancy of approximately 25 years, while Deep Panuke began producing natural gas in 2013 and is anticipated to continue for a mean production life of 13 years (CNSOPB n.d. (a)); however, new discoveries could extend the life of either project. These past and present offshore gas development projects comprise similar physical activities and components to the Project being assessed (albeit on a larger spatial and temporal scale) and are subject to the same overall regulatory framework established by the Accord Acts and regulations.

These ongoing offshore gas development projects have resulted or potentially will result in localized residual environmental effects. In particular, they have potential to cause a Change in Risk of Mortality and Physical Injury as well as a Change in Habitat Quality and Use affecting fish and fish habitat, marine mammals, sea turtles, and marine birds; a Change in Availability of Fisheries Resources affecting commercial fisheries; and a Change in Traditional Use affecting Aboriginal fisheries (refer to Table 10.2.1). These potential residual effects are localized in proximity to offshore gas development project activities and components. As noted in Section 10.2.2, the nearest production platforms for SOEP and Deep Panuke are located approximately 125 and 137 km from the LAA, respectively.

Table 10.2.1 Potential Residual Effects Associated with Offshore Gas Development Projects

Activities and Components Associated with Offshore Gas Development Projects	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Presence and Operation of Offshore Gas Production Platforms	Fish and Fish Habitat Marine Mammals and Sea Turtles	Change in Habitat Quality and Use	• Based on EA predictions for SOEP and Deep Panuke (MacLaren Plansearch 1996; Encana 2002; Encana 2006) the SPLs generated by the production platforms operating in support of those offshore gas development projects are assumed to be similar to or less than those generated by Project-related exploration drilling activities (130–190 dB re 1 µPa @ 1 m). • These SPLs are high enough to cause a localized Change in Habitat Quality and Use for fish, marine mammals, and sea turtles, as well as a Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles (refer to Section 7.1.1.2 for a summary of thresholds for physical and behavioural effects on fish and marine mammals).
	Marine Mammals and Sea Turtles	Change in Risk of Mortality or Physical Injury	
	Marine Birds	Change in Risk of Mortality or Physical Injury	• Nocturnally migrating birds may be attracted and/or disoriented by artificial night lighting on the SOEP and Deep Panuke platforms, thereby increasing their risk of injury or mortality.
	Commercial Fisheries	Change in Availability of Fisheries Resources	• SOEP and Deep Panuke are situated in NAFO Division 4W. • Offshore gas development projects have localized effects on access to fisheries resources for commercial and Aboriginal fishers due to the establishment of 500-m radius safety zones around their production platforms. Commercial and Aboriginal fishing activity has been, and will continue to be, excluded within these safety zones for the entire duration of gas production from SOEP and Deep Panuke. • Offshore gas development projects also cause environmental effects on fish and fish habitat due to the generation of underwater noise and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rates or otherwise cause a Change in Availability of Fisheries Resources for commercial fisheries or Change in Traditional Use for Aboriginal fisheries.
	Current Aboriginal Use of Lands and Resources for Traditional Purposes	Change in Traditional Use	

Table 10.2.1 Potential Residual Effects Associated with Offshore Gas Development Projects

Activities and Components Associated with Offshore Gas Development Projects	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
OSV Operations	Fish and Fish Habitat Marine Mammals and Sea Turtles	Change in Habitat Quality and Use	• Based on EA predictions for SOEP and Deep Panuke (MacLaren Plansearch 1996; Encana 2002; Encana 2006) SPLs generated by the OSVs operating in support of those offshore gas development projects are assumed to be similar to or less than those generated by Project OSVs (170–180 dB re 1 µPa @ 1 m). • These SPLs are high enough to cause a localized Change in Habitat Quality and Use for fish, marine mammals, and sea turtles (refer to Section 7.1.1.2 for a summary of thresholds for physical and behavioural effects on fish and marine mammals).
	Marine Mammals and Sea Turtles	Change in Risk of Mortality or Physical Injury	• The transiting of OSVs may cause a Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles due to potential vessel strikes.
	Marine Birds	Change in Risk of Mortality or Physical Injury	• Nocturnally migrating birds may be attracted and/or disoriented by artificial night lighting on the SOEP and Deep Panuke OSVs, thereby increasing their risk of injury or mortality. • As indicated in Section 7, the oil and gas industry has adopted OSV and helicopter traffic restrictions around Sable Island which includes maintaining a 2 km buffer from the island, except in the case of an emergency, to reduce the potential effects on marine birds.
Operational Discharges	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds Special Areas	Change in Habitat Quality and Use	• Discharges from the SOEP and Deep Panuke production platforms and OSVs (*e.g.*, produced water, grey and black water, ballast water, bilge water, and deck drainage deck drainage) are discharged in accordance with the OWTG and MARPOL and are therefore unlikely to cause a Change in Risk of Mortality or Physical Injury for marine species. • Discharges may cause a Change in Habitat Quality and Use for fish, marine mammals, sea turtles, and marine birds within a localized area around the OSVs and SOEP and Deep Panuke production platforms. • Depending on the location of the OSV at the time that the discharge is made, this Change in Habitat Quality and Use has potential to occur in a Special Area.

Table 10.2.1 Potential Residual Effects Associated with Offshore Gas Development Projects

Activities and Components Associated with Offshore Gas Development Projects	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Helicopter Transportation	Marine Mammals and Sea Turtles	Change in Habitat Quality and Use	• There is potential for helicopter traffic to elicit diving behaviour in marine mammals in response to physical presence or noise, although these behaviours will be temporary.
	Marine Birds	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Helicopter traffic may cause a localized Change in Risk of Mortality or Physical Injury for marine birds, due to potential bird strikes, as well as a Change in Habitat Quality and Use for marine birds in proximity to the helicopter due to atmospheric noise emissions. • As indicated in Section 7, the oil and gas industry has adopted OSV and helicopter traffic restrictions around Sable Island which includes maintaining a 2 km buffer from the island, except in the case of an emergency, to reduce the potential effects on marine birds.

The results of environmental effects monitoring (EEM) completed to date for SOEP and Deep Panuke have not identified any residual environmental effects on habitat quality and use in designated Special Areas (ExxonMobil 2012; McGregor 2012). The Change in Habitat Quality and Use caused by underwater noise emissions and discharges from these offshore gas development projects does not overlap spatially with any Special Areas. The Special Area in closest proximity to Deep Panuke is the Haddock Box, which is located approximately 49 km from the nearest production platform. The Special Areas in closest proximity to SOEP are the Sable Island National Park Reserve and the Scotian Slope/Shelf Break EBSA, which are located approximately 6 and 16 km from the nearest production platform, respectively.

10.2.1.2 Potential Residual Effects of BP's Proposed Tangier 3D Seismic Survey

In accordance with the Accord Acts, an EA must be completed before the CNSOPB can issue an authorization for seismic exploration programs. In July 2013, BP Exploration (Canada) Limited (BP) initiated the EA process with the CNSOPB for their proposed Tangier 3D Seismic Survey on the Scotian Slope.

BP's proposed Tangier 3D Seismic Survey will be carried out in two 3D acquisition phases: a multi-vessel Wide Azimuth Towed Streamer (WATS) survey (7750 km²) followed by a conventional, single-vessel Narrow Azimuth Towed Streamer (NATS) survey (4100 km²). It is anticipated that the WATS phase of the seismic survey will take approximately 140 days to complete, with data acquisition requiring approximately 125 days, and will be carried out between April and the end of November 2014. It is anticipated that the NATS phase of the seismic survey will take approximately 113 days to complete, with data acquisition requiring approximately 85 days, and will be carried out between April 2015 and the end of November 2015 (LGL 2014).

This future physical activity has potential to cause a Change in Risk of Mortality or Physical Injury as well as a Change in Habitat Quality and Use affecting fish and fish habitat, marine mammals and sea turtles, and marine birds; a Change in Habitat Quality and Use affecting Special Areas; a Change in Availability of Fisheries Resources affecting commercial fisheries; and a Change in Traditional Use affecting Aboriginal fishers (refer to Table 10.2.2). These potential residual effects are localized in proximity to activities and components associated with BP's proposed Tangier 3D Seismic Survey. As noted in Section 10.2.2, BP's exploration licences are located approximately 8.5 km from the Project Area, and BP's EL 2432 is partially included within the LAA.

Table 10.2.2 Potential Residual Effects Associated with BP's Proposed Tangier 3D Seismic Survey

Activities and Components Associated with BP's Proposed Tangier 3D Seismic Survey	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Airgun Array	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Peak SPLs generated by BP's proposed Tangier 3D Seismic Survey are predicted to be 248.2 dB re 1 µPa @ 1 m (LGL 2014), which is slightly higher than the SPLs expected to result from VSP activities in support of the Project (*i.e.*, 220–245 dB re 1 µPa @ 1 m). • In addition to a Change in Habitat Quality and Use, this level of underwater noise is high enough to cause a Change in Risk of Mortality or Physical Injury for fish, marine mammals, sea turtles, and marine birds diving in proximity to the sound source.
	Special Areas	Change in Habitat Quality and Use	• BP's proposed Tangier 3D Seismic Survey is anticipated to cause a Change in Habitat Quality and Use in a Special Area (i.e., the Scotian Slope/Shelf Break EBSA). Given that the BP seismic survey area is located almost entirely within the Scotian Slope/Shelf Break EBSA, underwater noise and discharges associated with seismic and support vessels will affect habitat quality in the EBSA.
Airgun Array Vessel Operations	Marine Mammals and Sea Turtles	Change in Risk of Mortality or Physical Injury	• The transiting of BP's seismic survey and support vessels will cause a Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles due to potential vessel strikes. • There is also a risk of sea turtle mortality as a result of entanglement in seismic gear.
Operational Discharges	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds Special Areas	Change in Habitat Quality and Use	• Discharges from BP's seismic survey and support vessels (*e.g.*, grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a Change in Risk of Mortality or Physical Injury for marine species. • Discharges may cause a Change in Habitat Quality and Use for fish, marine mammals, sea turtles, and marine birds within a localized area around the seismic survey and support vessels. • The Tangier 3D Seismic Survey area is located almost entirely within the Scotian Slope/Shelf Break EBSA; therefore, discharges from BP's seismic and support vessels have potential to affect habitat quality in this Special Area.
Airgun Array Vessel Operations	Special Areas	Change in Habitat Quality and Use	• Given that the the Tangier 3D Seismic Survey area is located almost entirely within the Scotian Slope/Shelf Break EBSA, underwater noise associated with BP's seismic and support vessels may cause a Change in Habitat Quality and Use in this Special Area.

Table 10.2.2 Potential Residual Effects Associated with BP's Proposed Tangier 3D Seismic Survey

Activities and Components Associated with BP's Proposed Tangier 3D Seismic Survey	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Airgun Array Vessel Operations	Commercial Fisheries	Change in Availability of Fisheries Resources	• The Tangier 3D Seismic Survey area is situated in NAFO Division 4W. • It may become necessary for commercial or Aboriginal fishers to exert a higher level of effort to achieve the same catch during BP's seismic operations, either due to the displacement of target fish species as a result of underwater noise from the airgun array, or due to the temporary displacement of fishing vessels to accommodate seismic vessels and streamers, either of which could affect catch rates or otherwise cause a Change in Availability of Fisheries Resources for commercial fisheries or Change in Traditional Use for Aboriginal fisheries. • There is potential for fishing gear damage/entanglement as a result of interaction with BP's seismic streamers.
	Current Aboriginal Use of Lands and Resources for Traditional Purposes	Change in Traditional Use	

As part of the EA process for BP's proposed Tangier 3D Seismic Survey, mitigation has been identified to minimize adverse environmental effects, including, but not limited to, adherence to the mitigation requirements specified by the SOCP. As concluded in the EA Report completed for that project, with monitoring and mitigation measures in place, residual effects of the Tangier 3D Seismic Survey are predicted to be not significant (LGL 2014).

10.2.1.3 Potential Residual Effects of Fisheries in the RAA

Fishing activity is the main activity affecting fish and fish habitat in the RAA (Burbridge 2011). As summarized in Sections 5.3.3 and 5.3.4, a diverse range of species is targeted by fisheries in the RAA, including groundfish (*e.g.*, cod, haddock, pollock, flatfishes), small pelagic fishes (*e.g.*, herring, mackerel), large pelagic fishes (*e.g.*, tuna, sharks, swordfish) and invertebrates (*e.g.*, lobster, crab, shrimp, scallop). The different types of gear employed in fisheries in the RAA include otter trawl, seine, longline, gillnet, handline, dredge, weir, traps and pots, and harpoon (Burbridge 2011). Past and present fishing activities in the RAA have potential to cause a Change in Habitat Quality and Use, and Change in Risk of Mortality or Physical Injury affecting fish and fish habitat, marine mammals and sea turtles, and marine birds; a Change in Habitat Quality and Use affecting Special Areas; a Change in Availability of Fisheries Resources affecting other commercial fishers; and a Change in Traditional Use affecting other Aboriginal fishers (refer to Table 10.2.3). These potential residual effects are localized in proximity to activities and components associated with fisheries.

Table 10.2.3 Potential Residual Effects Associated with Fisheries

Activities and Components Associated with Fisheries	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Use of Mobile Bottom-Contact Fishing Gear	Fish and Fish Habitat	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Commercial, recreational, and Aboriginal fisheries within the RAA cause a direct Change in Risk of Mortality or Physical Injury for targeted fish species as well as any non-targeted fish species that may be taken as bycatch. The use of mobile bottom-contact fishing gear that is dragged along the seafloor (*e.g.*, trawlers) for certain commercial groundfish fisheries can remove plants, corals, and sessile food items; overturn rocks; level rock outcrops; crush, bury, or expose benthic organisms; and re-suspend sediments, thereby causing a Change in Habitat Quality and Use and Change in Risk of Mortality or Physical Injury for marine benthos.
	Special Areas	Change in Habitat Quality and Use	• Certain Special Areas are subject to fishing closures or gear restrictions (refer to Table 5.2.18), including the Haddock Box and Sambro Bank Sponge Conservation Area, both of which are crossed by the LAA portion surrounding the OSV route to Halifax Harbour. The Haddock Box is closed to commercial groundfish fisheries and the Sambro Bank Sponge Conservation Area is closed to bottom-contact fishing gear. • Given that the Scotian Slope/Shelf Break EBSA is not currently subject to any fishing closures or gear restrictions, the use of mobile bottom-contact fishing gear has potential to cause a Change in Habitat Quality and Use in that Special Area, which is partially located within the Project Area.
Vessel Operations	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Fishing vessels may cause a localized Change in Habitat Quality and Use for fish, marine mammals, and sea turtles through the generation of underwater noise from engines and propellers during transiting. • Although SPLs produced during the transiting of fishing vessels are below the thresholds for physical injury to marine species, SPLs of other physical activities that may be carried out by fishing vessels (*e.g.*, depth sounding, bottom profiling, and side scan sonar) are high enough to cause injury or mortality to fish at close ranges (refer to Table 5.1.15 in Section 5.1.3.6). • The transiting of fishing vessels may cause a Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles due to potential vessel strikes. There is also a risk of sea turtle mortality as a result of entanglement in fishing gear.

Table 10.2.3 Potential Residual Effects Associated with Fisheries

Activities and Components Associated with Fisheries	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
			• Noise associated with fisheries has potential to cause a localized Change in Habitat Quality and Use that could result in sensory disturbance of marine birds. Any vessels that employ artificial night lighting may also attract and/or disorient nocturnally migrating marine birds and cause an associated Change in Risk of Mortality or Physical Injury.
	Special Areas	Change in Habitat Quality and Use	• Fishing vessels may be present in certain Special Areas (including the Scotian Slope/Shelf Break EBSA, Haddock Box, and Sambro Bank Sponge Conservation Area), thereby potentially causing a localized Change in Habitat Quality and Use in Special Areas through the generation of underwater noise from engines and propellers during transiting, as well as from other physical activities that may be carried out by fishing vessels (*e.g.*, depth sounding, bottom profiling, and side scan sonar)
Operational Discharges	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds Special Areas	Change in Habitat Quality and Use	• Discharges from fishing vessels (*e.g.*, grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a Change in Risk of Mortality or Physical Injury for marine species. • Discharges may cause a Change in Habitat Quality and Use for fish, marine mammals, sea turtles, and marine birds within a localized area around fishing vessels. • Depending on the location of the fishing vessel at the time that the discharge is made, this Change in Habitat Quality and Use has potential to occur in a Special Area.
Fishing Activity	Commercial Fisheries	Change in Availability of Fisheries Resources	• Fisheries can occur in any NAFO Division and Unit Area in the RAA and have potential to cause a Change in Availability of Fisheries Resources for competing commercial fisheries in the RAA or Change in Traditional Use for Aboriginal fisheries in the RAA (*e.g.*, through displacement of competitors from their preferred fishing grounds). • If fisheries resources are not harvested sustainably, the residual environmental effects of present fishing activity in the RAA could cause a Change in Availability of Fisheries Resources and Change in Traditional Use for future commercial and Aboriginal fishers due to decreased catch rate as well as resource depletion. • Fisheries also cause localized environmental effects on fish and fish habitat due
	Current Aboriginal Use of Lands and Resources for Traditional Purposes	Change in Traditional Use	

Table 10.2.3 Potential Residual Effects Associated with Fisheries

Activities and Components Associated with Fisheries	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
			to the generation of underwater noise and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rate or otherwise cause a Change in Availability of Fisheries Resources for commercial fisheries or Change in Traditional Use Aboriginal fisheries.

10.2.1.4 Potential Residual Effects of Other Ocean Users in the RAA

As summarized in Section 5.3.2, various other ocean users have been, and continue to be, active throughout the RAA, including ocean users conducting shipping, scientific research, and military activities. The past and present activities of other ocean users in the RAA have potential to cause a Change in Habitat Quality and Change in Risk of Mortality or Physical Injury affecting fish and fish habitat, marine mammals and sea turtles, and marine birds; a Change in Habitat Quality and Use affecting Special Areas; a Change in Availability of Fisheries Resources affecting commercial fishers; and a Change in Traditional Use affecting Aboriginal fishers (refer to Table 10.2.4). These potential residual effects are localized in proximity to activities and components associated with other ocean users.

Table 10.2.4 Potential Residual Effects Associated with Other Ocean Users

Activities and Components Associated with Other Ocean Users	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Vessel Operations	Fish and Fish Habitat Marine Mammals and Sea Turtles	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Other ocean users in the RAA can cause a Change in Risk of Mortality or Physical Injury and a Change in Habitat Quality and Use for fish, marine mammals, and sea turtles through the generation of underwater noise. • Although the SPLs produced by the types of vessels most commonly used by other ocean users are generally below the thresholds for physical injury to marine species, the SPLs of other physical activities that may be carried out by these ocean users (*e.g.*, naval sonar) are high enough to cause injury or mortality to some marine species in certain circumstances (refer to Table 5.1.15 in Section 5.1.3.6). • The transiting of vessels by other ocean users can cause a Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles due to potential vessel strikes.
	Special Areas	Change in Habitat Quality and Use	• The vessels of other ocean users can cause a Change in Habitat Quality and Use in Special Areas, including the Scotian Slope/Shelf Break EBSA, Haddock Box, and Sambro Bank Sponge Conservation Area, due to the generation of underwater noise. • The Scotian Slope/Shelf Break EBSA is partially located within the Project Area. The Haddock Box and Sambro Bank Sponge Conservation Area are both crossed by the LAA portion surrounding the OSV route to Halifax Harbour.
	Commercial Fisheries	Change in Availability of Fisheries Resources	• Other ocean users can occur in any NAFO Division and Unit Area in the RAA and have potential to cause a Change in Availability of Fisheries Resources for commercial fisheries and a Change in Traditional Use for Aboriginal fisheries through temporary displacement of commercial and Aboriginal fishing activity (due to vessel presence) or damage to fishing gear. • Other ocean users also cause localized environmental effects on fish and fish habitat due to the generation of underwater noise and water quality effects associated with discharges. However, these environmental effects on fish and fish habitat are generally not expected to be of sufficient magnitude, duration, or extent to affect catch rate or otherwise cause a Change in Availability of Fisheries Resources for commercial fisheries or a Change in Traditional Use for Aboriginal fisheries.
	Current Aboriginal Use of Lands and Resources for Traditional Purposes	Change in Traditional Use	

Table 10.2.4 Potential Residual Effects Associated with Other Ocean Users

Activities and Components Associated with Other Ocean Users	VCs Affected	Residual Environmental Effects	Explanation of Residual Environmental Effects
Helicopter Transportation	Marine Mammals and Sea Turtles	Change in Habitat Quality and Use	• There is potential for helicopter traffic to elicit diving behaviour in marine mammals in response to physical presence or noise, although these behaviours will be temporary. Helicopter traffic associated with other ocean users (where applicable) may therefore result in a temporary Change in Habitat Quality and Use for marine mammals.
	Marine Birds	Change in Risk of Mortality or Physical Injury Change in Habitat Quality and Use	• Helicopter traffic may also cause a Change in Risk of Mortality or Physical Injury for marine birds, due to potential bird strikes, as well as a Change in Habitat Quality and Use for marine birds due to atmospheric noise emissions. • Noise associated with other ocean users has potential to cause a Change in Habitat Quality and Use that could result in sensory disturbance of marine birds. Any vessels that employ artificial night lighting may also attract and/or disorient nocturnally migrating marine birds and cause an associated Change in Risk of Mortality or Physical Injury.
Operational Discharges	Fish and Fish Habitat Marine Mammals and Sea Turtles Marine Birds Special Areas		• Discharges from the vessels of other ocean users (*e.g.*, grey and black water, ballast water, bilge water, and deck drainage) will be discharged in accordance with MARPOL and are therefore unlikely to cause a Change in Risk of Mortality or Physical Injury for marine species. • Discharges may cause a Change in Habitat Quality and Use for fish, marine mammals, sea turtles, and marine birds within a localized area around the vessels of other ocean users. • Depending on the location of the vessel at the time that the discharge is made, this Change in Habitat Quality and Use has potential to occur in a Special Area.

10.2.2 Potential Cumulative Interactions

The residual environmental effects of the Project on each VC (*i.e.*, Fish and Fish Habitat, Marine Mammals and Sea Turtles, Marine Birds, Special Areas, Commercial Fisheries, and Current Aboriginal Use of Lands and Resources for Traditional Purposes) could overlap temporally with the residual environmental effects of each of the past, present, and future physical activities identified in Section 10.1.1.3. Potential temporal overlap between the Project and BP's proposed Tangier 3D Seismic Survey will be limited to the approximately 113 day NATS survey phase between April 2015 and the end of November 2015 (during which time data acquisition will only be carried out for approximately 85 days), as Shell's exploration drilling activities are not currently planned to commence until Q2 2015.

Spatially, the residual environmental effects of the Project on each VC will be limited to the Project Area and LAA. Key considerations in relation to spatial interactions with respect to cumulative environmental effects are:

- The residual environmental effects of the Project will not overlap spatially with the residual environmental effects of offshore gas development projects on any VC. The nearest production platforms for SOEP and Deep Panuke are located approximately 125 and 137 km from the LAA, respectively.

  Despite the lack of spatial overlap between the residual environmental effects of the Project and the residual environmental effects of offshore gas development projects on any VC, certain VCs may nonetheless be affected by sequential exposure to the residual environmental effects of the Project, Deep Panuke, and/or SOEP. The life cycles of several species of fish, marine mammals, sea turtles, and marine birds include long-distance movement within the RAA (refer to Section 5.2), and there is potential for members of these species to be affected by the combined residual environmental effects of the Project and offshore gas development projects (*i.e.*, the same individuals may be exposed to the residual environmental effects of multiple physical activities during the course of their migrations within the RAA). Similarly, because the customary or traditional fishing grounds of any given commercial or Aboriginal fisher may encompass a broad area or include multiple areas, there is potential for some fishers to be adversely affected by the combined residual environmental effects of the Project and fisheries and other ocean users (*i.e.*, the same fishers may be exposed to the residual environmental effects of multiple physical activities during the course of their harvesting activities within the RAA).

- The residual environmental effects of the Project could potentially overlap spatially with the residual environmental effects of BP's proposed Tangier 3D Seismic Survey on every VC. For this to occur, Project-related drilling, VSP, or OSV transiting activities would have to be carried out at the same time as BP's seismic data acquisition activities and in close enough proximity for the SPLs generated by the activities of both projects to overlap. BP's exploration licences are located approximately 8.5 km from the Project Area, and BP's EL 2432 is partially included within the LAA. The study area for the EA of the Tangier 3D Seismic Survey includes

a 25-km buffer around the survey area as the maximum range within which estimated SPLs from seismic data acquisition are predicted to meet or exceed 160 dB_{RMS} re 1 µPa (LGL 2014); this buffer overlaps with the LAA, the Project Area, the Scotian Slope/Shelf Break EBSA, and the Haddock Box.

- The residual environmental effects of the Project could overlap spatially with the residual environmental effects of fisheries and other ocean users on every VC. Although discharges from other physical activities in the RAA are expected to be routine discharges from vessels or platforms, the Project will have discharges from the MODU, the OSVs, and drilling activities. With respect to the Project's drilling discharges, the majority of the mass released by the Project-related discharge of drill muds and cuttings is expected to remain confined to an area within 100 m of the release site (RPS ASA 2014a) and it is anticipated that any potential smothering of marine benthos will be primarily limited to within 155 m (based on an average burial depth of 9.6 mm, cited in Neff *et al.* 2004). However, the 9.6 mm sediment thickness threshold is an average value only. Specific thresholds for injury or mortality from smothering are species-dependent, which means that burial of some species at depths of less than 9.6 mm may have adverse effects. Sediment dispersion and deposition resulting from discharges of drill muds and cuttings of 0.1 mm thickness are predicted to extend up to 1380 m from the release site and may therefore affect benthic species, as well as water and sediment quality, to varying degrees, for fish, marine mammals, sea turtles, and marine birds within that radius. Drill muds and cuttings will be discharged within the Project Area, which overlaps with the Scotian Slope/Shelf Break EBSA.

  The life cycles of several species of fish, marine mammals, sea turtles, and marine birds include long-distance movement within the RAA (refer to Section 5.2), and there is potential for members of these species to be affected by the combined residual environmental effects of the Project and fisheries and other ocean users (*i.e.*, the same individuals may be exposed to the residual environmental effects of multiple physical activities during the course of their migrations within the RAA). Similarly, because the customary or traditional fishing grounds of any given commercial or Aboriginal fisher may encompass a broad area or include multiple areas, there is potential for some fishers to be adversely affected by the combined residual environmental effects of the Project and fisheries and other ocean users (*i.e.*, the same fishers may be exposed to the residual environmental effects of multiple physical activities during the course of their harvesting activities within the RAA).

Table 10.2.5 applies the criteria from Section 10.1.2.2 to determine whether further assessment of cumulative environmental effects is warranted for each VC, and indicates where the residual effects of the Project may overlap and interact cumulatively with the environmental effects of other physical activities in the RAA. The potential cumulative environmental effects identified in Table 10.2.5 are assessed in Section 10.2.3.

Table 10.2.5 Cumulative Interactions between the Residual Effects of the Project and the Residual Effects of Other Physical Activities on Each VC

Environmental Effect	Potential Cumulative Environmental Effects*				Reasons that Further Assessment is not Warranted (only applicable for potential cumulative environmental effects marked as "✗")
	Offshore Gas Development Projects	BP's Proposed Tangier 3D Seismic Survey	Fisheries	Other Ocean Users	
Fish and Fish Habitat					
Change in Risk of Mortality or Physical Injury	✗	✓	✓	✓	• The nearest production platforms for SOEP and Deep Panuke are located approximately 152 and 171 km from the LAA, respectively. • The underwater SPLs produced by offshore gas development projects are at levels that would not cause a Change in Risk of Mortality or Physical Injury for fish or their eggs/larvae. • Discharges from the Project and offshore gas development projects will comply with the requirements of OWTG and MARPOL, at levels that are unlikely to cause mortality to fish species, and will rapidly become highly diluted in the open ocean.
Change in Habitat Quality and Use	✓	✓	✓	✓	
Marine Mammals and Sea Turtles					
Change in Risk of Mortality or Physical Injury	✓	✓	✓	✓	
Change in Habitat Quality and Use	✓	✓	✓	✓	

Table 10.2.5 Cumulative Interactions between the Residual Effects of the Project and the Residual Effects of Other Physical Activities on Each VC

Environmental Effect	Potential Cumulative Environmental Effects*				Reasons that Further Assessment is not Warranted (only applicable for potential cumulative environmental effects marked as "✗")
	Offshore Gas Development Projects	BP's Proposed Tangier 3D Seismic Survey	Fisheries	Other Ocean Users	
Marine Birds					
Change in Risk of Mortality or Physical Injury	✓	✓	✓	✓	
Change in Habitat Quality and Use	✓	✓	✓	✓	
Special Areas					
Change in Habitat Quality and Use	✗	✓	✓	✓	• Project activities and components are not expected to result in residual environmental effects in any Special Areas other than the Scotian Slope/Shelf Break EBSA (which is partially located with the Project Area) and the Haddock Box and Sambro Bank Sponge Conservation Area (both of which are crossed by the LAA portion surrounding the OSV route to Halifax Harbour) • The Special Area in closest proximity to Deep Panuke is the Haddock Box, which is located approximately 49 km from the nearest production platform. • The Special Areas in closest proximity to SOEP are the Sable Island National Park Reserve and Scotian Slope/Shelf Break EBSA, which are located approximately 6 and 16 km from the nearest production platforms, respectively. • The results of EEM completed to date for SOEP and Deep Panuke have not identified any apparent residual environmental effects on habitat quality and use in the Haddock Box, Sable Island National Park Reserve, the Scotian Slope/Shelf Break EBSA, or any other

Table 10.2.5 Cumulative Interactions between the Residual Effects of the Project and the Residual Effects of Other Physical Activities on Each VC

Environmental Effect	Potential Cumulative Environmental Effects*				Reasons that Further Assessment is not Warranted (only applicable for potential cumulative environmental effects marked as "✗")
	Offshore Gas Development Projects	BP's Proposed Tangier 3D Seismic Survey	Fisheries	Other Ocean Users	
					designated Special Area (ExxonMobil 2012; McGregor 2012). • The potential Change in Risk of Mortality or Physical Injury for marine birds nesting in the Sable Island National Park Reserve and associated Sable Island IBA (due to potential attraction to SOEP platforms and subsequent collision or stranding) is considered in the context of the Marine Birds VC for direct Project effects.
Commercial Fisheries					
Change in Availability of Fisheries Resources	✓	✓	✓	✓	
Current Aboriginal Use of Lands and Resources for Traditional Purposes					
Change in Traditional Use	✓	✓	✓	✓	

* The "✓" indicates that both of the following criteria are satisfied and that further assessment of potential cumulative environmental effects is warranted:

1) The Project could result in a demonstrable or measurable residual environmental effect on the VC.
2) The residual environmental effect of the Project is likely to act in a cumulative fashion with the residual environmental effect of the other physical activity (*i.e.*, the residual environmental effects of the Project and the other physical activity are likely to overlap).

The "✗"indicates that the above criteria are not satisfied and that no further assessment of potential cumulative environmental effects is warranted. Where applicable, an explanation is provided in the right-most column of the table.

10.2.3 Assessment of Cumulative Environmental Effects on Fish and Fish Habitat

This section assesses the potential cumulative Change in Habitat Quality and Use and the potential cumulative Change in Risk of Mortality or Physical Injury for Fish and Fish Habitat that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.3.1 Cumulative Change in Risk of Mortality or Physical Injury

Underwater noise emissions from the Project have potential to contribute to a cumulative Change in Risk of Mortality or Physical Injury. Some of the underwater noise emissions generated by BP's proposed Tangier 3D Seismic Survey, fisheries, and other ocean users during vessel transiting and other activities (*e.g.*, depth sounding, bottom profiling, naval or side scan sonar, airgun arrays) entail SPLs that are high enough to be harmful to fish at close ranges (refer to Table 5.1.15 in Section 5.1.3.6). SPLs generated by Project-related VSP activities will similarly be high enough to cause physical damage to fish in proximity to the sound source. However, cumulative interaction is not anticipated to occur given the infrequent nature and short duration of Project-related VSP activities, which may not be completed for each well, take approximately one day to complete, and will not necessarily coincide with any of the approximately 85 days of data acquisition required for the NATS phase of BP's proposed Tangier 3D Seismic Survey.

With respect to other physical activities in the RAA that generate underwater SPLs high enough to cause a Change in Risk of Mortality or Physical Injury, it is expected that the presence of an approaching vessel or drilling activity will locally displace some species from the area around operating VSP, seismic, sounding, profiling, or sonar sound sources before they are exposed to high SPLs in close proximity to those sound sources, and that most species will respond behaviourally to avoid underwater noise at lower levels than those at which injury or mortality would occur. The implementation of ramp-up procedures during VSP in accordance with the SOCP will mitigate potential underwater noise effects on fish, marine mammals, sea turtles, and diving birds in close proximity to Project and non-Project seismic sources.

The SPLs produced by the Project and BP's proposed Tangier 3D Seismic Survey are each high enough to cause a cumulative Change in Risk of Mortality or Physical Injury to fish eggs/larvae within a few metres of the respective seismic source. Fish eggs/larvae are immotile and are therefore more susceptible to harm in close proximity to these sound sources than other life stages of fish; however, the sound sources themselves are far enough apart that there will be no spatial overlap of residual environmental effects on fish eggs/larvae. The establishment of a 500-m radius safety zone around the MODU within which non-Project activities are excluded will further reduce potential cumulative interactions between underwater noise emissions from Project-related VSP activities and from other physical activities generating high SPLs in the RAA, as well as prevent the spatial overlap of residual environmental effects on fish eggs/larvae.

The deposition of Project-related drill muds and cuttings may smother marine benthos within a 155-m radius of the wellhead, thereby potentially contributing to a cumulative Change in Risk of

Mortality or Physical Injury in combination with the harmful effects that groundfishing can have on benthic organisms. However, the Project Area is not subject to a high level of groundfishing pressure and groundfishing is unlikely to take place in proximity to the MODU during Project activities. Potential cumulative environmental interactions between the Project and groundfisheries will be further limited by the presence of the 500-m radius safety zone excluding other physical activities, as well as the highly localized nature of the deposition of drilling muds and cuttings around the wellsite. The residual effects of Project-related drill muds and cuttings discharged inside the safety zone are unlikely to contribute to the residual effects of groundfishing outside of the safety zone.

