TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

12 SENSITIVE OR SPECIAL AREAS

Sensitive or Special Areas have been selected as a Valued Ecosystem Component (VEC) due to stakeholder and regulatory concerns about the vulnerability of sensitive or special areas to potential Project-related effects, including potential exposure to contaminants from operational discharges and accidental spills from the Project. Sensitive or Special Areas are often identified with rare or unique marine habitat features, habitat that supports sensitive life stages of valued marine resources, and/or critical habitat for species of special conservation status. For the purposes of this assessment, Sensitive or Special Areas are defined as:

- An area that is afforded some level of protection under federal or provincial legislation (*i.e.*, National Parks, ecological reserves, *Oceans Act* Marine Protected Areas (MPAs), National Marine Conservation Areas (NMCAs), National Historic Sites, fishery management areas)
- An area that may be under consideration for such legislative protection (*i.e.*, potential or proposed coastal or marine protected areas)
- An area that is known to have particular ecological or cultural importance and is not captured under federal or provincial regulatory frameworks (*e.g.*, corals; spawning, nursery, rearing, or migratory areas; areas of high productivity; rare or unique habitats; Important Bird Areas (IBAs); Ecologically and Biologically Significant Areas (EBSAs); areas of traditional harvesting activities)

The above definition is based on that used by the C-NLOPB (2009a). The identification of an area as sensitive or special does not automatically imply that this area will require the application of non-typical mitigations or restriction on activities. The timing, spatial extent, and nature of proposed Project activities, in addition to mitigations prescribed by legislation, will determine the level of restriction or mitigation that will be required.

As per the Scoping Document (C-NLOPB 2009), the Sensitive or Special Areas included in this assessment include important or essential habitat to support marine resources (see Chapters 7 to 10) or areas identified through the Placentia Bay-Grand Banks (PBGB) Large Ocean Management Area (LOMA) Integrated Management Plan Initiative. In the Nearshore Study Area, these Sensitive or Special Areas include capelin beaches (*e.g.*, Bellevue Beach) and eelgrass beds (Figure 12-1). Offshore Sensitive or Special Areas include those designated by the Northwest Atlantic Fisheries Organization (NAFO), specifically the Southeast Shoal Vulnerable Marine Ecosystem (VME) and various canyon areas and seamount and knoll VMEs. In addition, the following EBSAs, as identified by Fisheries and Oceans Canada (DFO), occur within the Offshore Study Area: Northeast Shelf and Slope; Virgin Rocks (immediately adjacent to the Offshore Study Area); Lily Canyon-Carson Canyon and Southeast Shoal and Tail of the Banks (Figure 12-2). The special areas atlas prepared by the Canadian Parks and Wilderness Society (CPAWS 2009) is also referenced where a special area has been identified within either the Nearshore or Offshore Study Area. The Bonavista

Cod Box is located outside of the Offshore Study Area and is therefore not considered.

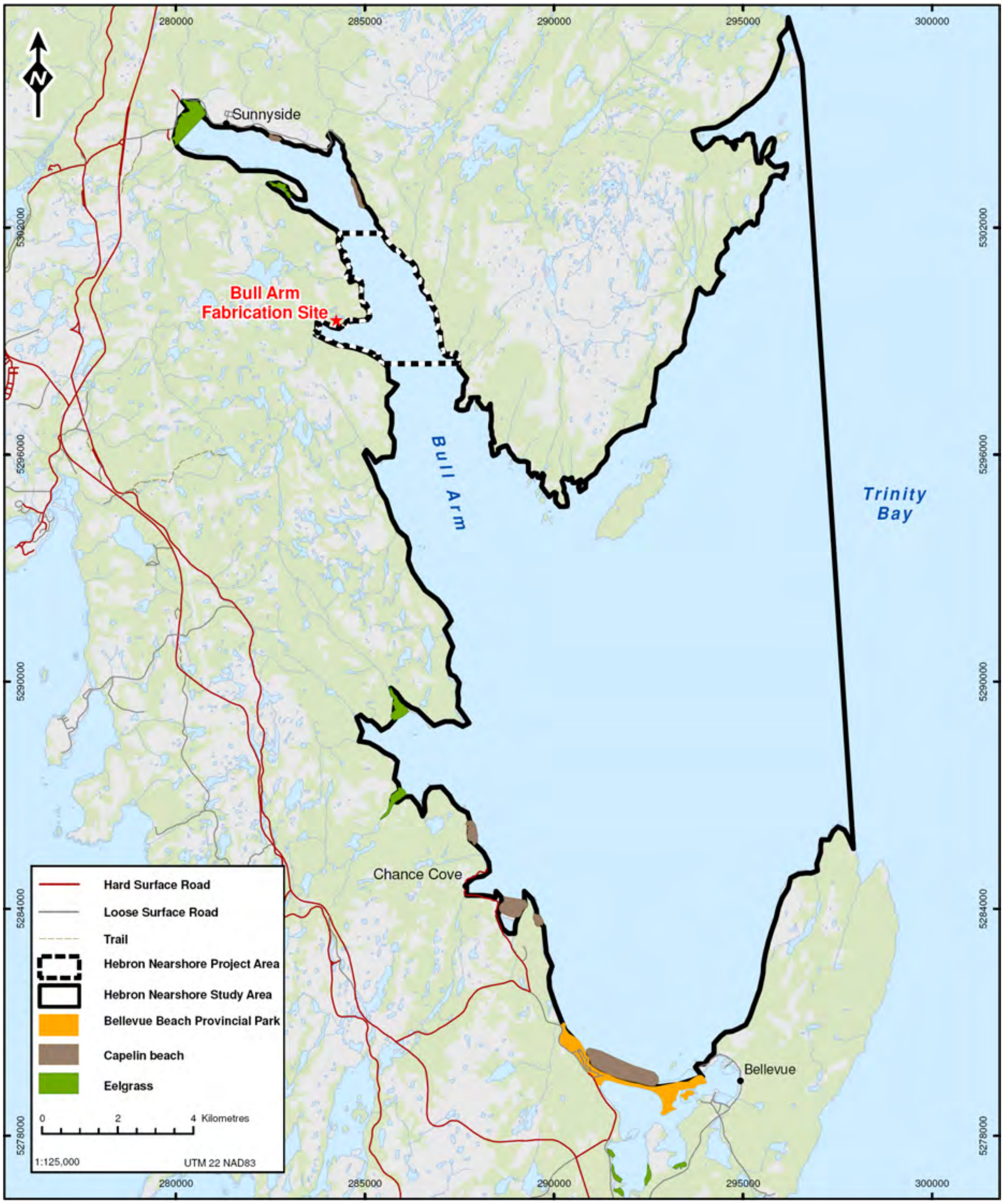

Figure 12-1 Identified Sensitive or Special Areas within the Nearshore Study Area

