Hebron

HEBRON PROJECT

Comprehensive Study Report

Consolidated Comments

September 2011

ExxonMobil Chevron SUNCOR ENERGY Statoil nalcor energy

Combined Comments and Response Document

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1.0 INTRODUCTION

This document combines the original response from ExxonMobil Canada Properties (EMCP) to regulator comments and follow-up comments. The comments are presented in the order as per the original Response Document (submitted November 30, 2010), with follow-up comments and responses (if any) immediately following the original response.

The document is organized as follows:

- Section 1 provides an introduction to this combined response document
- Section 2 provides the Hebron Project team's responses to the "Specific Comments" received from the Canada-Newfoundland Offshore Petroleum Board (C-NLOPB)
- Section 3 provides the Hebron Project team's responses to government agency general comments (Environment Canada, Transport Canada and the Newfoundland and Labrador Department of Environment and Conservation [NLDEC])
- Section 4 provides the Hebron Project team's responses to additional deficiencies and editorial comments from Fisheries and Oceans Canada (DFO)
- Section 5 provides the Hebron Project team's responses to other general comments (from the Fish, Food and Allied Workers (FFAW) Union, the Alder Society and Health Canada)
- Section 6 provides the Hebron Project team's responses to supporting document comments (air emissions modelling and oil spill modelling)
- Section 7 provides the Hebron Project team's responses to Appendix A comments on sea ice and iceberg sections
- Section 8 provides the Hebron Project team's responses to Natural Resources Canada comments
- Section 9 provides Hebron Project team's responses to regulatory agency comments on the August 2011 Tracked Changes CSR (Environment Canada and C-NLOPB)

2.0 SPECIFIC COMMENTS

2.1 Response to Section 1 Comments

EMCP Comment 1: TC 1

1-TC 1	**EA Reference:**:	Section 1.3 Regulatory Context Page 1-4, First Paragraph
Preamble:	It is stated that "Transport Canada may issue an approval under paragraph 5(1)(a) of the *Navigable Waters Protection Act* (NWPA)".	
Request 7-Sep-10	To reflect the March 2009 amendments to the NWPA, please change to "Transport Canada may issue an approval under **Part 1, Section 5 of the *Navigable Waters Protection Act***".	
EMCP Response 30-Nov-10	Noted, thank you and sentence will be amended in text.	

EMCP Comment 2: C-NLOPB 1

2-C-NLOPB 1	**EA Reference:**:	Section 1.5 Scope of the Project Page 1-7
Preamble:	In the list of project components and potential future activities, "etc." has been used.	
Request 7-Sep-10	The list of components and future activities that are included in the assessment should be identified in this section. The use of the term "etc." is not appropriate.	
EMCP Response 30-Nov-10	Noted, "*etc.*" will be removed from text and sentences with "*etc.*" have been amended to include the full list of components or potential future activities.	

2.2 Response to Section 2 Comments

EMCP Comment 3: C-NLOPB 2

3-CNLOPB 2	**EA Reference:**:	Section 2.1 Project Need and Justification Page 2-1
Preamble:	The Hebron Project's contribution to sustainable economic development within the Province is described in detail in the Socio-economic Impact Statement and the Canada-Newfoundland and Labrador Benefits Plan for the Project.	
Request 7-Sep-10	The Socio-economic Impact Statement has not been made available during the review of the CSR.	
EMCP Response 30-Nov-10	The sentence "*The Hebron Project's contribution to sustainable economic development.....*" was removed from the CSR as it was included as an information note.	

EMCP Comment 4: C-NLOPB 3

4-C-NLOPB 3	**EA Reference:**:	Section 2.6.4.1 Drilling Facilities Page 2-15
Preamble:	The CSR states that only non-aqueous fluid (NAF) based mud and cuttings will be re-injected and not water based cuttings. Section 21 of the OWTG states that each application for a Drilling Program Authorization or Production Operations Authorization should contain a description of specific pollution prevention measures that the operator plans to implement to reduce waste generation and discharge. Reinjection of water-based cutting would fit with reducing the amount of waste discharged from the facility.	
Request 7-Sep-10	It should be justified why it is not possible to re-inject water-based cuttings in terms of reducing waste discharged.	
EMCP Response 30-Nov-10	**The following text will be added to Section 2.6.4.1:** Water-based mud (WBM) cuttings are currently planned to be used on the first three hole sections of the Hebron wellbores. For the first hole section (conductor section), it is planned to return the WBM cuttings to the GBS shaft. Soil strengths immediately below the GBS base slab are anticipated to very weak and unable to sustain the additional hydrostatic load that would be introduced should the cuttings be returned to the Drilling Support Module (DSM) for re-injection. It is anticipated the DSM will be ±50 m above mean sea level. The returning fluid column would exert this equivalent hydrostatic head on the soils in the conductor hole section. Based on operational experience at Hibernia, it is anticipated this would result in significant fluid losses while drilling, subsequently creating a hole enlargement. This would pose potential risk to subsequent cementing operations of the conductor, overall well integrity and, potentially, stability of the soils beneath the base slab. Similarly, the second hole section (surface casing) is anticipated to encounter weak sands and soils. It is currently planned to return these cuttings to the lower levels of the Platform, where they will be routed to the shale chutes for overboard discharge. Attempting to route the returns to the higher elevation of the cuttings re-Injection system would introduce hydrostatic head that could also result in hole enlargement and risk to wellbore integrity. The third hole section (intermediate casing) will also be drilled with WBM systems. However, the geologic intervals to be penetrated typically return cuttings that tend to be tacky in texture and result in large masses, or clumps, of cuttings, that can best be defined as 'sticky'. These masses are not well suited to cuttings re-injection as they require large surface systems to dissolve the cuttings prior to routing to subsurface injection.	