The residual cumulative Change in Risk of Mortality or Physical Injury for Fish and Fish Habitat is generally predicted to be low in magnitude, limited in extent to the LAA, medium-term in duration, reversible, sporadic to regular in frequency, and to occur in a context of moderate disturbance. A cumulative Change in Risk of Mortality or Physical Injury associated with underwater noise is also considered unlikely to occur as a result of the varying spatial and temporal scale of VSP and seismic activity. The cumulative Change in Risk of Mortality or Physical Injury associated with the deposition of Project-related drill muds and cuttings is predicted to be primarily limited to the wellsite and Project Area (with potential to extend into the LAA if a drill site is located within 1380 m of the Project Area boundary) and to be short-term in duration.

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Risk of Mortality or Physical Injury for Fish and Fish Habitat is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.3.2 Cumulative Change in Habitat Quality and Use

Although routine discharges and underwater noise emissions from the Project are not likely to be detected outside the LAA, for species whose ranges cover a large extent of the RAA, individuals may be exposed to discharges from one or more physical activities, as well as various sources of underwater noise, throughout their life cycle. The Project will introduce an additional source of discharges and underwater noise that these individuals have potential to encounter. Fish and other marine wildlife may temporarily avoid localized areas subject to degraded water quality and/or underwater noise. The cumulative environmental effects of the Project in combination with other physical activities may therefore include a temporary reduction in the amount of habitat available within the RAA (*i.e.*, due to temporary avoidance of multiple areas at once). This cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated Special Areas, is affected; however, this is not expected to occur for the reasons provided below.

It is anticipated that discharges from the Project and from other physical activities will be in compliance with the requirements of OWTG and/or MARPOL (as applicable), at levels that are

intended to be protective of the marine environment, including fish, marine mammals, sea turtles, and marine birds. Any residual hydrocarbons in discharges are generally not associated with the formation of a slick.

Routine discharges are predicted to disperse quickly, causing only localized effects in water quality around the source. Given that the concentrations of individual discharges are expected to be rapidly diluted in the open ocean, and given the distances between the Project and other physical activities occurring in the offshore (including the exclusion of fisheries and other users within a 500-m radius safety zone surrounding the MODU), Project-related discharges are unlikely to mix or combine with discharges from other physical activities. As such, routine discharges from the Project and other physical activities are not expected cause a substantial cumulative Change in Habitat Quality and Use.

Although sediment dispersion modelling results indicate that dispersed sediment from Project-related discharge of drill muds and cuttings may extend up to a maximum distance of 1380 m from the release site (at a deposition thickness of 0.1 mm), the majority of the mass released by the model remains confined to an area within 100 m of the release site (RPS ASA 2014a). This 100 m spatial extent is well within the 500-m radius safety zone around the MODU within which other physical activities are excluded, thereby limiting potential cumulative interactions between Project-related drill muds and cuttings discharged inside the safety zone and discharges from other physical activities outside the safety zone. It is expected that Project-related discharges of drill muds and cuttings will be at such low water column concentrations outside of the 500-m radius safety zone that any potential cumulative Change in Habitat Quality and Use caused by interaction with the discharges of other physical activities would be negligible. It is similarly expected that any potential cumulative Change in Habitat Quality and Use caused by interaction between Project-related drill waste discharges and the sediments temporarily resuspended during groundfishing activity outside of the 500-m radius safety zone would be negligible based on the limited sedimentation expected beyond the safety zone.

The presence of Project and non-Project vessels in any particular area is generally anticipated to be short-term and transient in nature, thus limiting water quality and noise effects (and associated cumulative Changes in Habitat Quality and Use) at any given location, including designated Special Areas and other areas of importance for reproduction, foraging and feeding, and migration of fish, marine mammals, and/or sea turtles. Although OSVs, fishing vessels, and the vessels of other ocean users may be present in designated Special Areas, they are subject to special restrictions where necessary to protect sensitive marine species and habitats.

Conversely, underwater noise emissions produced during operation of the Project MODU and the production platforms for SOEP and Deep Panuke will be longer lasting and generated from a stationary source for the duration of Project exploration drilling activities at each well (*i.e.*, 130 days) and gas production activities at each SOEP and Deep Panuke platform (*i.e.*, several years), respectively. Although fish, marine mammals, and sea turtles are not expected to approach close enough to these offshore facilities to be exposed to sound levels capable of

causing auditory injury, the noise emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state. Additionally, given their distances from the Project Area (which is located approximately 162 km and 178 km from the nearest SOEP and Deep Panuke platforms, respectively), Browns Bank, the Georges Bank Oil and Gas Moratorium Area, the Georges Bank Fishery Closure (5Z), and the Emerald/Western Bank Haddock Nursery Closure (Haddock Box), noise emissions from the SOEP and Deep Panuke gas production platforms are not anticipated to interact cumulatively with the noise emissions from the Project to result in a cumulative Change in Habitat Quality and Use in designated Special Areas of importance for fish spawning.

The airgun array from BP's Tangier 3D Seismic Survey is expected to produce the highest levels of underwater noise of any physical activity in the RAA, and underwater noise emissions from that project are predicted to reach the Haddock Box (LGL 2014). According to the results of acoustic modelling carried out for the Tangier 3D Seismic Survey EA, the highest SPL from that project that will reach the Haddock Box is approximately 160–169 dB_{RMS} re 1 µPa (LGL 2014). The EA for the Tangier 3D Seismic Survey predicts that airgun sound will have negligible to minor disturbance effects on haddock and other fish in the Haddock Box; it concludes that the residual behavioural effects of exposure to airgun sound will be not significant for fish in the Haddock Box (LGL 2014). The results of acoustic modelling conducted for Shell's Shelburne Basin 3D Seismic Survey (Matthews 2013 in Appendix A of LGL 2013) indicates that there is potential for noise levels of 140–150 dB_{RMS} re 1 µPa to reach the Haddock Box as a result of Project-related VSP activities. These SPLs are similarly expected to have negligible disturbance effects on haddock and other fish in the Haddock Box.

In consideration of the above, cumulative water quality and noise effects are considered unlikely to disrupt the use of important habitat areas by fish. The localized areas potentially affected by the Project and other physical activities in such a way that causes any potential cumulative Change in Habitat Quality and Use for fish represent a relatively small proportion of the total amount of habitat available within the RAA.

The residual cumulative Change in Habitat Quality and Use for Fish and Fish Habitat is generally predicted to be low to moderate in magnitude, limited in extent to the LAA, short to medium-term in duration, reversible, sporadic to regular in frequency, and to occur in a context of moderate disturbance. However, the cumulative Change in Habitat Quality and Use associated with the deposition of Project-related drill muds and cuttings is predicted to be primarily limited to the wellsite and Project Area (with potential to extend into the LAA if the wellsite is located within 1380 m of the Project Area boundary).

With the application of proposed Project-related mitigation and environmental protection measures such as compliance with the OWTG, the residual cumulative environmental effect of a Change in Habitat Quality and Use for Fish and Fish Habitat is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.4 Assessment of Cumulative Environmental Effects on Marine Mammals and Sea Turtles

This section assesses the potential cumulative Change in Habitat Quality and Use and the potential cumulative Change in Risk of Mortality or Physical Injury for Marine Mammals and Sea Turtles that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.4.1 Cumulative Change in Risk of Mortality or Physical Injury

Underwater noise emissions from Project-related VSP activities will contribute to the underwater noise emissions of other physical activities generating high SPLs in the RAA to potentially result in a cumulative Change in Risk of Mortality or Physical Injury.

In addition, there will be a cumulative Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles due to increased potential for strikes with vessels conducting various physical activities within the RAA (including Project activities). Sea turtles are also at risk of mortality due to entanglement in fishing and seismic gear. Project activities, offshore gas development projects, BP's proposed Tangier 3D Seismic Survey, and the activities of fisheries and other ocean users all have potential to occur in different parts of the RAA at the same time, thereby cumulatively increasing Risk of Mortality or Physical Injury.

With the exception of the discussion of cumulative environmental effects on fish eggs/larvae and benthic organisms, the analysis of cumulative environmental effects from underwater noise and operational discharges provided in Section 10.2.3 is also applicable for Marine Mammals and Sea Turtles.

The transiting of the Project MODU and OSVs will represent only a small incremental increase over existing levels of marine traffic in the RAA, and will therefore only cause a small increase in the cumulative Change in Risk of Mortality or Physical Injury for marine mammals and sea turtles. Project OSVs will reduce the risk of collision with marine mammals and sea turtles by limiting their maximum speed to 18.5 km/h (10 knots) within the Project Area as a precautionary measure, avoiding known important areas for marine mammals (*e.g.*, Roseway Basin). In general, the presence of Project and non-Project vessels in any given area is anticipated to be short-term and transient in nature, thereby limiting opportunities for vessel strikes.

In summary, the residual cumulative Change in Risk of Mortality or Physical Injury for Marine Mammals and Sea Turtles is predicted to be low in magnitude, limited in extent to the LAA, medium-term in duration, reversible, sporadic to regular in frequency, and will occur in a context of moderate disturbance.

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Risk of Mortality or Physical Injury for Marine Mammals and Sea Turtles is predicted to be not significant. This

conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.4.2 Cumulative Change in Habitat Quality and Use

Similarly to the cumulative interactions discussed above for Fish and Fish Habitat, water quality and noise effects from the Project and other physical activities will temporarily reduce habitat availability within the RAA (*i.e.*, due to the potential for temporary avoidance of multiple areas at once). Although this cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour of marine mammals and sea turtles if the availability of important habitat areas, including designated Special Areas, is affected, the likelihood of this cumulative interaction is considered low given the distances over which Project and non-Project activities are taking place, as well as the localized nature of potential residual Project effects.

Underwater noise generated by various Project activities will contribute to the underwater noise produced by other physical activities in the RAA. The resultant cumulative increase in ambient underwater noise levels may adversely affect marine mammals through the masking of biologically significant sounds as well as avoidance behaviours. Additionally, the presence and noise of helicopter traffic has the potential to elicit temporary diving responses in marine mammals and thus the presence and noise of Project-related helicopter traffic may potentially trigger additional diving responses in individual marine mammals already exposed to the presence and noise of helicopter traffic from offshore gas development projects and other ocean users (where applicable).

Much of the analysis of cumulative environmental effects from underwater noise and operational discharges provided in Section 10.2.3.2 for Fish and Fish Habitat is also applicable for Marine Mammals and Sea Turtles.

BP's proposed Tangier 3D Seismic Survey as well as the Project will be carried out almost entirely within the Scotian Slope/Shelf Break EBSA, which is an important migratory route and foraging area for the endangered leatherback sea turtle as well as a migratory route for a number of marine mammal species. Based on consideration of the maximum range for SPLs ≥160 dB_{RMS} re 1 µPa (*i.e.*, the generally recognized SPL threshold for behavioural effects on marine mammals from impulsive sound sources) determined from acoustic modelling conducted for Shell's Shelburne Basin 3D Seismic Survey (Matthews 2013 in Appendix A of LGL 2013) as well as BP's proposed Tangier 3D Seismic Survey (LGL 2014), there is potential for a cumulative Change in Habitat Quality and Use within the Scotian Slope EBSA for marine mammals and sea turtles. That said, the area of potential overlap of underwater noise emissions ≥160 dB_{RMS} re 1 µPa from Project-related VSP activities and BP's airgun array would only account for a cumulative total of less than 6% of the total area of the EBSA. However, cumulative interaction is not anticipated to occur given the infrequent nature and short duration of Project-related VSP activities, which may not be completed for each well, take approximately one day to complete, and will not

necessarily coincide with any of the approximately 85 days of data acquisition required for the NATS phase of the Tangier 3D Seismic Survey. In the unlikely event that this cumulative interaction were to occur, it would be short-term, reversible and temporary in nature and would not occur with any regularity. As a result, residual underwater noise effects from Project-related VSP activities are not anticipated to contribute to residual underwater noise effects from the Tangier 3D Seismic Survey in such a way that causes a cumulative Change in Habitat Quality and Use that adversely affects overall use of the EBSA by marine mammals, sea turtles, or other marine wildlife.

In consideration of the above and the relevant analysis in Section 10.2.3.2, cumulative water quality and noise effects are considered unlikely to substantially disrupt the use of important habitat areas by marine mammals or sea turtles. The localized areas potentially affected by the Project and other physical activities in such a way that causes a cumulative Change in Habitat Quality and Use for marine mammals and sea turtles represent a relatively small proportion of the total amount of habitat available within the RAA.

With respect to behavioural responses in marine mammals and sea turtles (*i.e.*, masking and avoidance behaviour), Project-related underwater noise will represent only a small incremental increase over existing levels of underwater noise in the RAA. As noted in Section 10.2.3.2, the presence of Project and non-Project vessels in any given area is generally anticipated to be short-term and transient in nature, thus limiting potential cumulative interaction of underwater noise effects. The establishment of a 500-m radius safety zone around the MODU within which non-Project activities are excluded will reduce potential cumulative interactions between underwater noise emissions from the MODU and underwater noise emissions from other physical activities. Attenuation and dissipation of underwater noise emissions from the Project and other physical activities will reduce their potential cumulative behavioural effects on marine mammals, particularly given the expected distances between the Project and other physical activities. Project OSVs will avoid critical habitat for the northern bottlenose whale (The Gully, and Shortland and Haldimand canyons) and will avoid critical habitat for the North Atlantic right whale (Roseway Basin) from June 1 to December 31. OSVs will also maintain a 2 km avoidance buffer around Sable Island.

With respect to behavioural effects on marine mammals due to helicopter presence and noise, the standard protocol for oil and gas operators working offshore Nova Scotia is for helicopters to avoid flying over Sable Island, except in the case of an emergency. This mitigation will limit potential cumulative interactions between helicopter traffic from the Project, SOEP, and Deep Panuke and Sable Island seal populations. Project helicopters will also avoid flying over Roseway Basin, except in the case of an emergency. In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited that potential cumulative interactions with the residual environmental effects of other helicopter traffic in the RAA will be minimal and are not anticipated to result in a substantial cumulative Change in Habitat Quality and Use for marine mammals.

The residual cumulative Change in Habitat Quality and Use for Marine Mammals and Sea Turtles is predicted to be low to moderate in magnitude, limited in extent to the LAA, short to medium-term in duration, reversible, sporadic to regular in frequency, and to occur in a context of moderate disturbance.

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Habitat Quality and Use for Marine Mammals and Sea Turtles is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.5 Assessment of Cumulative Environmental Effects on Marine Birds

This section assesses the potential cumulative Change in Habitat Quality and Use and the potential cumulative Change in Risk of Mortality or Physical Injury for Marine Birds that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.5.1 Change in Risk of Mortality or Physical Injury

As discussed in Sections 10.2.3 and 10.2.4, underwater noise emissions from Project-related VSP activities will contribute to the underwater noise emissions of other physical activities generating high SPLs in the RAA to potentially result in a cumulative Change in Risk of Mortality or Physical Injury. Much of the analysis of provided in Section 10.2.3 regarding underwater noise emissions from Project-related VSP activities in combination with the underwater noise emissions of other physical activities generating high SPLs in the RAA is also relevant for diving marine birds. However, based on current scientific knowledge regarding the effects of underwater noise on birds (refer to Section 7.1), diving marine birds appear to be less sensitive to underwater noise emissions than fish, marine mammals, or sea turtles. Marine birds are therefore assumed to be less susceptible to a potential cumulative Change in Risk of Mortality or Physical Injury from underwater noise than fish or marine mammals and sea turtles.

Marine birds are vulnerable to potential injury or mortality when exposed to hydrocarbon contamination. Crude and heavy fuel oil, lubricants, and diesels accounted for most of the contamination found on the corpses of the more than 2800 oiled birds that were recovered during beached bird surveys conducted on Sable Island between 1993 and 2002. These fatalities were primarily attributable to unlawful ship-source pollution from large vessels (Stantec 2014). Thus, non-routine discharges from the Project and various other physical activities in the RAA could contribute to a cumulative Change in Risk of Mortality or Physical Injury for marine birds. However, routine discharges are expected to comply with government standards and requirements, and residual hydrocarbons in discharges released in accordance with the OWTG and/or MARPOL (as applicable) are generally not associated with the formation of a slick and are therefore unlikely to cause a measurable cumulative Change in Risk of Mortality or Physical Injury to marine birds.

Although rare, it is possible for helicopter traffic from the Project, offshore gas development projects, and other ocean users (where applicable) to strike flying marine birds. Thus, the Project may contribute to a cumulative Change in Risk of Mortality or Physical Injury due to potential collisions with marine birds.

The standard protocol for oil and gas operators working offshore Nova Scotia is for helicopters to avoid flying over Sable Island, except in the case of an emergency, which will mitigate potential disturbance of the Sable Island National Park Reserve (and associated Sable Island IBA) and birds nesting on the island. Helicopters transiting to and from the MODU will fly at altitudes greater than 300 m and at a lateral distance of 2 km away from active colonies when possible, thereby reducing the risk of collisions with marine birds. In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited that potential cumulative interactions with the residual environmental effects of other helicopter traffic in the RAA will be minimal and are not expected to result in a substantial Change in Risk of Mortality or Physical Injury for marine birds.

Artificial night lighting associated with the Project will contribute to the total amount of night lighting from various sources in the RAA, including lighting on the OSVs and platforms for offshore gas development projects, the BP seismic survey vessels, fishing vessels, and the vessels of other ocean users. Each of these sources of artificial night lighting can attract and/or disorient marine birds, thereby resulting in a cumulative Change in Risk of Mortality or Physical Injury due to potential strandings and increased opportunities for predation, collisions, exposure to vessel based threats, and emissions. Flaring by the MODU during Project activities (*e.g.*, testing) may similarly attract marine birds and result in increased mortality due to the lighting-related hazards identified above as well as the risk of incineration. Project-related flaring will contribute to the bird mortality risk already associated with gas flaring from offshore gas development projects.

Routine checks for stranded birds on the MODU and OSVs and appropriate procedures for release (*i.e.*, the protocol outlined in *The Leach's Storm Petrel: General Information and Handling Instructions* (Williams and Chardine 1999)) will be implemented to mitigate the environmental effects of Project-related artificial night lighting and flaring on birds. In addition, lighting on Project infrastructure will be reduced, to the extent possible without compromising worker safety. Flaring will only be undertaken during the Project as necessary to characterize the well potential and maintain safe operations, and will be carried out in accordance with CNSOPB *Drilling and Production Guidelines*. Project lighting and flaring will represent only a small increase over existing levels of lighting and flaring in the RAA, will be temporary and localized, and will occur at sufficient distance from other light sources (*i.e.*, at least 500 m from fishing vessels and the vessels of other ocean users) and flaring sources (*i.e.*, approximately 162 km and 178 km from SOEP and Deep Panuke, respectively) that the residual lighting and flaring effects of the Project are not anticipated to contribute to those of other physical activities within the RAA in such a way that causes a cumulative increase in light intensity affecting marine birds.

The residual cumulative Change in Risk of Mortality or Physical Injury for Marine Birds is predicted to be low to moderate in magnitude, limited in extent to the LAA, medium-term in duration,

reversible, sporadic (VSP activities) to continuous (artificial night lighting) in frequency, and will occur in a context of moderate disturbance.

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Risk of Mortality or Injury for Marine Birds is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.5.2 Change in Habitat Quality and Use

For marine birds whose ranges cover a large extent of the RAA, individuals may be exposed to various sources of liquid emissions and atmospheric noise (*i.e.*, offshore gas development projects, BP's proposed Tangier 3D Seismic Survey, fisheries, and other ocean users) throughout their life cycle, thereby potentially resulting in a cumulative Change in Habitat Quality and Use, when combined with discharges and atmospheric noise generated by the Project. Section 10.2.3 discusses potential cumulative interactions with respect to marine discharges.

Noise emissions generated from other physical activities may locally displace marine birds for short durations of time. The cumulative environmental effects of the Project in combination with other physical activities will therefore include a temporary reduction in the amount of marine bird habitat available within the RAA (*i.e.*, due to temporary avoidance of multiple areas at once). Although this cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated Special Areas, is affected, such a potential cumulative effect is considered unlikely given the mitigation measures that will be taken for the Project to avoid important areas.

The presence of Project and non-Project vessels in a particular area is generally anticipated to be short-term and transient in nature, thus limiting associated atmospheric noise effects at any given location, including Sable Island National Park Reserve and other areas of importance for reproduction, foraging and feeding, and/or migration of marine birds.

Conversely, atmospheric noise emissions produced during operation of the Project MODU and the production platforms for SOEP and Deep Panuke will be longer lasting and generated from a stationary source for the duration of Project exploration drilling activities at each well (*i.e.*, 130 days) and gas production activities at each SOEP and Deep Panuke platform (*i.e.*, several years), respectively. Noise emissions may cause behavioural responses such as temporary habitat avoidance or changes in activity state (*e.g.*, feeding, resting or travelling). However, the affected areas represent a very small portion of the total amount of bird habitat available in the RAA and are not known to contain any uniquely important habitat for marine birds.

The standard protocol for oil and gas operators working offshore Nova Scotia is for helicopters to avoid flying over Sable Island, except in the case of an emergency, which will mitigate potential

disturbance of the Sable Island National Park Reserve (and associated Sable Island IBA) and birds nesting on the island. Helicopters transiting to and from the MODU will fly at altitudes greater than 300 m and at a lateral distance of 2 km over active colonies when possible, thereby reducing disturbance to marine birds. In general, the residual environmental effects of helicopter traffic from the Project will be so spatially and temporally limited that potential cumulative interactions with the residual environmental effects of other helicopter traffic in the RAA will be minimal and are not expected to result in a substantial Change in Habitat Quality and Use for marine birds.

In consideration of the above, cumulative atmospheric noise effects are considered unlikely to substantially disrupt the use of important habitat areas by marine birds. The localized areas potentially affected by the Project and other physical activities in such a way that causes a cumulative Change in Habitat Quality and Use for marine birds will represent a relatively small proportion of the total amount of habitat available within the RAA.

The residual cumulative Change in Habitat Quality and Use for Marine Birds is predicted to be low to moderate in magnitude, limited in extent to the LAA, short to medium-term in duration, reversible, sporadic to regular in frequency, and will occur in a context of moderate disturbance.

With the application of proposed mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Habitat Quality and Use for Marine Birds is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.6 Assessment of Cumulative Environmental Effects on Special Areas

This section assesses the potential cumulative Change in Habitat Quality and Use in Special Areas that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.6.1 Change in Habitat Quality and Use

The Scotian Slope/Shelf Break EBSA is the only Special Area located within the Project Area. Given the distance of the Project Area from other Special Areas (Table 5.2.17 or 7.6.3), any potential cumulative interactions associated with the presence and operation of the MODU, including discharge of drill muds and cuttings as well as other discharges and emissions, VSP surveys, and well abandonment activities, would be restricted to the Scotian Slope/Shelf Break EBSA. Cumulative environmental effects from these activities would be localized and not extend to distances required to interact with other Special Areas. However, OSV transiting has potential to cumulatively interact with other physical activities in the Haddock Box and the Sambro Bank

Sponge Conservation Area, as both of those Special Areas are crossed by the LAA portion surrounding the OSV route to Halifax Harbour.

Many of the mechanisms for cumulative environmental effects on fish and fish habitat, marine mammals and sea turtles, and marine birds are also applicable to Special Areas:

- Marine discharges from the Project as well as from other physical activities could result in localized areas of water quality reduction throughout the RAA. Fish, marine mammals, sea turtles, and marine birds may temporarily avoid these areas. This cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated Special Areas, is affected. This cumulative environmental effect has potential to occur within the Scotian Slope/Shelf Break EBSA, where the Project Area is located, and in the Haddock Box and Sambro Bank Sponge Conservation Area, which are crossed by the OSV route portion of the LAA.
- The dispersion of Project-related discharges of drill muds and cuttings up to 1380 m (0.1 mm thickness of benthic deposition) from each wellsite could contribute to the residual environmental effects of fishing activity in the RAA, including the resuspension of sediments during groundfishing with mobile bottom contact fishing gear, in such a way that causes a cumulative Change in Habitat Quality and Use for benthic organisms within that 1380-m radius. This cumulative environmental effect has potential to occur within the Scotian Slope/Shelf Break EBSA, where the Project Area is located.
- Underwater noise generated by various Project activities and components will contribute to the underwater noise produced by other physical activities in the RAA. Fish, marine mammals, and sea turtles may temporarily avoid localized areas subject to underwater noise. This cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated Special Areas, is affected. In addition, a cumulative increase in ambient underwater noise levels may adversely affect marine mammals through the masking of biologically significant sounds and causing temporary avoidance. This cumulative environmental effect has potential to occur in the Scotian Slope/Shelf Break EBSA, where the Project Area is located, and in the Haddock Box and Sambro Bank Sponge Conservation Area, which are crossed by the OSV route portion of the LAA.
- The presence and noise of Project-related helicopter traffic may trigger additional diving responses in individual marine mammals already exposed to the presence and noise of helicopter traffic from offshore gas development projects and other ocean users (where applicable). This cumulative environmental effect has potential to occur in the Scotian Slope/Shelf Break EBSA.
- Atmospheric noise generated by various Project activities and components will contribute to the atmospheric noise produced by other physical activities in the RAA. The noise emissions from these activities may physically displace marine birds for short durations of time. This

cumulative Change in Habitat Quality and Use has potential to disrupt reproductive, foraging and feeding, and/or migratory behaviour if the availability of important habitat areas, including designated Special Areas, is affected. This cumulative environmental effect has potential to occur in the Scotian Slope/Shelf Break EBSA, which is a feeding/overwintering area for marine birds.

Given the importance of the Haddock Box and the Sambro Bank Sponge Conservation Area for fish and fish habitat, as well as the importance of the Scotian Slope/Shelf Break EBSA is for fish, marine mammals, sea turtles, and marine birds, much of the analysis of cumulative environmental effects provided for fish, marine mammals, sea turtles, and marine birds in Sections 10.2.3, 10.2.4, and 10.2.5 is also applicable for Special Areas.

The residual cumulative Change in Habitat Quality and Use in Special Areas is generally predicted to be low to moderate in magnitude, limited in extent to the LAA, short to medium-term in duration, reversible, sporadic to regular in frequency, and to occur in a context of moderate disturbance. However, the cumulative Change in Habitat Quality and Use associated with the deposition of Project-related drill muds and cuttings is predicted to be primarily limited to the wellsite and Project Area (with potential to extend into the LAA if a drill site is located within 1380 m of the Project Area boundary) and to be long-term in duration.

With the application of proposed Project-related mitigation and environmental protection measures, the residual cumulative environmental effects of a Change in Habitat Quality and Use in Special Areas, is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.7 Assessment of Cumulative Environmental Effects on Commercial Fisheries

This section assesses the potential cumulative Change in Availability of Fisheries Resources for Commercial Fisheries that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.7.1 Change in Availability of Fisheries Resources

A 500-m radius safety zone will be established around the MODU, in accordance with the *Nova Scotia Offshore Petroleum Drilling and Production Regulations*, within which fisheries activities will be excluded while the MODU is in operation. This will amount to the localized exclusion of fisheries within an area of approximately 0.8 km^2 for up to 130 days for each of the wells to be drilled in the Project Area. More specifically, the safety zone to be established for the Project will occupy only 0.0003% of the total available area in NAFO Division 4W. The safety zones associated with offshore gas development projects will increase the cumulative area that will be temporarily unavailable to fishers at any given time during Project activities occurring simultaneously with gas production from SOEP and Deep Panuke. For a fisher licensed to fish in

NAFO Division 4W, this is predicted to result in the temporary loss of a negligible percentage of the approximately 237 763 km^2 of total available area. No substantial Change in Availability of Fisheries Resources for fishers is anticipated to result from the cumulative interaction of the various safety zones associated with the Project, SOEP, and Deep Panuke. Alternative fishing locations are generally anticipated to be available nearby as these safety zones are relatively small and occupy an insignificant amount of the total harvestable grounds in the RAA

In addition to the safety zones associated with offshore oil and gas exploration and development (*i.e.*, the Project, Deep Panuke, and SOEP), the vessels and streamers to be used for BP's proposed Tangier 3D Seismic Survey, the presence of competing fishing vessels, and the marine traffic associated with other ocean users are other sources of potential conflict with fishing vessels within the RAA that could cause a Change in Availability of Fisheries Resources for fishers. Project OSVs are not expected to contribute to space-use conflicts with fishing vessels, as Project OSVs will use existing shipping routes when travelling between the MODU and the supply base in Halifax Harbour and Project-related OSV traffic will represent a minor component of total marine traffic in the RAA, occupy a negligible proportion of the total available fishing area in the RAA, and be short-term and transient in nature.

Fishers may adversely affect one another through direct competition over productive fishing grounds in such a way that causes a Change in Availability of Fisheries Resources. Any fishers that experience a change in access to their customary fishing areas as a result of the Project in combination with other physical activities in the RAA may be required to temporarily relocate their fishing effort. This could put additional pressure on nearby fishing areas and fishers may be adversely affected by the resultant competition for remaining fishing areas in the LAA and RAA, thereby causing a cumulative Change in Availability of Fisheries Resources.

The level of fishing effort within and surrounding the Project Area is low. The LAA does not include any unique fishing grounds or concentrated fishing effort that occurs exclusively within the LAA, nor is it likely to represent a substantial portion of a customary fishing area for a fisher. The potential for temporary loss of access to preferred fishing grounds as a result of the Project is therefore anticipated to be low and is unlikely to have any discernable effect on the overall distribution of fishing effort within the RAA (*i.e.*, is not predicted to increase space-use conflicts or fisheries competition in other areas within the RAA).

All of the physical activities within the RAA have some potential to inadvertently result in damage to fishing gear. The Project contributes to a potential cumulative Change in Availability of Fisheries Resources within the RAA due to potential sequential incidents of gear loss or damage. Project-related damage to fishing gear, if any, will be compensated in accordance with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2002).

Standard practices for communication among marine users, including the issuance of Notices to Mariners and Notices to Shipping (as appropriate), is expected to mitigate potential conflicts with fisheries as well as other ocean users.

In summary, the residual cumulative Change in Availability of Fisheries Resources for Commercial Fisheries is predicted to be low in magnitude, limited in extent to the LAA, medium-term in duration, reversible, continuous in frequency, and will occur in a context of moderate interference.

With the application of proposed mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Availability of Fisheries Resources for Commercial Fisheries is predicted to be not significant. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.8 Assessment of Cumulative Environmental Effects on Current Aboriginal Use of Lands and Resources for Traditional Purposes

This section assesses the potential cumulative Change in Traditional Use with respect to the Current Aboriginal Use of Lands and Resources for Traditional Purposes that may be caused by the residual environmental effects of the Project in combination with the residual environmental effects of other past, present, and future physical activities in the RAA.

10.2.8.1 Change in Traditional Use

Similarly to the cumulative effects assessed for Commercial Fisheries, the following cumulative environmental effect mechanisms are also applicable with respect to the Current Aboriginal Use of Lands and Resources for Traditional Purposes, specifically Aboriginal communal commercial fisheries and FSC fisheries:

- temporary displacement of Aboriginal fishers from their traditional fishing grounds due to establishment of 500-m radius safety zones around the Project MODU and offshore gas production platforms for SOEP and Deep Panuke
- space-use conflicts between Aboriginal fishing vessels and vessels associated with various other physical activities
- increased competition with other displaced fishers over remaining fishing areas
- risk of sequential incidents of gear loss or damage caused by the Project in combination with other physical activities in the RAA

The analysis of cumulative environmental effects provided in Sections 10.2.7 relating to commercial fisheries is also directly applicable for Aboriginal fishers. That section should be referred to for the assessment of potential cumulative effects related to a Change in Traditional Use. The analysis of cumulative effects provided in Section 10.2.3 regarding Fish and Fish Habitat an in Section 10.2.6 regarding Special Areas should also be referenced given that these VCs were identified by Aboriginal groups as important considerations with respect to traditional use.

For the reasons provided in Section 10.2.7, the residual cumulative Change in Traditional Use with respect to Current Aboriginal Use of Lands and Resources for Traditional Purposes is predicted to be low in magnitude, limited in extent to the LAA, medium-term in duration, reversible, continuous in frequency, and will occur in a context of moderate interference.

With the application of proposed mitigation and environmental protection measures, the residual cumulative environmental effect of a Change in Traditional Use with respect to the Current Aboriginal Use of Lands and Resources for Traditional Purposes is predicted to be not significant. As described in Sections 10.2.3 and 10.2.6, cumulative effects for Special Areas and Fish and Fish Habitat are also predicted to be not significant, further supporting this conclusion. This conclusion has been determined with a high level of confidence based on an understanding of the general environmental effects of exploration drilling and other physical activities in the RAA, as well as the effectiveness of standard mitigation measures.

10.2.9 Accidental Events

Section 19(1)(a) of CEAA, 2012 requires the assessment of the environmental effects of accidents and malfunctions that may occur in relation to the designated project. Accordingly, as per the CEA Agency's OPS*, Assessing Cumulative Environmental Effects Under the Canadian Environmental Assessment Act, 2012*, "the environmental effects of accidents and malfunctions must be considered in the assessment of cumulative environmental effects if they are likely to result from the designated project in combination with other physical activities that have been or will be carried out" (CEA Agency 2013b).

The potential environmental effects of various Project-related malfunction and accidental event scenarios are assessed in Section 8. All of these scenarios are considered very unlikely to occur, with the exception of small batch spills from the MODU (*i.e.*, spills less than 10 bbls). Based on Canadian offshore data, the return period for a spill of less than 10 bbls is 41 years (ERC 2014; Appendix F). Spill prevention and response procedures will be in place to reduce the risk of all spills, including small spills, and associated environmental effects (refer to Section 8). Given the low likelihood of a spill event occurring for one physical activity in the RAA, the likelihood of spills occurring from multiple physical activities in such a way that residual environmental effects have potential to overlap spatially or temporally is even more remote.

Although a small batch spill could cause residual adverse environmental effects to various VCs (refer to Section 8.5), it would be unlikely to interact with the residual environmental effects of discharges from offshore gas development projects, BP's proposed Tangier 3D Seismic Survey, fisheries, or other ocean users in such a way that causes a cumulative environmental effect.

The exclusion of fisheries and other ocean users within a 500-m radius safety zone surrounding the MODU will prevent undiluted small batch spills from combining with undiluted discharges from other physical activities. Given that the concentrations of discharges from other physical activities are expected to be rapidly diluted in the open ocean prior to any mixing or small batch spills in such a way that causes a cumulative environmental effect. Furthermore, Shell's spill response procedures will be implemented immediately upon identification of a small spill

with the intention of limiting the spatial extent of the spill (*i.e.*, containing, controlling and cleaning up spills as close to the platform spill site as possible), thus further limiting potential cumulative interactions between small batch spills and the discharges of other physical activities outside of the 500-m radius safety zone. The potential contribution of the residual environmental effects of a small batch spill to the residual environmental effects of another physical activity in the RAA is not considered a likely scenario and is therefore not assessed further.