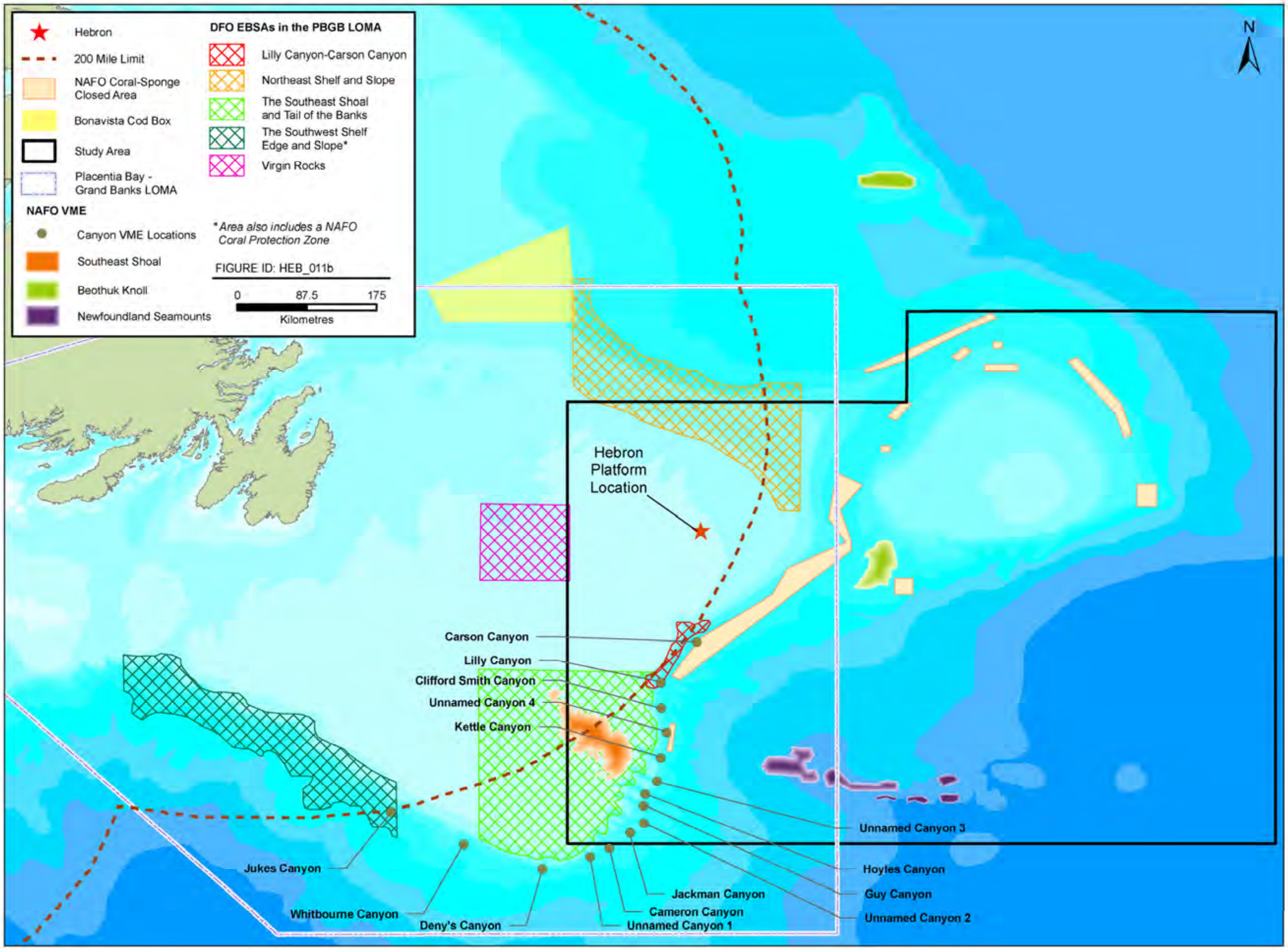

Figure 12-2 Identified Sensitive or Special Areas within the Offshore Study Area

This VEC is directly linked to several other VECs as Sensitive or Special Areas represent the physical habitat areas supporting biological resources that are also assessed separately including, Marine Fish and Fish Habitat (Chapter 7), Marine Birds (Chapter 9), Marine Mammals and Sea Turtles (Chapter 10) and Species at Risk (Chapter 11).

12.1 Environmental Assessment Boundaries

12.1.1 Spatial and Temporal

12.1.1.1 Nearshore

The Nearshore Study Area and Nearshore Project Area are defined in the Environmental Assessment Methods Chapter (Chapter 4). The affected area will vary by Project activity, the nature of the VEC and the sensitivity of different species within the VEC. The Affected Areas for several Project activities have been determined by modelling (see AMEC 2010; ASA 2011a, 2011b; JASCO 2010; Stantec 2010b).

The temporal boundary for the environmental assessment is determined by the schedule and duration of Project activities. These are further described in Table 12-1.

Table 12-1 Temporal Boundaries of Study Areas

Study Area	Temporal Scope
Nearshore	• Construction: 2011 to 2016, activities will occur year-round
Offshore	• Surveys (geophysical, geotechnical, geological, environmental): 2011 throughout life of Project, year-round • Construction activities: 2013 to end of Project, year-round • Site preparation / start-up / drilling as early as 2015 • Production year-round through to 2046 or longer • Potential expansion opportunities - as required, year-round through to end of Project • Decommissioning / abandonment: after approximately 2046

12.1.1.2 Offshore

The Offshore Study Area and Offshore Project Area are defined in the Environmental Assessment Methods Chapter (Chapter 4). For this VEC, the Offshore Affected Area of most relevance is that for an accidental oil spill. The identified Offshore Sensitive or Special Areas are all located outside of the predicted zones of influence of routine Project-related activities.

As well, while the Affected Area for an oil spill in some cases may overlap with a portion of an identified sensitive or special area, in these cases the assessment considers the potential for Project-related environmental effects on the identified area as a whole.

Ecologically, some of the identified Sensitive or Special Areas would be more vulnerable to Project-related environmental effects at certain times of the year and these vary between areas dependent on the species known to use the habitat. For instance, the Northeast Shelf and Slope EBSA is known to attract aggregations of spotted wolffish and Greenland halibut in the spring. The Lily Canyon-Carson Canyon EBSA attracts year-round aggregations of marine mammals for feeding and overwintering.

12.1.2 Administrative

The administrative boundaries for Sensitive or Special Areas overlap with those for Marine Fish and Fish Habitat as many of the identified sensitive or special areas are related to the protection of critical life stages of marine fish. A full discussion of administrative boundaries related to Marine Fish and Fish Habitat is found in Section 7.1.3.

Protection of marine sensitive areas is also provided by DFO's *Oceans Act*. The *Oceans Act*, which was passed in 1997, allows for the development of a national oceans strategy based on the principles of sustainable development, integrated management and the precautionary approach. Importantly, the *Act* also authorizes DFO to provide enhanced protection to marine areas which are determined to be ecologically or biologically significant (DFO 2004d). The Offshore Project Area is within an area currently being considered as part of an Integrated Management Plan for the PBGB LOMA. As part of this plan, DFO has identified EBSAs, which may require specific management measures. Some EBSAs may be put forward as Areas of Interest for MPA status and other EBSAs may be considered for protection under other management tools. The potential management implications for these EBSAs are still being determined through ongoing planning processes within DFO. Currently, none of the EBSAs within the Offshore Study Area (Figure 12-2) have been recommended as Areas of Interest or are subject to any special legislated protection measures or restrictions, although it is acknowledged that these may be implemented for some of the EBSAs at some point in the future.

Other Sensitive or Special Areas within the Offshore Study Area are those identified by NAFO, which has committed to identifying VMEs in the offshore environment. A number of proposed VMEs have been identified offshore Newfoundland, within the context of managing deep sea fisheries and their potential environmental implications of these activities. Other than restrictions on fishing in these areas, there are no management procedures in place that would be applicable to or affect planned Project activities.

Sensitive or Special Areas can also be linked to the federal *Species at Risk Act* (SARA), which protects the critical habitat of species assessed as Threatened or Endangered. Where identified, Sensitive or Special Areas are known to support Species at Risk; these are identified within the description of existing conditions.

12.2 Definition of Significance

A significant adverse residual environmental effect is one that alters the valued habitat of the identified Sensitive or Special Areas physically, chemically or biologically, in quality or extent, to such a degree that there is a decline in abundance of key species or species at risk or a change in community structure, beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population or community to its former level within several generations.

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

12.3 Existing Conditions

The following description of Sensitive or Special Areas in the Nearshore Study Area is based on existing data sources, supplemented by information supplied by local fishers in the area (B. Warren, pers. comm.). The description of Sensitive or Special Areas in the Offshore Study Area is based on existing government and scientific sources.

12.3.1 Nearshore

Two types of Sensitive or Special Areas are identified and considered in the nearshore: eelgrass beds and capelin beaches.