	Finally, at the current Project stage, analysis has been performed to identify candidate subsurface zones for cuttings re-injection. Modelling is currently planned to be completed to ensure containment can be maintained for the non-aqueous fluid (NAF)-based mud drill cuttings and avoid out of zone fracture. Injection of large volumes of WBM cuttings potentially poses a risk for out-of-zone fracture and the subsequent loss of containment of NAF materials. Thus, the proposed plan of water-based discharge provides a balanced approach that minimizes overall risk of environmental damage.
Follow-up Comment 28-Jan-11	"*Cuttings from the surface casing will be returned to the platform and discharged" and "Cuttings cannot be transferred for reinjection because of hydrostatic head*." Once cuttings are on the platform, hydrostatic head should not be an issue as cuttings can be discharged to a pump, which then could move cuttings to a higher elevation. Since the platform is in the early design stages, relocating parts or all of the reinjection system may be possible which would facilitate reducing hydrostatic head. The proponent should provide more reasoning than simply hydrostatic head as to the impediments to re-injecting cuttings generated during drilling with water-based muds. The proponent's assertion that cuttings in the third section of hole tend to be tacky is based on the proponent's present understanding of the geology. The proponent should be prepared to evaluate the geology to determine if their assertion is factual. The proponent is asked to describe what is meant by "large surface systems" to dissolve the cutting prior to routing to subsurface injection. While "injection of large volumes of WBM cuttings potentially poses a risk for out-of-zone fracture and the subsequent loss of containment of the NAF materials" the referenced capacity limit has not been demonstrated in any geological study provided by the proponent. The proponent should be prepared to reassess reinjection of WBM cuttings over the life of the project if geology permits.
EMCP Response 18-Mar-11	Analysis of empirical offset data from Hibernia operations has shown that the shallow soils will only have sufficient strength to return WBM cuttings to the lower levels of the Topsides. The proposed pumping system would challenge wellbore integrity by imposing hydrostatic loads on the wellbore. This could compromise structural integrity of the conductor and introduce risk to the installation. With respect to the nature of cuttings, the properties of returned cuttings from the third hole section are based on samples captured from Hibernia Platform operations. Hence, they are based on factual observations. Large surface systems employ pumps, troughs, tanks, and processing equipment to render the cuttings pumpable for an injection wellbore. Overall management of waste and cuttings generated from the Hebron Drilling facility is founded upon a balanced approach to minimize the volume of drilling waste generated and discharged overboard through use of a managed cuttings reinjection program to ensure integrity of the cuttings disposal zone, while reducing risk to the overall drilling operation. A primary objective of any cuttings injection program is maintaining integrity of the injection zone to avoid broaching and release of NAF materials in an unwanted fashion. Injection of waste volumes beyond the capacity of the target zone introduces this risk. Initial analysis has shown that the target zones for injection at Hebron are geologically similar to Hibernia, but much thinner, with correspondingly smaller capacity for waste disposal. Thus, the proposed cuttings management program provides the optimal balance of safety in operations and environmental management with overboard discharge of materials approved for discharge offshore (e.g., water base cuttings from upper hole intervals) to ensure sufficient remaining capacity for injection of NAF materials into appropriate target zones.

Follow-up Comment **20-Apr-11**	It appears EMCP has not understood the C-NLOPB's response, in that EMCP has narrowly focused on a pumping system, where the pumps used to pump mud down the hole are used to generate sufficient head to move cuttings to higher levels of the platform, where CRI is located. The C-NLOPB does not dispute EMPC assertion that under this pumping scenario, hydrostatic head may exceed that of the substrate and the integrity of the well bore could be compromised. What the C-NLOPB has put forth is that once the cuttings are on the platform, a hydraulic break [i.e. a tank] with a pumping system that would lift a fluid [mud] to whatever height one wishes be installed. Since this is a separate pumping system not connected to the one that circulates mud in the hole, well bore pressure is not affected because the pumps used to circulate mud in the well bore would only create sufficient pressure to return the cutting to the lower level of the platform, as EMPC has proposed to do in the CSR. EMCP's statement that "The proposed pumping system would challenge well bore integrity by imposing hydrostatic loads on the wellbore…" is simply irrelevant as they have failed to consider introduction of a hydraulic break. The proponent states properties of cuttings are based on samples captured from the Hibernia Platform. The Proponent has not made a connection between the geology of the formation the Hibernia platform drills trough and that of geology obtained from Hebron drilling programs. For such assertions to be valid, the proponent needs to provide a comparison of the geology of the Hibernia formation to that of Hebron to show they are similar. The Proponent has provided its objectives for disposal of cuttings with a reference to disposal at the Hibernia project. This does not address that disposal formations capacity has not been demonstrated or shown by the proponent or, as more detailed information is gained through injection of cuttings, that the proponent will reassess injection of WBM and cuttings. The description of the disposal formation capacity is relevant.
EMCP Response **17-Jun-11**	The overall waste management strategy is to ensure sufficient injection capability for the waste that poses the highest potential environmental risk. In the case of drilling operations, this will be the Non-Aqueous Drilling Fluid- (NADF-) related cuttings. Injecting Water-Based Drilling Fluid (WBDF) and related cuttings into a subsurface injection zone would consume capacity of available zones to accept the NADF related cuttings. While studies are ongoing, preliminary assessment of candidate zones at the Hebron location indicate less capacity exists compared to the offset operation, Hibernia. Hibernia has experienced challenges with its waste injection program in that capacity has been reached in specific wellbores where injection has been used only for NADF-related cuttings. Three wellbores have been used for waste injection, whereas the original program only envisioned two. Hebron has a lower well count than Hibernia, and as such, is exposed should primary candidate wellbores fail to accept the targeted volume. For Hebron, the WBDF used in the upper hole sections, and which will be discharged to sea, will be primarily composed of seawater, with some added viscosifiers. Since a very simple low density drilling fluid is required, there is little else, including very little barite, needed in the upper hole sections. Discharge of WBDF and related cuttings has been proven to pose little environmental risk, as previously described in the Hebron Comprehensive Study Report (EMCP 2010). In addition, microcosm and field studies conducted to date (Neff 2010) on the effects of WBDF and related cuttings discharges (from studies conducted in North Sea, Barents Sea, Off Sakhalin Island, Beaufort Sea) on the environment have shown: • no or minimal short term effects on zooplankton communities