10.3 FOLLOW-UP AND MONITORING

Given the nature of the Project (*e.g.,* exploration drilling), follow-up and monitoring requirements are limited (refer to Section 13). However, various monitoring programs are/will be undertaken in support of other physical activities in the RAA that are regulated by the CNSOPB (*i.e.*, Deep Panuke, SOEP, and BP's proposed Tangier 3D Seismic Survey). Encana and ExxonMobil also have obligations to conduct EEM for their offshore gas development projects (*i.e.*, SOEP and Deep Panuke, respectively), in accordance with an EEM process framework developed jointly in 2005 between the CNSOPB, the CEA Agency, DFO, and Environment Canada (CNSOPB n.d. (b)). Depending on the nature of their activities, fisheries and other ocean users may be subject to various monitoring requirements mandated by DFO, Transport Canada, and/or Environment Canada. Monitoring activities associated with the Project and other physical activities will support the development and implementation of adaptive management measures if previously unanticipated adverse environmental effects are identified, thereby reducing the overall potential for cumulative environmental effects.

Shell will communicate with fishers and other ocean users before, during, and after drilling programs, and details of safety zones will be published in Notices to Shipping and/or Notices to Mariners, as appropriate. This will allow fishers and other ocean users to plan accordingly and mitigate potential space-use conflicts or environmental effects.

11.0 BENEFITS TO CANADIANS

11.1 CHANGES TO THE PROJECT SINCE INITIALLY PROPOSED

The EA process has been used to support and better define the Project through early consideration of both potential effects as well as mitigation measures. As a result, changes have been made to the Project since initially proposed in order to address identified potential adverse effects and to enhance the associated benefits of the Project. Specifically, by considering environmental effects early in the Project planning phase, the EA can support better decision making and result in many benefits, such as (CEA Agency 2013c):

- avoidance or minimization of adverse environmental effects
- opportunities for public participation and Aboriginal consultation
- increased protection of human health
- reduced project costs and delays
- reduced risks of environmental harm or disasters
- increased government accountability and harmonization
- lessened probability of transboundary environmental effects
- informed decisions that contribute to responsible development of natural resources

The following provides a summary of the specific benefits provided as a result of changes made to the Project since it was originally proposed.

Reduced Adverse Environmental Effects

The EA process requires evaluation of alternative means of carrying out the Project that are deemed to be technically and economically feasible from an environmental perspective. This, along with the engineering design process, allows for optimization of environmental benefit and reduction of adverse environmental effects. The following decisions have been made in order to reduce the potential for adverse environmental effects as part of the Project:

- use of an existing industrial port facility for the onshore supply base as opposed to developing a greenfield site
- no bulk surface disposal of spent and excess WBM will occur as part of the Project to reduce marine disposal and effects

Public Participation and Aboriginal Engagement

To manage the impact of its operations and projects on the environment and society, Shell has a comprehensive set of standards and requirements covering HSSE & SP. Shell's General Business Principles provide high level guidance, while its Commitment and Policy on HSSE & SP reflects how the company aims to operate and involve communities close to its operations. As described in Sections 3 and 4 of this EIS, Shell has been actively engaging interested members of the public and Aboriginal communities regarding the Project. Issues raised during this engagement were used in the development of the scope of the EIS.

The EIS Guidelines, which guided the preparation of the EIS, were developed with input from federal agencies, the CNSOPB, Aboriginal communities and various stakeholders who offered comments during a public review period for the draft EIS Guidelines. To this end, stakeholders have influenced the EA process. A summary of the consultation and engagement activities carried out for the Project and key issues is provided in Sections 3 and 4 of this EIS.

11.2 BENEFITS OF THE PROJECT

The following provides an overview of the predicted benefits of the Project inclusive of environmental, social and economic considerations.

Contribution to Energy Diversity and Security

The importance of offshore petroleum as part of a sustainable energy mix for Nova Scotia is recognized in *Toward a Greener Future: Nova Scotia's 2009 Energy Strategy* (NSDOE 2009b), in which the Province commits to "encourage renewed offshore exploration and development, with its enormous potential for building future prosperity". The Strategy also includes a commitment for a substantial portion of the revenues from offshore oil and gas (*i.e.*, the Crown share) to be used "for enduring purposes, such as research and development or paying down debt". This can contribute to sustainable development such that "future generations as well as our own will benefit from these resources" (NSDOE 2009b).

The transition toward sustainable development requires a diverse and secure energy mix, that may include a variety of renewable and hydrocarbon sources. As part of its commitment to HSSE & SP, Shell understands its role in sustainable development as "helping to meet the world's growing energy needs in economically, socially and environmentally responsible ways". The Project contributes to provincial and national energy diversity and security by helping to determine the potential for future development of offshore oil resources underlying Shelburne Basin.

Technological Innovations

Shell strives to be an industry leader in safety performance considering technological and incident learnings from across industry to implement innovative approaches and encourage continuous improvement. As part of this aim, process and personal safety are critical components of Shell's corporate standards and policies with a key objective being no harm to people or the environmental as a result of Shell's operational activities.

The aftermath of the Deepwater Horizon Oil Spill, including the findings and recommendations of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (the Commission) and the Deepwater Horizon Study Group (DHSG), have led to numerous technical and technological innovations (*e.g.*, the development of capping stack subsea intervention equipment) that are being incorporated as appropriate throughout Project planning and design. Consideration of lessons learned from the human and technical errors that led to the Deepwater Horizon Oil Spill have and will continue to inform Shell's approach to process and personal safety. In association with the Project these improvements and technological innovations have influenced the following aspects of the Project:

- establishment of new and improvements to existing management systems
- well design, testing, and operational procedures
- well control equipment
- improved preventative and contingency procedures

Given its economic importance to the region and the increased scrutiny of offshore oil and gas activity, the Project is anticipated to receive a great deal of public and industry interest, thereby facilitating opportunities for transfer of technological innovation to other parts of Canada and internationally.

Increases in Scientific Knowledge

Studies undertaken in support of the Project and EA will serve to increase the scientific knowledge of the natural and cultural environment of the Southwest Scotian Shelf and Slope.

Environmental data (*e.g.*, wildlife observations) gathered during Shell's Shelburne Basin 3D Seismic Survey and the Shelburne Basin Venture Seabed Survey have been and will continue to be shared with regulators and stakeholders increasing the knowledge of species use of the Project Area. In addition to marine mammal and seabird monitoring, Shell is also planning to obtain site-specific information on seafloor conditions (inclusive of sediment samples and underwater photographs) at the potential wellsites in association with the Shelburne Basin Venture Seabed Survey to be conducted in 2014 (prior to drilling). The standard components of a seabed survey (*e.g.*, side scan sonar, multi-beam sonar, sub-bottom profile, magnetometer, gravity and bathymetric surveys, and ROV video surveys) will be supplemented with a seabed sampling program.

The results of this survey will further contribute to scientific knowledge of the deepwater benthic environment of the Southwest Scotian Slope, which is an area in which existing data is currently limited. Proposed monitoring studies to be conducted as part of the Shelburne Basin Venture Exploration Drilling Project (refer to Section 13) will serve to further increase scientific knowledge of the deepwater environment of the Project Area.

Community and Social Benefits

On January 20, 2012, it was announced that Shell was the successful bidder for four separate parcels resulting in $970 million in work expenditure bids. The work expenditure bid represents the amount of money the bidder intends to spend exploring the land parcels during the initial six-year period of a nine-year Exploration Licence. In November 2012, it was announced Shell was the successful bidder on four additional parcels, including two deepwater parcels to be combined with the previous four parcels to comprise the Project Area for the Shelburne Basin Venture Exploration Drilling Project. Work expenditure bids for these two additional parcels were approximately $28 million. In total, approximately $998 million has been committed for exploration expenditures associated with the Shelburne Basin Venture Exploration Drilling Project.

The Project will result in community and social benefits through direct and indirect economic impacts, including: government revenues from royalties; capital expenditures; wages, salaries, and benefits; non-wage spending on companies providing goods and services in support of the Project; and spinoff economic activity associated with increased employment and income in the region.

Royalties from Nova Scotia's petroleum industry are the third largest own-source of provincial revenue, but non-royalty ongoing Project expenditures are also an important source of economic benefits. As explained by the Nova Scotia Department of Energy (NSDOE 2009b),

> *Exploration and development have contributed greatly to Nova Scotia's economy and provincial finances. Sable revenues now account for nearly 10 per cent of provincial revenues, which pay for public services like health, education and debt reduction. Offshore development has an important role to play in building a strong economy.*
>
> *[…]*
>
> *Offshore production has fostered an important offshore service industry. Unlike royalties, which flow only during production, the provision of goods and services creates economic benefits during all phases of petroleum activity, from exploration through development, production, and decommissioning. The value of offshore goods and services provided by Nova Scotia companies here and in export markets will likely approach the value of all royalties received by the province. To date, the offshore industry has created work for about 1175 people each year in direct benefits, with about 770 indirect jobs annually. From 1996 to*

> *2006 the Sable project alone has generated about $2.3 billion in contracts awarded.*

Shell recognizes the importance of providing local benefits associated with the Project to Canadians and, in particular, to Nova Scotians. Under section 45 of the Accord Acts, an Operator is required to have an approved Benefits Plan prior to the approval or authorization of any work or activity in the Nova Scotia Offshore Area. As part of the Benefits Plan, an Operator is required to address how the following requirements will be met:

- provision of full and fair opportunity for manufacturers, consultants, contractors and service companies in Nova Scotia, and other parts of Canada, on a competitive basis in the supply of goods and services used in any proposed work or activity referred to in the Benefits Plan
- the establishment of an office in the Province to help support the Project
- first consideration given to residents of the Province for training and employment in the work or activity for which the Benefit Plan is being submitted
- the development and implementation of an education, training, research and development expenditure program in the Province related to petroleum resource activities in the offshore area
- first consideration given to services provided from within the Province, and to goods manufactured in the Province, where those services/goods are competitive in terms of fair market price, quality and delivery

Consistent with the requirements of the Accord Acts, Shell is committed to providing local benefits and opportunities associated with Project activities.

Shell will provide full and fair opportunity to Canadian individuals and organizations, in particular those from Nova Scotia, to participate in the Project and give first consideration to personnel, support and other goods and services that can be produced and provided within Nova Scotia. Key consideration will also be given to whether the associated goods and services can be delivered at a high standard of health, safety and environmental competency, are of high quality and are competitive in terms of fair market price.

11.3 SUMMARY

In summary, Shell has demonstrated a commitment to maximizing environmental, economic, and social benefits of the Project. The EA process for the Project has and will continue to shape Project design, planning and implementation, which will result in a Project that will not only create local social and economic benefits but will ultimately benefit other Canadians on a larger scale through technological innovation and scientific knowledge improvements.

12.0 SUMMARY OF ENVIRONMENTAL EFFECTS

12.1 CHANGES TO THE ENVIRONMENT

This section summarizes the changes that may be caused by the Project on the components of the environment listed in sections 5(1)(a) and (b) of CEAA, 2012, including those that are directly linked or necessarily incidental to federal decisions that would allow the Project to proceed (refer to Table 12.1.1). Conclusions in this section are summarized from the detailed analyses in Sections 7 through 9 and are categorized as follows:

- Changes to components of the environment within federal jurisdiction
- Changes to the environment that would occur on federal or transboundary lands
- Changes to the environment that are directly linked or necessarily incidental to federal decisions

Analysis regarding the potential changes to the environment summarized in Table 12.1.1 is provided in Sections 12.1.1 to 12.1.3 below.

Table 12.1.1 Summary of Changes to the Environment

Topic	Changes
Changes to Components of the Environment within Federal Jurisdiction	
Fish and Fish Habitat	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Marine Mammals and Sea Turtles	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Marine Birds	• Change in Risk of Mortality or Physical Injury • Change in Habitat Quality and Use
Changes to the Environment that Would Occur on Federal or Transboundary Lands	
Special Areas	• Change in Habitat Quality and Use
Commercial Fisheries	• Change in Availability of Fisheries Resources
Current Aboriginal Use of Lands and Resources for Traditional Purposes	• Change in Traditional Use
Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions	
Accord Acts Authorizations (Operations Authorization and Well Approval under the Accord Acts and *Nova Scotia Offshore Petroleum Drilling and Production Regulations*)	• Operations Authorizations and Well Approvals under the Accord Acts sanction offshore exploration drilling projects in their entirety. Therefore, the changes to the environment associated with all Project activities and components are directly linked or necessarily incidental to these authorizations.
Authorization under section 35(2)(b) of the *Fisheries Act* (if applicable)	• Change in Risk of Mortality or Physical Injury and/or Change in Habitat Quality and Use that constitutes serious harm to fish that are part of or support a commercial, recreational, or Aboriginal fishery.

12.1.1 Changes to Components of the Environment within Federal Jurisdiction

Section 5(1)(a) of CEAA, 2012 requires consideration of changes that may be caused to the following components of the environment that are within federal jurisdiction (*i.e.*, within the legislative authority of Parliament): fish and fish habitat, as defined in section 2(1) of the *Fisheries Act;* aquatic species, as defined in section 2(1) of SARA; and migratory birds, as defined in section 2(1) of the MBCA.

Changes affecting fish and fish habitat, marine mammals and sea turtles, and marine birds are summarized below. Greater detail is provided in Section 7.2 (Fish and Fish Habitat), Section 7.3 (Marine Mammals and Sea Turtles), and Section 7.4 (Marine Birds).

12.1.1.1Fish and Fish Habitat

Marine benthic, demersal, and pelagic fish species (including SOCI) and habitat are present in and around the Project Area, LAA, and RAA. Potential environmental effects of the Project on fish and fish habitat are:

- Change in Risk of Mortality or Physical Injury
- Change in Habitat Quality and Use

Fish within the LAA may be subject to increased risk of mortality or physical injury due to underwater noise emissions during certain Project activities (*i.e.*, MODU operation and VSP surveys) and the smothering of marine benthos during the deposition of routine discharges of drill muds and cuttings. Underwater noise emissions from MODU operation, VSP surveys, OSV operations, and well abandonment may also temporarily degrade the quality of fish habitat and result in sensory disturbance that triggers behavioural responses in fish within the LAA. The degradation of water and sediment quality as a result of routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly affect habitat quality and use for fish within the LAA. Accidental events (*e.g.*, spills), although unlikely to occur, could alter fish habitat and/or result in species mortality or injury within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 7.2.9, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, the residual environmental effects of Project activities and components on Fish and Fish Habitat are predicted to be not significant. With the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), accidental events are unlikely to result in significant residual adverse environmental effects on Fish and Fish Habitat.

12.1.1.2 Marine Mammals and Sea Turtles

Several species of baleen whales (*mysticetes*), toothed whales (*odontocetes*), seals (*pinnipeds*), and sea turtles (including SOCI) are present in and around the Project Area, LAA, and RAA. Potential environmental effects of the Project on marine mammals and sea turtles are:

- Change in Risk of Mortality or Physical Injury
- Change in Habitat Quality and Use

Marine mammal and sea turtles within the LAA may be subject to increased risk of mortality or physical injury due to auditory damage from underwater noise emissions during certain Project activities (*i.e.*, MODU operation and VSP surveys) and collisions with transiting OSVs. Underwater noise emissions from MODU operation, VSP surveys, and OSV operations may temporarily degrade the quality of marine mammal and sea turtle habitat and result in sensory disturbance that triggers behavioural responses in marine mammals and sea turtles within the LAA. Sensory disturbance associated with well abandonment and the localized degradation of water quality as a result of routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly affect habitat quality and use for marine mammals and sea turtles within the LAA. There is also potential for helicopter transportation to affect habitat quality and use for marine mammals by eliciting temporary diving behaviour. Accidental events (*e.g.*, spills), although unlikely to occur, could alter marine mammal and sea turtle habitat and/or result in species mortality or injury within the affected area, which could extend beyond the LAA into the RAA.

As determined in Section 7.3.10, with the application of proposed mitigation and environmental protection measures, the residual environmental effects of Project activities and components on Marine Mammals and Sea Turtles are predicted to be not significant. With the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), residual adverse environmental effects on Marine Mammals and Sea Turtles from accidental events are predicted to be not significant.

12.1.1.3 Marine Birds

Several species of pelagic (*i.e.*, offshore) and neritic (*i.e.*, inshore) seabirds, waterfowl, and shorebirds are present in and around the Project Area, LAA, and RAA. Potential environmental effects of the Project on marine birds are:

- Change in Risk of Mortality or Physical Injury
- Change in Habitat Quality and Use

Marine birds within the LAA may be subject to increased risk of mortality or physical injury due to underwater noise emissions; collisions with the MODU, helicopters, and OSVs; harm from flaring on the MODU; and exposure to other MODU or vessel-based threats. The presence of potential marine bird attractants (*e.g.*, Project-related lights, flares, sanitary wastes) may affect habitat quality and use in such a way that further increases risk of mortality or physical injury. Underwater noise emissions from MODU operation and VSP surveys may temporarily degrade the quality of marine bird habitat and result in sensory disturbance that triggers behavioural responses in marine birds within the LAA. The localized degradation of water quality as a result of routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly affect habitat quality and use for marine birds

within the LAA, as could atmospheric noise, artificial night lighting, and other sensory disturbance associated with MODU operation, helicopter transportation, and OSV operations. Accidental events (*e.g.*, spills), although unlikely to occur, could alter marine bird habitat and/or result in species mortality or injury within the affected area, which could extend beyond the LAA into the RAA.

As determined in Section 7.4.10, with the application of proposed mitigation and environmental protection measures, the residual environmental effects on Marine Birds are predicted to be not significant. Under certain circumstances, some accidental event scenarios could potentially result in a significant adverse effect on Marine Birds. However, with the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), significant residual adverse environmental effects on Marine Birds are unlikely to occur.

12.1.2 Changes to the Environment that Would Occur on Federal or Transboundary Lands

Section 5(1)(b) of CEAA, 2012 requires consideration of changes that may be caused to the environment that would occur on federal lands, in another province, or outside of Canada. All Project activities and components have the potential to result in changes to the environment that would occur on federal lands, including federal submerged lands and the federal waters and airspace above those lands. The OSV route enters Canada's territorial sea and internal waters (Halifax Harbour), the Project Area is located within Canada's EEZ on the Southwest Scotian Slope portion of Canada's continental shelf, and the helicopter route occurs in the airspace above these areas, all of which constitute federal lands as defined under section 2(1) of CEAA, 2012. Since the scope of the Project does not include any land-based activities or components, this EIS does not consider changes to the environment that would occur on terrestrial lands belonging to Her Majesty in right of Canada, or reserves, surrendered lands, or other lands that are set apart for the use and benefit of a band and are subject to the *Indian Act*.

A major accidental event (*e.g.*, subsea blowout) could conceivably result in transboundary effects outside of Nova Scotian or Canadian offshore areas if left unmitigated (refer to Section 8.4 and Appendix G). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), a major accidental event is extremely unlikely to occur and would not be left unmitigated. The Project is therefore not anticipated to result in any changes to the environment that would occur outside of the Nova Scotian or Canadian offshore area.

Changes to Fish and Fish Habitat, Marine Mammals and Sea Turtles, and Marine Birds will also occur on federal submerged lands and in federal waters. However, changes to those components of the environment are already addressed in Section 12.1.1, so this section focuses on Special Areas, Commercial Fisheries, and Current Aboriginal Use of Lands and Resources for Traditional Purposes (*i.e.*, Aboriginal fisheries).

Changes affecting Special Areas and Commercial Fisheries are summarized below. Greater detail is provided in Section 7.5 (Special Areas), Section 7.6 (Commercial Fisheries), and Current Aboriginal Use of Lands and Resources for Traditional Purposes (Section 7.7).

12.1.2.1 Special Areas

The Project Area overlaps spatially with a portion of the Scotian Slope/Shelf Break EBSA. The Haddock Box and the Sambro Bank Sponge Conservation Area are within the LAA portion surrounding the OSV route to Halifax Harbour; several other Special Areas are located within the RAA (see Section 5.2.8). The potential environmental effect of the Project on Special Areas is a Change in Habitat Quality and Use. However, given the localized effects of routine Project activities and the distance of the Special Areas from the Project, only the Scotian Slope Shelf Break EBSA has the potential to interact with routine Project activities.

Underwater noise emissions from MODU operation, VSP surveys, OSV operations, and well abandonment may temporarily degrade the quality of habitat in the portions of the Scotian Slope/Shelf Break EBSA and the Haddock Box encompassed by the LAA and result in localized sensory disturbance that triggers behavioural responses in marine species within these areas. The presence of artificial night lighting and other attractants associated with MODU operation, and the localized degradation of water and sediment quality as a result of routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, may similarly cause localized and temporary effects on habitat quality and use within the Scotian Slope/Shelf Break EBSA. The deposition of drill muds and cuttings may smother marine benthos and cause changes to the composition of the benthic macrofauna community within a highly localized area of the Scotian Slope/Shelf Break EBSA. Accidental events (*e.g.*, spills), although unlikely to occur, could temporarily affect habitat in Special Areas within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 7.5.9, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, residual environmental effects on Special Areas are predicted to be not significant. If left unmitigated, and under certain times of the year and environmental conditions, a major accidental event (*e.g.*, subsea blowout) could potentially result in a significant adverse effect on Special Areas (refer to Section 8.5). However, with the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), significant residual adverse environmental effects on Special Areas are unlikely to occur.

12.1.2.2 Commercial Fisheries

Commercial fisheries are present in and around the Project Area, LAA, and RAA. The potential environmental effect of the Project on commercial fisheries is a Change in Availability of Fisheries Resources.

The establishment of a 500-m radius safety zone around the MODU may affect the availability of fisheries resources for commercial fishers by excluding commercial fishing activities within that

radius. There is also potential for gear loss or damage to affect the availability of fisheries resources. Underwater noise emissions from MODU operation and VSP surveys may affect the availability of fisheries resources for commercial fishers if associated sensory disturbance within the LAA triggers behavioural responses in commercially-fished species (*e.g.*, avoidance). However, given the small extent of the affected area, the temporary nature of the activities, the availability of other similar fishing areas, and the Notices to Shipping and Notices to Mariners that Shell will provide regarding its operations, the potential for effects is considered low.

The degradation of water and sediment quality as a result of routine operational discharges and emissions, including the discharge of drill muds and cuttings as well as drilling and testing emissions, is unlikely to affect resource availability for commercial fishers given the temporary and localized nature of the potential effects around the wellsite. In addition, the potential smothering of marine benthos within a highly localized area of the Project Area/LAA, including benthic prey species for commercially fished species, as a result of the deposition of drill muds and cuttings is unlikely to affect the availability of fisheries resources for commercial fishers. Accidental events (*e.g.*, spills), although unlikely to occur, could damage fishing gear, result in the imposition of fisheries closures due to contamination of fish species commonly harvested for human consumption through CRA fisheries, alter fish habitat, and/or result in species mortality or injury for commercially important species within the affected area, which could extend beyond the LAA into the RAA.

As summarized in Section 7.6.9, in consideration of the extent of the potential interactions and the planned implementation of known and proven mitigation, residual environmental effects on Commercial Fisheries are predicted to be not significant. However, under certain circumstances, some accidental event scenarios could potentially result in a significant adverse effect on Commercial Fisheries (refer to Section 8.5). With the implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), significant residual adverse environmental effects on Commercial Fisheries are unlikely to occur.

12.1.2.3 Current Aboriginal Use of Lands and Resources for Traditional Purpose

Aboriginal communal commercial fisheries are present in and around the Project Area, LAA, and RAA. The potential environmental effect of the Project on Aboriginal communal commercial and FSC fisheries is a Change in Traditional Use. All of the mechanisms for a potential Change in Availability of Fisheries Resources for commercial fisheries, as well as the mitigation measures to reduce this environmental effect on commercial fisheries (refer to Section 12.1.3.2), are also applicable with respect to a potential Change in Traditional Use for Aboriginal communal commercial fisheries and FSC fisheries.

As summarized in Section 7.7.9, in consideration of the extent of the interactions and the planned implementation of known and proven mitigation, residual environmental effects on the Current Aboriginal Use of Land and Resources for Traditional Purposes are predicted to be not significant. Under certain circumstances some accidental event scenarios could potentially result in a significant adverse effect on Current Aboriginal Use of Land and Resources for

Traditional Purposes (refer to Section 8.5). However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), significant residual adverse environmental effects on the Current Aboriginal Use of Lands and Resources for Traditional Purposes are unlikely to occur.

With respect to Aboriginal peoples, the potential effects of any change that may be caused to the environment on health and socio-economic conditions; physical and cultural heritage; the current Aboriginal use of lands and resources for traditional purposes; or any structure, site or thing that is of historical, archaeological, paleontological, or archaeological significance are summarized in Section 12.2.1 of this EIS, in accordance with section 5(1)(c) of CEAA, 2012.

12.1.3 Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions

Section 5(2)(a) of CEAA, 2012 requires consideration of additional changes that may be caused to the environment and that are directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the designated project. This section focuses on changes to the environment other than those referred to under section 5(1)(a) and (b) of CEAA, 2012, which are considered in Sections 12.1.1 or 12.1.2 of this EIS.

12.1.3.1 Accord Acts

The primary regulatory approvals necessary to conduct an offshore drilling program are an Operations Authorization (Drilling) and a Well Approval (Approval to Drill a Well) pursuant to the Accord Acts and their regulations. Project activities and components authorized by the CNSOPB under these regulatory approvals may cause changes to the atmospheric environment through the release of air emissions and generation of noise associated with operation of the MODU, OSVs, and helicopters.

Project discharges and emissions will be in compliance with the requirements of MARPOL and/or the OWTG, at levels that are intended to be protective of the environment. As noted in Section 6, all nearshore and offshore Project-related vessel operations will take place in Canada's portion of the North American Emission Control Area (ECA), which was established under amendments to the *Dangerous Chemicals Regulations* pursuant to the *Canada Shipping Act* that were adopted in 2013 under Annex VI to MARPOL. New standards have been implemented for the ECA that are designed to progressively reduce allowable emissions of key air pollutants by ships such that, by 2020, emissions of sulphur oxide will be reduced by 96% and nitrogen oxides by 80% (Transport Canada 2013).

Atmospheric noise is assessed with respect to the Marine Birds VC and residual environmental effects are predicted to be not significant (refer to Section 7.4).

12.1.3.2 Fisheries Act

A *Fisheries Act* authorization is not expected to be required in support of the Project, as Project activities and components are not predicted to result in "serious harm to fish" (*i.e.*, the death of fish or any permanent alteration to, or destruction of, fish habitat) for species that are part of or support a CRA fishery. Although drilling discharges will result in localized alteration of benthic habitat, these effects will not be permanent and are not anticipated to affect CRA species. Habitat altered by the deposition of drill muds and cuttings will become available for use as fish habitat immediately following the completion of drilling operations and is expected to be recolonized by benthic communities within one to five years.

12.2 EFFECTS OF CHANGES TO THE ENVIRONMENT

This section summarizes the effects of changes that may be caused by the Project on the components of the environment listed in section 5(1)(c) and 5(2)(b) of CEAA, 2012, including those that are directly linked or necessarily incidental to federal decisions that would allow the Project to proceed. Conclusions in this section are summarized from the detailed analyses in Sections 7 through 9 and are categorized as follows:

- Effects of changes to the environment occurring in Canada of changes to the environment on Aboriginal people
- Effects of changes to the environment that are directly linked or necessarily incidental to federal decisions

12.2.1 Effects of Changes to the Environment on Aboriginal People

In accordance with section 5(1)(c) of CEAA, 2012, this section of the EIS summarizes the effects of changes to the environment on Aboriginal people caused by the Project. In particular, changes to the following environmental components are summarized:

- Health and socio-economic conditions
- The current Aboriginal use of lands and resources for traditional purposes
- Physical and cultural heritage and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance

Given its distance offshore, the Project is unlikely to affect any receptors that would be sensitive to atmospheric air or noise emissions from Project activities and components or accidental events. As stated in Section 2.7.2, Project-related air emissions for criteria air contaminants will remain well below the regulatory thresholds for human health effects. Emissions and discharges from routine drilling operations will meet OWTG and will not result in contamination of sediments or marine fish tissues such that consumption of marine fish species would result in adverse health effects. Thus, the Project is not expected to result in significant residual adverse environmental effects on the health of Aboriginal or non-Aboriginal people.

Accidental events (*e.g.*, spills), although unlikely to occur, could result in contamination of fish species commonly harvested for human consumption through communal commercial or CRA fisheries. However, fisheries closures would be imposed in the event of such an incident, thereby preventing human exposure to contaminated food sources. Similarly, the imposition of an exclusion zone around the affected area(s) would prevent human contact with spilled oil.

The TUS was conducted to characterize traditional use of marine waters in and around the Project Area and to identify potential interactions, issues and concerns with respect to effects on the current Aboriginal use of resources for traditional purposes. The TUS identifies several communal commercial fisheries that are active in and around the Project Area. Based on interviews conducted as of April 2014, the TUS reports that there are no known FSC fisheries currently occurring in the Project Area. Herring and lobster are fished within the LAA, and several finfish and invertebrate species are fished within the RAA for FSC purposes (MGS and UINR 2014). However, the TUS also acknowledges that this does not imply that FSC fisheries are not occurring in the Project Area or that the Project Area may not be accessed for future FSC fisheries needs. A precautionary approach is therefore taken, assuming that FSC fisheries could potentially occur in the Project Area and LAA, as well as the RAA. Shell also acknowledges that species fished for FSC purposes could be harvested outside the RAA but could potentially temporarily interact with the Project during migration activities through the Project Area or LAA.

As described in Section 7.7, the Project may interact with Aboriginal communal commercial and FSC fisheries, potentially resulting in a Change in Traditional Use. The mechanisms for this potential environmental effect on Aboriginal fisheries are similar to those considered with respect to a Change in Availability of Fisheries Resources for commercial fisheries in Section 12.1.2.3. Information regarding traditional Aboriginal fisheries and traditional resource use has been gathered through engagement with Aboriginal groups (refer to Section 4), including a TUS (refer to Appendix B). In consideration of the extent of the interactions and the planned implementation of known and proven mitigation (refer to Section 7.7), Project activities and components are not predicted to result in a loss of access to lands and resources for traditional purposes (beyond the 500-m radius safety zone established temporarily around the MODU), a change in availability of fisheries resources, or serious harm to fish that are part of or support a CRA fishery. Residual environmental effects on Current Aboriginal Use of Lands and Resources for Traditional Purposes are therefore predicted to be not significant.

Under certain circumstances, some accidental event scenarios could potentially result in a significant adverse effect on Aboriginal fisheries. However, with the development and implementation of proposed well control, spill response, contingency, and emergency response plans (refer to Section 8.1), significant residual adverse environmental effects on the Current Aboriginal Use of Lands and Resources for Traditional Purposes are unlikely to occur.

Project activities and components are not anticipated to result in any changes to the environment that would have an effect on Aboriginal or non-Aboriginal physical and cultural heritage areas, sites, structures, or other resources (or access to or availability of those areas, sites, structures, or resources). Given the distance offshore, heritage areas sites, structures, or

other such resources are not anticipated to be present in the Project Area. Prior to any Project-related seabed disturbance associated with offshore well drilling, testing, and abandonment, information gathered during the 2013 Shelburne Basin 3D Seismic Survey, the 2014 Shelburne Basin Venture Seabed Survey, and pre-drill ROV site surveys will be used to select drilling locations where no heritage resources are present. No other Project activities or components will involve seabed disturbance. In the unlikely event of a spill, the imposition of an exclusion zone around the affected area(s) could affect access to heritage sites or resources, but this would be temporary. No cultural heritage areas, sites, structures, or other such resources have been identified in or around the Project Area during the public, stakeholder, or Aboriginal engagement activities completed to date (refer to Sections 3 and 4).

12.2.2 Effects of Changes to the Environment that are Directly Linked or Necessarily Incidental to Federal Decisions

Section 5(2)(b) of CEAA, 2012 requires consideration of the effects of changes to the environment that are directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the designated project, if any of the following are affected:

- Health and socio-economic conditions
- Physical and cultural heritage and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance

Table 12.2.1 summarizes the changes to the environment that are linked to federal decisions on the Project which are required under the Accord Acts and the *Fisheries Act*.

Table 12.2.1 Summary of Changes to the Environment that are Potentially Contingent on Federal Decisions

Federal Decision	Changes (Potential Environmental Effects)	Affected VCs
Accord Acts Authorizations (Operations Authorization and Well Approval under the Accord Acts and *Nova Scotia Offshore Petroleum Drilling and Production Regulations*)	Change in Risk of Mortality or Physical Injury	• Fish and Fish Habitat • Marine Mammals and Sea Turtles • Marine Birds
	Change in Habitat Quality and Use	• Fish and Fish Habitat • Marine Mammals and Sea Turtles • Marine Birds • Special Areas
	Change in Availability of Fisheries Resources	• Commercial Fisheries
	Change in Traditional Use	• Current Aboriginal Use of Lands and Resources for Traditional Purposes
Fisheries Act Authorization	Change in Risk of Mortality or Physical Injury	• Fish and Fish Habitat

Table 12.2.1 Summary of Changes to the Environment that are Potentially Contingent on Federal Decisions

Federal Decision	Changes (Potential Environmental Effects)	Affected VCs
(Authorization for Serious Harm to Fish under section 35(2)(b) of the *Fisheries Act*)	Change in Habitat Quality and Use	• Fish and Fish Habitat

Operations Authorizations and Well Approvals under the Accord Acts sanction offshore exploration drilling projects in their entirety. Therefore, all Project activities and components are directly linked or necessarily incidental to these authorizations.

For the same reasons as explained above with respect to the effects of changes to the environment on Aboriginal people (refer to Section 12.2.1), Project activities and components are not expected to result in changes to the environment that would have an effect on health conditions; physical and cultural heritage; or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance for Aboriginal or non-Aboriginal people. However, effects on socio-economic conditions may occur from the following potential changes to the environment:

- Change in Risk of Mortality or Physical Injury for fish
- Change in Habitat Quality and Use for fish
- Change in Availability of Fisheries Resources for commercial and Aboriginal fisheries
- Change in Traditional Use for Aboriginal fisheries

Given that these potential changes to the environment are temporary and localized around the MODU and OSVs, and that other suitable fish habitat and fishing areas are readily available throughout the RAA, these potential changes to the environment are not anticipated to substantially affect socio-economic conditions for commercial or Aboriginal fishers (refer to Sections 7.6 and 7.7).