12.3.1.1 Eelgrass Beds

Eelgrass (*Zostera marina* L.) is a type of submerged aquatic vegetation that grows in estuaries and shallow bays. It is a perennial flowering plant that grows both by vegetative growth and by seed germination. Eelgrass abundance varies seasonally, with winter die-off and spring / summer re-growth, and annually due to a variety of factors. These can include physical and chemical disturbance, changes in nutrient availability, and changes in water quality parameters such as turbidity and salinity (Eelgrass Fact Sheet, http://www.oregon.gov/DSL/SSNERR/tides/tidesA13_eelgrassfacts.pdf).

Eelgrass has been recently assessed by DFO, and in eastern Canada, DFO has determined that eelgrass has characteristics which meet the criteria of an Ecologically Significant Species (DFO 2009i). These criteria include the following:

- By its structure, it creates habitat that is used preferentially by other species
- It physically support(s) other biota, and provides either settlement substrate or protection for this associated community
- It is abundant enough and sufficiently widely distributed to influence the overall ecology of that habitat

Eelgrass beds perform important ecological functions including filtering of the water column, stabilizing sediment, and buffering shorelines from erosion (DFO 2009i). Eelgrass beds are highly productive ecosystems due to both rapid turnover of eelgrass leaves and epiphytic algae on leaf surfaces and represent a valuable component of the coastal food chains and contributor to the nutrient cycle. Densities of a variety of invertebrate species are high in eelgrass beds as they feed on the epiphytes on eelgrass. The organisms, in turn, support higher trophic levels. The fish species that are likely to be present in the eelgrass include juvenile and adult cunner, juvenile lumpfish, juvenile lobster and pelagic juvenile Atlantic cod (between June and October), recently post-settled demersal juvenile Atlantic cod and herring. Eelgrass beds are also an important feeding area for some species of migrating birds.

Eelgrass is considered to meet the criteria for an ESS as severe perturbation of these species is deemed to have far greater ecological consequences than an equal perturbation of most other species associated with this community (DFO 2009i). Based on current knowledge, eelgrass, where it presently exists, can have controlling influence over key aspects of the nearshore marine ecosystem structure and function.

Based on existing surveys, eelgrass is distributed around Newfoundland with the greatest abundance on the southwest coast (DFO 2009i). While eelgrass occurs commonly in eastern Canada where there are suitable conditions, it is generally absent from rocky, high energy coastlines or areas of high turbidity. Therefore, eelgrass is constrained in many coastal areas around Newfoundland by both coastal features and the extent of ice scour. While there are no estimates of areal coverage in Newfoundland, except in a small number of individual embayments (*e.g.*, Newman Sound), there are several large beds on the west coast of the island. The location of several eelgrass beds within the Nearshore Study Area, as identified by local fishers (B. Warren, pers. comm.), is provided on Figure 12-1.

Declines in eelgrass beds have been documented around the world with possible explanations for these declines in the Maritime Provinces including eutrophication, disturbance by invasive green crab (*Carcinus maenas*), human activities, and environmental changes (DFO 2009i). In Newfoundland, however, there appears to be a general increase in eelgrass abundance in the last decade based on local knowledge. The increases in some locations may be due to improved conditions for eelgrass (milder temperatures, more favourable sea ice conditions) (DFO 2009i).

12.3.1.2 Capelin Beaches

Capelin *(Mallotus villosus)* have been addressed in the Marine Fish and Fish Habitat VEC; Section 7.3.2.4 provides a description of expected spawning behaviour of this species.

Local fishers (B. Warren, pers. comm.) have identified five smaller capelin beaches within the Nearshore Study Area (Figure 12-1). In addition, Bellevue Beach is located in the southern extent of the Nearshore Study Area. It is one of largest capelin spawning beaches on the east coast of Newfoundland and has been the subject of an annual production survey since 1990 (Nakashima and Wheeler 2002). Demersal spawning of capelin near Bellevue Beach is also reported (CPAWS 2009). Eelgrass, kelp and Irish moss beds have also been reported in the area of Bellevue Beach (CPAWS 2009).

Historically, capelin have spawned on Newfoundland beaches in June and July as three- and four-year-old fish. Beginning early in the 1990s, several changes in spawning behaviour were observed and continue to occur (DFO 2008c) as documented from observations at Bellevue Beach. Spawning now generally occurs four weeks later in July and August and is comprised of mostly two- and three-year-old fish. The amount of off-beach spawning is assumed to vary from year to year. As well, the average size of mature capelin continues to be smaller than that observed in the 1980s. While the initial shift in spawning behaviour appeared to be linked to below-average seawater temperatures, these trends have continued over time despite higher seawater temperatures since the mid-1990s.

DFO (2008c) indicates that Bellevue Beach continues to be a key spawning beach for capelin, with egg deposition in Bellevue Beach in 2007 being the fifth highest since 1990 and larval emergence from Bellevue Beach in 2007 being the fourth highest since 1990. While there are no recent estimates of abundance available for the entire capelin stock, spring acoustic surveys estimated abundances that are considerably lower than those from the late 1980s. Increases in the offshore abundance of capelin in 2007 and 2008 from spring acoustic surveys complement observations by fish harvesters that abundance has been increasing since 2006.

12.3.2 Offshore

The following text describes the Sensitive or Special Areas identified in the Offshore Study Area (refer to Figure 12-2); the descriptions are based on existing sources of data.

The Nearshore and Offshore Project Areas are within an area currently being considered as part of an Integrated Management Plan for the Placentia Bay-Grand Banks (PBGB) Large Ocean Management Area (LOMA) and falls within Canada's Newfoundland-Labrador Shelves Marine Ecoregion. This is relevant as the biogeographic classification system is used for: i) assessing and reporting on ecosystem status and trends; and ii) spatial planning for the conservation of ecosystem properties and management of human activities. As part of the LOMA plan, DFO has identified EBSAs that may require special management measures. Some EBSAs may be put forward as Areas of Interest for MPA status and other EBSAs may be considered for protection under other management tools. EBSAs are tools that are used to highlight an area of high biological or ecological significance and as such additional protections or management strategies may be applied to these areas. None of the EBSAs overlap with the Offshore Project Area. There are no MPAs within or immediately adjacent to the Offshore Project Area.

12.3.2.1 Ecologically and Biologically Significant Areas

As stated above, the Offshore Project Area is within an area currently being considered as part of an Integrated Management Plan for the PBGB LOMA. As part of this plan, DFO has identified EBSAs which may require specific management measures. None of the EBSAs overlap with the Offshore Project Area (Figure 12-2). The closest, which is the Northeast Shelf and Slope EBSA, is located 39 km from the Offshore Project Area. The other EBSAs are all located south of the Project Area, with the exception of the

Virgin Rocks, which is adjacent to the western boundary of the Offshore Study Area.

EBSAs are identified based on pre-established criteria, including primary criteria of uniqueness, aggregation and fitness consequences and secondary criteria of resilience and naturalness (DFO 2004d). In total, 11 EBSAs have been identified, evaluated and ranked for the PBGB LOMA (DFO 2007d). Of these 11, the Southeast Shoal and Tail of the Banks EBSA was given the highest priority ranking. The other three EBSAs being considered within this assessment were ranked in the bottom four. Each of these areas and the rationale for selection as an EBSA is provided in more detail below as described in DFO (2007d).

The Southeast Shoal and Tail of the Banks Ecologically and Biologically Significant Area

The Southeast Shoal and Tail of the Banks EBSA is an area east of 51°W and south of 45°N, extending to the edge of the Grand Bank (DFO 2007d). The Southeast Shoal has the warmest bottom water temperatures on the Grand Banks and a well-defined gyre making it very productive area for plankton (CPAWS 2009). It is unique in that it is the only shallow sandy offshore shoal in the LOMA, it contains relict populations of blue mussel, wedge clam and capelin associated with beach habitats, and it contains the highest benthic biomass on the Grand Bank. It is also known to be:

- The only known offshore spawning site for capelin
- The single nursery area of the entire stock of yellowtail flounder
- A spawning area for several groundfish species (American plaice, yellowtail flounder and Atlantic cod)
- An important nursery area for NAFO Division 3NO cod and American plaice
- An area that attracts large aggregations of marine mammals (especially humpbacks and northern bottlenose) and marine birds due to presence of forage species
- An area with the densest concentration of striped wolffish (listed as ‘special concern’ SARA and assessed as “special concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
- An area which supports the highest density of American plaice on the Grand Banks since the mid-1990s

The Southeast Shoal and Tail of the Banks EBSA is a naturally dynamic sandy bottom habitat that is subject to regular physical disturbance by wave action from storms and is thus less sensitive to disturbance. Fishing has greatly altered the ecosystem within the EBSA and, therefore, DFO (2007d) concludes that ecosystem and community resilience in the Southeast Shoal area has been diminished and is likely sensitive to further disturbance.