	• effects on benthic macro- and mega-faunal communities are minimal and restricted to approximately 100 m • no evidence of ecologically-significant bioaccumulation of metals and petroleum hydrocarbons by marine organisms residing or deployed in cages near WBDF and related cuttings discharges • no evidence of toxicity effects associated with WBDF constituents • ecological effects are due to physical disturbances of water column and benthic environment • ecological effects associated with WBDF and related cuttings are similar to physical disturbances associated with natural process, such as ice scour, river floods, and storms • benthic communities, if affected at all, recover quickly from WBDF and related cuttings The most abundant metal (and contaminant) in most WBDF and related cuttings is barium, with nearly all the barium in drilling fluid in the form of inert barite ($BaSO_4$), which is added when it is necessary to increase the drilling fluid's density (Neff 2005). Using barium as a tracer, the zone of detection for both single and multiple wells found that background levels for barium were achieved at 1,000 to 3,000 m from the drill source. The extent of barium contamination has been confirmed by the Grand Banks Environmental Effects Monitoring (EEM) programs. Drill cuttings releases at White Rose and Terra Nova are a mixture of WBDF and related cuttings and NADF-related cuttings, all which contain barium as an available tracer. Background barium concentrations have been achieved at Terra Nova within 1,000 to 2,000 m from drill source (Suncor Energy 2010) and within 2,400 m at White Rose (Husky Energy 2009). Hibernia has been discharging only WBDF and related cuttings since 2002, although prior to Q3 2002, WBDF and related cuttings, as well as NADF-related cuttings were released. Barium concentrations remain elevated out to 500 m from the Hibernia discharge point. The results beyond 500 m are comparable to baseline levels (Stantec 2009). In respect of WBDF and related cuttings, recovery begins as soon as discharge of drilling wastes is completed and often is well advanced within a year. This was demonstrated by Daan and Mulder (1993, 1996), who studied the effects of WBM discharges from a platform in the Dutch Sector of the North Sea, where surveys were performed two months and one year after completion of drilling. These surveys revealed no measurable adverse effects on the benthic community, even at stations as close as 25 m from the discharge (the transect studies ranged from 25 to 5,000 m down-current from the WBM discharge). Only small amounts of drilling fluid and cuttings solids were detected in sediments near the platform, suggesting that the discharged solids were transported away from the site and diluted to non-detectable concentrations within two months after completion of drilling. As described in the CSR, and supported by the above effects summary, the residual environmental effect of disposing WBDF and related cuttings has been assessed as not significant; injection would not change this assessment. In contrast, injecting WBDF and related cuttings into a disposal reservoir, will put the available capacity of the disposal reservoir for NADF-related cuttings at risk, and is misaligned with EMCP's overall waste management strategy.

EMCP Comment 5: C-NLOPB 4

5-C-NLOPB 4	**EA Reference:**:	Section 2.6.4.1 Drilling Facilities Page 2-15
Preamble:	Cuttings that are discharged inside the GBS	
Request 7-Sep-10	The potential bacterial action and the potential need to treat should be addressed as well as the associated environmental effect of the treatment and deposit of cutting in the GBS.	
EMCP Response 30-Nov-10	**The following text will be added to Section 2.6.4.1:** The growth of anaerobic bacteria and the resulting production of hydrogen sulfide could be potential health issues in addition to being corrosive to facilities. Anaerobic bacteria require very low or no oxygen in their environment in order to survive and grow. The GBS shaft for Hebron will be designed with a passive seawater circulation system using natural convection. Cold seawater will enter from the bottom of the shaft and warmer water will exit at the top of the shaft, with direct discharge to the ocean. The constant replenishment of fresh seawater (containing dissolved oxygen) will minimize the possibility for developing the anaerobic conditions suitable for growth of anaerobic bacteria, thereby minimizing the growth of anaerobic bacteria action in the GBS without the need for to add biocides. This circulation system design will account for drill cuttings that may be discharged at the shaft bottom.	
Follow-up Comment 28-Jan-11	The response lacks technical details to show that natural convection, as described, would occur and the flow sufficient to prevent anaerobic activity in the GBS. Please provide the technical aspects or studies, including calculation, of how the conclusion of natural convection would create a sufficient flow of seawater to eliminate anaerobic action in the GBS. The response should also consider that the cutting pile in the GBS would be a source of anaerobic bacteria, which could contribute to the presence of anaerobic bacteria in GBS seawater. EMCP should provide a technical discussion of how sufficient convective flow will be achieved to prevent anaerobic conditions from developing.	
EMCP Response 18-Mar-11	Design parameters for the natural convection seawater circulation system proposed for Hebron are mainly controlled by heat dissipation requirements inside the GBS shaft. Heat inside the shaft is generated by drilling conductors, export risers, oil in the storage cells and other permanent mechanical outfitting, including allowances for future development risers. Inlet and outlet piping is sized and installed such that sufficient flow circulates in and out of the shaft to prevent the water temperature inside the shaft from rising. Water flowing in and out of the shaft has the added effect of preventing water stagnation and minimizing bacterial action. However, at this stage in FEED, EMCP is still in the process of collecting heat source information to progress the design. It is also the intention to perform a study during FEED to determine whether the use of biocides is required as an add-on to prevent bacterial action inside the shaft. The study will take into account the cuttings pile as a potential source of bacteria inside the shaft.	
Follow-up Comment 20-Apr-11	The Proponent appears not to have contemplated how natural convection, as proposed, will achieve the desired effect. For the propose of this environmental assessment, the proponent should consider the need to add chemicals, i.e. biocides, to the as the worst case and should assess their use on the receiving environment. If the use of chemicals has not been assessed, it may be necessary for the proponent to amend its environmental assessment to account for the use of chemicals. The proponent should set aside the natural convection theory and assess a worst case, the use of chemicals so that if chemicals need to be used the Proponent will not have to amend its environmental assessment.	