In consideration of the extent of the interactions and the planned implementation of known and proven mitigation, as described in Sections 7.2, 7.6, and 7.7, residual environmental effects on Fish and Fish Habitat, and associated residual environmental effects on socio-economic conditions pertaining to Commercial Fisheries and Current Aboriginal Use of Lands and Resources for Traditional Purposes, are predicted to be not significant.

12.3 SUMMARY

The Project has the potential to result in residual adverse environmental effects in relation to the following:

- Changes to components of the environment within federal jurisdiction
- Changes to the environment that would occur on federal or transboundary lands
- Changes to the environment that are directly linked or necessarily incidental to federal decisions
- Effects of changes to the environment occurring in Canada of changes to the environment on Aboriginal people
- Effects of changes to the environment that are directly linked or necessarily incidental to federal decisions

The residual environmental effects of Project activities and components on Fish and Fish Habitat, Marine Mammals and Sea Turtles, Marine Birds, Special Areas, Commercial Fisheries, and Current Aboriginal Use of Lands and Resources for Traditional Purposes are predicted to be not significant.

In the unlikely event of a Project-related accidental event resulting in the large-scale release of oil (*e.g.*, blowout), effects to Marine Birds, Special Areas, Commercial Fisheries, and Current Aboriginal Land and Resource Use for Traditional Purposes have potential to be significant if the spill trajectory overlaps spatially and temporally with sensitive receptors. However, given the low probability for an incident of this scale to occur, combined with the low probability for spatial and temporal overlap, significant effects are not likely to occur during the life of the Project.

13.0 ENVIRONMENTAL MANAGEMENT

13.1 ENVIRONMENTAL MANAGEMENT PLANS

Shell is committed to protecting the environment and actively managing its environmental performance. This is reflected in Shell's Business Principles and HSSE & SP control framework and management system. Design features and mitigation measures have been incorporated into the Project to prevent or reduce potential environmental effects.

Environmental management plans are used to verify that proper measures and controls are in place in order to reduce the potential for environmental effects as well as provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety. As part of this Project, the following Project-specific management plans will be developed and will be submitted to the CNSOPB for review and approval:

- Environmental Protection Plan (including a Waste Management Plan)
- Safety Plan
- Emergency Response Plan, inclusive of an Oil Spill Response Plan, Well Containment Plan, Dispersants Operations Plan, Relief Well Contingency Plan (refer to Section 8.1 for more information)
- Canada-Nova Scotia Benefits Plan

In addition, Shell has committed to developing and implementing Fisheries Communications Plans for commercial and Aboriginal fisheries representatives, which will facilitate coordinated communication around routine Project activities and accidental events.

All operations relating to the Project will be required as a minimum to comply with Shell standards and with external regulatory standards. Where requirements differ, the more stringent requirement will apply. Shell will require contractors to demonstrate that they have in place a Health, Safety and Environment Management System compatible with these standards, and that they are committed to implementing it. Shell will also comply with commitments, including monitoring, if required, for all permits, authorizations, and licences. In the event that sub-contractors are used, the main contractor will be required to ensure that these sub-contractors also conform to the same standards and requirements.

13.2 FOLLOW-UP AND MONITORING

Under CEAA, 2012, a follow-up program is defined as a program for "verifying the accuracy of the environmental assessment of a designated project" and "determining the effectiveness of any mitigation measures." By this definition, there is no required follow-up program as the effects of routine exploration drilling activities and effectiveness of mitigation measures are well-

understood (refer to Section 7). There are however, various mitigation, reporting and monitoring commitments to be fulfilled by Shell (refer to Section 14 for a list of commitments). In particular, Shell will implement the following monitoring and reporting requirements for the Project:

- The observation, forecasting and reporting of physical environment data will be conducted in accordance with the *Offshore Physical Environment Guidelines* (NEB *et al*. 2008) to promote the safe and prudent conduct of routine operations and emergency response.

- MMOs will be employed to monitor and report on marine mammal and sea turtle sightings during VSP surveys to enable shutdown or delay in the presence of a marine mammal or sea turtle species listed on Schedule 1 of SARA, as well as all other baleen whales and sea turtles. Monitoring will involve visual observations. Following the program, copies of the marine mammal and sea turtle observer reports will be provided to DFO.

- In the event that a vessel collision with a marine mammal or sea turtle occurs, Shell will contact the Marine Animal Response Society (MARS) or the Coast Guard to relay the incident information.

- Routine checks for stranded birds on the MODU and OSVs (with handling as per the Williams and Chardine protocol) will be conducted in compliance with the requirements for documenting and reporting any stranded birds (or bird mortalities) to the CWS during the drilling program.

- Shell will continue to engage commercial and Aboriginal fishers to share Project details as applicable and facilitate coordination of activities.

- In the event that fishing gear is damaged or lost due to Project activities, the compensation claims process will be activated as per the *Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2002).

- Incidents will be reported in accordance with the *Incident Reporting and Investigation Guidelines* (C-NLOPB and CNSOPB 2012).

In the unlikely event of an accidental event, Shell will implement measures outlined in its Emergency Response Plan and integrated contingency plans (refer to Section 8.1) as applicable. Depending on the incident, specific monitoring (*e.g.*, environmental effects monitoring) and follow-up programs may be required and will be developed in consultation with applicable regulatory agencies. Section 8.5 provides additional information on monitoring and reporting that may be required in the event of an accidental event. In general this may involve monitoring various aspects of the marine environment until specific endpoints are achieved and residual hydrocarbons reach acceptable background levels. In addition, records of marine mammal, sea turtle, and birds with visible oiling would be maintained. With respect to effects on fisheries, post-spill monitoring could involve monitoring contamination levels in fish species including sensory testing of seafood for "taint", as well as chemical analysis, as deemed necessary by government authorities.

In summary, for routine Project activities, environmental effects monitoring for the Project is limited to monitoring marine mammals and sea turtles during VSP surveys. In the event of an accidental event, specific monitoring programs will be developed through consultation with federal and provincial government agencies, Aboriginal groups, the public and other stakeholders.

14.0 SUMMARY AND CONCLUSIONS

Shell is proposing to conduct an exploratory drilling program within the area of its offshore Exploration Licences 2423, 2424, 2425, 2426, 2429 and 2430. The Shelburne Basin Venture Exploration Drilling Project will consist of up to seven exploration wells drilled over a four-year period from 2015 to 2019 in association with the exploration periods of the Licences. This document is intended to fulfill requirements for an EIS pursuant to CEAA, 2012 as specified by Project-specific EIS Guidelines, as well as EA requirements of the CNSOPB pursuant to the Accord Acts.

This section provides a summary of the EIS including a summary of the potential effects of the Project, mitigation measures, and residual and cumulative effects and their significance. The specific mitigation measures related to public concerns and potential effects on Aboriginal rights and related interests are also summarized. A description of the outstanding public concerns and outstanding Aboriginal issues is provided.

14.1 SUMMARY OF POTENTIAL EFFECTS, ADVERSE RESIDUAL EFFECTS AND THEIR SIGNIFICANCE

14.1.1 Potential Environmental Effects

The assessment methods used in the preparation of this EIS included an evaluation of the potential environmental effects for each VC that may arise during the Project as well as from accidental events. The evaluation of potential cumulative effects considers whether there is potential for the residual environmental effects of the Project to interact cumulatively with the residual environmental effects of other past, present, or future (*i.e.*, certain or reasonably foreseeable) physical activities in the vicinity of the Project. In support of the EA process, additional studies were undertaken including sediment dispersion modelling (RPS ASA 2014a), oil spill fate and trajectory modelling (RPS ASA 2014b), spill risk and probability analysis (ERC 2014) and a traditional use study (MGS and UINR 2014). These studies are appended to the EIS.

Routine operations assessed include the presence and operation of the MODU (including lights and underwater noise), discharge of drill muds and cuttings, other discharges and emissions, vertical seismic profiling, helicopter transportation, OSV operations and well abandonment. These activities reflect the scope of the Project as outlined in the EIS Guidelines and represent physical activities that would occur throughout the life of the Project forming the basis of the effects assessment.

Accidental events that could occur during exploration drilling and potentially result in adverse environmental effects include operational batch spills (10 bbl and 100 bbl), SBM whole mud spill, subsea blowout, and vessel spill. The probability of a large oil spill occurring during an exploration drilling project is very low (refer to Appendix F). However, as discussed in Section 8.5, significant adverse residual environmental effects could potentially occur to Marine Birds, Special Areas,

Commercial Fisheries, and Current Aboriginal Use of Lands and Resources for Traditional Purposes in the unlikely event of an accidental spill.

Environmental factors, which could potentially affect offshore exploration drilling activities include: fog, extreme weather conditions, sea ice and superstructure icing, seismic events and tsunamis, and sediment and seafloor stability. Effects from sea ice, seismic activity, tsunamis and sediment and seafloor stability will be minimal given the limited duration of offshore activities (*i.e.*, approximately 130 days to drill an individual well over the four year period), the absence of permanent offshore infrastructure, and lack of site-specific risk factors (*e.g.*, low potential for sea ice in Project Area). MODU design standards for harsh weather conditions and standard operating procedures including the monitoring of meteorological conditions, stop-work procedures and safe work practices will minimize the risk of adverse effects of the environment on the Project. In consideration of the implementation of appropriate engineering design standards and adherence to the *Offshore Physical Environment Guidelines*, the residual effects of the physical environment on the Project are predicted to be not significant.

VCs specified in the EIS Guidelines for assessment and evaluated in this EIS are presented in Table 14.1.1, along with potential interactions and effects, which formed the basis for the effects analysis.

Table 14.1.1 Potential Effects

Project Activities and Components	Fish and Fish Habitat		Marine Mammals and Sea Turtles		Marine Birds		Special Areas	Commercial Fisheries	Current Aboriginal Use of Lands and Resources for Traditional Purposes*
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Habitat Quality and Use	Change in Availability of Fisheries Resources	Change in Traditional Use
Presence and Operation of MODU (including lights, safety zone and underwater noise)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discharge of Drill Muds and Cuttings	✓	✓		✓		✓	✓	✓	✓
Other Discharges and Emissions (including drilling and testing emissions)		✓		✓	✓	✓	✓	✓	✓
Vertical Seismic Profiling	✓	✓	✓	✓	✓	✓	✓	✓	✓
Helicopter Transportation				✓	✓	✓	✓		

Table 14.1.1 Potential Effects

Project Activities and Components	Fish and Fish Habitat		Marine Mammals and Sea Turtles		Marine Birds		Special Areas	Commercial Fisheries	Current Aboriginal Use of Lands and Resources for Traditional Purposes*
	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Risk of Mortality or Physical Injury	Change in Habitat Quality and Use	Change in Habitat Quality and Use	Change in Availability of Fisheries Resources	Change in Traditional Use
OSV Operations (including transit and transfer activities)		✓	✓	✓	✓	✓	✓	✓	✓
Well Abandonment		✓		✓			✓	✓	✓
Accidental Events									
100bbl Batch Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓
10bbl Batch Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓
SBM Whole Mud Spill	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subsea Blowout	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vessel Spill (nearshore)	✓	✓	✓	✓	✓	✓	✓	✓	✓
* Considers Aboriginal and Treaty Rights									

14.1.2 Residual, Accidental and Cumulative Environmental Effects

Sections 7, 8 and 10 of this EIS present the residual, accidental and cumulative effects evaluation, respectfully, for each VC. Effects predictions, including potential environmental effects, mitigation and residual effects are summarized for each VC in the respective VC sections.

Physical activities identified as having potential to act in combination with the Project to result in cumulative environmental effects were evaluated in the context of each VC. These included consideration of: current offshore gas development projects on the Scotian Shelf (*e.g.*, SOEP and Deep Panuke); BP's proposed Tangier 3D Seismic Survey; fisheries; and other ocean uses. Predicted cumulative effects were generally predicted to be low in magnitude, limited in extent to the LAA, medium-term in duration, reversible, sporadic to regular in frequency, and to occur in a moderate context. It is predicted therefore, that Project-related environmental effects (including cumulative effects) are not significant (refer to Section 10).

Table 14.1.2 summarizes the significance of residual effects findings for each VC, and, where applicable, the likelihood of significant residual adverse environmental effects occurring.

Table 14.1.2 Summary of Residual Environmental Effects

VC	Routine Operations	Accidental Effects		Cumulative Effects
	Significance of Residual Environmental Effect	Significance of Residual Environmental Effect	Likelihood of Significant Effect	Significance of Residual Environmental Effect
Fish and Fish Habitat	N	N	N/A	N
Mammals and Sea Turtles	N	N	N/A	N
Marine Birds	N	S	L	N
Special Areas	N	S	L	N
Commercial Fisheries	N	S	L	N
Current Aboriginal Use of Land and Resources for Traditional Purposes	N	S	L	N

Key:
N = Not significant residual environmental effect (adverse)
S = Significant residual environmental effect (adverse)
L = Low likelihood

Exploration drilling is a highly regulated activity, with standard mitigation requirements, although Shell has examined various aspects of the Project in an effort to further reduce environmental effects (refer to Section 2.8 for a review of alternative means). As outlined in Section 8.1, Shell has numerous design measures, operational procedures and dedicated resources to prevent spills of any size and to respond to spills entering the marine environment, thereby reducing the risk of

significant adverse environmental effects. With the implementation of the proposed mitigation measures, adverse residual environmental effects of routine Project activities are predicted to be not significant for all VCs.

14.2 SUMMARY OF MITIGATION, MONITORING AND FOLLOW-UP COMMITMMENTS

Mitigation is proposed to reduce or eliminate adverse environmental effects. Most potential Project and cumulative environmental effects will be addressed by mitigation measures for each VC. Design features and mitigation measures have been incorporated into the Project to prevent or reduce potential environmental effects. A summary of mitigation, monitoring and follow-up commitments is provided in Table 14.2.1. As requested by the EIS Guidelines, the relevance of commitments to changes to the environment and effects of changes to the environment as defined by section 5 of CEAA, 2012 (refer to Section 12 of this EIS), is indicated.

Table 14.2.1 Summary of Commitments

No.	Proponent Commitments	EIS Section Reference	Relevant Category of Environmental Effect Under Section 5 of CEAA, 2012				
			Changes to the Environment			Effects of Changes to the Environment	
			Changes to Components Within Federal Jurisdiction	Changes Occurring on Federal or Transboundary Lands	Changes that are Directly Linked or Necessarily Incidental to Federal Decisions	Effects On Aboriginal People	Effects that are Directly Linked or Necessarily Incidental to Federal Decisions
General							
1	Shell will comply with the terms and conditions of approval, for all permits, authorizations, and licences obtained in support of the Project.	13.2	✓	✓	✓	✓	✓
2	Prior to mobilization at the selected drilling site, the MODU will undergo the required regulatory inspections to demonstrate that it meets Canadian and CNSOPB safety and technical specifications.	2.4	✓	✓	✓	✓	✓
3	Shell will obtain a Certificate of Fitness from an independent third party Certifying Authority for the MODU prior to commencement of drilling operations in accordance with the *Nova Scotia Offshore Certificate of Fitness Regulations*.	9.3	✓	✓	✓	✓	✓

Table 14.2.1 Summary of Commitments

No.	Proponent Commitments	EIS Section Reference	Relevant Category of Environmental Effect Under Section 5 of CEAA, 2012				
			Changes to the Environment			Effects of Changes to the Environment	
			Changes to Components Within Federal Jurisdiction	Changes Occurring on Federal or Transboundary Lands	Changes that are Directly Linked or Necessarily Incidental to Federal Decisions	Effects On Aboriginal People	Effects that are Directly Linked or Necessarily Incidental to Federal Decisions
4	Flaring, during exploration drilling, will be restricted to the amount necessary to characterize the well potential (refer to Section 2.4.3) and as necessary for the safety of the operation.	2.7, 7.4	✓	✓	✓		✓
5	All operations relating to the Project will be required at a minimum to comply with Shell standards and with external regulatory standards. Where requirements differ, the more stringent requirement will apply. Shell will require contractors to demonstrate that they have in place a Health, Safety and Environment Management System compatible with these standards, and that they are committed to implementing it.	2.8, 13.1	✓	✓	✓	✓	✓
6	Routine checks for stranded birds will be conducted on the MODU and OSVs and appropriate procedures for release will be implemented. If stranded birds are found during routine inspections, they will be handled using the protocol outlined in *The Leach's Storm Petrel: General Information and Handling Instructions* (Williams and Chardine 1999), including obtaining the associated permit from CWS, and in compliance with the requirements for documenting and reporting strandings and mortalities to the CWS.	7.4, 13.2	✓	✓	✓		✓
7	The observation, forecasting and reporting of physical environment data will be conducted in accordance with the *Offshore Physical Environment Guidelines* (NEB *et al.* 2008) to promote the safe and prudent conduct of routine operations and emergency response.	9.3, 13.2	✓	✓	✓	✓	✓

Table 14.2.1 Summary of Commitments

No.	Proponent Commitments	EIS Section Reference	Relevant Category of Environmental Effect Under Section 5 of CEAA, 2012				
			Changes to the Environment			Effects of Changes to the Environment	
			Changes to Components Within Federal Jurisdiction	Changes Occurring on Federal or Transboundary Lands	Changes that are Directly Linked or Necessarily Incidental to Federal Decisions	Effects On Aboriginal People	Effects that are Directly Linked or Necessarily Incidental to Federal Decisions
8	The following Project-specific management plans will be developed and submitted to the CNSOPB for review and approval: • Environmental Protection Plan • Safety Plan • Emergency Response Plan, Well Control Plan, Oil Soil Response Plan, and Relief Well Contingency Plan • Waste Management Plan	2.7, 2.8, 8.4, 13.1, 13.2	✓	✓	✓	✓	✓
OSVs and Helicopters							
9	OSVs will be compliant with the *Canada Shipping Act* and national and international regulations while at sea, *Eastern Canadian Vessel Traffic Services Zone Regulations* when operating in nearshore or harbour areas, and applicable Port Authority requirements when in a port. Ship operations will also adhere to Annex I of MARPOL, of which Canada has incorporated provisions under various sections of *the Canada Shipping Act* and its regulations.	2.4, 7.4	✓	✓	✓	✓	✓
10	In preparation for the Project, OSVs will undergo Shell's internal audit process as well as additional external inspections/audits, including the CNSOPB pre-authorization inspection process, during Q4 of 2014 or Q1 of 2015.	2.4, 9.3	✓	✓	✓	✓	✓
11	OSVs will avoid the Gully, as per the *Gully Marine Protected Area Regulations*, when travelling to and from the MODU.	7.5	✓	✓	✓		✓
12	Fuelling of OSVs will be conducted at a permitted facility and in accordance with	8.1	✓	✓	✓	✓	✓

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	fuelling procedures, reducing the risk of a spill during transfer operations.						
13	OSVs will use existing shipping routes when travelling to and from the MODU, adhere to standard navigation procedures, and reduce speeds to 18.5 km/hour (10 knots) within the Project Area.	7.4, 7.7, 7.3, 7.6	✓	✓	✓	✓	✓
14	To reduce risk of collision, Project OSVs will avoid critical habitat for the northern bottlenose whale (The Gully, and Shortland and Haldimand canyons) and will avoid critical habitat for the North Atlantic right whale (Roseway Basin) from June 1 to December 31. OSVs will also maintain a 2 km avoidance buffer around Sable Island.	7.3, 7.5	✓	✓	✓		✓
15	Except in the case of an emergency, Project helicopters will avoid flying over Roseway Basin and Sable Island.	2.4, 7.3	✓	✓	✓		✓
16	Helicopters transiting to and from the MODU will fly at altitudes greater than 300 m and at a lateral distance of 2 km from active colonies when possible.	7.4, 7.5	✓	✓	✓		✓
17	Measures will be taken as appropriate to monitor and mitigate effects of the environment (*e.g.,* icing, fog) on OSV and helicopter transportation. Pilots and OSV operators will have the authority and obligation to suspend or modify operations in case of adverse weather that compromises the safety of helicopter or OSV operations.	9.3	✓	✓	✓	✓	✓
Project Design							
18	Engineering design for the Project will adhere to national/international standards for site-specific normal and extreme physical	9.3	✓	✓	✓	✓	✓

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	environmental conditions.						
19	Lighting on Project infrastructure will be reduced to the extent that worker safety is not compromised.	7.4	✓	✓	✓		✓
20	Well design reviews will be carried out and approved by appropriate qualified internal discipline authorities and technical experts. The same principles apply to the input parameters, which are used as the basis for the well design.	8.4	✓	✓	✓	✓	✓
21	The transfer of SBM to the OSV and spent SBM from the OSV will occur through a closed system thereby minimizing the risk of spillage to the marine or terrestrial environment.	8.1	✓	✓	✓	✓	✓
22	Shell will conduct a seabed survey in the Project Area in 2014 to obtain site-specific information on the seafloor conditions at the potential wellsites and identify potential geohazards (*e.g.*, sediment scour, liquefaction of sediments from seismic events, shallow gas pockets, and slope failure) that could be present in the vicinity of proposed drilling sites and therefore require avoidance. Any evidence of sediment scour or seafloor instability will be noted and incorporated into Project planning and design as appropriate.	9.2, 9.3, 11.2	✓	✓	✓	✓	✓
23	The results of the seabed survey conducted in the spring of 2014 and pre-drill ROV surveys conducted at each potential wellsite will inform the selection of drilling locations that avoid areas where known heritage resources, coral concentrations, or other sensitive or unique benthic habitat are	6.2, 7.2, 7.5	✓	✓	✓	✓	✓

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	present.						
24	Once the MODU is in position, pre-drill site surveys will be conducted using an ROV deployed to the seabed. These surveys will be conducted to confirm that no potential surface seabed hazards or sensitivities are present at the drilling location.	2.4, 11.2	✓	✓	✓	✓	✓
25	Two independent barriers will be maintained at all times once the BOP is installed on the wellhead. These barriers will be verified by testing both prior to and following installation; should one barrier be lost, operations will be stopped and the focus of operations will shift to regaining a two-barrier status.	8.4	✓	✓	✓	✓	✓
Wastes/Discharges							
26	The OCSG will be applied in selecting chemicals for drilling, as well as to guide the proper treatment and disposal of chemicals selected.	2.7	✓	✓	✓	✓	✓
27	Constituents in drilling muds will be screened using the OCSG to assess the viability of using lower toxicity chemicals.	7.5	✓	✓	✓	✓	✓
28	Offshore waste discharges and emissions associated with the Project (*i.e.*, operational discharges and emissions from the MODU and OSVs) will be managed in compliance with MARPOL and treated in accordance with the OWTG, as applicable.	2.7, 7.2, 7.3, 7.4, 7.5	✓	✓	✓	✓	✓
29	In accordance with the OWTG, drilling solids associated with the use of SBM will be treated prior to marine disposal such that the "synthetic-on-cuttings" does not exceed 6.9 g/100 g oil on wet solids.	2.7, 7.2, 7.5	✓	✓	✓	✓	✓

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30	No whole SBM base fluid or any whole mud containing SBM as a base fluid will be discharged at sea.	2.7	✓	✓	✓	✓	✓
31	Waste discharges that do not meet OWTG requirements will not be discharged to the ocean, but brought to shore for disposal.	7.5	✓	✓	✓	✓	✓
32	Hazardous wastes, including any waste dangerous goods, generated during the Project will be stored in the appropriate containers/containment and in designated areas on board the MODU for transportation to shore.	2.7	✓	✓	✓	✓	✓
33	The transportation of any dangerous goods, waste dangerous goods or hazardous substances will occur in compliance with the *Transportation of Dangerous Goods Act* and its associated regulations.	2.7	✓	✓	✓	✓	✓
34	Wastes destined for onshore treatment, recycling and/or disposal will be managed in accordance with the Nova Scotia *Solid Waste-Resource Management Regulations* and will comply with any applicable federal and provincial waste requirements as well as municipal by-laws.	2.7			✓		✓
35	The air emissions from the Project will comply with the *Air Quality Regulations* under the Nova Scotia *Environment Act*, and meet the National Ambient Air Quality Objectives under CEPA, 1999.	2.7		✓	✓		✓
36	Any flaring required as an essential safety component of well drilling will occur in accordance with the CNSOPB *Drilling and Production Guidelines*.	2.7	✓	✓	✓		✓
37	Prior to transiting into Canadian waters, the MODU will undergo normal ballast tank	2.7	✓	✓	✓	✓	✓

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	flushing procedures, as required under IMO's *Ballast Water Management Convention* and Transport Canada's *Ballast Water Control and Management Regulations*.						
Accidental Events							
38	Shell and its contractors will have measures in place to reduce the potential for vessel spills. This includes: • All activities adhering to Annex I of MARPOL • Adherence to standard navigation procedures, Transport Canada regulations and CCG requirements, and • Special attention to activities presenting increased risks for marine traffic including loading and offloading, docking and extreme weather events	8.2	✓	✓	✓	✓	✓
39	A Dispersants Operations Plan will be developed as part of the OSRP, which will outline the process and procedures for determining whether to utilize dispersants and initiate deployment of dispersants in the unlikely event of an oil spill incident in the Project Area.	8.1	✓	✓	✓	✓	✓
40	Shell will have available local staff and agencies, and Aboriginal representatives trained in accordance with its Incident Command System and able to respond to accidental spills. Dependent on the size and scale of the incident, Shell will draw on various support organizations/agencies to provide the appropriate and necessary	8.1	✓	✓	✓	✓	✓

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	resources and response.						
41	Personnel potentially involved in oil spill response will receive specialized training, and drills will be conducted periodically to familiarize personnel with on-site equipment, proper deployment techniques and maintenance procedures, and management of incidents.	8.1	✓	✓	✓	✓	✓
42	Shell will work with the appropriate government agencies and undertake a Net Environmental Benefits Analysis (NEBA) to evaluate the risks and benefits of dispersing oil in the water column.	8.1, 8.5	✓	✓	✓	✓	✓
43	If required, for a nearshore spill, shoreline clean-up and possible collection and cleaning of fur-bearing marine mammals and oiled marine birds would be conducted.	8.5	✓	✓	✓	✓	✓
44	As part of spill response, marine mammal and marine bird hazing techniques may be used if deemed necessary to deter animals from entering affected areas and prevent further oiling.	8.5	✓	✓	✓		✓
45	In the unlikely event of an accidental spill, oiled birds will be collected and rehabilitated as practical.	8.5	✓	✓	✓		✓
46	In the event that a vessel collision with a marine mammal or sea turtle occurs, Shell will contact the Marine Animal Response Society (MARS) or the Coast Guard to relay the incident information.	7.3, 13.2	✓	✓	✓		✓
47	Incidents will be reported in accordance with the *Incident Reporting and Investigation Guidelines* (C-NLOPB and CNSOPB 2012).	13.2	✓	✓	✓	✓	✓
48	In the unlikely event of an accidental spill, specific monitoring (*e.g.*, environmental	8.5, 13.2	✓	✓	✓	✓	✓

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	effects monitoring) and follow-up programs may be required and will be developed in consultation with applicable regulatory agencies.						
49	As part of any spill monitoring, records will be kept of any marine mammals or sea turtles encountered and any evidence of visible oiling.	8.5	✓	✓	✓		✓
50	Project-related damage to fishing gear, if any, will be compensated in accordance with the *Compensation Guidelines with Respect to Damages Relating to Offshore Petroleum Activity* (C-NLOPB and CNSOPB 2002).	7.6, 7.7, 8.5		✓	✓	✓	✓
Vertical Seismic Profiling							
51	VSP surveys will adhere, at a minimum, with mitigation measures described in the SOCP.	7.3	✓	✓	✓	✓	✓
52	A ramp-up procedure will be implemented before any VSP activity begins. Additionally, VSP shutdown procedures will be implemented if a marine mammal or sea turtle species listed on Schedule 1 of SARA, as well as all other baleen whales and sea turtles are observed within 1 km of the wellsite.	7.3	✓	✓	✓		✓
53	MMOs will be employed to monitor and report on marine mammal and sea turtle sightings during VSP surveys to enable shutdown or delay in the presence of a marine mammal or sea turtle species listed on Schedule 1 of SARA, as well as all other baleen whales and sea turtles. Monitoring will involve visual observations. Following the program, copies of the marine mammal and	7.3, 13.2	✓	✓	✓		✓

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	sea turtle observer reports will be provided to DFO.						
Consultation and Engagement							
54	Shell will communicate with fishers before, during, and after drilling programs. Details of safety zones will be published in Notices to Mariners and Notices to Shipping, which will allow fishers and other ocean users to plan accordingly.	7.6, 7.7		✓	✓	✓	✓
55	Shell will continue to engage commercial and Aboriginal fishers to share Project details as applicable. A Fisheries Communications Plan will be used to help facilitate coordinated communication with commercial and Aboriginal fishers.	3, 4, 13.2		✓	✓	✓	✓

14.3 SUMMARY OF COMMENTS FROM THE PUBLIC

Engagement activities in association with the Shelburne Basin Venture have been ongoing since 2012. Initially focused on engaging stakeholders interested in or potentially affected by the Shelburne Basin 3D Seismic Survey, Shell has expanded the scope of stakeholders to include others that have been identified or have expressed interest during the planning phase for the Shelburne Basin Venture Exploration Drilling Project. Section 3 of this EIS describes the consultation and engagement activities conducted to date on the Project.

Questions and comments raised during engagement activities have been tracked and managed since August 2013 for the Project and have been considered in the preparation of the EIS. Table 3.4.1 in Section 3 provides an overview of the issues identified through public engagement completed prior to submission of the EIS and responses to address these concerns.

Shell will continue to engage with stakeholders throughout the Project to answer any questions they may have about the Project both prior to and following submission and to resolve outstanding issues from public consultation. A summary of outstanding issues (*i.e.*, issues that will require ongoing effort post-EIS) is provided below in Table 14.3.1.

Table 14.3.1 Outstanding Public Concerns

Outstanding Issue	Response
Request for a detailed Emergency Response Plan including logistics	• Shell provided interested parties with information and the anticipated timeline for the development of the ERP, including the highlights and commitments that will be contained within the ERP. • Shell advised stakeholders that following submission, the ERP would be posted on the CNSOPB website for public consideration. Shell will advise stakeholders when the ERP has been posted. • Shell will continue to engage with stakeholders throughout the Project to answer questions they may have about the ERP both prior to and following submission.
Fisheries Engagement	• Shell will also continue to engage on a regular basis with its key fisheries stakeholders and also to provide regular updates in the form of newsletters so that other ocean users are made aware of upcoming activities. Shell will include additional fisheries representatives in information circulations as requested/appropriate. • In order to facilitate coordinated communication, Shell has drafted and will utilize a Fisheries Communications Plan in order to communicate with fisheries representatives during Project activities. • This plan considers communications both before and during the operations phases to coordinate efforts and activities.

14.4 SUMMARY OF ABORIGINAL ENGAGEMENT

Shell places a high priority on engagement with First Nations and is committed to meaningful and productive collaboration in association with the Project. The goal of Shell's Aboriginal engagement for the Project is to ensure that Shell, and the appropriate Crown agencies and decision makers, are aware of, and have relevant information on, the potential for Project effects on the exercise of Aboriginal and Treaty rights, and to the extent possible, to limit or mitigate those effects. In the context of this EIS, Current Aboriginal Use of Lands and Resources for Traditional Purposes refers to communal commercial, as well as FSC fishing activities by Aboriginal peoples that could potentially interact with the Project. It is included as a VC in recognition of the cultural and economic importance of fishing to Aboriginal peoples and also in recognition of potential or established Aboriginal and Treaty rights.

Shell's Aboriginal engagement approach has included: distribution of Project information packages; face to face meetings; phone calls and emails to stakeholders seeking input and feedback; development and participation by First Nations in Supplier Information Sessions in Nova Scotia and development of jointly-agreed-upon Fisheries Communications as requested. In addition to the engagement efforts by Shell, the provincial and federal governments are consulting with Aboriginal organizations in Nova Scotia and New Brunswick to understand potential Project effects on Aboriginal and Treaty rights and to take adverse effects into consideration before reaching a regulatory decision on the Project. To facilitate this engagement and consultation process, a TUS is being undertaken for this Project (refer to Appendix B) to characterize Aboriginal use of marine waters in the vicinity of the Project for FSC and/or commercial purposes.

Questions and comments raised during engagement activities have been tracked and managed for the Project since August 2013 and have been considered in the preparation of the EIS. Table 4.5.1 in Section 4 provides an overview of the issues identified through Aboriginal engagement completed prior to submission of the EIS and Shell's responses to address these concerns.

Ongoing Project updates, stakeholder check-ins and timely responses to stakeholder questions or concerns will take place throughout the Project. A summary of outstanding issues (*i.e.*, issues that will require ongoing effort post-EIS) is provided below in Table 14.4.1.

Table 14.4.1 Outstanding Aboriginal Issues

Outstanding Issue	Response
Fisheries Engagement	• Shell will continue to engage on a regular basis with its key fisheries stakeholders in Nova Scotia and New Brunswick as applicable and also to provide regular updates in the form of newsletters so that other ocean users are aware of upcoming activities. • In order to facilitate coordinated communication and two-way dialogue, Shell has drafted and will utilize a Fisheries Communications Plan in order to communicate with fisheries representatives throughout the Shelburne Basin Venture Exploration Drilling Project. • This plan considers communications both before and during the operations phases to coordinate efforts and activities.
Traditional Use Study	• Interviews are ongoing with First Nations in New Brunswick and Nova Scotia in association with the TUS as appended to the EIS (refer to Appendix B).

14.5 CONCLUSIONS

Shell has demonstrated a commitment to maximizing environmental, economic, and social benefits of the Project. The EA process for the Project has and will continue to shape Project design, planning and implementation, which will result in a Project that will not only create local social and economic benefits but will ultimately benefit other Canadians on a larger scale through technological innovation and scientific knowledge improvements.

Changes to the environment and effects of these changes (including cumulative effects from other past, present, and certain or reasonably foreseeable future physical activities) are predicted to be not significant for routine Project activities. Effects of changes to the environment on Aboriginal peoples (including cumulative effects) are also predicted to be not significant for routine Project activities.

Although unlikely to occur, some accidental spill scenarios could result in significant adverse residual effects on Marine Birds, Special Areas, Commercial Fisheries, and Current Aboriginal Use of Lands and Resources for Traditional Purposes. Spill prevention and response measures that will be in place during the Project operations will reduce the risk of potential accidental events and associated adverse environmental effects.

In summary, the Project is not likely to result in significant adverse residual environmental effects, including cumulative effects, provided that the proposed mitigation and monitoring programs are implemented.