Northeast Shelf and Slope Ecologically and Biologically Significant Area

The Northeast Shelf and Slope EBSA is on the northeastern Grand Bank, starting at the Nose of the Bank, from 48°W to 50°W, and from the edge of the shelf (*e.g.*, 200 m depth contour) to the 1,000 m depth contour (Figure 12-2). It is ranked ninth of the eleven identified EBSAs in the PBGB LOMA and is identified as an EBSA because portions of the area are known for:

- Aggregations of spotted wolffish (listed as "threatened" under SARA and assessed as "threatened" under COSEWIC) in spring
- High concentrations of Greenland halibut in spring
- Aggregations of marine mammals, particularly harp seals (Sackville Spur west), hooded seals (Sackville Spur east) and pilot whales
- Two important coral areas at Tobin's Point and Funk Island Spur (CPAWS 2009).

While the area is important to the function of some species, it is not considered otherwise unique. The area is also not considered particularly sensitive to disturbance as compared to other slope areas occurring in the region.

Lily Canyon-Carson Canyon Ecologically and Biologically Significant Area

Lily Canyon-Carson Canyon is an area from 44.8°N to 45.6°N along the 200 m depth of the southeast slope of Grand Bank and is ranked eighth of the eleven identified EBSAs in the PBGB LOMA. The area is assigned a low ranking for uniqueness as various other canyons occur throughout the Grand Banks, and while the area is important to the feeding and productivity of Iceland scallops, the species is known to occur elsewhere. The EBSA received a high ranking for aggregation as a high proportion of Iceland scallops are known to occur in the canyons, as well as year-round aggregations of marine mammals for feeding and overwintering (CPAWS 2009). The EBSA is also ranked high for fitness consequences (*i.e.*, the degree that natural activities take place that contribute significantly to the survival or reproduction of a species or population) and naturalness as the area remains highly productive, and the deeper parts of the canyons are relatively undisturbed.

Virgin Rocks Ecologically and Biologically Significant Area

The Virgin Rocks EBSA comprises the area from 46°N to 46.8°N and from 50°W to 51°W (located outside of but immediately adjacent to the Offshore Study Area). It is ranked lowest in priority of the 11 identified EBSAs. The area is considered geologically unique, as large nearly exposed rocks on the Grand Banks are a one of a kind geological feature/habitat in the LOMA. The area is known to attract aggregations of capelin and marine birds and support spawning and breeding of Atlantic cod, American plaice and yellowtail flounder, although these species are known to spawn elsewhere (CPAWS 2009). While the physical habitat of this EBSA has low sensitivity to disturbance, intensive fishing has resulted in the decline of several of the traditionally abundant species in the area thereby reducing the resiliency of the community and ecosystem.

12.3.2.2 Northwest Atlantic Fisheries Organization Vunerable Marine Ecosytems

As identified above in Section 12.2.2, NAFO has committed to identifying candidate VMEs using criteria that have received general consensus internationally (*i.e.*, the Food and Agriculture Organization (FAO) of the United Nations *International Guidelines for the Management of Deep Sea Fisheries in the High Seas*) (NAFO 2008). The NAFO Ecosystem Working Group has proposed a number of VMEs, including many of the canyons along the shelf edge, seamounts and knolls, the Southeast Shoal, cold seeps, and carbonate mounds and hydrothermal vents, in the NAFO regulatory area.

Candidate VMEs are identified within the context of managing deep sea fisheries and their potential environmental implications of these activities. Therefore, the focus in identifying candidate VMEs has been on the areas that are currently fished (where the necessary benthic data to identity candidate VMEs is available), or that are currently technically feasible for fishing. For this reason, VMEs are being defined where data has been collected and where the bottom depth is less than the presumed current maximum trawl depth of approximately 2,000 m (NAFO 2008). Areas outside of the existing fishing area will be subject to new fishing area protocols in the future, and VMEs will be later identified as part of that process. Identified and delineated VMEs in the existing fishing areas will likely be subject to additional management measures aimed to protect the high species biodiversity within these special regions (NAFO 2008).

The FAO guidelines suggest five criteria for identifying VMEs:

- Uniqueness or rarity
- Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (*e.g.*, nursery grounds or rearing areas), or of rare, threatened or endangered marine species
- Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities
- Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics: slow growth rates, late age of maturity, low or unpredictable recruitment, or long-lived
- Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features

Sessile and very low mobility organisms (*e.g.*, corals, sponges, bivalves) were identified by NAFO (2008) as the most likely foundation organisms for VMEs. Corals create vertical relief and increase the availability of microhabitats. This in turn attracts and provides for aggregations of feeding species, a nursery area for juveniles, fish spawning aggregation sites and attachment substrate for fish egg cases and sedentary invertebrates. These functions are known to be served by deep water coral habitats, creating areas high in invertebrate biodiversity and supporting a large abundance of fish. Concentrations of sponges, particularly those of large size, are also known to be habitat-forming structures, often with numerous other species living within and around their body structures.

Bottom trawling is known to have deleterious effects on complex habitats. The structural characteristics and long-lived nature of some deep water corals make them especially vulnerable to damage by the mechanical effects of bottom fishing activities. In identifying coral VME components, the size, structural complexity, gregariousness, fragility, vulnerability to fishing gears, rarity, longevity, role in the ecosystem (associated species, biodiversity) and international recognition of status were considered.

Canyon Vunerable Marine Ecosytems

Geological features, such as canyons are known to support vulnerable species, communities or habitats and therefore qualify as VMEs (NAFO 2008). Canyon ecosystems can support diverse biological communities, including sensitive structure-forming coldwater corals and deep sea fishes (Gordon and Fenton 2002; Rutherford and Breeze 2002).

Thirteen offshore canyons, which occur along the continental shelf break, have been identified as potential VMEs and are located within the Hebron Offshore Study Area (NAFO 2008). These include: Denys Canyon, Unnamed Canyon 1, Cameron Canyon, Jackman Canyon, Unnamed Canyon 2, Guy Canyon, Hoyles Canyon, Unnamed Canyon 3, Kettle Canyon, Unnamed Canyon 4, Clifford Smith Canyon, Lilly Canyon, and Carson Canyon (Figure 12-2).

The upper limit of these canyons were delineated by the 200 m depth contour, while the lower limit varied but generally was determined by the 2,000 m depth contour. NAFO recognizes that the ecology of these canyons is not well documented, but has based their proposals on research from other canyons such as The Gully (Gordon and Fenton 2002), which suggests that these features support vulnerable species and communities.

Seamounts and Knolls Vunerable Marine Ecosytems

A seamount is an elevation of the sea floor, 1,000 m or higher, that can be flat-topped or peaked and can occur as isolated peaks or as a chain of peaks. Ecosystems surrounding these features are considered sensitive to anthropogenic disturbance because they are comprised of species that are mostly slow-growing, long-lived, late to mature, and experience low natural mortality. Corals and sponges are often associated with these features, as well as aggregations of deep sea fishes.

In proximity to the Offshore Study Area, there is one seamount chain, the Newfoundland Seamounts, located in deep water beyond the continental slope and one isolated knoll, known as the Beothuk Knoll (Figure12-2). Despite the lack of detailed survey information, there is evidence of the occurrence of coldwater corals and potentially vulnerable deep sea fishes on these seamounts, which is why they have been proposed as VMEs (NAFO 2008).