EMCP Response 17-Jun-11	The use of biocides as a controlling agent for biological growth in the processing systems has been identified in Chapter 2. Any biocides used will be screened in accordance with an approved and established chemical management system. The discharge of waste streams, including biocides, have been assessed within the CSR. Therefore, if biocides are to be used in the GBS shaft, it is predicted that there will be a not significant environmental effect. The Operator will identify, in its EPP, any biocide that may used and the concentrations that may be discharged to the marine environment.

EMCP Comment 6: EC 1

6-EC 01	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-15
Preamble:	In the March 2009 project description (Table 2.1-5, P. 2-23) the proponent mentioned investigating the use of pilotless flares. The CSR states that "fuel gas will be continuously used for flare pilots" and makes no mention of pilotless flares.	
Request 7-Sep-10	What was the outcome of the investigation into the use of pilotless flares?	
EMCP Response 30-Nov-10	The primary function of the flare system is to safely dispose of flammable gases during unplanned events. To achieve this function, maximizing ignition probability, flame stability and free movement of gas to the flare tip provides the highest level of safety. The Hebron Project evaluated pilotless flare technology and concluded the following. 1. Flare ignition by standard, continuous pilots is preferred: a) Gas-fired continuous pilots have minimal greenhouse gas (GHG) emissions impact. They are described in and recommended by proven industry standards (*e.g.*, API STD 537) as providing high ignition probability and flame stability, and the Operator has significant operating and design experience with gas-fired continuous pilots. b) Continuous, non-burning ignition devices such as the sparker and glow bar are described in, but not recommended by industry standards (*e.g.*, API STD 537), due to their inability to guarantee ignition and their inability to maintain a stable flame. c) Discontinuous ignition devices such as the ballistic pellet are not recommended by industry standards (*e.g.*, API STD 537). Use of a discontinuous ignition device with an open flare increases GHG emissions, as the GHG contribution of methane (CH_4) is much higher than the GHG contribution from CH_4 combustion products (CO_2). 2. Gas disposal by an open flare stack and with no gas recovery is preferred: a) An open flare stack presents no obstructions to gas flow and is therefore the safest choice. b) Gas recovery systems require blockage (*e.g.*, valves) of the piloted flare such that gas is recovered without the introduction of air, which could create a flammable atmosphere inside the flare header or gas processing facilities. This blockage introduces the possibility that, when emergency disposal of gas is required, the flare header remains blocked, with potentially severe consequences to the platform. The emissions-reduction potential of gas recovery systems is minimal as only low-rate gas leakage can feasibly be recovered. The total quantity of low-rate gas leakage is very small compared to overall platform emissions (approximately 3 to 4 percent of total platform GHG emissions), and its recovery does not justify the potential reduction in platform safety caused by introduction of blockages in the flare header.	

Follow-up Comment 28-Jan-11	The proponent has alluded to a risk assessment completed in regard to gas recovery. Please provide information on the risk assessment completed.
EMCP Response 18-Mar-11	The evaluation described above did not involve a formal risk assessment. The analysis of the flaring system was based on ExxonMobil's global operating experience and industry practice in this field.

EMCP Comment 7: C-NLOPB 5

7-C-NLOPB 5	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-16, Third Bullet
Preamble:	It is stated that produced water will be discharged in accordance with the OWTG 2002.	
Request 7-Sep-10	The proponent should evaluate technology beyond the standard hydro cyclone separation to see if it is possible to achieve oil in water concentrations lower than those of the OWTG and if it is economically or technically feasible to implement.	
EMCP Response 30-Nov-10	**Third bullet, page 2-16, Section 2.6.4.2. The following text will be added after the sentence: "Produced water will be discharged from a single point…depth."** Water treatment technology was evaluated, and Compact Flotation Units (CFUs) were identified as the most advanced proven water treatment technologies available on the market for offshore application. The Hebron produced water treatment system includes compact floatation units (CFUs) in addition to hydrocyclones operating in series. The heavy, API 20 Hebron crude is expected to be difficult to separate from produced water. Thus, both hydrocyclones and CFUs are expected to be necessary to meet OWTG 2002 guidelines.	
Follow-up Comment 28-Jan-11	The response in part addresses the request in that the proponent looked at additional equipment for produced water treatment to meet the OWTG 2002. The proponent has determined that (comparatively) more advanced treatment will be required at Hebron to meet the performance targets for discharge oil-in-water as set out in the OWTG (2002). However, there is no discussion of achieving better performance than that indicated in the guidelines. The statement on page 13 (response to comment 8) that at start-up the facility will have "best commercially available and proven treatment technology" should be followed by a commitment to periodically review commercially available treatment technologies to determine if better performance could be achieved.	
EMCP Response 18-Mar-11	The treatment of produced water from the Hebron field will be one of the most challenging applications of offshore water treatment technology within ExxonMobil's global operations. Accordingly, EMCP will be using best available technology in both the separation and water treatment processes. It is anticipated that, even with the application of best available separation and treatment technology and operating practices, the Project will be challenged, particularly in its early years, to consistently meet the new 24 hour OIW limit of 44mg/L specified in the 2010 OWTG. This limit was established on the basis of historical performance data from existing producing projects offshore Newfoundland and Labrador with lighter weight crudes (30o to 35o API). Unlike existing projects, the Hebron field will produce a heavy crude (~20o API) presenting additional oil and water separation challenges and making it more difficult to consistently meet the new OIW limits. Notwithstanding these challenges, EMCP is committed to operate within regulatory limits for produced water discharge with a focus on continuous improvement through upgrades to existing facilities and application of new technology, where feasible and economic. EMCP's plans in this regard will be more fully described in its Environmental Protection Plan for the drilling and operations phase of the Project.	