The Project will result in community and social benefits through direct and indirect economic effects, including: government revenues from royalties; capital expenditures; wages, salaries, and benefits; non-wage spending on companies providing goods and services in support of the Project; and spinoff economic activity associated with increased employment and income in the region. In addition to community and social benefits, the Project will contribute to energy diversity and security in Nova Scotia, support technological innovations and increases in scientific knowledge.

15.0 REFERENCES

AANDC [Aboriginal Affairs and Northern Development Canada]. 2008. Aboriginal Peoples and Communities. First Nation Profiles. Last Updated 2008. Available from: http://pse5-esd5.ainc-inac.gc.ca/fnp/Main/Search/FNListGrid.aspx?lang=eng

AANDC [Aboriginal Affairs and Northern Development Canada]. 2011. Aboriginal Consultation and Accommodation-Updated Guidelines for Federal Officials to Fulfill the Duty to Consult. March 2011. Available from: http://www.ainc-inac.gc.ca/eng/1100100014664

AANDC [Aboriginal Affairs and Northern Development Canada]. 2012. Mi'kmaq in Nova Scotia Summary as of December 31, 2012. Based on AANDC Indian Registry System (IRS, Indian Register Population affiliated with First Nations by Gender and Residency, December 31, 2012. Available from: http://novascotia.ca/abor/docs/demographics/NS_RegisteredPopulation_31Dec2012.pdf

AANDC [Aboriginal Affairs and Northern Development Canada]. 2013. Peace and Friendship Treaties (1725-1779). Available from: http://www.aadnc-aandc.gc.ca/eng/1360937048903/1360937104633

Abbriano, R.M., Carranza, M.M., Hogle, S.L., Levin, R.A., Netburn, A.N., Seto, K.L., Snyder S.M., Franks, P.J.S. 2011. Deepwater Horizon oil spill: A review of the planktonic response. Oceanography, 24(3): 294-301.

ACCDC [Atlantic Canada Conservation Data Center]. 2011. Species Ranks. Obtained from the ACCDC, April 2011.

Ackleh, A.S., Ioup, G.E., Ioup, J.W., Ma, B., Newcomb, J.J., Pal, N., Sidorovskaia, N.A., Tiemann, C. 2012. Assessing the Deepwater Horizon oil spill impact on marine mammal population through acoustics: endangered sperm whales. J. Acoust. Soc. Am., 131: 2306-2314.

ACZISC [Atlantic Coastal Zone Information Steering Committee]. 2011. State of the Scotian Shelf Report: The Scotian Shelf in Context. Prepared by the ACZISC: Oceans and Coastal Management Division, Bedford Institute of Oceanography, Fisheries and Oceans Canada. Available from: http://coinatlantic.ca/docs/scotian-shelf-in-context.pdf

Ainley, D.G., Grau, C.R., Roudybush, T.E., Morrell, S.H., Utts, J.M. 1981. Petroleum ingestion reduces reproduction in Cassin's Auklets. Mar. Pollut. Bull., 12: 314-317.

Albers, P.H., Loughlin, T.R. 2003. Effects of PAHs on marine birds, mammals, and reptiles. In: Douben, P.E.T., editor. PAHs: An Ecotoxicological Perspective. John Wiley and Sons, London. pp 243-261.

Angus, W.D. and G. Mitchell. 2010. Facts do not justify banning Canada's current offshore drilling operations: a senate review in the wake of BP's Deepwater Horizon Incident. Eighth report of the Standing Senate Committee on Energy, the Environment, and Natural Resources.

ASM [American Society for Microbiology]. 2011. A Report from the American Academy of Microbiology: Microbes and Oil Spills, FAQ. 16pp.

Assembly of Nova Scotia Mi'kmaq Chiefs. 2007. Mi'kmaq Ecological Knowledge Study Protocol, 1st Edition. Produced by Mi'kmaq Rights Initiative. Available from: http://www.aboriginalsustainabilitynetwork.org/wp-content/uploads/2009/01/mikmaq-ecological-knowldege-study-protocol.pdf

Atlantic Leatherback Turtle Recovery Team. 2006. Recovery Strategy for Leatherback Turtle (*Dermochelys coriacea*) in Atlantic Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa, vi + 45pp.

Au, W.W.L., Hastings, M.C. 2008. Principles of marine bioacoustics. Spring Science, LCC.

Bain, D.E., Williams, R. 2006. Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance. Paper SC/58/E35 presented to the IWC Scient. Commit., IWC Annu. Meet., 1-13 June, St. Kitts.

Bakke, T., Berge, J.A., Nøs, K., Oreld, F., Reiersen, L.O., Byrne, K. 1989. Long-term recolonization and chemical changes in sediments contaminated with oil-based drill cuttings. In: Englehardt, F.R., Ray, J.P., Gillam, A.H., editors. Drilling Waste, Elsevier Applied Science Publishers Ltd., New York, NY. 872 pp.

Bakke, T., Klungsøyr, J., Sanni, S. 2013. Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry. Mar. Environ. Res., 92: 154-169.

Bakke, T., Green, A.M.V., Iversen, P.E. 2011. Offshore environmental monitoring in Norway: Regulations, results and developments (Chapter 25). In: Lee, K., Neff, J., editors. Produced Water, Springer, NY.

Bakke, T., Green, N.W., Næs, K., Pedersen, A. 1986. Drill cuttings on the sea bed: phase 1 and 2. Field experiments on benthic recolonization and chemical changes in response to various types and amounts of cuttings. In: SFT/Statfjord Unit Joint Research Project Symposium, 24-26 February 2006, Trondheim, Norway.

Barlow, J., Gisiner, R. 2006. Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. J. Cetac. Res. Manage., 7(3): 239-249.

Beauchamp, J., Bouchard, H., de Margerie, P., Otis, N., Savaria, J.-Y., 2009. Recovery Strategy for the Blue Whale *Balaenoptera musculus* (Northwest Atlantic Population) in Canada [Final]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 62pp.

Belanger, M., Tan, L., Askin, N., Wittnich, C. 2010. Chronological effects of the Deepwater Horizon Gulf of Mexico oil spill on regional seabird casualties. J. Mar. Anim. Ecol., 3: 10-14.

BEPCo. Canada Company. 2004. Environmental Assessment Report-Exploration Drilling on EL2407. Prepared by Jacques Whitford Ltd. in association with S.L. Ross Environmental Research Ltd. and Coastal Oceans Associates Ltd.

Best, B. 2009. Atlantic Cod in Canada [presentation]. DFO. Economic Analysis and Statistics.

BIO [Bedford Institute of Oceanography]. 2013a. Smooth Skate (*Malacoraja senta*). Bedford Institute of Oceanography-Research. Fisheries and Oceans Canada. Available from: http://www.bio.gc.ca/science/research-recherche/fisheries-pecheries/rays-raies/atlantic-atlantique/malacoraja-senta-eng.php

BIO [Bedford Institute of Oceanography]. 2013b. Scotian Slope/Rise Monitoring Program. [updated 26 Mar 2013; cited 10 Dec 2013]. Available from: http://www.bio.gc.ca/science/monitoring-monitorage/azomp-pmzao/slope-pente/slope-pente-eng.php

Boehm, P.D., Turton, D., Ravel, A., Caudle, D., French, D., Rabalais, N., Spies, R., Johnson, J. 2001. Deepwater Program: Literature Review, Environmental Risks of Chemical Products Used in Gulf of Mexico Deepwater Oil and Gas Operations. Vol. 1 Technical Report. OCS Study MMS 2001-011. US Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Boersma, P.D., Parrish, J.K., Kettle, A.B. 1995. Common murre abundance, phenology, and productivity on the Barren Islands, Alaska: The Exxon Valdez oil spill and long-term environmental change. In: Wells, P.G., Butler, J.N., Hughes, J.S., editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM STP 1219. American Society for Testing and Materials, Philadelphia, PA. 965 pp: 820-853.

Booman, C., Dalen, J., Leivestad, H., Levsen, A., van der Meeren, T., Toklum, K. 1996. Effecter av luftkanonskyting påegg, larver og yngel. Fisken Og Havet 3: 1-83 (Norwegian with English summary).

Bossart, G.D., Lutcavage, M., Mealey, B., Lutz, P. 1995. The dermatopathologic effects of oil on loggerhead sea turtles (*Caretta caretta*). In: Frink, L., Ball-Weir, K., Smith, C., editors. Wildlife and Oil Spills: Response, Research, and Contingency Plan. Tri-State Bird Rescue and Research, DE. 182 pp: 180-181.

Boudreau, P.R., Gordon, D.C., Harding, G.C., Loder, J.W., Black, J., Bowen, W.D., Campana, S., Crandford, P.J., Drinkwater, K.F., van Eeckhaute, L., *et al.* 1999. The possible environmental impacts of petroleum exploration activities on the Georges Bank ecosystem. DFO Can. Stock Assess. Sec. Res. Doc 98/170.

Bourne, W.R.P. 1979. Birds and gas flares. Mar. Pollut. Bull., 10: 124-125.

Bowen, W.D., den Heyer, C., McMillan, J.I., Hammill, M.O. 2011. Pup Production of Scotian Shelf Grey Seal *Halichoerus grypus* Colonies in 2010. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/066: vi + 25pp.

Boyne, A.W., Amirault, D.L. 1999. Habitat characteristics of piping plover nesting beaches in Nova Scotia, New Brunswick and Prince Edward Island. In: Higgins, K.F., Brashier, M.R., Kruse, C.D., editors. Proceedings, Piping Plovers and Least Terns of the Great Plains and Nearby. Brookings: South Dakota State University. 132 pp.

Breeze, H., Fenton, D., Rutherford, R.J., Silva, M.A. 2002. The Scotian Shelf: An Ecological Overview for Ocean Planning. DFO Ca. Tech. Rep. Fish. Aquat. Sci. 2393.

Brickman, D., Drozdowski, A. 2012. Canadian Technical Report of Hydrography and Ocean Sciences: Atlas of Model Currents and Variability in Maritime Canadian Waters. vi+ 64pp.

Brodie, P.F. 2000. Halifax Harbour and Marine Mammals: Life in the Shipping Lanes. Preserving the Environment of Halifax Harbour. [Workshop #1]. Halifax Regional Municipality and Fisheries and Oceans Canada.

Brown, M.W., Fenton, D., Smedbol, K., Merriman, C., Robichaud-Leblanc, K., Conway, J.D. 2009. Recovery Strategy for the North Atlantic Right Whale (*Eubalaena glacialis*) in Atlantic Canadian Waters [Final]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada. vi + 66p.

Brown, R.G.B. 1986. Revised Atlas of Eastern Canadian Seabirds. Bedford Institute of Oceanography, Dartmouth, NS, and Canadian Wildlife Service, Ottawa, ON.

Burbridge, C. 2011. State of the Scotian Shelf Report: Marine Habitats and Communities. Prepared for the Atlantic Coastal Zone Information Steering Committee [ACZISC]. 31 pp. Available from: http://coinatlantic.ca/docs/marine-habitats-and-communities.pdf

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: effects of spill volume. Mar. Pollut. Bull., 26: 140-143.

Burke, C.M., Montevecchi, W.A., Wiese, F.K. 2012. Inadequate environmental monitoring around offshore oil and gas platforms on the Grand Bank of Eastern Canada: Are risks to marine birds known? J. Environ. Manage., 104: 121-126.

Butler, R.G., Harfenist, A., Leighton, F.A., Peakall, D.B. 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's storm-petrels: short and long-term effects. J. Appl. Ecol., 25: 125-143.

Calvert, A. 2004. Demographic modeling of populations of the Piping Plover *Charadrius melodus* in Atlantic Canada and implications for conservation planning. Contract report to Canadian Wildlife Service-Atlantic Region, Sackville N.B. 41 pp.

Campana, S.E., Gibson, A.J.F., Fowler, M., Dorey, A., Joyce, W. 2013. Population Dynamics of Northwest Atlantic porbeagle (*Lamna nasus*), with an Assessment of Status and Projections for Recovery. Fisheries and Oceans Canada. Can. Sci. Advis. Sec. Res. Doc. 2012/096. iv + 84pp.

Campana, S.E., Joyce, W., Marks, L. 2003. Status of the Porbeagle Shark (*Lamna nasus*) Population in the Northwest Atlantic in the Context of Species at Risk. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/007.

Campbell, J.S., Simms, J.M. 2009. Status Report on Coral and Sponge Conservation in Canada. Fisheries and Oceans Canada: vii + 87pp.

Canadian Coast Guard. 2006. Visitors Guide to Sable Island, Nova Scotia. Fisheries and Oceans Canada and Canadian Coast Guard, Maritimes Region. Prepared by Gerry Forbes. [updated 2006 June 8; cited 2012 June 26]. Available from: http://www.ccg-gcc.gc.ca/folios/00018/docs/sable-island-visitors-guide-eng.pdf

Cargnelli, L.M., Griesbach, S.J., Berrien, P.L., Morse, W.W., Johnson, D.L., Morse, W.W. 1999a. Haddock, *Melanogrammus aeglefinus*, life history and habitat characteristics. National Marine Fisheries Service, NOAA Technical Memorandum, NMFS-NE-128: 31pp.

Cargnelli, L.M., Griesbach, S.J., Packer, D.B., Berrien, P.L., Johnson, D.L., Morse, W.W. 1999b. Pollock, *Pollachius virens*, life history and habitat characteristics. National Marine Fisheries Service. NOAA Technical Memorandum, NMFS-NE-13: 30pp.

Carls, M.G., Rice, S.D., Hose, J.E. 1999. Sensitivity of fish embryos to weathered crude oil: Part 1. Low-level exposure during incubation causes malformations, genetic damage, and mortality in larval Pacific herring (*Clupea pallasi*). Environ. Toxicol. Chem. 18: 481-493.

CCME [Canadian Council of Ministers of the Environment]. 2002. Sediment Quality Guidelines for the Protection of Aquatic Life. Canadian Environmental Quality Guidelines. Available from: http://st-ts.ccme.ca/

CCME [Canadian Council of Ministers of the Environment]. 2014. Water Quality Guidelines for the Protection of Aquatic Life. Canadian Environmental Quality Guidelines. Available from: http://st-ts.ccme.ca/

CEA Agency [Canadian Environmental Assessment Agency]. 1994. A Reference Guide for the Canadian Environmental Assessment Act: Determining Whether A Project is Likely to Cause Significant Adverse Environmental Effects. Available from: http://www.ceaa-acee.gc.ca/Content/D/2/1/D213D286-2512-47F4-B9C3 08B5C01E5005/Determining_Whether_a_Project_is_Likely_to_Cause_Significant_Adverse_Environmental_Effects.pdf

CEA Agency [Canadian Environmental Assessment Agency]. 2013a. Reference Guide: Considering Aboriginal Traditional Knowledge in Environmental Assessments Conducted Under the *Canadian Environmental Assessment Act, 2012*. Available from: http://www.ceaa-acee.gc.ca/Content/C/3/C/C3C7E0D3-8DB1-47D0-AFC2-A8D4D1EFAAB3/ATK_Reference_Guide-eng.pdf.

CEA Agency [Canadian Environmental Assessment Agency]. 2013b. Operational Policy Statement: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012. [updated May 2013; cited Feb 2014]. Available from: https://www.ceaa-acee.gc.ca/Content/1/D/A/1DA9E048-4B72-49FA-B585-B340E81DD6AE/CEA_OPS_May_2013-eng.pdf

CEA Agency [Canadian Environmental Assessment Agency]. 2013c. Basics of Environmental Assessment. [cited 2014 Jan 15]. Available from: http://www.ceaa-acee.gc.ca/default.asp?lang=en&n=B053F859-1#gen04

CEA Agency [Canadian Environmental Assessment Agency]. 2013d. Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012. Available from: https://www.ceaa-acee.gc.ca/default.asp?lang=En&n=1B095C22-1

CEA Agency [Canadian Environmental Assessment Agency]. 2014. Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the *Canadian Environmental Assessment Act, 2012,* Shelburne Basin Venture Exploration Drilling Project, Shell Canada Limited. Final version issued February 28, 2014. Available from: http://www.ceaa-acee.gc.ca/050/documents/p80058/98476E.pdf.

Chadwick, M. 2004. Proceedings of the Peer Review on Potential Impacts of Seismic Energy on Snow Crab. Gulf Region, DFO Sci. Adv. Sec. Proc. Ser. 2004/045.

Chapman, C.J., Hawkins, A.D. 1969. The Importance of Sound in Fish Behaviour in Relation to Capture by Trawls. FAO Fish. Rep. 62: 717-729.

Chardine, J.W. 1995. The distribution and abundance of aquatic birds in Canada in relation to the threat of oil pollution. In: Frink, L., Ball-Weir, K., Smith, C., editors. Wildlife and Oil Spills: Response, Research, and Contingency Plan. Tri-State Bird Rescue and Research, DE. pp. 23-36.

Choi, J.S., Zisserson, B.M., Cameron, B.J. 2012. Assessment of Scotian Shelf Snow Crab in 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/024. iv + 95 p.

Christian, J.R., Mathieu, A., Buchanan, R.A. 2004. Chronic Effects of Seismic Energy on Snow Crab (*Chionoecetes opilio*). Environ. Stud. Res. Funds Rep. No. 158.

Christian, J.R., Mathieu, A., Thomson, D.H., White, D., Buchanan, R.A. 2003. Effect of Seismic Energy on Snow Crab (*Chionoecetes opilio*). Environ. Stud. Res. Funds Rep. No. 144.

Clark, C.W. 1990. Acoustic behavior of mysticete whales. In: Thomas, J., Kastelein, R., editors. Sensory Abilities of Cetaceans. Plenum Press. pp. 571-583.

Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., Ponirakis, D. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Mar. Ecol. Prog. Ser. 395: 201-222. Available from: http://dx.doi.org/10.3354/meps08402

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environ. Pollut., 33: 1-22.

C-NLOPB [Canadian-Newfoundland and Labrador Offshore Petroleum Board]. 2011. C-NLOPB Responding to SBM Spill by Husky Energy. C-NLOPB Media Centre, Incident Bulletins. 2011 Sept 20. Available from: http://www.cnlopb.nl.ca/ib_sep202011.shtml

C-NLOPB, CNSOPB [Canadian-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board]. 2002. Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity. Available from: http://cnsopb.ns.ca/sites/default/files/pdfs/CompGuidelines.pdf

CNSOPB [Canada-Nova Scotia Offshore Petroleum Resources Board]. n.d.(a). Offshore Activity: Offshore Projects. Available from: http://www.cnsopb.ns.ca/offshore-activity/offshore-projects

CNSOPB [Canada-Nova Scotia Offshore Petroleum Resources Board]. n.d.(b). Environment: Environmental Effects Monitoring. Available from: http://www.cnsopb.ns.ca/environment/environmental-effects-monitoring

CNSOPB [Canadian Nova Scotia Offshore Petroleum Board]. 2011. A Synopsis of Nova Scotia's Offshore Oil and Gas Environmental Effects Monitoring Programs: Summary Report. [cited 2012 July 2]. Available from: http://www.cnsopb.ns.ca/pdfs/EEM_Summary_Report.pdf

CNSOPB [Canadian Nova Scotia Offshore Petroleum Board]. 2012a. Offshore Board Announces Results of Call for Bids NS11-1. Latest News: News for Friday, January 20, 2012. Available from: http://www.cnsopb.ns.ca/news/offshore-board-announces-results-call-bids-ns11-1

CNSOPB [Canadian Nova Scotia Offshore Petroleum Board]. 2012b. News Release: Offshore Board Announces Results of Call for Bids NS12-1. (For Immediate Release on November

16, 2012). 2pp. Available from: http://www.cnsopb.ns.ca/sites/default/files/pdfs/final_bids_award_news_release_nov_16.pdf

CNSOPB [Canadian Nova Scotia Offshore Petroleum Board]. 2012c. Marine Protected Area: The Gully. [cited 2012 July]. Available from: http://cnsopb.ns.ca/marine_protected_area.pdf

CNSOPB [Canadian Nova Scotia Offshore Petroleum Board]. 2013. Geoscience: Regional Geology. Available from: http://cnsopb.ns.ca/geoscience/geoscience-overview/regional-geology

Cochonat, P., Masson, D., Armigliato, A., Bornhold, B., Camerlenghi, A., Cagatay, N., Favali, P., Kvalstad, T., Kopf, A., Lykousis, V., *et al.* 2007. History, monitoring and prediction of geohazards. In: Cochonat, P., Dürr, S., Gunn, V., Herzig, P., Mevel, C., Mienert, J., Schneider, R., Weaver, P.P.E., Winkler, A., editors. The Deep-Sea Frontier: Science Challenges for a Sustainable Future. 52 pp: 9-15.

Cogswell, A.T., Kenchington, E.L.R., Lirette, C.G., MacIsaac, K., Best, M.M., Beazley, L.I., Vickers, J. 2009. The Current State of Knowledge Concerning the Distribution of Coral in the Maritime Provinces. Can. Tech. Rep. Fish. Aquat. Sci. 2855: v + 66 p.

Colavecchia, M.V., Backus, S.M., Hodson, P.V., Parrott, J.L. 2004. Toxicity of oil sands to early life stages of fathead minnows (*Pimephales promelas*). Environ. Toxicol. Chem., 23: 1709-1718.

Cormack, D., Nichols, J.A. 1977. The Concentrations of Oil in Sea Water Resulting from Natural and Chemically Induced Dispersion of Oil Slicks. 1977 International Oil Spill Conference.

Cornell Lab of Ornithology. 2014. eBird. [cited 2014 Jan]. Available from: http://ebird.org/ebird/map/

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2002a. COSEWIC Assessment and Update Status Report on the Northern Bottlenose Whale *Hyperoodon ampullatus* (Scotian Shelf population) in Canada. Committee on the Status of Endangered Wildlife in Canada. [cited 2012 July 3] Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2002b. COSEWIC Assessment and Update Status Report on the Blue Whale *Balaenoptera musculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 32pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2004. COSEWIC Assessment and Status Report on the Striped Bass *Morone saxatilis* in Canada.

Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006a. COSEWIC Assessment and Status Report on the Blue Shark *Prionace glauca* (Atlantic and Pacific populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 46pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006b. COSEWIC Assessment and Status Report on the White Shark *Carcharodon carcharias* (Atlantic and Pacific populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 31pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006c. COSEWIC Assessment and Update Status Report on the Harbour Porpoise *Phocoena phocoena* (Northwest Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 32pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006d. COSEWIC Assessment and Update Status Report on the Sowerby's Beaked Whale *Mesoplodon bidens* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 20pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006e. COSEWIC Assessment and Update Status Report on the Ivory Gull *Pagophila eburnean* in Canada. Ottawa. vi + 42 pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2006f. COSEWIC Assessment and Update Status Report on the Shortfin Mako (Atlantic population) *Isurus oxyrinchus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2007a. COSEWIC Assessment and Status Report on the Roughhead Grenadier *Macrourus berglax* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 40pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2007b. COSEWIC Assessment and Status Report on the Red Knot *Calidris canutus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. vii + 58 pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2008a. COSEWIC Assessment and Status Report on the Roundnose Grenadier *Coryphaenoides rupestris* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 42pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2008b. COSEWIC Assessment and Update Status Report on the Killer Whale *Orcinus orca* (Southern Resident population, Northern Resident population, West Coast Transient population, Offshore population and Northwest Atlantic / Eastern Arctic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 65pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2009a. COSEWIC Assessment and Status Report on the Savannah Sparrow *princeps* subspecies *Passerculus sandwichensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 21pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2009b. COSEWIC Assessment and Status Report on the American Plaice *Hippoglossoides platessoides* (Maritime population, Newfoundland and Labrador population and Arctic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 74pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2009c. COSEWIC Assessment and Status Report on the Basking Shark *Cetorhinus maximus* (Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 56pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2009d. COSEWIC Assessment and Update Status Report on the Roseate Tern *Sterna dougallii* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. vii + 48 pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2010a. COSEWIC Assessment and Status Report on the Atlantic Salmon *Salmo salar* (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Quebec Western North Shore population, Anticosti Island population, Inner St. Lawrence population, Lake Ontario population, Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2010b. COSEWIC Assessment and Status Report on the Spiny Dogfish *Squalus acanthias* (Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 50pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2010c. COSEWIC Assessment and Status Report on the Deepwater Redfish/ Acadian Redfish Complex *Sebates mentella* and *Sebates faciatus*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 80pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2010d. COSEWIC Assessment and Status Report on the Atlantic Cod *Gadus morhua* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 105pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2010e. COSEWIC Assessment and Status Report on the Loggerhead Sea Turtle *Caretta caretta* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii+ 75pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2011a. COSEWIC Assessment and Status Report on the Atlantic Sturgeon *Acipenser oxyinchus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii +50pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2011b. COSEWIC Assessment and Status Report on the Northern Bottlenose Whale in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii +31pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012a. COSEWIC Assessment and Status Report on the Thorny Skate *Amblyraja radiata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 75pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012b. COSEWIC Assessment and Status Report on the Atlantic Wolffish *Anarhichas lupus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 56pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012c. COSEWIC Assessment and Status Report on the American Eel *Anguilla rostrata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 109pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012d. COSEWIC Assessment and Status Report on the Northern Wolffish *Anarhichas denticulatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 41pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012e. COSEWIC Assessment and Status Report on the Spotted Wolffish *Anarhichas minor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 44pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

COSEWIC [Committee on the Status of Endangered Wildlife in Canada]. 2012f. COSEWIC Assessment and Status Report on the Leatherback Sea Turtle *Dermochelys coriacea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 58pp. Available from: http://www.sararegistry.gc.ca/default_e.cfm

Couillard, C.M.A. 2002. Microscale test to measure petroleum oil toxicity to mummichog embryos. Environ. Toxicol., 17: 195-202.

Cranford, P.J., Armsworthy, S.L., McGee, S. King, T. Lee, K., Tremblay, G.H. 2005. Scallops as sentinel organisms for offshore environmental effects monitoring. In: Armsworthy, S.L. Cranford, P.J., Lee, K., editors. Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies, Battelle Press, Columbus, OH. 631pp: 267-296

Cranford, P.J., Gordon, Jr., D.C. 1992. The influence of dilute clay suspensions on sea scallop (*Placopecten magellanicus*) feeding activity and tissue growth. Neth. J. Sea Res., 30: 107-120.

Cranford, P.J., Gordon, Jr., D.C., Lee, K., Armsworthy, S.L., Tremblay, G.-H. 1999. Chronic toxicity and physical disturbance effects of water-and oil-based drilling fluids and some major constituents on adult sea scallops (*Placopecten magellanicus*). Mar. Environ. Res., 48: 225-256.

Cripps, G.C., Shears, J. 1997. The fate in the marine environment of a minor diesel fuel spill from an Antarctic research station. Environ. Monit. Assess., 46(3): 221-232.

CWS [Canadian Wildlife Service]. 2013a. Monitoring Terns in Nova Scotia: Census Techniques, Population Trends, and Colony Dynamics. Draft technical report obtained from CWS December 2013.

CWS [Canadian Wildlife Service]. 2013b. Unpublished data. Report of Harlequin Surveys in Eastern Canada in 2013.

D'Amico, A., Gisiner, R.C., Ketten, D.R., Hammock, J.A., Johnson, C., Tyack, P.L., Mead, J. 2009. Beaked whale strandings and naval exercises. Aquat. Mamm., 35(4): 452-472.

Dahlheim, M.E., Ljungblad, D.K. 1990. Preliminary hearing study on gray whales 12 (*Eschrichtius robustus*) in the field. In: Thomas, J., Kastelein, R., editors. 13 Sensory Abilities of Cetaceans. New York: Plenum Press. pp. 335-346.

Dahlheim, M.E., Matkin, C.O. 1994. Assessment of injuries to Prince William Sound killer whales. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez. Academic Press, San Diego, CA. 395 pp: 163-171.

Daling, P.S., Indrebo, G. 1996. Recent Improvements in Optimizing use of Dispersants as a Cost-effective Oil Spill Countermeasure Technique. International Conference on Health, Safety and Environment, New Orleans, 9-12 June 1996.

Daury, R.W., Bateman, M.C. 1996. The Barrow's Goldeneye (*Bucephala islandica*) in the Atlantic Provinces and Maine. Regional report. Canadian Wildlife Service, Atlantic Region, Sackville, Canada.

Davenport, J., Angel, M.V., Gray, J.S., Crisp, D.J., Davies, J.M. 1982. Oil and planktonic ecosystems (and Discussion). Phil. Trans. R. Soc. Lond. B., 297(1087): 369-384. doi: 10.1098/rstb.1982.0048

Day, R.H., Murphy, S.M., Wiens, J.A., Hayward, G.D., Harner, E.J., Smith, L.N. 1997. Effects of the Exxon Valdez oil spill on habitat use by birds in Prince William Sound, Alaska. Ecol. Appl., 7: 593-613.

DCENR [Department of Communications, Energy and Natural Resources]. 2007. Second Strategic Environmental Assessment for Oil and Gas Activity in Ireland's Offshore Atlantic Waters: IOSEA2 Porcupine Basin. Environmental Report. Prepared by ERT (Scotland) Ltd. and Aqua-Fact International Services.

De Robertis, A., Handegard, N.O. 2013. Fish avoidance of research vessels and the efficacy of noise-reduced vessels: A review. ICES J. Mar. Sci/J. Conseil. 70(1): 34-45.

DeRuiter, S.L., Tyack, P.L., Lin, Y.-T., Newhall, A.E., Lynch, J.F., Miller, P.J.O. 2006. Modeling acoustic propagation of airgun array pulses recorded on tagged sperm whales (*Physeter macrocephalus*). J. Acoust. Soc. Am., 120(6): 4100-4114.

Desharnais, F., Collison, N.E.B. 2001. Background Noise Levels in the Area of the Gully, Laurentian Channel and Sable Bank. Prepared for Fisheries and Oceans Canada, Oceans and Coastal Management Division, by Defense Research Establishment Atlantic, April 2001. (DREA ECR 2001-028).

DFO [Fisheries and Oceans Canada]. 1997. DFO Stock Status Report B3-06. Scotian Shelf Capelin. 3 pp.

DFO [Fisheries and Oceans Canada]. 1999. Update on the Status of Unit 3 Redfish, 1999. DFO Can. Sci. Advis. Sec. Res. Doc. 99/152.

DFO [Fisheries and Oceans Canada]. 2001. Update on the Status of Redfish Stocks in the Northwest Atlantic: Redfish in Units 1 and 2 and Division 3O. DFO Science Stock Status Report. B4-03 (2001).

DFO [Fisheries and Oceans Canada]. 2002a. Monkfish on the Scotian Shelf and Northeast Georges Bank (Div. 4VWX and 5Zc). DFO Science Stock Status Report A3-30(2002).

DFO [Fisheries and Oceans Canada]. 2002b. Canada's Ocean Strategy: Our Oceans, Our Future: Canada's Ocean Strategy. Fisheries and Oceans Canada, Oceans Directorate: Ottawa, Ontario. 39pp. Available from: http://www.dfo-mpo.gc.ca/oceans/publications/cos-soc/pdf/cos-soc-eng.pdf

DFO [Fisheries and Oceans Canada]. 2004a. Potential Impacts of Seismic Energy on Snow Crab. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/003.

DFO [Fisheries and Oceans Canada]. 2004b. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. Habitat Status Report 2004/002, September 2004.

DFO [Fisheries and Oceans Canada]. 2005a. The Scotian Shelf: An Atlas of Human Activities. [cited 6 Dec 2013]. Published by the Oceans and Coastal Management Division, Oceans and Habitat Branch, Dartmouth NS. Available [archived] from: http://www.inter.dfo-mpo.gc.ca/Maritimes/Oceans/OCMD/Atlas/Human-Use-Atlas

DFO [Fisheries and Oceans Canada]. 2005b. Framework for Classification and Characterization of Scotia-Fundy Benthic Habitats. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/071.

DFO [Fisheries and Oceans Canada]. 2006. Coral Conservation Plan: Maritimes Region (2006-2010). Oceans and Coastal Management Report 2006-01. Prepared by: ESSIM Planning Office, Oceans and Coastal Management Division, Oceans and Habitat Branch, Maritimes Region. Fisheries and Oceans Canada, Bedford Institute of Oceanography. Available from: http://www.mar.dfo-mpo.gc.ca/folios/00260/docs/322312.pdf

DFO [Fisheries and Oceans Canada]. 2007a. Statement of Canadian Practice with Respect to the Mitigation of Seismic Sound in the Marine Environment. Available from: http://www.dfo-mpo.gc.ca/oceans/management-gestion/integratedmanagement-gestionintegree/seismic-sismique/pdf/statement-enonce-eng.pdf

DFO [Fisheries and Oceans Canada]. 2007b. Assessment of Spiny Dogfish in Atlantic Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/046.

DFO [Fisheries and Oceans Canada]. 2008a. Marine Protected Area: The Gully. [cited 2012 July 3]. Available from: http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/mpa-zpm/atlantic-atlantique/factsheets-feuillets/gully-eng.htm

DFO [Fisheries and Oceans Canada]. 2008b. Aboriginal Fisheries Strategy. [cited 2012 July 24]. Available from: http://www.dfo-mpo.gc.ca/fm-gp/aboriginal-autochtones/afs-srapa-eng.htm

DFO [Fisheries and Oceans Canada]. 2009a. Aquatic Species at Risk-The Spotted Wolffish. Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/spottedwolf-louptachete-eng.htm

DFO [Fisheries and Oceans Canada]. 2009b. Aquatic Species at Risk-The Northern Wolffish. Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/northernwolffish-loupatetelarge-eng.htm

DFO [Fisheries and Oceans Canada]. 2009c. Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas. Available from: http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/benthi-eng.htm

DFO [Fisheries and Oceans Canada]. 2009d. Contaminant Monitoring in the Gully Marine Protected Area. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/002. 15pp. Available from: http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/SAR-AS/2009/2009_002_e.pdf

DFO [Fisheries and Oceans Canada]. 2009e. Marine Protected Areas on the Eastern Scotian Shelf: Selecting the Next Area of Interest [Consultation booklet]. DFO/2009-1625. Available from: http://www.inter.dfo-mpo.gc.ca/folios/00263/docs/AOI_Consultation_Booklet_FINAL.pdf

DFO [Fisheries and Oceans Canada]. 2009f. Underwater World: Atlantic Halibut-Estuary and Gulf of St. Lawrence (Canadian East Coast). Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/atlantichalibut-fletanatlantique-eng.html

DFO [Fisheries and Oceans Canada]. 2009g. Proceedings of a Workshop on Canadian Science and Management Strategies for Atlantic Hagfish [22-23 October 2007]. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/009. Available from: http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/Pro-CR/2009/2009_009_e.pdf

DFO [Fisheries and Oceans Canada]. 2009h. Underwater World: Yellowtail Flounder, Western North Atlantic Ocean. Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/yellowtailflounder-limandeaqueuejaune-eng.html

DFO [Fisheries and Oceans Canada]. 2009i. Underwater World: Short-Finned Squid, North American Atlantic coast. Available from: http://www.dfo-mpo.gc.ca/Science/publications/uww-msm/articles/shortfinnedsquid-calmaranageoirescourtes-eng.html

DFO [Fisheries and Oceans Canada]. 2010a. Aquatic Species at Risk-The Shortfin Mako, Atlantic Population. Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/shortfinmako-requintaupebleu-eng.htm

DFO [Fisheries and Oceans Canada]. 2010b. Aquatic Species -Details for Monkfish. Available from: http://www.dfo-mpo.gc.ca/species-especes/aquatic-aquatique/monkfish-baudroie-amerique-eng.htm

DFO [Fisheries and Oceans Canada]. 2010c. Aquatic Species-Details for Witch Flounder. Available from: http://www.dfo-mpo.gc.ca/species-especes/aquatic-aquatique/witch-flounder-plie-grise-eng.htm

DFO [Fisheries and Oceans Canada]. 2011a. The Marine Environment and Fisheries of Georges Bank, Nova Scotia: Consideration of the Potential Interactions Associated with Offshore Petroleum Activities. DFO Can. Tech. Rep. Fish. Aquat. Sci. 2945: xxxv + 492pp. Available from: http://www.dfo-mpo.gc.ca/Library/344232.pdf

DFO [Fisheries and Oceans Canada]. 2011b. Considerations for the Estimation of Incidental Catch in the Eastern Canadian Swordfish/Other Tunas Longline Fishery. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/057.