Proposed Southeast Shoal Vunerable Marine Ecosytems

The Southeast Shoal is the shallowest area on the southeastern Grand Banks (Figure 12-2) and attracts many fish and marine mammal species that feed in summer and apparently overwinter (NAFO 2008; CPAWS 2009). Although the area is shallow and much of the bottom is comprised of sand, the Southeast Shoal is still considered to qualify as a VME based on several of the suggested FAO criteria.

The area is considered physically unique on the Grand Banks, as the last area to remain above sea level prior to the last glacial period. As past beach habitat, it supports two possible relict bivalve populations, including the wedge clam (*Mesoderma deauratum*). It is the only known offshore area for the spawning of 3NO capelin (currently under moratorium) and is important habitat for several other species under moratorium or at-risk, including cod, American plaice and striped wolffish. The Southeast Shoal is an area of high productivity and biodiversity, and is an important feeding area for several marine mammals, including humpback whales, as well as for various marine birds. The proposed VME is located within the boundaries of DFO's Southeast Shoal and Tail of the Banks EBSA.

12.4 Project-Valued Ecosystem Component Interactions

12.4.1 Nearshore

With respect to eelgrass beds and potential interactions with nearshore Project-related activities, the major concern is the potential for physical and/or chemical alteration or disturbance of areas in which eelgrass is present. Eelgrass beds (Figure 12-1) are located at sufficient distance from the Nearshore Project Area such that there is no potential for physical disturbance of these sensitive habitats from routine Project activities and physical works, including Project-related sedimentation. Eelgrass is common in areas of high sedimentation such as estuaries (Short *et al.* 2002). There is potential for species that use eelgrass bed habitats (including pelagic juvenile Atlantic cod (between June and October) and recently post-settled demersal juvenile Atlantic cod) to experience disturbance and/or avoidance effects due to Project-related noise and lights. These potential effects are fully considered and assessed in the respective VECs (*i.e.*, Marine Fish and Fish Habitat, Marine Birds). The residual adverse environmental effects have been rated as not significant and these interactions are not further assessed in this VEC.

There is potential for eelgrass beds to be physically affected by an accidental spill in the nearshore environment during construction, which could result in a potential widespread die-off of meadows as will as individual plants. This potential interaction is fully assessed below (Section 12.5.1.1).

Similar to eelgrass beds, the identification of potential interactions between capelin beaches and Project activities has to be inclusive of the potential for physical alteration or disturbance of capelin beaches and potential interactions with spawning capelin within the Nearshore Study Area. Routine

Project activities and physical works are not expected to spatially overlap with capelin beaches in a manner that could result in measureable physical alteration or disturbance of these habitats. While spawning capelin could interact with various Project activities that generate noise and lights, the resulting potential for disturbance / avoidance has been fully assessed in the Marine Fish and Fish Habitat VEC (Chapter 7) and the residual adverse environmental effects have been rated as not significant. This effect is not further assessed in this VEC.

There is potential for capelin beaches to be physically affected by an accidental oil spill in the nearshore environment during construction resulting in a reduction of habitat quality. This potential interaction is fully assessed below.

12.4.2 Offshore

The identified Sensitive or Special Areas located in or proximate to the Offshore Study Area are all located outside of the Hebron Offshore Project Area (Figure 12-2). The closest identified Sensitive or Special Area is the Northeast Shelf and Slope EBSA, which is located 39 km from the Project Area. Due to the degree of separation, there will be no spatial overlap and resulting interactions between routine Project activities and the identified Offshore Sensitive or Special Areas.

There is potential for a number of accidental event scenarios resulting in release of hydrocarbons to interact with identified Sensitive or Special Areas within the Offshore Study Area, resulting in a reduction of habitat quality. The potential for interactions as a result of accidents, malfunctions and/or unplanned events is fully assessed in Section 12.5.1.2.

12.4.3 Summary

In summary, both the nearshore and offshore assessments are limited to the potential for interactions resulting from accidents, malfunctions and/or unplanned events. This interaction creates the potential for changes in habitat quality. For nearshore eelgrass beds, there is also the potential for mortality of individual plants as a result of oiling. Effects on species using the sensitive areas (*e.g.*, change in habitat use and direct mortality) are addressed in their respective VEC sections (Marine Fish and Fish Habitat (Chapter 7), Marine Birds (Chapter 9), Marine Mammals and Sea Turtles (Chapter 10) and Species at Risk (Chapter 11)) and are not further assessed in this VEC.

As the potential for interactions between Project activities and the Sensitive or Special Areas in the Nearshore and Offshore are limited to accidental events which are not considered likely Project effects, cumulative environmental effects are not assessed in relation to these accidental events.

A summary of the potential environmental effects resulting from Project-VEC interactions resulting from accidents, malfunctions and unplanned events is included in Table 12-2.

Table 12-2 Potential Project-related Interactions: Sensitive or Special Areas

Project Activities and Physical Works	Potential Environmental Effects	
	Habitat Quality	Mortality
Accidents, Malfunctions and Unplanned Events		
Nearshore Bund Wall Rupture		
Nearshore Spill (at Bull Arm Site)	x	x[A]
Offshore Failure or Spill from OLS	x	
Offshore Subsea Blowout	x	
Offshore Crude Oil Surface Spill	x	
Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS, Hebron Platform) [B]	x	
Marine Vessel Incident (*i.e.*, fuel spills)	x	
Collisions (involving Platform, vessel, and/or iceberg)[B]	x	

A A spill could result in mortality of individual plants in the eelgrass beds. The potential for mortality of other species using Sensitive or Special Areas, including marine fish, birds, mammals and species at risk are assessed in their respective VECs (Sections 7.5, 9.5, 10.5, 11.4, 11.5 and 11.6, respectively)
B Interactions can occur both nearshore and offshore

12.5 Environmental Effects Analysis and Mitigation

12.5.1 Accidents, Malfunctions and Unplanned Events

Although unlikely, an accidental event can occur at any time of the year, and therefore a conservative approach has been taken in conducting the following effects assessment, assuming that an accidental event could occur at the most sensitive time of year for any of the identified Sensitive or Special Areas.

12.5.1.1 Nearshore

The assessment of the nearshore environment is limited to oiling of eelgrass beds and capelin beaches (refer to Figure 12-1) as a result of an accidental release of hydrocarbons during the construction of the Hebron Gravity Base Structure at the Bull Arm Fabrication Site. This assessment considers the unlikely worst case scenario of a construction vessel accident resulting in 100 m^3 of marine diesel or 1,000 m^3 of IFO-180 (a heavier form of diesel) of fuel being spilled without any response or action to contain or clean up the spill. Based on the results of the spill modelling (ASA 2011a), spills of 100 m^3 of marine diesel have a 60 percent chance of hitting the Bull Arm shoreline in summer, and 30 percent probability to do so in the winter season. IFO-180 spills of 1,000 m^3 have a 100 percent chance of impacting the Bull Arm shoreline in the summer and a 90 percent chance during the winter season without the application of spill response measures. Conservatively, the following assessment is based on the worst-case scenario of diesel fuel reaching these Sensitive or Special Areas.

Eelgrass Beds

Sea grasses are sensitive to hydrocarbon uptake and oiling. Direct contact with oil causes eelgrass plants to lose their leaves Dean *et al.* 1998). As eelgrass leaves are rough and without a mucous layer like many seaweeds, oil will readily stick. Direct oiling can occur where eelgrass beds occurs in very shallow water and form a canopy layer on the water surface, allowing oiling of the floating eelgrass tops (Den Hartog and Jacobs 1980). However, direct oiling is uncommon, with uptake of hydrocarbon from the water column being the main concern. Moderate hydrocarbon concentrations in the water column for a few hours or low concentrations for a few days will result in mortality of individual plants, with a bed of eelgrass possibly taking several years to recover from die-off resulting from oiling (Fingas 2001).