EMCP Comment 8: C-NLOPB 6

8-C-NLOPB 6	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-16, Third Bullet
Preamble:	It is stated that the details regarding produced water re-injection feasibility will be addressed in the Development Plan. Produced water is the major waste discharged from oil and gas processing. Elimination of this waste stream removes, though re-injection, one of the greatest sources of effects the Hebron project will have on the environment.	
Request 7-Sep-10	More detail should be provided as to the viability of re-injecting produced water. Also, initiating re-injection of produced water at the start of the project can reduce some of negative effects produced water may have on the reservoir.	
EMCP Response 30-Nov-10	**The following text will be added to Section 2.x.x.x** (new subsection on Produced Water) **PRODUCED WATER MANAGEMENT** ***Introduction*** Produced water outfall from the Hebron Platform is estimated at up to 45,000 m^3/d. The Project Team is investigating the feasibility of injecting produced water into the reservoir for pressure maintenance. The overboard discharge of treated produced water is allowed by the Offshore Waste Treatment Guidelines (OWTG) (NEB *et al.* 2010). ExxonMobil has completed its initial assessment of produced water re-injection (PWRI) and concluded there are unacceptable risks associated with initiating PWRI until factors associated with these risks are better known. Initial assessment indicates that PWRI into the producing formations for pressure maintenance purposes may be technically feasible, if technical risks can be reduced through further data acquisition and studies post start-up. ExxonMobil is committed to adopting PWRI once it is demonstrated that the risks and costs are manageable. Preliminary studies identified several potential risks to adopting PWRI: • Souring potential is up to 50 percent greater than with injecting sea water only due to temperature and the presence of volatile fatty acids (VFAs) • PWRI could result in greater than predicted increases in injection pressure (potentially beyond pressure limits) • Fracture containment could be compromised with increasing use of produced water • Scaling potential is increased when injecting produced water into the formation Confirming that these risks are manageable requires additional data that can only be obtained and analyzed post start-up and after several years of operation. For example, VFA content is highly variable across reservoirs and more produced water samples are required. Further, only a very small number of formation water samples are currently available – more are needed to draw firm conclusions. A dedicated produced water disposal reservoir was investigated and found not to be feasible. The cumulative volume of water produced in 30 years is approximately 366 million m^3 and a suitable reservoir could not be identified. In addition, over-pressuring of the disposal formation is a significant risk. ***Produced Water Management Strategy*** Hebron will initially operate with marine discharge of produced water at start-up. As more wells come on-line and production data and experience is gathered, further testing on rock properties and produced water / sea water / reservoir compatibility will be carried out as additional core samples and produced water become available. Hebron will switch to PWRI for routine operations, once testing and studies (post-start-up) demonstrate that the risk and impacts of PWRI are understood and	

	acceptable. When PWRI is adopted, the facility will maintain flexibility for marine discharge during unplanned events (*e.g.*, equipment failure) or planned maintenance. In addition, it will be necessary to preserve the option to return to marine discharge if unexpected complications arise with PWRI (*e.g.*, loss of oil recovery, reservoir souring, scaling, plugging). In the base design, the water injection system is designed to inject at the predicted pressures required for PWRI. The Topsides facilities include space and connections for the future installation of the low pressure incremental equipment required to route produced water into the water injection system. ***Produced Water Re-injection Feasibility Studies*** Large volumes of seawater will be needed for pressure maintenance and the design team investigated if produced water could be used to satisfy a portion of those needs. Several risks arise when mixing produced water with seawater and injecting into a producing formation that need to be well understood before committing to produced water re-injection: • Compatibility of seawater and produced water with each other and the reservoir • Potential to "plug" the formation • Potential for injection pressures to increase with produced water / seawater mix compared to seawater only injection • Potential for bacterial contamination of the producing formation The proceeding sections summarize the studies completed to date, and further work to be completed. ***Injectivity*** Water injectivity (the ability to inject water into the producing formation) can be impaired over time by injecting produced water with higher concentrations of suspended solids and even relatively low concentrations of oil-in-water. Both of these would increase the risk of plugging pore throats in the near-well region where the injected water first enters the formation. In turn, such plugging may accelerate the rate of fracture growth and extend fractures beyond desired boundaries, leading to a potential loss of conformance and thereby reduced effectiveness in supporting reservoir pressure. Thermal effects of PWRI may also influence water injectivity since PWRI is likely to raise the injected water temperature (compared to seawater-only) and thus increase the fracture extension pressure, leading to a reduction in injectivity index. An injectivity study was conducted to assess the required injection pressure to achieve fracture injection for all potential injection wells in Hebron and how the injection requirements may change PWRI versus seawater injection. The injectivity study found that PWRI is technically feasible from an injectivity standpoint; however, there are several vulnerabilities that require additional operational data to confirm. A key area of risk is that fracture pressure will increase through time with PWRI, and increasing fracture pressures can lead to a greater risk for loss of fracture containment during injection. ***Scaling*** Both seawater and produced water are a complex solution of dissolved components (many types of “salts”). Upon mixing, the positive and negative ions in each must reach a new balance and sometimes they combine to form a solid that precipitates out of solution. Some of these chemical reactions take time to occur and precipitation can occur during injection process, as pressure and temperature changes take place. The rock fractures and pore spaces can then get plugged by these solids and hinder or prevent future injection.