DFO [Fisheries and Oceans Canada]. 2011c. Using Satellite Tracking Data to Define Important Habitat for Leatherback Turtles in Atlantic Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/036. Available from: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2012/2012_036-eng.pdf

DFO [Fisheries and Oceans Canada]. 2011d. Recovery Potential Assessment for Northern Bottlenose Whales (*Hyperoodon ampullatus*) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/031. Available from: http://www.dfo-mpo.gc.ca/Csas-sccs/publications/sar-as/2011/2011_031-eng.pdf

DFO [Fisheries and Oceans Canada]. 2012a. Assessment of the Status of 4X5Y Haddock in 2011, 2012. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/023.

DFO [Fisheries and Oceans Canada]. 2012b. Reference Points for Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in the Northwest Atlantic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/004. (Erratum: June 2013)

DFO [Fisheries and Oceans Canada]. 2012c. Ice Navigation in Canadian Waters. Icebreaking Program, Navigational Services Directorate, Fisheries and Oceans Canada, Canadian

Coast Guard, Ottawa, ON. Available from: http://www.ccg-gcc.gc.ca/folios/00913/docs/ice-navigation-dans-les-galces-eng.pdf

DFO [Fisheries and Oceans Canada]. 2013a. Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting. Available from: http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html.

DFO [Fisheries and Oceans Canada]. 2013b. 2011 Value of Atlantic Coast Commercial Landings, by Region. Preliminary data.

DFO [Fisheries and Oceans Canada]. 2013c. Facts on Canadian Fisheries: Lobster. [cited 2013 Dec 17]. Available from: http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/lobster-homard-eng.htm

DFO [Fisheries and Oceans Canada]. 2013d. Habitat Closures will Protect Globally-Unique Sponge Grounds. Backgrounder. Available from: http://www.dfo-mpo.gc.ca/media/back-fiche/2013/hq-ac22a-eng.htm

DFO [Fisheries and Oceans Canada]. 2013e. Satellite Tagging Uncovers Surprising Birthing Ground of Porbeagle Sharks. Available from: http://www.dfo-mpo.gc.ca/science/publications/article/2011/01-24-11-eng.html

DFO [Fisheries and Oceans Canada]. 2013f. Aquatic Species at Risk-Cusk. Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/cusk-brosme-eng.htm

DFO [Fisheries and Oceans Canada]. 2013g. Recent Oceanographic Conditions Over the Scotian Slope/Rise. Atlantic Zone Off-Shelf Monitoring Program. Available from: http://www.bio.gc.ca/science/monitoring-monitorage/azomp-pmzao/slope-pente/conditions-eng.php

DFO [Fisheries and Oceans Canada]. 2013h. Aquatic Species at Risk-Atlantic Cod (Newfoundland and Labrador population). Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/atlanticcod-morue_nl-tnl-eng.htm

DFO [Fisheries and Oceans Canada]. 2013i. Aquatic Species at Risk-American Plaice (Maritime population) Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/american-plaice-plie-eng.htm

DFO [Fisheries and Oceans Canada]. 2013j. Aquatic Species at Risk-American Eel. Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/eel-anguille-eng.htm

DFO [Fisheries and Oceans Canada]. 2013k. Aquatic Species at Risk-Acadian Redfish (Atlantic population). Available from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/acadia-redfish-sebaste-acadie-eng.html#information

DFO [Fisheries and Oceans Canada]. 2013l. Underwater World: White Hake (Western Atlantic Ocean population). Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/whitehake-merlucheblanche-eng.html

DFO [Fisheries and Oceans Canada]. 2013m. Underwater World: North American lobster (Northwest Atlantic population). Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/americanlobster-homarddamerique-eng.html

DFO [Fisheries and Oceans Canada]. 2013n. Managed Fisheries-Jonah Crab. Available from: http://www.bio.gc.ca/science/research-recherche/fisheries-pecheries/managed-gere/jonah-nordique-eng.php

DFO [Fisheries and Oceans Canada]. 2013o. Search Aquatic Species at Risk: Aquatic Species at Risk in Canadian Waters. Available from: http://www.dfo-mpo.gc.ca/species-especes/listing-eng.htm

DFO [Fisheries and Oceans Canada]. 2013p. Facts on Canadian Fisheries: Haddock. Available from: http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/haddock-aiglefin-eng.htm

DFO [Fisheries and Oceans Canada]. 2013q. Underwater World: Sandlance. Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/sandlance-lancon-eng.htm

DFO [Fisheries and Oceans Canada]. 2013r. 2012 Assessment of 4VWX Silver Hake. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/018. Available from: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_018-eng.pdf

DFO [Fisheries and Oceans Canada]. 2013s. Underwater World: The Witch Flounder. Available from: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/witchflounder-pliegrise-eng.htm

DFO [Fisheries and Oceans Canada]. 2013t. Facts on Canadian Fisheries: Shrimp. Available from: http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/shrimp-crevette-eng.htm

DFO [Fisheries and Oceans Canada]. 2013u. Fisheries Protection Policy Statement. Available from: http://www.dfo-mpo.gc.ca/pnw-ppe/pol/index-eng.html

DFO [Fisheries and Oceans Canada]. 2013v. Ocean and Ecosystem Science Seminar Series. [cited 2013 Dec 10]. Available from: http://www2.mar.dfo-mpo.gc.ca/bin/cgi/ocean/biosem/biosem.pl?startdate=01-12-2010&language=English

DFO [Fisheries and Oceans Canada]. 2013w. Fisheries and Oceans Canada Provides Expertise to Assess the Impacts of Gulf of Mexico Oil Spill. [cited 2014 April]. Available from: http://www.dfo-mpo.gc.ca/science/publications/article/2012/07-06-12-eng.html

DFO [Fisheries and Oceans Canada]. 2013x. Assessment of Lobster (*Homarus americanus*) in Lobster Fishing Area (LFA) 34. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/024. Available from: http://publications.gc.ca/collections/collection_2013/mpo-dfo/Fs70-6-2013-024-eng.pdf

Diamond, T. 2013. Spreadsheet titled "MSI seabird status Tony Diamond." Obtained from CWS December 2013.

Doherty, P., Horsman, T. 2007. Ecologically and Biologically Significant Areas of the Scotian Shelf and Environs: A Compilation of Scientific Expert Opinion. DFO Can. Tech. Rep. Fish. Aquat. Sci. 2774: 57 + xii pp.

Dooling, R.J., Therrien, S.A. 2012. Hearing in birds: what changes from air to water. In: Popper, A.N., Hawkins, A., editors. The Effects of Noise on Aquatic Life: Advances in Experimental Medicine and Biology. Vol. 730, pp. 77-82.

Dow Piniak, W.E., Mann, D.A., Eckert, S.A., Harms, C.A. 2012a. Amphibious hearing in sea turtles. In: Popper, A. N., Hawkins, A., editors. The Effects of Noise on Aquatic Life: Advances in Experimental Medicine and Biology. Vol. 730, pp. 83-87.

Dow Piniak, W.E., Eckert, S.A., Harms, C.A., Stringer, E.M. 2012b. Underwater hearing sensitivity of the leatherback sea turtle (*Dermochelys coriacea*): Assessing the potential effect of anthropogenic noise. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156; 35pp.

Drinkwater, K.F., Mountain, D.B., Herman, A. 1998. Northwest Atlantic Fisheries Organization (NAFO) Scientific council meeting-June 1998: Recent changes in the hydrography of the Scotian Shelf and Gulf of Maine-A return to conditions of the 1960s? Serial No. N3024. NAFO SCR Doc. 98/37; 16pp. Available from: http://archive.nafo.int/open/sc/1998/scr-98-037.pdf

Earthquakes Canada. 2013. Earthquake Search (On-line Bulletin). Natural Resourses Canada. [cited 2013 Dec 3]. Available from: http://www.earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bull-eng.php

Edds, P.L., Macfarlane, J.A.F. 1987. Occurrence and general behavior of balaenopterid cetaceans summering in the St. Lawrence Estuary, Canada. Can. J. Zool., 65: 1363-1376.

Encana [Encana Energy Corporation]. 2002. Deep Panuke Offshore Gas Development. Comprehensive Study Report. Available from: http://www.ceaa-acee.gc.ca/68D50708-docs/report_e.pdf

Encana [Encana Energy Corporation]. 2005. CEAA Environmental Assessment. Vertical seismic profiles (VSPs) on Lower Musquodoboit, Margaree, Huckleberry, Grand Pre, and Cohasset. 18pp. Canadian Environmental Assessment Registry: 05-01-15110; Canada-Nova Scotia Offshore Petroleum Board: 30,008.20

Encana [Encana Energy Corporation]. 2006. Deep Panuke Environmental Assessment Report. Volume 4 [Document No. DMEN-X00-RP-RE-00-0005 Rev 01U]. Available from: http://www.cnsopb.ns.ca/pdfs/1.pdf and http://www.cnsopb.ns.ca/pdfs/2.pdf

Encana [Encana Energy Corporation]. 2013. Deep Panuke. [updated 2013 Dec 9]. Available from: http://www.encana.com/operations/canada/deep-panuke.html

Engelhardt, F.R. 1978. Petroleum hydrocarbons in Arctic ringed seals, *Phoca hispida*, following experimental oil exposure. In: Proceedings of the Conference on the Assessment of the Ecological Impacts of Oil Spills, 14-17 June 1978, Keystone, CO. American Institute of Biological Science: 614-628.

Engelhardt, F.R. 1982. Hydrocarbon metabolism and cortisol balance in oil exposed ringed seals, *Phoca hispida*. Comp. Biochem. Physiol., 72C: 133-136.

Environment Australia. 2003. Recovery Plan for Marine Turtles in Australia. Prepared by the Marine Species Section Approvals and Wildlife Division, Environment Australia in consultation with the Marine Turtle Recovery Team Canberra [cited 7 March 2011] Available from: www.environment.gov.au/coasts/publications/turtle-recovery/index.html

Environment Canada. 2006. Recovery Strategy for the Roseate Tern (*Sterna dougallii*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. vii + 37pp.

Environment Canada. 2007. Management Plan for the Harlequin Duck (*Histrionicus histrionicus*) Eastern Population, in Atlantic Canada and Québec. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. vii + 32 pp.

Environment Canada. 2010. Amended Recovery Strategy for the Roseate Tern (*Sterna dougallii*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. vii + 36pp.

Environment Canada. 2011. Management Plan for the Barrow's Goldeneye (*Bucephala islandica*), Eastern Population, in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iv + 15 pp.

Environment Canada. 2012a. Recovery Strategy for the Piping Plover (Charadrius melodus melodus) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. v + 29 pp.

Environment Canada. 2012b. Sea Ice Climatic Atlas for the East Coast 1981-2010. Canadian Ice Service. Available from: http://www.ec.gc.ca/glaces-ice/

Environment Canada. 2012c. Canadian Tropical Cyclone Season Summaries for 2010-2012. Storm Track Maps. Available from: http://www.ec.gc.ca/ouragans-hurricanes/default.asp?lang=En&n=D50DD0ED-1

Environment Canada. 2013a. Canadian Climate Normals 1971-2000. Station Data-Sable Island, Nova Scotia. Available from: http://climate.weather.gc.ca/climate_normals/results_e.html?stnID=6454&lang=e&dCode=0&province=NS&provBut=Go&month1=0&month2=12

Environment Canada. 2013b. Learn About Hurricanes. Canadian Hurricane Center. Available from: http://www.ec.gc.ca/ouragans-hurricanes/default.asp?lang=En&n=77977664-1

Environment Canada. 2013c. National Air Pollution Surveillance Program (NAPS). Available from: http://www.ec.gc.ca/rnspa-naps/

Environment Canada. 2013d. Canadian Wildlife Service, Atlantic Canada Colonial Waterbird database. Spreadsheet titled "Other seabirds and colonies Nova Scotia-Bay of Fundy" obtained December 2013.

Environment Canada. 2013e. Canadian Wildlife Service, Atlantic Canada Colonial Waterbird database. Spreadsheet titled "Gull survey Nova Scotia 2013" obtained December 2013.

Environment Canada. 2013f. Canada's Lightning Detection Network. Available from: http://ec.gc.ca/foudre-lightning/default.asp?lang=En&n=D88E34E8-1

Eppley, Z.A. 1992. Assessing indirect effects of oil in the presence of natural variation: The problem of reproductive failure in South Polar Skuas during the Bahia Paraiso oil spill. Mar. Pollut. Bull., 25: 307-312.

Eppley, Z.A., Rubega, M.A. 1990. Indirect effects of an oil spill: Reproductive failure in a population of South Polar Skuas following the 'Bahia Paraiso' oil spill in Antarctica. Mar. Ecol.-Prog. Ser., 67: 1-6.

Erbe, C. 2002. Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. Mar. Mamm. Sci., 18(2): 394-418.

ERC [Environmental Research Consulting]. 2014. Analysis of Potential Blowouts and Spills from Offshore Wells and Activities: Perspectives on Shelburne Basin Venture Exploration Drilling Project. [2014 Jan 17] Prepared by Etkin, D.S. for Shell Canada Limited, Stantec Consulting Ltd., RPS ASA.

Erikson, D.E. 1995. Surveys of Murre colony attendance in the Northern Gulf of Alaska following the Exxon Valdez oil spill. In: Wells, P.G., Butler, J.N., Hughes, J.S., editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM STP 1219. American Society for Testing and Materials. Philadelphia, PA. 965 pp: 780-819.

Erskine, A.J. 1992. Atlas of the Breeding Birds of the Maritime Provinces. Nimbus Publishing Ltd.and the Nova Scotia Museum. 270 pp.

ESTC [Environmental Science and Technology Centre]. 2013. Spill Technology Database, Oil Technology Database. Available from: http://www.etc-cte.ec.gc.ca/databases/OilProperties/oil_prop_e.html

Esler, D., Bowman, T.D., Trust, K.A., Ballachey, B.E., Dean, T.A., Jewett, S.C., O'Clair, C.E. 2002. Harlequin duck population recovery following the 'Exxon Valdez' oil spill: progress, process and constraints. Mar. Ecol.-Prog. Ser., 241: 271–286.

Etkin, D.S. 2014. Analysis of Potential Blowouts and Spills from Offshore Wells and Activities: Perspectives on Shelburne Basin Venture Exploration Project. Environmental Research Consulting.

ExxonMobil [ExxonMobil Canada Properties Incorporated]. 2012. Annual Report 2011 (Revised). Offshore Environmental Effects Monitoring Program. ExxonMobil Canada Properties-Sable Offshore Energy Project. Available from: http://www.cnsopb.ns.ca/sites/default/files/pdfs/2011_annual_report_-_offshore_eem_-_revision_final.pdf

Fewtrell, J.L., McCauley, R.D. 2012. Impact of air gun noise on the behaviour of marine fish and squid. Mar. Pollut. Bull., 64(5): 984-993.

Fifield, D.A., Lewis, K.P., Gjerdrum, C., Robertson, G.J., Wells, R. 2009. Offshore seabird monitoring program. Environ. Stud. Res. Funds Rep. No. 183: v + 68pp. + App.

Filadelfo, R., Mintz, J., Michlovich, E., D'Amico, A., Tyack, P.L., Ketten, D.R. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aquat. Mamm., 35(4): 435-444.

Fingas, M.F., Kyle, D.A., Laroche, N., Fieldhouse, B., Sergy, G., Stoodley, G. 1995. The effectiveness of oil spill-treating agents. In: Lane, P., editor. The Use of Chemicals in Oil Spill Response. ASTM STP1252, American Society of Testing and Materials, Philadelphia, Pennsylvania, p. 286-298.

Fingas, M.F., Stoodley, R.G., Stone, N., Hollins, R., Bier, I. 1991. Testing the effectiveness of spill-treating agents: laboratory test development and initial results. In: Proceedings of the 1991 International Oil SpillConference. API. Washington, DC.

Fisheries Hydroacoustic Working Group. 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities. Memorandum. Available from: http://www.wsdot.wa.gov/NR/rdonlyres/4019ED62-B403-489C-AF05-5F4713D663C9/0/BA_InterimCriteriaAgree.pdf

FLMNH [Florida Museum of Natural History]. 2013a. Education-Biological Profiles: Black Dogfish. Available from: http://www.flmnh.ufl.edu/fish/Gallery/Descript/Blackdogfish/blackdogfish.html

FLMNH [Florida Museum of Natural History]. 2013b. Education-Biological Profiles: White Marlin. Available from: http://www.flmnh.ufl.edu/fish/Gallery/Descript/whitemarlin/whitemarlin.html

Fodrie, F.J., Heck, Jr., K.L. 2011. Response of coastal fishes to the Gulf of Mexico oil disaster. PLoS ONE, 6(7): e21609. doi: 10.1371/journal.pone.0021609

Fraker, M.A. 2013. Killer whale (*Orcinus orca*) deaths in Prince William Sound, Alaska, 1985–1990, Human and Ecological Risk Assessment: An International Journal, 19(1): 28-52.

Franci, C.D., Guillemette, M., Pelletier, E., Chastel, O., Bonnefoi, S., Verreault, J. 2014. Endocrine status of a migratory bird potentially exposed to the Deepwater Horizon oil spill: A case study of northern gannets breeding on Bonaventure Island, Eastern Canada. Sci. Total Environ. 473-474:110-116. doi: 10.1016/j.scitotenv.2013.12.006

French-McCay, D.P. 2004. Oil spill impact modeling: development and validation. Environ. Toxicol. Chem., 23(10): 2441-2456.

French-McCay, D. 2009. State-of-the-art and research needs for oil spill impact assessment modeling. In: Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 601-653. Available from: http://www.asascience.com/about/publications/pdf/2009/FrenchMcCay_AMOP09-biomodel-with-cite.pdf

French-McCay, D.P., Payne, J.R. 2001. Model of oil fate and water concentrations with and without application of dispersants. In: The Proceedings of the 24th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar. Environment Canada, Ottawa, Canada. pp. 611-645.

French-McCay, D.P., Rowe, J.J., Nordhausen, W., Payne, J.R. 2006. Modeling Potential Impacts of Effective Dispersant Use on Aquatic Biota. In the Proceedings of the 29th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar. Environment Canada, Ottawa, Canada, pp. 855-878.

Frink, L., White, J. 1990. A perspective on the effects of oil on birds. In: The Effects of Oil on Wildlife: Research, Rehabilitation and General Concerns, Proceedings from the Oil Symposium, Herndon, VA, Volume 2, October 16-18, 1990. Presented by International Wildlife Research, Tri-State Bird Rescue and Research, Inc., and International Bird Rescue Research Center, pp. 13-16.

Frost, H. 2004. Fog. Carpstone Press.

Fry, D.M. 1990. Oil exposure and stress effects on avian reproduction. In: The Effects of Oil on Wildlife: Research, Rehabilitation and General Concerns, Proceedings from The Oil Symposium, Herndon, VA, Volume 2, October 16-18, 1990. Presented by International Wildlife Research, Tri-State Bird Rescue and Research, Inc., and International Bird Rescue Research Center.

Gauthreaux, Jr., S.A., Belser, C.G. 2006. Effects of artificial night lighting on migrating birds. In: Rich, C., Longcore, T., editors. Ecological Consequences of Artificial Night Lighting. Island Press, Washington, D.C. pp. 67-93.

Geraci, J.R. 1990. Cetaceans and oil: physiologic and toxic effects. In: Geraci, J.R., St. Aubin, D.J., editors. Sea Mammals and Oil: Confronting the Risks. Academic Press, San Diego, CA. 282 pp: 167-197.

Geraci, J.R., Smith, T.G. 1976. Direct and indirect effects of oil on ringed seals (*Phoca hispida*) of the Beaufort Sea. J. Fish. Res. Board Can., 33: 1976-1984.

Geraci, J.R., St. Aubin, D.J. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev., 42: 1-12.

Geraci, J.R., St. Aubin, D.J. 1982. Study of the Effects of Oil on Cetaceans [Final report]. Report from University of Guelph for US Bureau of Land Management, Washington, DC. NTIS PB83-152991. 274 pp.

Geraci, J.R., St. Aubin, D.J. 1990. Sea mammals and oil: confronting the risks. Academic Press, New York, NY.

Gilde, K., Pinckney, J.L. 2012. Sublethal effects of crude oil on the community structure of estuarine phytoplankton. Estuar. Coast., 35(3): 853-861.

Gjerdrum, C., Allard, K., Bolduc, F. 2012. Pelagic seabird monitoring in the northwest Atlantic. Northwest Atlantic Fisheries Organization. Scientific Council Meeting-June 2012. Serial No. N6055. NAFO SCR Doc. 12/029. Available from: http://archive.nafo.int/open/sc/2012/scr12-029.pdf

Gjerdrum, C., Head, E.J.H., Fifield, D.A. 2008. Monitoring seabirds at sea in eastern Canada. Atlantic Zone Monitoring Program (AZMP) Bulletin No. 7, March 2008: 52-58. Available

from: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/docs/bulletin_7_09.pdf

GMRI [Gulf of Maine Research Institute]. 2014. Atlantic Herring-Biology. Available from: http://www.gma.org/herring/biology/default.asp

González, J.J., Viñas, L., Franco, M.A., Fumega, J., Soriano, J.A., Grueiro, G., Muniategui, S., López-Mahía, P., Prada, D., Bayona, J.M., *et al.* 2009. Spatial and temporal distribution of dissolved/dispersed aromatic hydrocarbons in seawater in the area affected by the Prestige oil spill. Mar. Pollut. Bull., 53(5-7): 250-259.

Goossen, J.P., Amirault-Langlais, D.L., editors. 2009. The 2006 International Piping Plover Census in Canada. Technical Report Series No. 490. Canadian Wildlife Service (Environment Canada), Edmonton, Alberta and Sackville, New Brunswick.

Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., Thompson, D. 2004. A review of the effects of seismic surveys on marine mammals. Mar. Tech. Soc. J., 37(4): 16-34.

Gorsline, J., Holmes, W.N., Cronshaw, J. 1981. The effects of ingested petroleum on the naphthalene-metabolizing properties of liver tissue in seawater-adapted Mallard Ducks (*Anas platyrhynchos*). Environ.Res., 24: 377-390.

Goudie, R.I. 1990. The Status of the Harlequin Duck (*Histrionicus histrionicus*) in eastern North America. Unpublished report to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa.

Government of Canada. 2012. Species Profile Ivory Gull. [cited 2014 Feb]. Available from: http://www.registrelep-sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=50.

Graham, W.M., Condon, R.H., Carmichael, R.H., D'Ambra, I., Patterson, H.K., Linn, L.J., Hernandez, Jr., F.J. 2010. Oil carbon entered the coastal planktonic food web during the Deepwater Horizon oil spill. Environ. Res. Lett., 5(4): 045301, doi:10.1088/1748-9326/5/4/045301

Gramentz, D. 1988. Involvement of loggerhead turtle with the plastic, metal and hydrocarbon pollution in the central Mediterranean. Mar. Pollut. Bull.,19: 11-13.

Haig, S.M., Elliott-Smith, E. 2004. Piping Plover. In: Poole, A., editor. The Birds of North America Online Database. Available from: http://bna.birds.cornell.edu/BNA/account/Piping_Plover/

Hall, R.J., Belisle, A.A., Sileo, L. 1983. Residues of petroleum hydrocarbons in tissues of sea turtles exposed to the Ixtoc 1 oil spill. J. Wildlife Dis.,19: 106-109.

Han, G., Loder, J.W. 2003. Three-dimensional seasonal-mean circulation and hydrography on the eastern Scotian Shelf. J Geophys. Res., 108(C5), 3136. doi:10.1029/2002JC001463

Hardy Associates Ltd.. 1984. Nearshore Marine Fish Habitat in Nova Scotia. Prepared for Fisheries and Oceans Canada.

Harris, R.E., Miller, G.W., Richardson, W.J. 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Mar. Mamm. Sci. 17(4): 795-812.

Hartung, R. 1965. Some effects of oiling on reproduction of ducks. J. Wildlife Manage., 29: 872-874.

Hartung, R. 1995. Assessment of the potential for long-term toxicological effects of the Exxon Valdez oil spill on birds and mammals. In: Wells, P.G. Butler, J.N., Hughes, J.S., editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM STP 1219. American Society for Testing and Materials, Philadelphia, PA. 965 pp: 693-725.

Harvey, J.T., Dahlheim, M.E. 1994. Cetaceans in oil. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez. Academic Press, San Diego, CA. 395 pp: 257-264.

Hassel, A., Knutsen, T., Dalen, J., Løkkeborg, S., Skaar, K., Østensen, Ø., Haugland, E.K., Fonn, M., Høines, Å., Misund, O.A. 2003. Reaction of sandeel to seismic shooting: a field experiment and fishery statistics study. Institute of Marine Research, Bergen, Norway.

Hassel, A., Knutsen, T., Dalen, J., Skaar, K., Løkkeborg, S., Misund, O.A., Ostensen, O., Fonn, M., Haugland, E.K. 2004. Influence of seismic shooting on the lesser sandeel (*Ammodytes marinus*). ICES J. Mar. Sci., 61(7): 1165-1173.

Hastings, M.C., Popper, A.N. 2005. Effects of Sound on Fish. California Department of Transportation Contract 43A0139, Task Order 1. Available from: http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf

Hazel, J., Lawler, I.R., Marsh, H., Robson, S. 2007. Vessel speed increases collision risk for the green sea turtle *Chelonia mydas*. Endang. Species Res., 3: 105-113.

Hebert, D., Petitpas, R., Petrie, B., Brickman, D. 2012. Meteorological, sea ice and physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine during 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/055. iv + 42pp. Available from: http://www.dfo-mpo.gc.ca/Csas-sccs/publications/resdocs-docrech/2013/2013_058-eng.pdf

Heintz, R.A., Short, J.W., Rice, S.D. 1999. Sensitivity of fish embryos to weathered crude oil. Part 2. Environ. Toxicol. Chem., 18: 494-503.

Hegmann, G., Cocklin, C., Creasey, R., Dupuis, S., Kennedy, A., Kingsley, L., Ross, W., Spaling, H., Stalker, D. 1999. Cumulative Effects Assessment Practitioners Guide. Prepared by AXYS

Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec. Available from: https://www.ceaa-acee.gc.ca/Content/4/3/9/43952694-0363-4B1E-B2B3 47365FAF1ED7/Cumulative_Effects_Assessment_Practitioners_Guide.pdf

Hemre, G.I., Taranger, G.L., Hansen, T. 2002. Gonadal development influences nutrient utilization in cod (*Gadus morhua*). Aquaculture, 214: 201-209.

Hendon, L.A., Carlson, E.A., Manning, S., Brouwer, M. 2008. Molecular and developmental effects of exposure to pyrene in the early life-stages of *Cyprinodon variegatus*. Comp. Biochem. Physiol., 147: 205-215.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound. In: Reynolds, J.E., Perrin, W.F., Reeves, R.R., Montgomery, S., Ragen, T.J., editors. Marine Mammal Research: Conservation Beyond Crisis. John Hopkins University Press, Baltimore, Maryland. pp.101-124.

Holand, P. 2013. Blowout and Well Release Characteristics and Frequencies, 2013. SINTEF Report F25705. SINTEF Technology and Society. Trondheim, Norway. 114 pp.

Holmes, W.N., Cronshaw, J., Cavanaugh, K.P. 1978. The effects of ingested petroleum on laying in mallard ducks (*Anas platyrhynchos*). In: Lindstedt-Siva, J., editor. Proceedings of Energy/Environment '78, Los Angeles. Society of Petroleum Industry Biologists. 321 pp: 301-309.

Horsman, T.L., Shackell, N.L. 2009. Atlas of Important Habitat for Key Fish Species of the Scotian Shelf, Canada. DFO Can. Tech. Rep. Fish. Aquat. Sci. 2835 viii + 82pp. Available from: http://www.dfo-mpo.gc.ca/Library/337080.pdf

Houser, D.S., Helweg, D.A., Moore, P.W.B. 2001. A bandpass filter-bank model of auditory 45 sensitivity in the humpback whale. Aquat. Mammals, 27: 82-91.

Hurley, G.V. 2011. Strategic Environmental Assessment-Petroleum Exploration Activities on the Southwestern Scotian Shelf. [Consultant report]. Prepared by Hurley Environment Ltd. for the Canada-Nova Scotia Offshore Petroleum Board: Nov., 2011. 94pp. + App.

Hurley, G., Ellis, J. 2004. Environmental Effects of Exploratory Drilling in Offshore Canada: Environmental Effects Monitoring Data and Literature Review-Final Report. Prepared for the Canadian Environmental Assessment Agency-Regulatory Advisory Committee. 61pp. + App.

Husky Energy. 2011. White Rose Environmental Effects Monitoring Program. Prepared by Jacques Whitford Environment Limited for Husky Energy, St. John's, NL.

Hutt, D.L., Vachon, P.W. 2003. Estimating underwater acoustical parameters from space-based synthetic aperture radar imagery. American Meteorological Society. P6.10. Available from: https://ams.confex.com/ams/pdfpapers/58594.pdf

IAIA [International Association for Impact Assessment]. 1999. Principles of Environmental Impact Assessment Best Practice. Available from: http://www.iaia.org/publicdocuments/special-publications/Principles%20of%20IA_web.pdf

ICCAT [International Commission for the Conservation of Atlantic Tunas]. 2012a. Report of the 2011 Yellowfin Tuna ICCAT Stock Assessment Session.

ICCAT [International Commission for the Conservation of Atlantic Tunas]. 2012b. Report of the 2011 Bigeye Tuna ICCAT Stock Assessment Session.

ICCAT [International Commission for the Conservation of Atlantic Tunas]. 2012c. Report of the 2011 Swordfish ICCAT Stock Assessment Session.

Imber, M. 1975. Behavior of petrels in relation to the moon and artificial lights. Notornis, 22: 302-306.

IMO [International Maritime Organization]. 2007. Routing Measures Other than Traffic Separation Schemes. SN.1/Circ 263. 23 October 2007.

Incardona, J.P., Collier, T.K., Scholz, N.L. 2004. Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. Toxicol. Appl. Pharm., 196: 191-205.

Incardona, J.P., Gardner, L.D., Linbo, T.L., Brown, T.L., Esbaugh, A.J., Mager, E. M. Stieglitz, J.D., French, B.L., Labenia, J.S., Laetz, C.A., *et al.* 2014. Deepwater Horizon crude oil impacts the developing hearts of large predatory pelagic fish. Available from: www.pnas.org/cgi/doi/10.1073/pnas.1320950111

Intertek Moody Marine. 2012. Second Annual Surveillance Report Clearwater Seafoods Ltd.Partnership Eastern Canada Offshore Lobster (*Homarus americanus*), 2012. Canada Offshore Lobster Fishery-Surveillance Report 2 2012.

Irons, D.B., Kendall, S.J., Erickson, W.P., McDonald, L.L., Lance, B.K. 2000. Nine years after the Exxon Valdez oil spill: Effects on marine bird populations in Prince William Sound, Alaska. Condor, 102: 723-737.

Irwin, R.J. 1997. Environmental Contaminants Encyclopedia Crude Oil Entry. National Park Service, Water Resources Divisions, Water Operations Branch, CO.

ITOPF [The International Tanker Owners Pollution Federation Limited]. 2004. Oil Spill Effects on Fisheries. Technical Information Paper No. 3.

James, M.C., Martin, K., Dutton, P.H. 2004. Hybridization between a green turtle, *Chelonia mydas* and loggerhead turtle, *Caretta caretta*, and the first record of a green turtle in Atlantic Canada. Can. Field Nat., 118(4): 579-582.

James, M.C., Ottensmeyer, C.A., Myers, R.A. 2005. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecol. Lett., 8: 195-201.

Jensen, A.S., Silber, G.K. 2003. Large whale ship strike database. US Department of Commerce, *NOAA Technical Memorandum*, NMFS-OPR-25. 37pp.

Jenssen, B.M. 1996. An overview of exposure to, and effects of, petroleum oil and organochlorine pollution in grey seals (*Halichoerus grypus*). Sci. Total Environ., 186: 109-118.

Jewett, S.C., Dean, T.A., Smith, R.O., Blanchard, A. 1999. Exxon Valdez oil spill: impacts and recovery in the soft-bottom benthic community in and adjacent to eelgrass beds. Mar. Ecol.-Prog. Ser.,185: 59-83.

Johansson, S., Larsson, U., Boehm, P. 1980. The Tsesis oil spill-Impact on the pelagic ecosystem. Mar. Pollut. Bull.,11: 284-293.

Johnson, S.R., Richardson, W.J., Yazvenko, S.B., Blokhin, S.A., Gailey, G., Jenkerson, M.R., Meier, S.K., Melton, H.R., Newcomer, M.W., Perlov, A.S., *et al.* 2007. A western gray whale mitigation and monitoring program for a 3D seismic survey, Sakhalin Island, Russia. Environ. Monit. Assess., 134(1-3): 1-19.

JWEL [Jacques Whitford Environment Limited]. 2001a. Kerr-McGee Offshore Canada Ltd. Characterization of Benthic Habitat in the Pinehurst and Pembroke Blocks Exploratory Licenses 2396 and 2386. iii + 45pp.