The effects of oil spills can be more pronounced for eelgrass beds growing in sheltered bays that are poorly flushed, as oil will tend to persist for longer periods resulting in chronic contamination (Dean and Jewett 2001). The timing of a spill will also influence the nature of the effects. In the spring, seed production and viability could be affected (Beak Consultants 1975), while a spill in late summer or winter when leaf sloughing is at its peak, may encounter mats of drift blades which will tend to catch and retain oil for later decomposition in the intertidal zone. Hatcher and Larkum (1982) also indicates that the surfactants applied to mitigate oil spills could have a permanent and more significant detrimental effect on eelgrass than the spill itself.

Studies of the effects of oil spills on eelgrass communities have been conducted in association with the *Exxon Valdez* oil spill in Prince William Sound, Alaska, and the *Amoco Cadiz* spill near Roscoff, France, and are discussed below. The results of both studies indicate that recovery of the eelgrass beds can occur within a couple of years, although there may be a longer effect for some components of the benthic communities. Thus, it is the associated faunal communities that tend to be more sensitive to hydrocarbon pollution than the eelgrass plants themselves. There is very little information on the effect of diesel oil on eelgrass in particular. Even though diesel can be more toxic than crude oil initially, these studies are useful in assessing the longer term effects of polycyclic aromatic hydrocarbons (PAHs) in the sediment of an eelgrass bed.

Dean *et al.* (1998) compared populations of eelgrass at oiled versus reference sites between 1990 and 1995 following the *Exxon Valdez* spill. Injury to eelgrass beds in heavily oiled bays appeared to be slight and did not persist for more than a year after the spill. Populations recovered from possible injuries by 1991 and there were no differences in shoot or flowering shoot densities between oiled and reference sites in 1990 or subsequent years.

Jewett and Dean (1997) did report effects on eelgrass communities as a result of the *Exxon Valdez* spill. Dominant taxa within the eelgrass community, including infaunal amphipods, infaunal bivalves, helmet crabs, and leather stars were less abundant at oiled than at reference sites in 1990.

Other taxa, including several families of opportunistic or stress-tolerant infaunal polychaetes and gastropods, epifaunal polychaetes and mussels, and small cod, were more abundant at oiled sites. By 1995, there was evidence of a recovery of most, but not all, community constituents. Exceptions may relate to oiling or the inherent site differences not associated with the oil spill (Harwell and Gentile 2006). Some evidence of slight hydrocarbon contamination still existed at some sites, and three infaunal bivalves, two amphipods, a crab, and a sea star were still more abundant at reference sites than at oiled sites.

These results are consistent with observations reported by Den Hartog and Jacobs (1980). During 1976 to1978, the ecology of eelgrass communities near Roscoff (France) was studied. When a spill of crude oil and bunker fuel occurred in March 1978 and covered the eelgrass communities in question, the study was continued to document the effects of this spill. The results indicated that the eelgrass itself and the general structure of the eelgrass beds showed little effects from the spill. In the short-term, plants had black "burnt" leaves, but these were shed according to the pattern normal for the species. The study of mobile animals demonstrated that the oil spill had a considerable, but selective influence: effects on the Gastropoda were minimal; representatives of the Cumacea, Tanaidacea and Echinodermata recovered within a year; effects on the Isopoda were detectable but questionable due to low numbers before the spill occurred; and the effects on Amphipoda was of high magnitude (of the 26 species found before the oil spill 21 were not observed after the spill).

Den Hartog and Jacobs (1980) speculated that the difference in effect may have been attributable to the location of the eelgrass beds below the level of mean low water neap tide, which implied that contact between the oil slick and the eelgrass lasted only for at most six hours a day. During this time, the flat-lying eelgrass leaves formed a buffer between the oil slick and the bottom. Due to the firm rhizome mat, mixing of oil and sediment was not possible in the eelgrass bed. This could result in filter feeders such as most Amphipoda and some families of Polychaeta being more affected. The *Amoco Cadiz* spill occurred in the early spring, just after the winter peak of a number of littoral organisms, and before the start of the rapid development of the eelgrass. The authors were uncertain of potential fate and effects of a spill in the summer.

Bokn *et al.* (1993) discussed the effects of the water-accommodated fractions of diesel on rock shore populations. In a rocky littoral, diesel oil spills usually result in extensive animal mortalities, and variable, but less severe impacts on seaweeds (*e.g.*, Blumer *et al.* 1971; Pople *et al.* 1990). Data for the Solbergstrand mesocosms suggest that animal populations were most affected by oil treatments and indicate that a chronic low-level exposure to water-accommodated fractions of diesel oil may have only limited direct effect on seaweed stocks (Bokn *et al.* 1993).

Research on eelgrass disturbance and recovery in Newfoundland coastal waters suggests that eelgrass may recover from disturbance (*i.e.*, physical removal) in two to three years (Laurel *et al.* 2003); however, only the removal of the above-substrate biomass (shoots and blades) was investigated, as underground rhizomes remained intact after the disturbance. The recovery of eelgrass meadows could take much longer if any spill resulted in appreciable mortality of the underground rhizomes in affected eelgrass beds.

Should an accidental spill of diesel hydrocarbons occur in the nearshore environment as a result of this Project, plans will be in place to quickly initiate response and clean-up measures, limiting the potential for diesel to reach eelgrass beds. In the scenario of a diesel hydrocarbon spill in Bull Arm reaching areas with eelgrass beds present (10 percent or less probability of this occurring based on modelling results (ASA 2011a) without the implementation of spill countermeasures), existing knowledge and experience indicates that damage to eelgrass would likely be slight with recovery occurring within a year of the spill. Exposure and subsequent recovery should be aided by the coastal features of the study area (*i.e.*, this area would not be considered sheltered or poorly flushed). Experience from the sites of other spills indicates that there could be a change in the composition of mobile benthic communities associated with the eelgrass beds. While most components are likely to recover within several years following a spill, some taxa such as Amphipoda and some families of Polychaeta, may take longer to return. In addition, relatively low levels of oil retained in intertidal or shallow subtidal sediments could potentially affect a variety of species. Payne et al. (1988, in Hurley and Ellis 2004) conducted laboratory experiments that exposed male winter flounder to sediments contaminated with a range of Venezuelan crude oil concentrations for approximately four months and observed sub-lethal effects from sediment containing aromatic hydrocarbons as low as 1 ppm. Considering the community level effects of the invertebrate community within an eelgrass bed, the residual adverse environmental effect of an accidental event in the worst case scenario is rated as significant. The probability of this residual adverse environmental effect occurring is considered low as: accidental events will be prevented through spill prevention procedures; a contingency plan will be in place to limit exposure of sensitive areas to hydrocarbons should a spill occur; and modelling has indicated that the probability of an uncontained spill of diesel fuel reaching an eelgrass bed is 10 percent or less.

Capelin Beaches

Pebble beaches where capelin are known to spawn are shore accumulations of coarse sediment that form in a higher energy wave environment compared to sand beaches. They are permeable (except to semi-solid oils) with a mobile and unstable surface layer that supports little life.

Oil that interacts with pebble beaches is less likely to stay stranded at lower tide zones, but will be more concentrated on the upper beach. Oil persistence is a function of oil type, penetration depth, and wave energy. Oil will penetrate a pebble beach to occupy the spaces between pebbles, although oil-in-sediment amounts are usually very low. Very light oil, such as diesel, though able to penetrate the sediment, would be washed through the beach sediment and into the sea by wave action. This is assumed to be the likely fate of a diesel fuel spill in the Hebron Nearshore Study Area, although some small amounts could become buried in the sediments.

Sensitive flora and fauna may be adversely affected by diesel fuel on shore and in the water column. A spill between May and July could likely interact with a capelin spawning event (up to 100 percent (IFO-180) probability based on modelling results without the implementation of spill countermeasures). If this occurs during the spawning period, the spill would not only affect the physical beach environment, but may also affect fish and fish eggs and larvae. This potential effect has also been addressed in the Marine Fish and Fish Habitat VEC (Section 7.5.4).