	The only way to obtain a clear answer on the compatibility of Hebron produced water with seawater from the Grand Banks is to mix the two waters in a laboratory study and observe what happens under different temperature and pressure conditions. Such a definitive study cannot be done as yet, since there are no production wells available to sample. The produced water at the Hebron platform will be a mix of produced water from several different reservoirs and, therefore, is not presently available for study. However, the Project does have small samples of what is now "aged" water produced from individual reservoirs. These samples were obtained during production testing of individual wells from individual reservoirs in the late 1990s. These are now considered "aged" samples and, although ionic composition is the same, the potential loss of volatile organics and possible changes in organic composition could alter ionic reactions when mixed with seawater. Using these samples, the Project has proceeded with a small-scale study to obtain a preliminary understanding regarding the compatibility of the two waters. The results of this small-scale study suggest with low certainty that mixing produced water and seawater is possible. However, further investigation is required, using samples of Hebron produced water from actual production wells, to confirm and validate these preliminary compatibility test results. ***Souring (bacterial contamination)*** In the oil producing reservoir, bacteria are present. Hydrogen sulfides (H_2S) act as an energy source and VFAs are the nutrient source. An increase in growth of bacteria could result in a plugging of the formation, or souring of the reservoir. Levels of souring are dependent upon VFA concentration in formation water. An initial study of Pool 1 (Ben Nevis reservoir) souring susceptibility was conducted in 2005, using a range of levels of souring nutrients (VFAs) in formation water. Pool 1 predictions indicate potential for significant total-wellstream mass of H_2S, and that the sulphide content forecast for mixed produced water / sea water injection is up to 50 percent higher than that for seawater-only injection. PWRI is likely to increase the souring susceptibility of Pool 1 *vs*. sea water only injection, however, further studies are required to determine the effects and extent of souring from PWRI and if mitigations are available to control bacterial contamination, and prevent reservoir souring. ***Disposal Reservoir*** An evaluation was made to identify non-producing subsurface formations that could potentially serve as repositories for produced water. Ideally, such formations would be relatively thick and laterally continuous with high capacity for accepting a large volume of fluid, and would provide minimal potential for migration of injected fluid into other formations, or for entering subsurface faults that are conductive in character. Screening of wireline well logs and mud logs revealed only one prospective non-producing formation that would merit quantitative analysis of its potential water storage capacity. A unit of porcelaneous mudstone (also known as the Tilton Member) exists in the Paleocene section approximately 300 m above the top of the Ben Nevis formation in the Hebron initial development area, and this unit was subjected to preliminary investigation as a possible storage compartment for Hebron produced water. Screening-level calculations were performed to estimate the thickness trend, average net-to-gross, average porosity and, subsequently, the net pore volume of this formation within the Hebron Unit boundary. Results indicated that the porcelaneous mudstone unit is predicted to have far too little storage capacity to accept the forecasted volume of produced water over the life of the Hebron Project (an estimated 366 million m^3 plus additional produced water if future expansions are developed).

	A screening assessment of the disposal equipment required on the Topsides was performed, and it was found that a produced water disposal system (in addition to the required water injection required for reservoir maintenance) would result in approximately 150,000 t of CO_2e being released into the atmosphere annually (4.5 million tonnes over 30 years). The overall conclusion of the Project's evaluation is that disposal of produced water into a non-producing formation is not a feasible nor the preferred option. ***Plan for Completing further Produced Water Re-injection Feasibility Assessment*** In order to complete an assessment of PWRI and ensure all risks are understood, additional formation water samples are required. This can only be completed post start-up and analyses will include measuring produced water compositions for each distinct hydrocarbon resource and determining the degree of intra-reservoir variability in water compositions. Produced water from a few geographically-distributed wells is likely to provide the highest-confidence data. Further testing of produced water is required to confirm the scaling tendency/severity of sea water / produced water for both in-situ reservoir conditions and for operating conditions of wells / facilities. The concentration of VFA nutrients in produced water is needed for better forecasting of souring behaviour and additional measurements of variability will aid in characterizing the effects of mixed produced water / sea water. Further testing is also required on the reservoir rock properties, and some fresh core material will be acquired in select new wells to enable lab displacement measurements of mixed-produced water / sea water- waterflooding. ***Topsides Facilities*** The Hebron Topsides facilities include the best commercially proven water treatment technology and equipment for offshore applications. Heavy oil separation challenges warrant a robust produced water treatment system that includes hydrocyclones, CFUs, and degassing drum. In addition, Hebron will include Vessel Internal Electrostatic Coalsescer technology, which minimizes emulsion layer thickness and creates a better defined oil / water interface, helping to mitigate oil carry-under from separators to the produced water treating system. Pre-investment has been made in the water injections system to allow for PWRI to be initiated at a later date. Design elements include: • System designed to inject at predicted pressures required for PWRI • Inclusion of manifolds to blend produced water with sea water make-up, • Injection pump seals designed for the fine particles in produced water (a specialist application) • Include space and connections for the future installation of the low pressure incremental equipment required to route produced water into the water injection system (*i.e.*, low pressure booster pumps and filters) ***Summary*** ExxonMobil is committed to adopting PWRI for routine operations once it is demonstrated that the associated risks are acceptable. The Produced Water management strategy will be to operate with marine discharge of produced water at start-up using best commercially available and proven treatment technology. Hebron will switch to PWRI for routine operations, if testing and studies demonstrate that the risk and impacts of PWRI are understood and acceptable. The option will be preserved to return to marine discharge if unexpected