JWEL [Jacques Whitford Environment Limited]. 2001b. Environmental Assessment of Deepwater Exploration Drilling on Torbrook, Weymouth, Barrington, Plympton, Caledonia, and Highland. Report prepared for PanCanadian Energy Corporation.

JWEL [Jacques Whitford Environment Limited]. 2002a. Environmental Assessment of Exploration Drilling of the Pinehurst and Pembroke Licenses (EL2396 and EL2386). Kerr-McGee Offshore Canada Ltd. vii + 115pp.

JWEL [Jacques Whitford Environment Limited]. 2002b. Deep Panuke Offshore Gas Development Comprehensive Study Report. xiv + 439pp. + App.

JWEL [Jacques Whitford Environment Limited]. 2003. Shell Canada Limited Characterization of Benthic Habitat Exploration Licenses 2381 and 2382. Iii + 53pp.

JWEL [Jacques Whitford Environment Limited]. 2008. Purdy's Shoal Dredging Project. Prepared for Halifax Port Authority, October 2008. [Jacques Whitford Project No. 1017165]. Canadian Environmental Assessment Registry Reference No. 08-01-39530.

Kasuya, T. 1986. Distribution and behavior of Baird's beaked whales off the Pacific coast of Japan. Sci. Rep. Whales Res. Inst., 37: 61-83.

Kenchington, E., Siferd, T., Lirette, C. 2012. Arctic Marine Biodiversity: Indicators for Monitoring Coral and Sponge Megafauna in the Eastern Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/003: v + 37pp.

Kennedy, E., Bennett, L., Campana, S., Clark, K., Comeau, P., Fowler, M., Gjerdrum, C., Gregoire, F., Hannah, C., Harris, L., *et al.* 2011. The Marine Ecosystem of Georges Bank. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/059: xiv + 232pp. (Erratum: October 2011).

Kenny, P. 1993. Ester-based muds show promise for replacing some oil-based muds. Oil Gas J. 91: 88-91.

Ketten, D.R., Bartol, M. 2005. Functional Measures of Sea Turtle Hearing. Woods Hole Oceanographic Institution: ONR Award No: N00014-02-1-0510.

KMKNO [Kwilmu'kw Maw-klusuaqn]. n.d. Mi'kmaq Rights Initiative. Our History. Available from: http://mikmaqrights.com/about-us/our-history/

Kostyvchenko, L.P. 1973. Effects of elastic waves generated in marine seismic prospecting on fish eggs in the Black Sea. Hydrobiol. J., 9: 45-48.

Lacroix, D.L., Lancot, R.B., Reed, J.A., McDonald, T.L. 2003. Effect of underwater seismic surveys on molting male long-tailed ducks in the Beaufort Sea, Alaska. Can. J. Zool., 81: 1862-1875.

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

Larsen, E.M. and S.A. Richardson. 1990. Some effects of a major oil spill on wintering shorebirds at Grays Harbor, Washington. Northwestern Naturalist, 71: 88-92.

Latha, G., Senthilvadivu, S., Venkatesan, R., Rajendran, V. 2005. Sound of shallow and deep water lobsters: measurements, analysis, and characterization (L). J. Acoust. Soc. Am., 117: 2720-2723.

Lebreton, J.D., Hines, J.E., Pradel, R., Nichols, J.D., Spendelow, J.A. 2003. Estimation by capture-recapture of recruitment and dispersal over several sites. Oikos, 101: 253-264.

Lee, K., Armsworthy, S.L., Cobanli, S.E., Cochrane, N.A., Cranford, P.J., Drozdowski, A., Hamoutene, D., Hannah, C.G., Kennedy, E., King, T., *et al.* 2011. Consideration of the

Potential Impacts on the Marine Environment Associated with Offshore Petroleum Exploration and Development Activities. DFO. Can. Sci. Advis. Sec. Res. Doc. 2011/060: xii + 134pp.

Lee, W.Y., Nicol, J.A.C. 1977. The effects of the water soluble fractions of No. 2 fuel oil on thesurvival and behaviour of coastal and oceanic zooplankton. Environ. Pollut., 123: 279-292.

Leighton, F.A. 1993. The toxicity of petroleum oils to birds. Environ. Rev., 1: 92-103.

Leighton, F.A., Butler, R.G., Peakall, D.B. 1985. Oil and Arctic marine birds: an assessment of risk. In: Engelhardt, F.R., editor. Petroleum Effects in the Arctic Environment, Elsevier Applied Science Publishers, London. 281 pp: 183-215.

Leonardi, M.O., Klempau, A.E. 2003. Artificial photoperiod influence on the immune system of juvenile rainbow trout (*Oncorhynchus mykiss*) in the southern hemisphere. Aquaculture, 221: 581-591

LGL [LGL Limited]. 2005. Western Newfoundland and Labrador Offshore Area Strategic Environmental Assessment. LGL Rep. SA8858. Rep. by LGL Limited, St. John's, NL, Oceans Limited, St. John's, NL, Canning and Pitt Associates, Inc., St. John's, NL, and PAL Environmental Services, St. John's, NL, for Canada-Newfoundland and Labrador Offshore Petroleum Board, St. John's, NL. 335pp. + App.

LGL [LGL Limited]. 2013. Environmental Assessment of Shell Canada Limited's Shelburne Basin 3D Seismic Survey in Exploration Licenses 2423, 2424, 2425, and 2426. Prepared for Shell Canada Limited LGL Rep. SA1175. 127p + App

LGL [LGL Limited]. 2014. Final environmental assessment of BP Exploration (Canada) Limited's Tangier 3D Seismic Survey. BP Document NS-HS-REP-BP-01-000 and LGL Rep. SA1222. Rep. by LGL Limited, Mahone Bay, NS and St. John's, NL for BP Exploration Canada Limited, Calgary, AB. 177 p + appendices. Available from: http://www.cnsopb.ns.ca/sites/default/files/pdfs/bp_tangier_seismic_final_environmental_assessment.pdf

LGL, Coastal Ocean Associates, S.L. Ross. 2000. Environmental Assessment of Exploration Drilling at the Adamant N-97 Site on Sable Bank, Nova Scotia. Report for Canada-Nova Scotia Offshore Petroleum Board and Mobil Oil Canada Properties. 29pp.

Ljungblad, D.K., Würsig, B., Swartz, S.L., Keene, J.M. 1988. Observations on the behavioral responses of bowhead whales (*Balaena mysticetus*) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic, 41(3): 183-194.

Lock, A.R., Brown, R.G.B., Gerriets, S.H. 1994. Gazetteer of Marine Birds in Atlantic Canada. An Atlas of Seabird Vulnerability to Oil Pollution. Canadian Wildlife Service, Environmental Conservation Branch, Environment Canada, Atlantic Region. 137 pp.

Lowry, L.F., Frost, K.J., Pitcher, K.W. 1994. Observations of oiling of harbor seals in Prince William Sound. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez. Academic Press, San Diego, CA. 395 pp: 209-225.

Luksenburg, J.A., Parsons, E.C.M. 2009. The effects of aircraft on cetaceans: implications for aerial whalewatching. International Whaling Commission, SC/61/WW2. 10pp. Available from: http://www.researchgate.net/publication/228409420_The_effects_of_aircraft_on_cetaceans_implications_for_aerial_whalewatching/file/9fcfd50b0a3b9d8a7a.pdf

Lutz, P.L., Lutcavage, M., Caillouet, C.W. 1989. The effects of petroleum on sea turtles: applicability to Kemp's Ridley. In: Landry, A.M., editor. Proceedings of the First International symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, October 1-4, 1985, Galvaston, TX, Texas A&M University Sea Grant Program. pp. 52-54.

M&NP [Maritimes and Northeast Pipeline]. 2009. Maritimes and Northeast Pipeline. [updated 2013 Dec 9]. Available from: http://www.mnpp.com/canada/

MacLaren Plansearch [MacLaren Plansearch (1991) Limited]. 1996. Sable Offshore Energy Project. Volume 3: Environmental Impact Statement. Available from: http://www.soep.com/cgi-bin/getpage?pageid=1/15/0&dpa=3/0/0/0

Madsen, P.T. 2005. Marine mammals and noise: problems with root mean square sound pressure levels for transients. J. Acoust. Soc. Am., 117(6): 3952–3957.

Maguire, J.J., Lester, B. 2012. Bluefin tuna (*Thunnus thynnus*) in Atlantic Canadian Waters: Biology, Status, Recovery Potential, and Measures for Mitigation. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/002: vi + 28pp.

Malme, C.I., Miles, P.R., Clark, C.W., Tyack, P., Bird, J.E. 1984. Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior / Phase II: January 1984 Migration. BBN Report 5586 from Bolt Beranek & Newman Inc., Cambridge, MA, for US Minerals Management Service, Anchorage, AK. Various pages.

Malme, C.I., Miles, P.R., Tyack, P., Clark, C.W., Bird, J.E. 1985. Investigation of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Feeding Humpback Whale Behavior. BBN Report 5851 from BBN Labs Inc., Cambridge, MA, for US Minerals Management Service, Anchorage, AK. OCS Study MMS 85-0019.

Malme, C.I., Wursig, B., Bird, J.E., Tyack, P. 1988. Observations of feeding gray whale responses to controlled industrial noise exposure. In: Sackinger, W.M., Jeffries, M.O., editors. Port and Ocean Engineering Under Arctic Conditions. Volumn II. University of Alaska, Fairbanks, AK, Geophys. Inst. 131pp: 55-73.

Manly, B.F.J., Moulton, V.D., Elliott, R.E., Miller, G.W., Richardson, W.J. 2007. Analysis of Covariance of Fall Migrations of Bowhead Whales in Relation to Human Activities and Environmental Factors, Alaskan Beaufort Sea: Phase I, 1996-1998. LGL Rep. TA2799-2; OCS Study MMS 2005-033. Rep. from LGL Limited, King City, Ont., and WEST Inc., Cheyenne, WY, for U.S. Minerals Manage. Serv., Herndon, VA, and Anchorage, AK. 128pp.

Marine Stewardship Council. 2009. Eastern Canada Offshore Lobster. [cited 2013 Dec 17]. Available from: http://www.msc.org/track-a-fishery/fisheries-in-the-program/certified/north-west-atlantic/Eastern-Canada-offshore-lobster.html

Marquenie, J.M., Wagner, J., Stephenson, M.T., Lucas, L. 2014. Green Lighting the Way: Managing Impacts from Offshore Platform Lighting on Migratory Birds. Presentation at the Society of Petroleum Engineers International Conference on Health, Safety and the Environment, Long Beach, California, USA, March 17-19, 2014.

Martin, K.J., Alessi, S.C., Gaspard, J.C., Tucker, A.D., Bauer, G.B., Mann, D.A. 2012. Underwater hearing in the loggerhead turtle (*Caretta caretta*): A comparison of behavioral and auditory evoked potential audiograms. J. Exp. Biol., 215: 3001-3009.

Marty, G.D., Hose, J.E., McGurk, M.D., Brown, E.D., Hinton, D.E. 1997. Histopathology and cytogenetic evaluation of Pacific herring larvae exposed to petroleum hydrocarbons in the laboratory or in Prince William Sound Alaska, after the Exxon Valdez oil spill. Can. J. Fish Aquat. Sci., 54: 1846-1857.

Matkin, C.O., Ellis, G.M., Dahlheim, M.E., Zeh, J. 1994. Status of killer whales in Prince William Sound, 1985-1992. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez, Academic Press, San Diego, CA. 395 pp: 141-162.

Matkin, C.O., Saulitis, E.L., Ellis, G.M., Olesiuk, P., Rice, S.D. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska. Mar. Ecol.-Prog. Ser., 356: 269-281.

Matthews, M.-N.R. 2013. Underwater Sound Modelling of Shell's 2013 Shelburne Basin 3D Seismic Survey. JASCO Document 00421, Version 5.0. Technical report by JASCO Applied Sciences for LGL Limited, Environmental Research Associates.

MBBA [Maritime Breeding Bird Atlas]. 2010. Data Summaries. [cited 2013 Nov]. Available from: http://www.mba-aom.ca/jsp/datasummaries.jsp?lang=en

McAuliffe, C.D., Johnson, J.C., Greene, S.H., Canevari, G.P., Searl, T.D. 1980. Dispersion and weathering of chemically treated crude oils on the ocean. Environ. Sci. Technol.,14(12): 1509-1518. doi: 10.1021/es60172a012

McAuliffe, C.D. 1987. Organism exposure to volatile/soluble hydrocarbons from crude oil spills-a field and laboratory comparison. Proceedings of the 1987 Oil Spill Conference. Washington, DC.: API. pp. 275-288.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A. Murdoch, J., McCabe, K. 2000a. Marine Seismic Surveys: Analysis of Airgun Signals and Effects of Air Gun Exposure on Humpback Whales, Sea Turtles, Fishes and Squid. Report prepared by the Centre for Marine Science and Technology (Report R99-15), Curtin University, Perth, WA, for Australian Petroleum Production Association, Sydney, NSW.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., McCabe, K. 2000b. Marine seismic surveys-A study of environmental implications. Australian Petroleum Producers and Exploration Association. APPEA J., 40: 692-706.

McCauley, R.D., Fewtrell, J., Popper, A.N. 2003. High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am., 113(1): 638-642.

McCauley, R.D., Jenner, M.-N., Jenner, C., McCabe, K.A., Murdoch, J. 1998. The response of humpback whales (*Megaptera novaeangliae)* to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. Australian Petroleum Producers and Exploration Association. APPEA J.

McEwan, E.H., Whitehead, P.M. 1980. Uptake and clearance of petroleum hydrocarbons by the Glaucous-winged Gull (*Larus glaucescens*) and the Mallard Duck (*Anas platyrhynchos*). Can. J. of Zoolog., 58: 723-726.

McGregor [McGregor GeoScience Limited]. 2012. Offshore Environmental Effects Monitoring for Deep Panuke. Program Annual Report 2012. McGregor Project Number: 1113-EEMRDP. Prepared for Encana Corporation. Available from: http://www.cnsopb.ns.ca/sites/default/files/pdfs/2012-1113_eemrdp_rev1.pdf

Mellor, C. 2014. Geoscience gets $12m lift from Nova Scotia taxpayers. The Chronicle Herald [Internet]. 2012 May 13. Available from: http://thechronicleherald.ca/business/1207229-geoscience-gets-12m-lift-from-nova-scotia-taxpayers

Miller, G.W., Elliott, R.E., Koski, W.R., Moulton, V.D., Richardson, W.J. 1999. Whales. In: Richardson, W.J., editor. Marine mammal and acoustical monitoring of western geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998. LGL Rep. TA2230-3. Rep. from LGL Limited, King City, Ont., and Greeneridge Sciences Inc., Santa Barbara, CA, for

Western Geophysical, Houston, TX, and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 390 pp: 5-1 to 5-109.

Miller, G.W., Moulton, V.D., Davis, R.A., Holst, M., Millman, P., MacGillivray, A., Hannay, D. 2005. Monitoring seismic effects on marine mammals-Southeastern Beaufort Sea, 2001-2002. In: Armsworthy, S.L., Cranford, P.J., Lee, K., editors. Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. Battelle Press, Columbus, OH. 631 pp: 511-542.

Milton, S., Lutz, P., Shigenaka, G. 2010. (reprint). Oil Toxicity and Impacts on Sea Turtles In: Shigenaka, G., editor. Oil and Sea Turtles: Biology, Planning, and Response. National Oceanic and Atmospheric Administration, 112 pp.

MGS & UINR [Membertou Geomatics Solutions and Unama'ki Institute of Natural Resources]. 2014. Traditional Use and Mi'kmaq Fisheries of the Shelburne Basin, Nova Scotia: Draft Report. Submitted to Stantec by MGS & UINR, April 17, 2014. 39pp.

MMS [Minerals Management Service]. 2000. Gulf of Mexico Deepwater Operations and Activities. Environmental Assessment. Minerals Management Service, Gulf of Mexico OCS Region. OCS EIS/EA MMS 2000-001.

Moller, T.H., Dicks, B., Whittle, K.J., Girin, M. 1999. Fishing and Harvesting Bans in Oil Spill Response. #095 International Oil Spill Conference. Available from: http://www.itopf.com/_assets/documents/fishban.pdf

Montevecchi, W.A. 2006. Influences of artificial light on marine birds. In: Rich, C., Longcore, T., editors. Ecological Consequences of Artificial Night Lighting. Island Press, Washington, D.C. 478 pp: 94-113.

Montevecchi, W.A., Wiese, F.K., Davoren, G.K., Diamond, A.W., Huettmann, F., Linke, J. 1999. Seabird Attraction to Offshore Platforms and Seabird Monitoring From Offshore Support Vessels and Other Ships: Literature Review and Monitoring Designs. Prepared for the Canadian Association of Petroleum Producers. 56pp.

Moors, H.B. 2012. Acoustic Monitoring of Scotian Shelf Northern Bottlenose Whales (*Hyperoodon ampullatus*). PhD thesis. Dalhousie University. Available from: http://dalspace.library.dal.ca/handle/10222/15238

Mosbech, A., editor. 2002. Potential Environmental Impacts of Oil Spills in Greenland. An Assessment of Information Status and Research Needs. National Environmental Research Institute, Denmark. NERI Technical Report No. 415, 118 pp. Available from: http://technical-reports.dmu.dk

Moulton, V.D., Holst, M. 2010. Effects of Seismic Survey Sound on Cetaceans in the Northwest Atlantic. ESRF Rep.182.

Moulton, V.D. Lawson, J.W. 2002. Seals, 2001. In: Richardson, W.J., Lawson, J.W., editors. Marine mammal monitoring of Western Geco's open-water seismic program in the Alaskan Beaufort Sea, 2001. LGL Rep. TA2564-4. Rep. from LGL Limited, King City, Ont., for WesternGeco LLC, Anchorage, AK; BP Explor. (Alaska) Inc., Anchorage, AK; and Nat. Mar. Fish. Serv., Anchorage, AK, and Silver Spring, MD. 95 pp: 3-1 to 3-46.

Moulton, V.D., Miller, G.W. 2005. Marine mammal monitoring of a seismic survey on the Scotian Slope, 2003. In: Lee, K., Bain, H., Hurley, G.V., editors. Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf Before and During Active Seismic Programs. ESRF Rep 151: xx + 154pp: 29-40.

Müeller-Blenkle, C., Jones, E., Reid, D., Lüdemann, K., Kafemann, R., Elepfandt, A. 2008. Reactions of cod (*Gadus morhua*) to low frequency sound resembling offshore wind turbine noise emissions. Bioacoustics, 17: 207-209.

Murphy, S.M., Mabee, T.J. 1999. Status of Black Oystercatchers in Prince William Sound after the Exxon Valdez Oil Spill. Exxon Valdez Oil Spill Restoration Project. Final Report.

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. n.d. Rebuilding an Appetite for Gulf Seafood after Deepwater Horizon. Staff Working Paper No. 16. Available from: http://permanent.access.gpo.gov/gpo8569/Rebuilding%20an%20Appetite%20for%20Gulf%20Seafood%20after%20Deepwater%20Horizon_0.pdf

NCNS [Native Council of Nova Scotia]. 2009. Memorandum of Association and By-laws of Native Council of Nova Scotia. Available from: http://ncns.ca/bylaws.pdf

NCNS [Native Council of Nova Scotia]. 2013. Native Council of Nova Scotia. [cited 2013 Nov]. Available from: http://ncns.ca/.

NEB, C-NLOPB, CNSOPB [National Energy Board, Canadian Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board]. 2008. Guidelines Respecting Physical Environmental Programs during Petroleum Drilling and Production Activities on Frontier Lands. Minister of Public Works and Government Services Canada. September 2008.

NEB, C-NLOPB, CNSOPB [National Energy Board, Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board]. 2009. Offshore Chemical Selection Guidelines for Drilling and Production Activities on Frontier Lands. iii + 13 pp. Available from: http://www.C-NLOPB.nl.ca/pdfs/guidelines/ocsg.pdf

NEB, C-NLOPB, CNSOPB [National Energy Board, Canada-Newfoundland and Labrador Offshore Petroleum Board and Canada-Nova Scotia Offshore Petroleum Board]. 2010. Offshore Waste Treatment Guidelines. Available from: http://www.C-NLOPB.nl.ca/pdfs/guidelines/owtg1012e.pdf

Neff, J.M. 1985. Polycyclic aromatic hydrocarbons. In: Rand, G.M., Petrocelli, S.R., editors. Fundamentals of Aquatic Toxicology. Washington: Hemisphere Publ. Corp. pp. 416-454.

Neff, J.M. 2005. Composition, Environmental Fates, and Biological Effect of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography. Submitted to Petroleum Environmental Research Form (PERF) and American Petroleum Institute, Duxbury, MA.

Neff, J.M. 2010. Fates and Effects of Water Based Drilling Muds and Cuttings in Cold-Water Environments. Prepared for Shell Exploration and Production Company, Houston, Texas, x + 287pp.

Neff, J.M., Breteler, R.J., Carr, R.S. 1989. Bioaccumulation, food chain transfer, and biological effects of barium and chromium from drilling muds by flounder (*Pseudopleuronectes americanus*) and lobster (*Homarus americanus*). In: Engelhardt, F.R., Ray, J.P., Gillam, A.H., editors. Drilling Wastes. Elsevier Applied Science Publishers, London. pp. 439-460.

Neff, J.M., Kjeilen-Eilersten, G., Trannum, H., Jak, R., Smit, M., Durell, G. 2004. Literature Report on Burial: Derivation of PNEC as Component in the MEMW Model Tool. ERMS Report No. 9B. AM 2004/024. 25pp.

Neff, J.M., McKelvie, S., Ayers, Jr., R.C. 2000. Environmental Impacts of Synthetic Based Drilling Fluids. OCS Study MMS 2000-64. US Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Program, New Orleans, LA. 118pp.

Nelvik Norsk Hydro Ltd. 2010. Image of Nelvik 1-3000 m semi-submersible. Semi-Submersible Drilling Operation. Available from: http://nelvikhydro.ca/submersible.php

NERI [National Environmental Research Institute]. 2011. Underwater Noise from the Drillship Stena Forth in Disko West, Baffin Bay, Greenland. NERI Technical Report No. 838. 34 pp. Available from: http://www2.dmu.dk/pub/fr838.pdf

Nevitt, G.A., Bonadonna, F. 2005. Sensitivity to dimethyl sulphide suggests a mechanism for olfactory navigation by seabirds. Biol. Lett.,1(3): 303-305.

Nisbet, I.C.T., Spendelow, J.A. 1999. Contribution of research to management and recovery of the roseate tern: review of a twelve-year project. Waterbirds, 22: 239-252.

NOAA [National Oceanic and Atmospheric Administration]. 2004. NOAA Technical Memorandum NMFS-NE-191 Essential fish habitat source document: northern shortfin squid, *Illex illecebrosus*, life history and habitat characteristics. Vi + 45pp.

NOAA [National Oceanic and Atmospheric Administration]. 2006. Status of Fisheries Resources off the Northeastern US: Red Hake. Available from: http://www.nefsc.noaa.gov/sos/spsyn/pg/redhake/

NOAA [National Oceanic and Atmospheric Administration]. 2007. What are Ichthyoplankton? Southwest Fisheries Science Center (SWFSC). Available from: http://swfsc.noaa.gov/textblock.aspx?Division=FRD&id=6210.

NOAA [National Oceanic and Atmospheric Administration]. 2009. NOAA's Centre for Tsunami Research: Frequently Asked Question Results. Available from: http://nctr.pmel.noaa.gov/faq_display.php

NOAA [National Oceanic and Atmospheric Administration]. 2010. Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report. 2010 Nov 2: Operational Period 196. Available from: http://www.restorethegulf.gov/sites/default/files/documents/pdf/Consolidated%20Wildlife%20Table%20110210.pdf

NOAA [National Oceanic and Atmospheric Administration]. 2013a. Fish Watch: North Atlantic Albacore tuna. Available from: http://www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/atl_albacore_tuna.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013b. Fish Watch: Atlantic Herring. Available from: http://www.fishwatch.gov/seafood_profiles/species/herring/species_pages/atl_herring.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013c. Fish Watch: Atlantic Mackerel. Available from: http://www.fishwatch.gov/seafood_profiles/species/mackerel/species_pages/atlantic_mackerel.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013d. Fish Watch: Atlantic Bigeye Tuna. Available from: http://www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/atl_bigeye_tuna.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013e. Fish Watch: Western Atlantic Bluefin Tuna. Available from: http://www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/atl_bluefin_tuna.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013f. Fish Watch: North Atlantic Swordfish. Available from: http://www.fishwatch.gov/seafood_profiles/species/swordfish/species_pages/north_atlantic_swordfish.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013g. Fish Watch: Atlantic Yellowfin Tuna. Available from: http://www.fishwatch.gov/seafood_profiles/species/tuna/species_pages/atl_yellowfin_tuna.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013h. Fish Watch: Haddock. Available from: http://www.fishwatch.gov/seafood_profiles/species/haddock/species_pages/haddock.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013i. Fish Watch: Monkfish. Available from: http://www.fishwatch.gov/seafood_profiles/species/haddock/species_pages/monkfish.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013j. Fish Watch: Atlantic Pollock. Available from: http://www.fishwatch.gov/seafood_profiles/species/pollock/species_pages/atlantic_pollock.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013k. Fish Watch: Greenland Turbot. Available from: http://www.fishwatch.gov/seafood_profiles/species/turbot/species_pages/greenland_turbot.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013l. Fish Watch: Yellowtail Flounder. Available from: http://www.fishwatch.gov/seafood_profiles/species/flounder/species_pages/yellowtail_flounder.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013m. Fish Watch: Atlantic Northern Shrimp. Available from: http://www.fishwatch.gov/seafood_profiles/species/shrimp/species_pages/atl_nothern_shrimp.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013n. NOAA Fisheries-Marine Mammal Stock Assessment Reports (SARs) by Species/Stock. Available from: http://www.nmfs.noaa.gov/pr/sars/species.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013o. NOAA Fisheries-Office of Protected Resources. Kemp's Ridley Turtle (*Lepidochelys kempii)*. Available from: http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013p. NOAA Fisheries-Office of Protected Resources. Green Turtle (*Chelonia mydas*). Available from: http://www.nmfs.noaa.gov/pr/species/turtles/green.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013q. Fish Watch: Atlantic Sea Scallop. Available from: http://www.fishwatch.gov/seafood_profiles/species/scallop/species_pages/atlantic_sea_scallop.htm

NOAA [National Oceanic and Atmospheric Administration]. 2013r. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals. Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts. vii + 24pp. + Appendices. Available from: http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf

NOAA [National Oceanic and Atmospheric Administration]. 2013s. NOAA Fisheries: Interim Sound Threshold Guidance. [cited 2013 Aug]. Available from: http://www.nwr.noaa.gov/protected_species/marine_mammals/killer_whale/threshold_guidance.html

NOAA [National Oceanic and Atmospheric Administration]. 2014a. Dolphins and Whales and the Gulf of Mexico Oil Spill. NOAA Fisheries: Office of Protected Resources. Available from: http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm

NOAA [National Oceanic and Atmospheric Administration]. 2014b. NOAA Actively Investigates Dolphin Deaths. NOAA Fisheries. Available from: http://www.nmfs.noaa.gov/stories/2011/04/0414_noaa_actively_investigates_dolphin_deaths.html

NOAA [National Oceanic and Atmospheric Administration]. 2014c. Sea Turtles and the Gulf of Mexico Oil Spill. NOAA Fisheries: Office of Protected Resources. Available from: http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm

NOAA [National Oceanic and Atmospheric Administration]. 2014d. Sea Turtles and the Gulf Oil Spill: Meet NOAA's Barbars Schroeder. Available from: http://www.noaa.gov/features/04_resources/seaturtle_oil.html

NOAA [National Oceanic and Atmospheric Administration]. 2014e. Oil Spill Response and Killer Whales. NOAA Office of Response and Restoration. Available from: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/oil-spill-response-and-killer-whales.html

Nowacek, D.P., Thorne, L.H., Johnston, D.W., Tyack, P.L. 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev., 37: 81-115.

NRC [National Research Council]. 1985. Oil in the Sea: Inputs, Fates and Effects. National Academy Press, Washington, D.C. 601p.

NRC [National Research Council]. 2005. Marine mammals populations and ocean noise: determining when noise causes biologically significant effects. The National Academies Press, Washington, DC.

NRCan and NSPD [Natural Resources Canada and Nova Scotia Petroleum Directorate]. 1999. Georges Bank Review Panel Report.

NRCan [Natural Resources Canada]. 2010. Geology of the Scotian Margin. Available from: http://www.nrcan.gc.ca/earth-sciences/energy-mineral/geology/marine-geoscience/geology-of-scotian-margin/7287

NRCan [Natural Resources Canada]. 2013. Earthquake Map of Canada, 1627-2010. Available from: http://earthquakescanada.nrcan.gc.ca/historic_eq/images/caneqmap_e.pdf

NRI [Net Resources International]. 2012. Manatee Field, Gulf of Mexico, United States of America. Offshore Technology.com. [cited 2013 July]. Available from: http://www.offshore-technology.com/projects/manatee/

NSDFA [Nova Scotia Department of Fisheries and Aquaculture]. 2013. Aquaculture Site Mapping Tool. Available from: http://novascotia.ca/fish/programs-and-services/industry-support-services/aquaculture/site-mapping-tool/

NSDNR [Nova Scotia Department of Natural Resources]. 2011a. Shapefile titled "cormorant_colonies_2011_survey". Obtained January 2014.

NSDNR [Nova Scotia Department of Natural Resources]. 2011b. General Status Ranks of Wild Species in Nova Scotia. Obtained from the Atlantic Conservation Data Center in April 2011. Also available from: http://www.gov.ns.ca/natr/wildlife/genstatus/ranks.asp

NSDNR [Nova Scotia Department of Natural Resources]. 2013. Shapefile titled "eider_islands". Obtained January 2014.

NSDOE [Nova Scotia Department of Energy]. 2009a. Natural Gas: Sable Offshore Energy Project. [updated 2009 Sept 15; cited 2013 Dec 9]. Available from: http://www.gov.ns.ca/energy/oil-gas/offshore/current-activity/sable-offshore.asp

NSDOE [Nova Scotia Department of Energy]. 2009b. Toward a Greener Future: Nova Scotia's 2009 Energy Strategy. [cited 2014 Jan 15]. Available from: www.gov.ns.ca/energy/energystrategy

NSOAA [Nova Scotia Office of Aboriginal Affairs]. 2011. Aboriginal People in Nova Scotia: Facts Sheets and Additional Information. Available from: http://novascotia.ca/abor/aboriginal-people/demographics/

NSOAA [Nova Scotia Office of Aboriginal Affairs]. 2012. Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. Office of Aboriginal Affairs. Available from: http://www.gov.ns.ca/abor/docs/Proponents%20Guide%20November%202011%20ecopy.pdf.

O'Boyle, R. 2011. Benefits of Marine Protected Areas and Fisheries Closures in the Northwest Atlantic. DFO Can. Tech. Rep. Fish. Aquat. Sci. 2948: iii + 68pp.

O'Boyle, R. 2012. State of the Scotian Shelf Report: Fish Stock Status and Commercial Fisheries. Atlantic Coastal Zone Information Steering Committee [ACZISC]. 36 pp. Available from: http://coinatlantic.ca/docs/fish-j-status-and-commercial-fisheries.pdf

O'Hara, P.D., Morandin, L.A. 2010. Effects of Sheens associated with Offshore Oil and Gas Development on the Feather Microstructure of Pelagic Seabirds. Mar. Pollut. Bull., 60: 672-678.

Office of Naval Research. 2002. Ocean Life: Green Sea Turtle-Current Research, Science and Technology Focus, Oceanography. Available from: http://www.onr.navy.mil/focus/ocean/life/turtle4.htm

Oropesa, A., Pérez-López, M., Hernández, D., García, J., Fidalgo, L., López-Beceiro, A., Soler, F. 2007. Acetylcholinesterase activity in seabirds affected by the Prestige oil spill on the Galician coast (NW Spain). Sci. Total Environ., 372: 532-538.

Orr, C.D., Parsons, J.L. 1982. Ivory gulls *Pagophila eburnea* and ice-edges in Davis Strait and the Labrador Sea. Can. Field Nat., 96: 323-328.

OSPAR [OSPAR Commission]. 2007. Assessment of the Impact on the Marine Environment of Offshore Oil and Gas Activity-An Overview of Monitoring Results in the United Kingdom, the Netherlands and Norway.

OSPAR [OSPAR Commission]. 2009. Overview of the Impacts of Anthropogenic Underwater Sound in the Marine Environment. Publication number 441/2009. 134pp. Available from: http://qsr2010.ospar.org/media/assessments/p00441_Noise_background_document.pdf

Ott, R., Peterson, C., Rice, S. 2001. Exxon Valdez Oil Spill (EVOS) Legacy: Shifting Paradigms in Oil Ecotoxicology. Available from: http://www.alaskaforum.org

Paine, M.D., Leggett, W.C., McRuer, J.K., Frank, K.T. 1988. Effects of Chronic Exposure to the Water-Soluble Fraction (WSF) of Hibernia Crude Oil on Capelin (*Mallotus villosus*) Embryos. Ca. Tech. Rep. Fish. Aquat. Sci., No. 1627: iv + 25 pp.

Parks Canada. 2010. Sable Island What We Heard: A Summary of Public Input. [cited 2012 July 4]. Available from: http://www.pc.gc.ca/eng/pn-np/ns/sable/plan/plan01/plan01b.aspx

Parks Canada. 2011. Canada and Nova Scotia Reach Historic Agreement to Designate Sable Island as a National Park Reserve. [cited 2012 June 26]. Available from: http://www.pc.gc.ca/apps/cp-nr/release_e.asp?id=1785&andor1=nr

Parks, S., Ketten, D.R., O'Malley, J.T., Arruda, J. 2007. Anatomical predictions of hearing in the North Atlantic right whale. The Anatom. Rec., 290: 734-744.

Parks, S.E., Johnson, M.P., Nowacek, D.P., Tyack, P.L. 2012. Changes in Vocal Behavior of North Atlantic Right Whales in Increased Noise. In: Popper, A.N., Hawkins, A. editors. The Effects of Noise on Aquatic Life, Springer, pp. 317-320.

Payne, J.F., Andrews, C.A., Fancey, L.L., Cook, A.L., Christian, J.R. 2007. Pilot Study on the Effects of Seismic Air Gun Noise on Lobster (*Homarus americanus*). DFO Can. Tech. Rep. Fish. Aquat. Sci. No. 2712.