As discussed above, the typical fuel used by marine vessels is (a marine diesel and IFO-180 (a heavier diesel that is more persistent). Several diesel oil spills have been studied in the past, focusing on the physical properties and movement of diesel, along with the biological effects of diesel in the marine environment (Hooper and Morgan 1999). Diesel has been found to have an immediate toxic effect on many intertidal organisms, including periwinkles, limpets, gastropods, amphipods and most meiofaunal organisms within several kilometres of the original spill (Wormald 1976; Stirling 1977; Pople *et al.* 1995; Cripps and Shears 1997). One such spill was found to have contaminated the water and shoreline with diesel within a 2 km radius of the original spill. Intertidal areas were most directly affected, but all components of the surrounding ecosystem were contaminated during the first weeks after the spill. Hydrocarbons were detected in tissues from birds, limpets, algae, calms, fish and crustaceans in harbours a couple of kilometres away (Kennicutt *et al.* 1991). Based on this, eggs and larvae within the beach would be more at risk from the physiological effects of a spill, being unable to actively avoid the fuel.

Recruitment to a population would not be affected unless more than 50 percent of the larvae in a large portion of the spawning area were lost (Rice 1985). Thus, while the effects of a spill in the nearshore environment during capelin spawning are considered significant in relation to spawning success at beaches in the Hebron Nearshore Study Area, the effect of this relatively localized spill on egg and larval survival would likely be undetectable at the population level given the high rate of natural mortality (Leggett *et al.* 1983). There are many capelin beaches along the coast of Newfoundland that would remain unaffected.

Recommended mitigation for oiling of pebble / cobble beaches is to flush the area with water quickly, while the spilled oil is still fresh. Low-pressure flushing may assist in moving light oil (such as diesel) through the sediment into the ocean for collection. Manual cleaning can also be effective, although sediment removal should be avoided. Responders must be careful to minimize sediment removal. All cleanup methods employed require measures to ensure the collection and proper disposal of oil as it is liberated from the shore.

The following response methods are recommended for pebble beaches in British Columbia and include recommendations applicable to diesel fuels (http://www.env.gov.bc.ca/eemp/resources/pdf/shorelines_and_diesel.pdf):

- Natural recovery is preferred for small spills of light oils (*e.g.*, diesel) in remote areas
- Flooding can flush mobile oils from surface and subsurface sediments for collection
- Low-pressure cold washing can flush mobile oil from surface and subsurface sediments (more effective for viscous oils than flooding)
- Manual removal minimizes the amount of oiled and un-oiled sediments that may be collected (not practical for deeply penetrated / buried oil) and is useful for asphalt patches, tar patties and oiled debris in smaller areas
- Mechanical removal of oiled sediment is useful for large amounts of semi solid oils (front-end loaders may be the equipment of choice)
- Sorbents may be helpful for recovering small volumes of light / medium oils
- Mechanical tilling / aeration is appropriate for light oils in surface and subsurface sediments used in combination with surf washing
- Sediment reworking or surf washing is appropriate on exposed coasts after mobile oil is removed or for small areas of oiled sediments (minimizes erosion) but is dependent on availability of wave energy
- Avoid excessive removal of sediment (natural replacements are slow and it could lead to erosion of the beach)
- Avoid large volumes of waste that contain low amounts of oil from sediment removal
- Avoid spreading oil into lower tidal zones or flushing it deeper into sediments

A contingency plan, specific for nearshore construction activities at Bull Arm, will take into account various coastal habitats in the nearshore environment and will adjust to incorporate response and clean-up measures as appropriate.

While considered unlikely, there is a low potential for diesel fuel to be carried into the sediments and become buried. In this scenario, hydrocarbon contamination can persist for years before natural physical and biological degradation diminishes potential effects. In this case, the sensitive life stages of eggs and larvae can continue to affect the productivity of the capelin beach. Therefore, the residual adverse environmental effect is rated as significant.

The likelihood of a spill occurring is low; spill prevention procedures, education and training will be implemented site-wide. In the event of a spill, a contingency plan will be in place to limit exposure of sensitive areas to hydrocarbons.

12.5.1.2 Offshore

In the Offshore Study Area, the Sensitive or Special Areas, as discussed in Section 12.2, have a combination of unique physical features, which in turn result in high productivity and/or aggregations of species. In assessing the potential environmental effects of an accidental event on these Sensitive or Special Areas, it is important to consider the potential habitat effects as well as the potential effects on the species that may be present in the area should an accidental event occur. Therefore, there is potential overlap with the environmental effects assessment undertaken for other VECs, including, Fish and Fish Habitat (Chapter 7), Marine Birds (Chapter 9), Marine Mammals and Sea Turtles (Chapter 10) and Species at Risk (Chapter 11). This is discussed below.

Note that the following assessments are based on the conservative approach that hydrocarbons from an accidental event were to reach the Sensitive or Special Area at the most sensitive time of year. Spill prevention and contingency plans will be in place to reduce both the likelihood of an accidental event occurring and the likelihood of hydrocarbons reaching any of the Sensitive or Special Areas identified in the offshore. The areas discussed in the following paragraphs are shown in Figure 12-2.

The Southeast Shoal and Tail of the Banks Ecologically and Biologically Significant Area

The Southeast Shoal and Tail of the Banks EBSA contains a shallow sandy offshore shoal that is unique in the LOMA. While an accidental event is unlikely to affect the substrate within this area, hydrocarbons on the surface or in the water column as a result of a spill may affect the species present in the area. Capelin, Atlantic cod and yellowtail flounder may spawn here and aggregations of striped wolffish, marine mammals (especially humpbacks and northern bottlenose), and marine birds are known to occur.

This Sensitive or Special Area is located 158 km south of the Hebron Project Area. Spill trajectory models indicate that hydrocarbon from a spill at the Project Area without the implementation of countermeasures would interact with this Sensitive or Special Area. If hydrocarbons did reach the area, fish eggs and larvae present at that time could be affected. Yellowtail larvae can be near the surface for several days to two weeks, and have been caught on the Grand Bank from June to September (Walsh 1992). Thus, there is potential for effects on larvae if a spill occurred in August and September. Yellowtail flounder are batch spawners, with individuals from the same population spawning multiple times throughout the season, so population level effects are not expected.

Based on the above, any decline in productivity is unlikely to be at a level beyond which natural recruitment would not return the population or community to its former level within several generations. The residual adverse environmental effect is, therefore, rated as not significant. The potential for adverse environmental effects to occur as a result of the Project is also considered unlikely given the low probability of an accidental event occurring.

Northeast Shelf and Slope Ecologically and Biologically Significant Area

The Northeast Shelf and Slope EBSA is the closest Sensitive or Special Area to the Project Area at a distance of 39 km north to northeast. Based on spill trajectory models for a spill during any month of the year, there is a probability of 30 percent or less that hydrocarbons from an accidental event (without the implementation of countermeasures) will reach this EBSA. Habitat in the area is not considered particularly unique, although it is known to support aggregations of wolffish and Greenland halibut in spring, and aggregations of marine mammals, particularly harp seals, hooded seals and pilot whales. The potential residual adverse environmental effects of oiling on fish, birds, marine mammals and those individual species considered at-risk has been assessed separately (see Chapters 7, 9, 10 and 11, respectively) and is rated as not significant. This rating is considered applicable to this EBSA as the effects will be temporary and at a level from which natural recruitment could return the population or community to its former level within several generations.