	complications arise with PWRI (*e.g.*, loss of oil recovery, reservoir souring, scaling, plugging). The Hebron water injection system will be designed to inject at predicted pressures required for PWRI, and include pre-investment for potential establishment of PWRI (space and connections for additional PWRI equipment). A post-start-up study and testing plan will be developed to address uncertainties.
Follow-up Comment 28-Jan-11	a) The produced water volume on page 10 (45,000 m^3/d) and on page 3 (56,000 m^3/d) do not agree. b) Please provide a copy of ExxonMobil's "initial assessment of produced water re-injection", "injectivity study" and the "initial study of Pool 1 (Ben Nevis reservoir) souring susceptibility", all of which are mentioned in the response. c) The proponent states: "*The overall conclusion of the Project's evaluation is that disposal of produced water into a non-producing formation is not feasible nor the preferred option*." The proponent has not shown how it concluded re-injection into a non-producing formation is not feasible or why it is not the preferred option. The proponent should consider in its response if it is possible to dispose of some of the produced water into a non-producing formation thereby reducing the projects overall environmental footprint, and if rejection into a non-producing formation would allow time to fully examine re-injecting produced water into the reservoir (possibly avoiding discharge of produced water). When looking at reinjection of produced water into the reservoir the proponent should also examine the possibility of reinjection into depleted parts of the reservoir or other such parts where produced water would likely have minimal effect on the reservoir. In examining the additional emissions, the proponent could have compared the emission for injection into a disposal formation to those of re-injecting into the reservoir to show there is a considerable difference in emissions. When looking at additional emissions, the consequences of the additional emissions should be weighted against the effects produced water may have on the receiving environment. The Proponent does not mention if sulphite removal or cooling is necessary, and if needed, has it been considered in the topsides design? Also will the well and process equipment be designed to handle produced water so modification will not be required later. The Proponent also does not seem to have considered the possibility that produced water could be re-injected into separate parts of the reservoir either where water injection has not commenced or where the part is nearing depletion. The proponent should consider discussing the possibility. The potential to dispose of a portion of the produced water in a disposal reservoir (rather than all 366 million m^3) or into depleted portions of the producing reservoir, was not discussed nor was an incremental CO_2eq value assigned as compared to CO_2eq for PWRI for pressure support. The all-or-nothing approach we see here is a familiar one The impact of warm produced water on injectivity is discussed (page 11) but options available to cool produced water via external (ex. seabed cooling) loops or internal loops (*e.g.* to dump heat to the GBS cell to aid convection (see comment 5 above)) are not discussed. Since there is evidence that produced water and seawater reactions occur rapidly after mixing, the proponent should contemplate how a mixed system could be provided with sufficient residence time before injection to allow particulates to evolve for filtration.
EMCP Response 18-Mar-11	**a)** The correct volume of produced water is 56,000 m^3/d. The incorrect volumes cited in the CSR will be replaced with 56,000 m^3/d. **b)** The reports requested will be submitted as Part 2 documents with the Hebron Development Plan application.

	c) A comprehensive discussion of the proposed produced water management strategy was presented to the C-NLOPB on 19-Oct-2010 and is summarized in our initial response. It is important to point out, as described in our initial response, ExxonMobil is committed to adopting PWRI once it is demonstrated that the risks and costs are manageable**.** The ability to re-inject produced water is mostly a function of subsurface factors, primarily the availability of a disposal aquifer with sufficient capacity to contain the water volumes being generated, rather than topsides facilities design. The feasibility of produced water reinjection examined the availability of subsurface aquifer for disposal, re-injecting into a producing formation, and the uncertainties associated with these options. A reservoir capable of holding the total volume of produced water has not been identified and injection into multiple reservoirs adds significant design and operational complexity. As indicated in our previous response, there are uncertainties with re-injection into the producing reservoir and more data is required to understand the risk and impacts of PWRI. The CSR assessed the potential environmental effects associated with the discharge of treated produced water, and determined that there are no significant effects from this discharge.
Follow-up Comment 20-Apr-11	It is understood that reinjection of produced water into a producing reservoir has certain risks which, if not mitigated, can have a serious effect on the quality and volume of oil recovered. Some of these risks are difficult to address until production has commenced and volumes of produced water obtained. EMCP appears to have taken an all or nothing approach to reinjection of produced water, and is unwilling to consider other options to dispose of produced water or the possibilities to re-inject a portion of produced water. The proponent has not presented information to preclude injection of some of the produced to a non-producing reservoir or that injection of produced water into selected parts of the reservoir is not possible. The proponent has not addressed if additional equipment may be required for the successful reinjection of produced water as mentioned in the C-NLOPB's response. The proponent has focused on the fact that no significant effects on the receiving environment due to the discharge of produced water have been detected to justify the discharge of produced water. EMPC has stated meeting the a 44 mg/L daily oil concentration for produced water may be challenging but is unwilling to consider that with reinjection of produced meeting this oil content is irrelevant nor the implication of not meeting this target may have on their operation. The proponent has not also considered produced water reinjection comparing CO_2eq estimates (150,000 t of CO_2eq being released into the atmosphere annually) to other alternatives or to CO_2eq from degradation of discharged oil.
EMCP Response 17-Jun-11	It is EMCP's understanding that the purpose of environmental assessment is to identify potential environmental effects of project activities, apply mitigation, where warranted, to reduce these environmental effects, and with the application of mitigation, determine the significance of the residual adverse environmental effects. As such, the potential environmental effects that may be associated with the discharge of produced water into the marine environment for each Valued Ecosystem Component (VEC) was fully assessed in the Comprehensive Study Report (CSR) and determined to be not significant. Notwithstanding the results of the environmental assessment, EMCP has undertaken a feasibility assessment of produced water re-injection (PWRI). Furthermore, pending the results of additional studies, EMCP has committed to establishing PWRI, once it is demonstrated that the risks are manageable and costs are not prohibitive. The CSR provided an evaluation of the applicability of "best available / practicable technology (*e.g.*, PWRI), as outlined in the Scoping Document (C-NLOPB *et al.* 2009). In addition, the Platform design includes the best proven technology currently available today for the treatment of produced water prior to