Payne, J.F., Coady, J., White, D. 2009. Potential Effects of Seismic Airgun Discharges on Monkfish Eggs (*Lophius americanus*) and Larvae. Environ. Stud. Res. Funds Rep. 170. St. John's, NL. 35pp.

Pearson, W.H., Skalski, J.R., Malme, C.I. 1992. Effects of sounds from a geophysical survey device on behavior of captive rockfish (*Sebastes spp*.). Can. J. Fish. Aquat. Sci., 49(7): 1343-1356.

Pecknold, S., Osler, J., DeTracey, B. 2010. A comparison of measured ocean acoustic ambient noise with estimates from RADARSAT remote sensing, Proceedings of Acoustics Week in Canada 2010, Victoria, BC, October 13-15, 2010.

Pelot, R., Wootton, D. 2004. Merchant Traffic Through Eastern Canadian Waters: Canadian Port of Call Versus Transient Shipping Traffic. Maritime Activity and Risk Investigation Network. MARIN Report #2004-09. Available from: http://www.marin-research.ca/pdf/2004-09.pdf

Petersen, G.I., Kristensen. P. 1998. Bioaccumulation of lipophilic substances in fish early life stages. Environ. Toxicol. Chem., 17: 1385-1395.

Petrie, B. 2007. Does the North Atlantic Oscillation affect hydrographic properties on the Canadian Atlantic Continental Shelf? Atmos. Ocean., 45(3): 141-151.

Piatt, J.F., Nettleship, D.N. 1985. Diving depths of four alcids. Auk, 102: 293-297.

Piggott, C.L. 1964. Ambient sea noise at low frequencies in shallow water of the Scotian Shelf. J. Acoust. Soc. Am., 36(11): 2152-2163.

Piper, D.J.W., Campbell, D.C. 2002. Surficial Geology of the Scotian Slope, Eastern Canada, Geological Survey of Canada, Current Research 2002-E15.10pp.

Pollino, C.A, Holdway, D.A. 2002. Toxicity testing of crude oil and related compounds using early life stages of the crimson-spotted rainbowfish (*Melanotaenia fluviatilis*). Ecotox. Environ. Safe., 52: 180-189.

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R., Marquenie, J.M. 2008. Green light for nocturnally migrating birds. Ecol. Soc., 13(2):art 47. Available from: http://www.ecologyandsociety.org/vol13/iss2/art47/

Popper, A.N. 2003. Effects of anthropogenic sounds on fishes. Fisheries, 28(10): 24-31.

Popper, A.N., Fewtrell, J., Smith, M.E., McCauley, R.D. 2004. Anthropogenic sound: effects on the behavior and physiology of fishes. Mar. Tech. Soc. J., 37(4):35-40.

Popper, A.N., Hastings, M.C. 2009. Review paper: The effects of anthropogenic sound on fishes. J. Fish Biol., 75: 455-489. doi:10.1111/j.1095-8649.2009.02319.x

Popper, A.N., Hawkins, A., editors. 2012. The Effects of Noise on Aquatic Life. Series: Advances in Experimental Medicine and Biology. Vol. 730. Springer. doi: 10.1007/978-1-4419-7311-5

Potter, J.R., Thillet, M., Douglas, C., Chitre, M.A., Doborzynski, Z., Seekings, P.J. 2007. Visual and passive acoustic marine mammal observations and high-frequency seismic source characteristics recorded during a seismic survey. IEEE J. Oceanic Eng., 32(2): 469-483.

Reeves, R.R., Stewart, B.S., Clapham, P.J., Powell, J.A. (eds). 2002. National Audubon Society guide to marine mammals of the world. Chanticleer Press, Inc., New York.

Reichmuth, C. 2007. Assessing the Hearing Capabilities of Mysticete Whales. A Proposed Research Strategy for the Joint Industry Programme on Sound and Marine Life. Long Marine Laboratory; September 12, 2007. Available from: http://www.soundandmarinelife.org/Site/Products/MysticeteHearingWhitePaper-Reichmuth.pdf

Renaud, P.E., Jensen, T., Wassbotten, I., Mannvik, H.P., Botnen, H. 2008. Offshore Sediment Monitoring on the Norwegian Shelf-A Regional Approach 1996e 2006. Akvaplan-Niva, Tromsø, Norway. Report 3487e003. Available from: http://www.norskoljeoggass.no/PageFiles/6544/Milj%C3%B8overv%C3%A5king%20av%20offshorevirksomheten%20-%20Regional%20sedimentoverv%C3%A5king%201996-2006.pdf

Rice, S.D. 1985. Effects of oil on fish. In: Engelhardt, F.R., editor. Petroleum Effects in the Arctic Environment, Elsevier Science Publishing Co., NY. xxiv + 282 pp: 157-182.

Richardson, W.J., Greene, Jr., C.R., Malme, C.I., Thomson, D.H. 1995. Marine mammals and noise. Academic Press, San Diego, California. 576 pp: 631-700.

Richardson, W.J., Holst, M., Koski, W.R., Cummings, M. 2009. Responses of cetaceans to large-source seismic surveys by Lamont-Doherty Earth Observatory. In: Abstr. 18th Bienn. Conf. Biol. Mar. Mamm., Québec, Oct. 2009. 306 pp: 213.

Richardson, W.J., Malme, C. I. 1993. Man-made noise and behavioral responses. In: Burns, J.J., Montague, J.J., Cowles, C.J., editors. The Bowhead Whale. Soc. Mar. Mammal., Spec. Publ. No. 2.

Richardson, W.J., Wursig, B. 1995. Influences of man-made noise and other human actions on cetacean behaviour. Mar. Freshw. Behav. Physiol., 29: 183–209.

Richardson, W.J., Würsig, B., Greene, C.R. 1986. Reactions of bowhead whales, *Balaena mysticetus*, to seismic exploration in the Canadian Beaufort Sea. J. Acoust. Soc. Am., 79(4): 1117-1128.

Risch, D., Corkeron, P.J., Ellison, W.T., Van Parijs, S.M. 2012. Changes in humpback whale song occurrence in response to an acoustic source 200 km away. PLoS ONE 7(1): e29741, 29741-29746. Available from: http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0029741

Robert, M., Benoit, R., Savard, J.-P.L. 1999a. COSEWIC Status Report on the Eastern Population of Barrow's Goldeneye (*Bucephala islandica*) in Canada. Canadian Wildlife Service, Quebec Region.

Robert, M., Savard, J.-P.L., Fitzgerald, G., Laporte, P. 1999b. Satellite tracking of Barrow's Goldeneyes in eastern North America: location of breeding areas and molting sites. In: Proceedings of the 15th International Symposium on Biolotelemetry, Juneau, AK.

Robert, M., Vaillancourt, M.-A., Drapeau, P. 2010. Characteristics of nest cavities of Barrow's Goldeneyes in eastern North America. J. Field Ornithol., 81(3): 287-293.

Robertson, G.J., Goudie, R.I. 1999. Harlequin duck (*Histrionicus histrionicus*). In: Poole, A., Gill, F., editors. The Birds of North America, No. 466. The Birds of North America, Inc., Philadelphia, PA.

Rolland, R.M., Parks, S.E., Hunt, K.E., Castellote, M., Corkeron, P.J., Nowacek, D.P., Wasser, S.K., Kraus, S.D. 2012. Evidence that ship noise increases stress in right whales. Proc. R. Soc. B. doi:10.1098/rspb.2011.2429.

Ronconi, R. 2013. A report on the latest status and trends of terns and gulls breeding on Sable Island. Prepared for Parks Canada; Contract # 13-2009.

Ronconi, R., Wong, S. 2003. Estimates of changes in seabird numbers in the Grand Manan Archipelago, New Brunswick, Canada. Waterbirds, 26(4): 462-472.

Rozee, P. 2000. The Fisheries of the Halifax Inlet. Preserving the Environment of Halifax Harbour. [Workshop #1]. Halifax Regional Municipality and Fisheries and Oceans Canada. Halifax, Nova Scotia.

RPS ASA. 2014a. Sediment Dispersion Modelling in Support of the Shelburne Basin Exploration Drilling Program.

RPS ASA. 2014b. Trajectory Modelling in Support of the Shelburne Basin Exploration Drilling Program.

Sætre, R., Ona, E. 1996. Seismiske undersøkelser og skader på fiskeegg og -larver; en vurdering av mulige effekter på bestandsnivå. Havforskningsinstituttet, Fisken og Havet, nr. 8-1996. 25 pp. Institute of Marine Research, Bergen, Norway. (In Norwegian with English abstract.)Sanders, H.L., Grassle, J.F., Hampson, G.R., Morse, L.S., Garner-Price, S., Jones, C.C. 1980. Anatomy of an oil spill: long-term effects from the grounding of the barge Florida off West Falmouth, Massachusetts. J. Mar. Res., 38: 265-380.

Santulli, A., Messina, C., Ceffa, L., Curatolo, A., Rivas, G., Fabi, G., Damelio, V. 1999. Biochemical responses of European sea bass (*Dicentrachus labrax*) to the stress induced by offshore experimental seismic prospecting. Mar. Poll. Bull., 38(12): 1105-1114.

Sanders, H.L., Grassle, J.F., Hampson, G.R., Morse, L.S., Garner-Price, S., Jones, C.C. 1980. Anatomy of an oil spill: long-term effects from the grounding of the barge Florida off West Falmouth, Massachusetts. J. Mar. Res., 38: 265-380.

SARA [Species at Risk Act]. 2012. Species at Risk Public Registry. Available from: http://www.sararegistry.gc.ca/default_e.cfm

SARA [Species at Risk Act]. 2013a. Species at Risk Public Registry. Species Profile: Porbeagle shark. Available from: http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=810

SARA [Species at Risk Act]. 2013b. Species at Risk Public Registry. Species Profile: Cusk. Available from: http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=756

Schaanning, M., Bakke, T. 1997. Environmental fate of drill cuttings in mesocosm and field. WDF97/3/6. In: SEBA, UK National Workshop on Drilling Fluids Aberdeen, UK.

Seiser, P.E., Duffy, L.K., McGuire, A.D., Roby, D.D., Golet, G.H., Litzow, M.A. 2000. Comparison of pigeon guillemot, *Cepphus columba*, blood parameters from oiled and unoiled areas of Alaska eight years after the Exxon Valdez oil spill. Mar. Pollut. Bull., 40: 52-164.

Seuront, L. 2011. Hydrocarbon contamination decreases mating success in a marine planktonic copepod. PLoS ONE, 6(10): e26283.

Shackell, N.L., Frank, K.T. 2000. Larval fish diversity on the Scotian Shelf. Can. J. Fish. Aquat. Sci., 57: 1747-1760.

Shell [Shell Canada Limited]. n.d. Sustainable Development. [cited 2014 Jan 15]. Available from: http://www.shell.ca/en/environment-society/sustainable-development-tpkg.html

Shell and Stantec [Shell Canada Limited and Stantec Consulting Ltd.]. 2013. Project Description: Shelburne Basin Venture Exploration Drilling Project. Available from: http://www.ceaa-acee.gc.ca/050/documents/p80058/96608E.pdf

Shell [Shell Canada Limited]. 2013. Shell Canada, Shelburne WAZ 3D Marine Mammal Observation Reports. Available from: http://cnsopb.ns.ca/environment/environmental-assessments/file-no-3000828

Sibley, D.A. 2000. National Audubon Society: The Sibley guide to birds. Chanticleer Press. 543 pp.

Simpson, R.D., Smith, S.D.A., Pople, A.R. 1995. The effects of a spillage of diesel fuel on a rocky shore in the sub-Antarctic region (Macquarie Island). Mar. Pollut. Bull., 31(4-12): 367-371.

S.L. Ross [S.L. Ross Environmental Research Limited]. 2012. Oil Spill Fate and Behavious Modelling in Support of Corridor Resources Old Harry Exploratory Drilling Environmental Assessment Updated Report. Prepared for Corridor Resources Inc. 54 pp.

Slotte, A., Hansen, K., Dalen, J., Ona, E. 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. Fish. Res., 67: 143-150.

Smultea, M.A., Würsig, B. 1995. Behavioral reactions of bottlenose dolphins to the Mega Borg oil spill, Gulf of Mexico 1990. Aquat. Mammals, 21: 171-181.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene, Jr., C.R., Lastal, D., Ketten, D.R., Miller, J.H., Nachitgall, P.E., *et al.* 2007. Special Issue: marine mammal noise exposure criteria: initial scientific recommendations. Aquat. Mammals, 33(4): 411-521.

Southall, B.L., Rowles, T., Gulland, F., Baird, R.W., Jepson, P.D. 2013. Final Report of the Independent Scientific Review Panel Investigating Potential Contributing Factors to a 2008 Mass Stranding of Melon-Headed Whales (*Peponocephala electra*) in Antsohihy, Madagascar. Available from:

http://iwc.int/private/downloads/dec7jrij06gosggkgw848ogc8/Madagascar%20ISRP%20FINAL%20REPORT%20SUMMARY_English.pdf

Spraker, T.R., Lowry, L.F., Frost, K.J. 1994. Gross necropsy and histopathological lesions found in harbor seals. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez, Academic Press, San Diego, CA. 395 pp: 281-311.

St. Aubin, D.J. 1990. Physiologic and toxic effects on polar bears. In: Geraci, J.R., St. Aubin, D.J., editors. Sea Mammals and Oil: Confronting the Risks. Academic Press, San Diego, CA. 282 pp: 235-239.

St. Aubin, D.J., Geraci, J.R., Smith, T.G., Friesen T.G. 1985. How do bottlenose dolphins, *Tursiops truncatus*, react to oil films under different light conditions? Can. J. Fish Aquat. Sci., 42: 430-436.

Stantec [Stantec Consulting Ltd.]. 2010. Final CEAA Environmental Screening Report for Extension of Pier C at South End Container Terminal. Prepared for Transport Canada on behalf of Halifax Port Authority, June 2010. TC File No. A 7036-28-17-2 U. CEAR No. 09-01-54333.

Stantec [Stantec Consulting Ltd.]. 2012a. Strategic Environmental Assessment for Offshore Petroleum Activities. Eastern Scotian Slope (Phase 1B). v +194 pp.

Stantec [Stantec Consulting Ltd.]. 2012b. Fisheries and Oceans *Canadian Environmental Assessment Act* (CEAA) Screening Report for Fairview Cove Infill Project. Prepared for Fisheries and Oceans Canada on behalf of Halifax Port Authority, February 2012. DFO File No. 10-HMAR-MA1-00119. CEAR No. 11-01-61900.

Stantec [Stantec Consulting Ltd.]. 2013a. Strategic Environmental Assessment for Offshore Petroleum Activities. Eastern Scotian Slope and Laurentian Fan (Phase 2B). iv + 221 pp.

Stantec [Stantec Consulting Ltd.]. 2013b. Environmental Assessment: Old Harry Prospect Exploration Drilling Program. xxvii + 617 pp

Stantec [Stantec Consulting Ltd.]. 2014. Strategic Environmental Assessment for Offshore Petroleum Exploration Activities. Western Scotian Slope (Phase 3B). Prepared for the Canada-Nova Scotia Offshore Petroleum Board, Halifax, NS. iv + 282 pp.

Stantec [Stantec Consulting Ltd.], AMEC Earth and Environment, Chumis Cultural Resource Services and Coastal, Assessment, Liaison, and Monitoring. 2012. Reply Evidence: Recovery of the Biophysical and Human Environments from Oil Spills nbridge Northern Gateway Project. Prepared for Northern Gateway Pipelines Limited Partnership, July 2012.

Statistics Canada. 2011. National Household Survey Data (2011). Available from: http://www12.statcan.gc.ca/nhs-enm/

Statistics Canada. 2013. List of Indian Band Areas and the Census Subdivisions They Include. National Household Survey Aboriginal Population Profile-About the Data. [updated 2013 Dec 13]. Available from: http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/aprof/help-aide/a-tab.cfm?Lang=E

Stemp, R. 1985. Observations on the effects of seismic exploration on seabirds. In: Greene, G.D., Engelhardt, F.R., Paterson, R.J., editors. Proceeding Workshop on Effects of Explosives Use in the Marine Environment, January, 1985, Halifax, NS. Canadian Oil and Gas Lands Administration, Environmental Protection Branch, Ottawa, ON. Technical Report No. 5; pp. 217-233.

Stenhouse, I.J. 2004. Canadian Management Plan for Ivory Gull (*Pagophila eburnea*). Canadian Wildlife Service, St. John's, NL. x + 22 pp.

Stirling, H.P. 1977. Effects of a spill of marine diesel oil on the rocky shore fauna of Lamma Island, Hong Kong. Environ. Pollut., 12(2): 93-117.

Stone, C.J., Katona, S.K., Mainwaring, A., Allen, J.M., Corbett, H.D. 1992. Respiration and surfacing rates of fin whales (*Balaenoptera physalus*) observed from a lighthouse tower. Rep. int. Whal. Commn., 42: 739-745.

Stone, C.J., Tasker, M.L. 2006. The effects of seismic airguns on cetaceans in UK waters. J. Cetac. Res. Manage., 8(3): 255-263.

Stubblefield, W.A., Hancock, G.A., Prince, H.H., Ringer, R.K. 1995. Effects of naturally weathered Exxon Valdez crude oil on mallard reproduction. Environ. Toxicol. Chem., 14: 1951-1960.

Stucker, J.H., Cuthbert, F.J. 2006. Distribution of Non-breeding Great Lakes Piping Plovers along Atlantic and Gulf of Mexico Coastlines: 10 Years of Band Resightings. US Fish and Wildlife Service, East Lansing, MI and Panama City, FL. 20 pp.

Suchanek, T.H. 1993. Oil impacts on marine invertebrate populations and communities. Integr. Comp. Biol., 33(6): 510-523.

Suncor Energy. 2011. Terra Nova Environmental Effects Monitoring Program (2010). Prepared by Stantec Consulting Ltd. for Suncor Energy Inc., St. John's, NL.

Sundermeyer, J.K., Lucke, K., Dahne, M., Gallus, A., Krugel, K., Siebert, U. 2012. Effects of underwater explosions on presence and habitat use of harbor porpoises in the German Baltic Sea. In: Popper, A.N., Hawkins, A., editors. Effects of Noise on Aquatic Life. Vol. 730, 289-291.

Swail, V.R., Cardone, V.J., Ferguson, M., Gummer, D.J., Harris, E.L., Orelup, E.A., Cox, A.T. 2006. The MSC50 Wind and Wave Reanalysis. 9th International Workshop on Wave Hindcasting and Forecasting. Victoria, BC.

Szaro, R.C., Dieter, M.P., Heinz, G.H. 1978. Effects of chronic ingestion of South Louisiana crude oil on mallard ducklings. Environ. Res., 17: 426-436.

TC [Transport Canada]. 2013a. Navigable Waters Protection Program-Overview. [updated 2013 Sept 19]. Available from: http://www.tc.gc.ca/eng/marinesafety/oep-nwpp-menu-1978.htm

TC [Transport Canada]. 2013b. Canada Continues to Align Air Emissions Measures with the United States. [updated 2013 Aug 19; cited 2014 Jan 17]. Available from: http://www.tc.gc.ca/eng/mediaroom/releases-2013-h055e-7161.html

Teal, J.M., Howarth, R.W. 1984. Oil spill studies: A review of ecological effects. Environ. Manage., 8(1): 27-43.

Theobald, P., Lepper, P., Robinson, S., Hazelwood, D. 2009. Cumulative Noise Exposure Assessment for Maine Mammals using Sound Exposure Level as a Metric. 8 pp. Available from: http://promitheas.iacm.forth.gr/uam2009/lectures/pdf/27-3.pdf

Thomas, P. 2010. Status appraisal summary for status retention, *Histrionicus histrionicus*. Environment Canada-Canadian Wildlife Service.

Thomas, P.W., Robert, M. 2001. The Updated Status of the Harlequin Duck (*Histrionicus histrionicus*) in eastern North America. Unpublished report to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa, Ontario.

Thomsen, B. 2002. An Experiment on How Seismic Shooting Affects Caged Fish. Thesis, Faroese Fisheries Laboratory, University of Aberdeen, Aberdeen, Scotland. 16 August.

Thomson, D.H., Davis, R.A., Hillis, T. 1991. Effects of Operational Discharges from Ships on Marine Life. Rep. by LGL Limited, King City, ON, for Government Consulting Group, Ottawa, ON, and Canadian Coast Guard, Ottawa, ON. 30 pp.

Todd, W.E.C. 1963. Birds of the Labrador Peninsula and adjacent areas. Carnegie Museum and University of Toronto Press, Toronto, ON.

Tolstoganova, L.K. 2002. Acoustical behaviour in king crab (*Paralithodes camtschaticus*). In: Paul, A.J., Dawe, *E.G.*, Elner, R., Jamieson, G.S., Kruse, G.H., Otto, R.S., Sainte-Marie, B., Shirley, T.C., Woodby, D., editors. Crabs in Cold Water Regions: Biology, Management, and Economics. University of Alaska Sea Grant, AK-SG-02-01, Fairbanks, AK. pp. 247-254.

Tougaard, J., Kyhn, L.A., Amundin, M., Wennerberg, D., Bordin, C. 2012. Behavioral reactions of harbor porpoises to pile-driving noise. In: Popper, A.N., Hawkins, A., editors. The Effects of Noise on Aquatic Life. Vol. 730, 277-280.

Trivelpiece, W.Z., Butler, R.G., Miller, D.S., Peakall, D.B. 1984. Reduced survival of chicks of oil-dosed adult Leach's storm-petrels. Condor, 86: 81-82.

Trudel, K. 1985. Zooplankton. In: Duval, W.S., editor. A Review of the Biological Fate and Effects of Oil in Cold Marine Environments. Report by ESL Ltd., SL Ross Environmental Research Ltd. and Arctic Laboratories Ltd. For Environment Canada, Edmonton, AB. 242 pp.

Trudel, B.K., Belore, R.C., Jessiman, B.J., Ross, S.L. 1989. A Mico-computer Based Spill Impact Assessment System for Untreated and Chemically Dispersed Oil Spills in the U.S. Gulf of Mexico. Proceedings of the1989 International Oil Spill Conference.

Trust, K.A., Eslerà, D., Woodin, B.R., Stegeman, J.J. 2000. Cytochrome P450 1A Induction in Sea Ducks Inhabiting Nearshore Areas of Prince William Sound, Alaska. Mar. Pollut. Bull., 40(5): 397-403 .

Tufts, R.W. 1986. Birds of Nova Scotia. Numbus Publishing Ltd.and the Nova Scotia Museum. Halifax, NS.

Turnpenny, A.W.H., Nedwell, J.R. 1994. The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sounds Generated by Seismic Surveys. Report by Fawley Aquatic Research Laboratory Ltd. (FCR 089/94) for U.K. Offshore Operators Association (UKOAA).

Tyack, P.L. 2008. Implications for marine mammals of large-scale changes in the marine acoustic environment. J. Mammal., 89(3): 549-558.

Tyack, P.L., Johnson, M.P., Madsen, P.T., Miller, P.J., Lynch, J. 2006. Biological significance of acoustic impacts on marine mammals: examples using an acoustic recording tag to define acoustic exposure of sperm whales, *Physeter catodon*, exposed to airgun sounds in controlled exposure experiments. Eos, Trans. Am. Geophys. Union 87(36), Joint Assembly Suppl., Abstract OS42A-02. 23-26 May, Baltimore, MD.

van der Hoop, J.M., Vanderlaan, A.S.M., Taggart, C.T. 2012. Absolute probability estimates of lethal vessel strikes to North Atlantic right whales in Roseway Basin, Scotian Shelf. Ecolog. Applic., 22(7): 2021-2033.

van Opzeeland, I. Slabbekoorn, H. 2012. Importance of underwater sounds for migration of fish and aquatic mammals. In: Popper, A.N., Hawkins, A., editors. The Effects of Noise on Aquatic Life. Vol. 730, 357-359.

Vanderlaan, A.S.M., Corbett, J.J., Green, S.L., Callahan, J.A., Wang, C. Kenney, R.D., Taggart, C.T., Firestone, J. 2009. Probability and mitigation of vessel encounters with North Atlantic right whales. Endang. Species Res., 6: 273-285.

Vanderlaan, A.S.M., Taggart, C.T. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Mar. Mammal Sci., 23: 144-156.

Vanderlaan, A.S.M., Taggart, C.T., Serdynska, A.R., Kenney, R.D., Brown, M.W. 2008. Reducing the risk of lethal encounters: vessels and right whales in the Bay of Fundy and on the Scotian Shelf. Endang. Species Res., 4: 282-297.

Vangilder, L.D., Peterle, T.J. 1980. South Louisiana crude oil and DDE in the diet of Mallard hens: Effects on reproduction and duckling survival. B. Environ. Contam. Tox. 25: 23-28.

Varela, M., Bode, A., Lorenzo, J., Ivarez-Ossorio, M.T.A., Miranda, A., Patrocinio, T., Anadón, R., Viesca, L., Rodríguez, N., Valdés, L., *et al.* 2006. The effect of the "Prestige" oil spill on the plankton of the N-NW Spanish coast. Mar. Pollut. Bull., 53: 272-286.

Vargo, S., Lutz, P., Odell, D., Van Vleet E., Bossart, G. 1986. Study of the Effects of Oil on Marine Turtles. Final report to Minerals Management Service MMS Contract No. 14-12-0001-30063. 181 pp.

Velando, A., Munilla, I., Leyenda, P.M. 2005. Short-term indirect effects of the Prestige oil spill on European shags: changes in availability of prey. Mar. Ecol.-Prog. Ser., 302: 263-274.

von Ziegesar, O., Miller, E., Dahlheim, M.E. 1994. Impacts on humpback whales in Prince William Sound. In: Loughlin, T.R., editor. Marine Mammals and the Exxon Valdez. Academic Press, Inc., San Diego, CA. pp. 173-191.

Votier, S.C., Hatchwell, B.J., Beckerman, A., McCleery, R.H., Hunter, F.M., Pellatt, J., Trinder, M., Birkhead, T.R. 2005. Oil pollution and climate have wide-scale impacts on seabird demographics. Ecol. Lett., 8: 1157-1164.

Walmsley, D., Theriault, J. 2011. State of the Scotian Shelf Report: Ocean Noise. Atlantic Coastal Zone Information Steering Committee [ACZISC]. 25 pp. Available from: http://coinatlantic.ca/docs/ocean-noise.pdf

Ward, J.G., Sharp, P.L. 1974. Effects of aircraft disturbance on moulting sea ducks at Herschel Island, Yukon Territory, August 1973. Arctic Gas Biological Report Series, 14(2): 1-54.

Wardle, C.S., Carter, T.J., Urquhart, G.G., Johnstone, A.D.F., Ziolkowski, A.M., Hampson, G., Mackie, D. 2001. Effects of seismic airguns on marine fish. Cont. Shelf Res., 21(8-10): 1005-1027.

WDCS [Whale and Dolphin Conservation Society]. 2004. Oceans of Noise: A WDCS Science Report. Editors: Simmonds, M., Dolman, S., Weilgart, L. 78 pp + App. Available from: http://www.wdcs.org/submissions_bin/OceansofNoise.pdf

Weir, C.R. 1976. Annotated bibliography of bird kills at man-made obstacles: a review of the state-of-the-art and solutions. Can. Wildl. Serv., Ont. Reg., Ottawa. 85 pp.

Weir, C.R. 2008. Overt responses of humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), and Atlantic spotted dolphins (*Stenella frontalis*) to seismic exploration off Angola. Aquat. Mamm., 34(1): 71-83.

White, C.M., Ritchie, R.J., Cooper, B.A. 1995. Density and productivity of bald eagles in Prince William Sound, Alaska, after the Exxon Valdez oil spill. In: Wells, P.G., Butler, J.N., Hughes, J.S., editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM STP 1219. American Society for Testing and Materials, Philadelphia, PA. 965 pp: 762-779.

Wiens, J.A. 1995. Recovery of seabirds following the Exxon Valdez oil spill: an overview. In: Wells, P.G., Butler, J.N., Hughes, J.S., editors. Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters. ASTM STP 1219. American Society for Testing and Materials, Philadelphia, PA. 965 pp: 854-893.

Wiens, J.A. 1996. Oil, seabirds, and science: the effects of the Exxon Valdez oil spill. BioScience, 46: 587-597.

Wiese, F.K., Montevecchi, W.A. 2000. Marine Bird and Mammal Surveys on the Newfoundland Grand Banks from Offshore Supply Vessels. Report prepared for Husky Oil. Memorial University of Newfoundland, St. John's, NL.

Wiese, F.K., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W., Linke, J. 2001. Seabirds at risk around offshore oil platforms in the Northwest Atlantic. Mar. Pollut. Bull., 42: 1285-1290.

Wiese, F.K., Robertson, G.J. 2004. Assessing impacts of chronic oil discharges at sea on seabirds: a general oiled seabird mortality model applied to eastern Canada. J. Wildlife Manage., 68: 627-638.

Wiese, F.K., Robertson, G.J., Gaston, A.J. 2004. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on thick-billed murre *Uria lomvia* populations in the eastern Canadian Arctic. Biol. Conserv.,116: 205-216.

Wiese, F.K., Ryan, P.C. 1999. Trends of chronic oil pollution in southeast Newfoundland assessed through beached-bird surveys, 1984-1997. Bird Trends, 7: 36-40.

Wiese, F.K., Ryan, P.C. 2003. The extent of chronic marine oil pollution in southeastern Newfoundland waters assessed through beached bird surveys 1984–1999. Mar. Pollut. Bull., 46: 1090-1101.

Williams, A.S. 1985. Rehabilitating oiled seabirds. In: Burridge, J., Kane, M., editors. A Field Manual, International Bird Rescue Research Center, Berkely, CA. 79 pp.

Williams, R., Clark, C.W., Ponirakis, D., Ashe, E. 2013. Acoustic quality of critical habitats for three threatened whale populations. Anim. Conserv., 17(2): 174-185.

Williams, U., Chardine, J. 1999. The Leach's Storm Petrel: General Information and Handling Instructions. 4 pp. Available from: http://www.cnlopb.nl.ca/pdfs/mkiseislab/mki_app_h.pdf

Wolfe, D.A., Krahn, M.M., Casillas, E., Sol, S., Thomas, T.A., Lunz, J., Scott, K.J. 1996. Toxicity of intertidal and subtidal sediments in contaminated by the Exxon Valdez oil spill. In: Rice, S.D., Spies, R.B., Wolfe, D.A., Wright, B.A., editors. Proceedings of the Exxon Valdez Oil Spill Symposium, American Fisheries Society Symposium 18; pp.121-139.

Worcester, T., Parker, M. 2010. Ecosystem Status and Trends Report for the Gulf of Maine and Scotian Shelf. DFO. Can. Sci. Advis. Sec. Res. Doc. 2010/070. vi + 59 pp.

Wright, A.J. 2008. International Workshop on Shipping Noise and Marine Mammals, Hamburg, Germany. 21st-24th April 2008. Okeanos-Foundation for the Sea, Auf der Marienhohe 15, D-64297 Darmstadt. 33+ v.

Wright, A.J., Aguilar Soto, N., Baldwin, A.L., Bateson, M., Beale, C.M., Clark, C., Deak, T., Edwards, E.F., Fernández, A., Godinho, A., *et al.* 2007a. Do marine mammals experience stress related to anthropogenic noise? Intern. J. Comp. Psychol., 20(2-3): 274-316.

Wright, A.J., Aguilar Soto, N., Baldwin, A.L., Bateson, M., Beale, C.M., Clark, C., Deak, T., Edwards, E.F., Fernández, A., Godinho, A., *et al.* 2007b. Anthropogenic noise as a stressor in animals: a multidisciplinary perspective. Intern. J. Comp. Psychol., 20(2-3): 250-273.

Wright, A.J., Deak, T., Parsons, E.C.M. 2009. Concerns related to chronic stress in marine mammals. IWC Working Pap. SC/61/E16: 7 pp.

Wright, A.J., Deak, T., Parsons, E.C.M. 2011. Size matters: management of stress responses and chronic stress in beaked whales and other marine mammals may require larger exclusion zones. Mar. Pollut. Bull., 63(1-4): 5-9.

Wright, A.J., Kuczaj, S. 2007. Noise-related stress and marine mammals: An introduction. Intern. J. Comp. Psychol., 20(2-3): iii-viii.

Würsig, B. 1990. Cetaceans and oil: ecologic perspectives. In: Geraci, J.R., St. Aubin, D.J., editors. Sea Mammals and Oil: Confronting the Risks. Academic Press, San Diego, CA. 282 pp: 129-165.

WWF [World Wildlife Fund]. 2009. An Ocean of Diversity-The Seabeds of the Canadian Scotian Shelf and Bay of Fundy. 24 pp.

Wysocki, L.E., Dittami, J.P., Ladich, F. 2006. Ship noise and cortisol secretion in European freshwater fishes. Biol.Conserv., 128: 501-508.

Xia, K., Hagood, G., Childers, C., Atkins, J., Rogers, B., Ware, L., Ambrust, K., Jewell, J., Diaz, D., Gatian, N., *et al.* 2012. Polycyclic aromatic hydrocarbons (PAHs) in Mississippi seafood from areas affected by the Deepwater Horizon oil spill. Environ. Sci. Technol., 46(10): 5310-5318.

Yender, R.J., Michel, J., Lord, C. 2002. Managing Seafood Safety after an Oil Spill. Seattle Hazardous Materials Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration. 72 pp.

Zhai, L., Platt, T., Tang, C., Sathyendranath, S., Hernandez Walls, R. 2011. Phytoplankton phenology on the Scotian Shelf. ICES J. of Mar. Sci., 68: 781-791.

Zhdanova, I.V., Reebs, S.G. 2006. Circadian rhythms in fish. Behav. Physiol. Fish, 24: 197-238.

Zwanenburg, K.C.T., Bundy, A., Strain, P., Bowen, W.D., Breeze, H., Campana, S.E., Hannah, C., Head, E., Gordon, D. 2006. Implications of Ecosystem Dynamics for the Integrated Management of the Eastern Scotian Shelf. DFO Can. Tech. Rep. Fish. Aquat. Sci. 2652: xiii + 91 pp.

Personal Communication:

CWS [Canadian Wildlife Service]. 2012. Personal communication. Email Correspondence June 2012.

DFO [Fisheries and Oceans Canada]. 2012. Personal Communication.

DFO [Fisheries and Oceans Canada]. 2013. Personal Communication.

Gjerdrum, C. 2012. Canadian Wildlife Service, Environment Canada. Nov. 2012.

NSDNR [Nova Scotia Department of Natural Resources]. 2014. Personal Communication. Email correspondence in January 2014 regarding cormorant and eider data received from NSDNR.

Stantec [Stantec Consulting Ltd.]. 2013. Personal Communication.