Lily Canyon-Carson Canyon Ecologically and Biologically Significant Area

The Lily Canyon-Carson Canyon EBSA is located 91 km south east of the Project Area. Spill trajectory models indicate that hydrocarbon from a spill at the Project Area without the implementation of countermeasures would interact with this Sensitive or Special Area. Lily Canyon-Carson Canyon is similar to other canyon habitat that occurs along the slope of the Grand Banks, but is particularly important for Iceland scallops, and marine mammals aggregate in the area to feed and overwintering. As any hydrocarbons from an accidental event would be present at the surface or in the water column, the bottom habitat present in this EBSA is unlikely to be affected. Benthic species, like Iceland scallops, are also at low risk of potential effects. The residual adverse environmental effects of oiling on marine mammals have been assessed separately (see Chapter 10) and rated as not significant. While there is a potential for productivity of the EBSA to be diminished if hydrocarbons from accidental releases reach this EBSA, the effects will be temporary and at a level from which natural recruitment could return the population or community to its former level within several generations.

Virgin Rocks Ecologically and Biologically Significant Area

The Virgin Rocks EBSA is considered geologically unique as the rocks are near the surface on the middle of the Grand Bank. Schools of capelin have been reported to occur which would attract marine birds. Atlantic cod, American plaice and yellowtail flounder are reported to spawn near the Virgin Rocks (Ollerhead *et al.* 2004). The Virgin Rocks EBSA is located 90 km to the west of the Project Area and is actually located adjacent to the western boundary of the Study Area (*i.e.*, immediately adjacent to but outside of the Study Area; Figure 12-2). Trajectory models indicate that hydrocarbon released during an accidental event would generally move in an easterly direction. Therefore, based on modelling, there is less than a 10 percent probability that hydrocarbons will reach this EBSA. As any hydrocarbons from an accidental event would be present at the surface or in the water column, the bottom habitat present in this EBSA is unlikely to be affected. Any adverse environmental effects on individuals of fish eggs and larvae and marine birds are assessed separately in Chapters 7 and 9, respectively. While there is a potential for productivity of the EBSA to be diminished if hydrocarbons reach this EBSA, the effects will be temporary and at a level from which natural recruitment could return the population or community to its former level within several generations. Therefore, the residual adverse environmental effect on this EBSA is rated as not significant.

Canyon Vulnerable Marine Ecosystems

The potential canyon VMEs identified within the Offshore Study Area are known to support diverse biological communities, including sensitive structure-forming coldwater corals and deep sea fishes. Spill trajectory models indicate that hydrocarbon from a spill at the Project Area without the implementation of countermeasures would interact with this Sensitive or Special Area. Hydrocarbons reaching these VMEs at the surface or even the water column would be unlikely to adversely affect sensitive deepwater corals and deep sea fishes located at or near the seafloor. The productivity and diversity of the benthic community is therefore not at risk and the residual adverse environmental effects are therefore rated as not significant.

Seamounts and Knolls Vulnerable Marine Ecosystems

Like the canyon VMEs, seamount and knolls support communities of invertebrate species that are mostly slow growing, long-lived, late to mature, and experience low natural mortality. Corals and sponges are often associated with these features, as well as a variety of deep sea fishes. Spill trajectory models indicate that hydrocarbon from a spill at the Project Area without the implementation of countermeasures would interact with this Sensitive or Special Area. Hydrocarbons reaching these VMEs at the surface or in the water column would be unlikely to adversely affect sensitive deep-water corals and/or sponges on the ocean floor and deep sea fishes. The productivity and diversity of the benthic community is not considered at risk and the residual adverse environmental effects are therefore rated as not significant.

Proposed Southeast Shoal Vulnerable Marine Ecosystem

The proposed VME is located within the boundaries of DFO's Southeast Shoal and Tail of the Banks EBSA. Therefore the assessment provided above for the Southeast Shoal and Tail of the Banks EBSA is considered applicable to this VME (*i.e.*, not significant).

A summary of the residual environmental effects assessment from accidental events on Sensitive or Special Areas is provided in Table 12-3.

Table 12-3 Environmental Effects Assessment: Accidental Events

Project Activity	Potential Environmental Effect	Mitigation	Evaluation Criteria for Assessing Residual Adverse Environmental Effects				
			Magnitude	Geographic Extent	Duration/ Frequency	Reversibility	Ecological/ Socio-economic Context
Nearshore Spill	• Change in Habitat Quality • Potential Mortality (For eelgrass beds only)	• Emergency Response Contingency Plan • Spill prevention and Response Plan	3	3	2/1	R	2
Offshore Failure or Spill from OLS	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	5	2/1	R	2
Offshore Subsea Blowout	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	5	2/1	R	2
Offshore Crude Oil Surface Spill	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	5	2/1	R	2
Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS, Hebron Platform)[A]	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	1	2/1	R	2
Marine Vessel Incident (*i.e.*, fuel spills)	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	5	2/1	R	2
Collisions (involving Platform, vessel and/or iceberg)[A]	• Change in Habitat Quality	• Oil spill prevention and response procedures	1	3	2/1	R	2

KEY

Magnitude:
1 = Low: <10 percent of any Sensitive or Special Area will be affected
2 = Medium: 11 to 25 percent of any Senstitive or Special Area will be affected
3 = High: >25 percent of any Sensitive or Special Area will be affected

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

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

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

Reversibility:
R = Reversible
I = Irreversible

Ecological / Socio-economic Context:
1 = Area is relatively pristine or not adversely affected by human activity
2 = Evidence of adverse environmental effects

A Activity can occur both nearshore and offshore

12.5.2 Cumulative Environmental Effects

CEAA requires that environmental assessments consider the cumulative environmental effects that are likely to result from the Project in combination with other projects or activities. For the Sensitive or Special Areas VEC, the assessment of potential Hebron Project-related environmental effects for both the nearshore and offshore are limited to accidental events, and are considered unlikely to occur, because of spill prevention activities and spill response procedures. Therefore an assessment of cumulative environmental effects in relation to these accidental events is not required under CEAA or considered appropriate here.

The potential for Project-related cumulative environmental effects on the various species that may use these Sensitive or Special Areas, but may also be present in the Nearshore and Offshore Project Areas at other times and therefore exposed to routine Project activities, is considered and assessed in the respective VECs (*i.e.*, Marine Fish and Fish Habitat (Chapter 7), Marine Birds (Chapter 9), Marine Mammals and Sea Turtles (Chapter 10), and Species at Risk (Chapter 11)).

12.5.3 Determination of Significance

The determination of significance is based on the definition provided in Section 12.2. It considers the magnitude, geographic extent, duration, frequency, reversibility and ecological context of each environmental effect within the Study Area, and their interactions, as presented in the preceding analysis (Table 12-4).

Table 12-4 Residual Environmental Effects Summary: Sensitive or Special Areas

Phase	Residual Adverse Environmental Effect Rating[A]	Level of Confidence	Probability of Occurrence (Likelihood)
Accidents, Malfunctions and Unplanned Events	S	3	1

KEY

Residual Environmental Effects Rating:
S = Significant Adverse Environmental Effect
NS = Not Significant Adverse Environmental Effect

Level of Confidence in the Effect Rating:
1 = Low level of Confidence
2 = Medium Level of Confidence
3 = High level of Confidence

Probability of Occurrence of Significant Environmental Effect:
1 = Low Probability of Occurrence
2 = Medium Probability of Occurrence
3 = High Probability of Occurrence

A As determined in consideration of established residual environmental effects rating criteria

Significant adverse residual environmental effects are predicted for identified Sensitive or Special Areas in the Nearshore Study Area; however, no significant adverse residual environmental effects are predicted for identified Sensitive or Special Areas in the Offshore Study Area. Using a precautionary approach, it is concluded that there is potential for a significant residual adverse environmental effect to the Sensitive or Special Areas VEC should hydrocarbons from an accidental event reach the identified nearshore eelgrass beds. However, the likelihood of a significant residual adverse environmental effect occurring is considered low.

12.5.4 Follow-up and Monitoring

Potential Project effects assessed in association with this VEC are limited to accidental events. Depending on the nature, timing and extent of an accidental event associated with the Project, a monitoring program will be implemented to determine environmental effects related to the event (refer to Chapter 14 for more information on accidental event mitigation and contingency plans). This would be particularly important for sensitive or special nearshore areas, where experience from other accidental events indicates the potential for multi-year effects.