	overboard discharge. An assessment of the various options for partial re-injection of produced water is not necessary for determination of significance. The determination in the CSR, regarding the residual environmental effects associated with the marine discharge of treated produced water, as not significant would not change should PWRI be implemented. While there may be questions regarding the technical feasibility of PWRI, the Produced Water Management Strategy (submitted as a Part 2 document to the Development Plan) addresses some of these issues in greater detail. With regard to the potential to dispose into multiple reservoirs, EMCP undertook an evaluation to identify non-producing subsurface formations that could potentially serve as repositories for produced water. Screening of wireline well logs and mud logs revealed only two prospective non-producing formations that would merit quantitative analysis of their potential water storage capacity. These units were subjected to preliminary investigation as possible storage compartments for Hebron produced water. Screening-level calculations were performed to estimate the thickness trend, average net-to-gross, average porosity and, subsequently, the net pore volume of these sand members within the Hebron Unit boundary. Results indicated that these sand members were predicted to have far too little combined storage capacity to accept the forecasted volume of produced water over the life of the Hebron Project. As indicated in the Development Plan (EMCP 2011), preinvestment has been made in the water injections system design to allow for PWRI to be initiated at a later date. This preinvestment includes deck space and connections for the future installation of the low-pressure incremental equipment required to route produced water into the water injection system. With regard to $C0_2$ equivalent estimates, the figure given for greenhouse gas equivalents applies to the case of produced water disposal (*i.e.*, into a non-producing reservoir) and recognizes that there is significant additional energy required to concurrently inject produced water for disposal in addition to seawater injection for reservoir pressure maintenance. This is different from PWRI where produced water is used for reservoir pressure maintenance. If PWRI could be realized for pressure maintenance (needs further study given the potential reservoir impacts discussed), then the difference between greenhouse gas emissions from PWRI compared to seawater injection would be negligible.
Follow-up Comment 29-Jul-11	The proponent's response implies that a determination of no significant environmental effects is sufficient. However, Section 5.3.4.1 of the scoping document, Construction and Operational Discharges, states that the Proponent must evaluate means to reduce or recover waste beyond those specified in the regulations or in guidance. This means that even where waste discharge may be determined to have no significant adverse environmental effects, that waste discharge should be further reduced where feasible. In the case of produced water, that means reducing the produced water oil content, or the volume discharged. Section 1.3, Waste Minimization, of the C-NLOPB's December 2010 Offshore Waste Treatment Guidelines (OWTG), states: *Offshore operators are expected to take all reasonable measures to minimize the volumes of waste materials generated by their operations, and to minimize the quantity of substances of potential environmental concern contained within these waste materials.* and *In keeping with the spirit of waste minimization and the regulatory requirement for continual improvement outlined in subsections 5(2)(b) and 5(2)(i) of the Regulations, the Boards expect that operators will strive to minimize the concentrations and volumes of waste materials discharged to the environment, and will adopt best practices in waste management*

	and treatment. In addition, Section 2.2.1, Treatment and Monitoring, of the OWTG states: *…[T]he operator should consider the technical and economic feasibility of alternatives to conventional marine discharge of produced water. Operators should consider proven and practicable best practices in produced water management and treatment, to reduce oil-in-water concentrations to as low as practicable, or to reduce or eliminate produced water discharges to sea.* The proponent therefore should describe its technical and economic rationale for concluding that re-injection of produced water into a non-producing formation is not reasonable to undertake at this time.
EMCP Response 4-Aug-11	Section 2.6.4.3 Produced Water Management, has been revised to include additional text regarding the technical and economic limitations associated with the re-injection of produced water into non-producing formation(s). **Section 2.6.4.3 was revised as follows**. **Introduction** The management of water during Hebron production operations will be one of the most technically complex and challenging operations for an offshore production facility. Produced water discharge rates from the Hebron Platform are estimated at up to 56,000 m^3/d. The management of such high water volumes requires extensive equipment and associated piping which contributes significantly to topsides weight and costs as well as operational complexity. As part of its overall water management strategy the operator is investigating the feasibility of injecting produced water mixed with seawater, into the reservoir for pressure maintenance. A mix of seawater and produced water is required, as the volumes of produced water are insufficient to maintain reservoir pressure. EMCP has completed its initial assessment of produced water re-injection (PWRI) into the producing formations and has concluded there are unacceptable risks associated with initiating PWRI until factors associated with these risks are better known. Initial assessment indicates that PWRI into the producing formations for pressure maintenance purposes may be technically feasible, if technical risks can be reduced through further data acquisition and studies post start-up. ExxonMobil is committed to adopting PWRI once it is demonstrated that the risks and costs are manageable. Preliminary studies identified several potential risks to adopting PWRI: • Souring potential is up to 50 percent greater than with injecting seawater only due to temperature and the presence of volatile fatty acids (VFAs) • PWRI could result in greater than predicted increases in injection pressure (potentially beyond pressure limits) • Fracture containment could be compromised with increasing use of produced water • Scaling potential is increased when injecting produced water into the formation Confirming that these risks are manageable requires additional data that can only be obtained and analyzed post start-up and after several years of operation. For example, VFA content is highly variable across reservoirs and more produced water samples are required. Further, only a very small number of formation water samples are currently available – more are needed to draw firm conclusions. The operator examined the potential to inject produced water (including partial reinjection) into dedicated disposal reservoir(s). Based on this evaluation, suitable reservoir capacity to accept the produced water was limited. The cumulative volume of water produced in 30 years is approximately 366 million m3.. Over-pressuring of the disposal formation would also be a significant risk. With regard to partial

	reinjection, such an approach would require a duplication of the pumping facilities and associated piping currently required for seawater injection, additional well slots, and increased power generation capacity. The topsides design includes approximately 100 MW of power generation. Adding separate pumping facilities would require an increase in power generation of approximately 25 percent, and thereby increase the emissions. Produced water injection into dedicated reservoirs would exacerbate the weight, cost and operational challenges already inherent in offshore processing of a heavy crude. The added pumps and power generation equipment, as well as the use of well slots for additional dedicated injection wells, is not technically feasible, economically viable, nor environmentally sound. **Produced Water Management Strategy** Hebron will initially operate with marine discharge of produced water at start-up. As more wells come on-line and production data and experience is gathered, further testing on rock properties and produced water / seawater / reservoir compatibility will be carried out as additional core samples and produced water become available. Hebron will switch to PWRI for routine operations, once testing and studies (post-start-up) demonstrate that the risk and impacts of PWRI are understood and acceptable. When PWRI is adopted, the facility will maintain flexibility for marine discharge during unplanned events (e.g., equipment failure) or planned maintenance. In addition, it will be necessary to preserve the option to return to marine discharge if unexpected complications arise with PWRI (e.g., loss of oil recovery, reservoir souring, scaling, plugging). In the base design, the water injection system is designed to inject at the predicted pressures required for PWRI. The Topsides facilities include space and connections for the future installation of the low pressure incremental equipment required to route produced water into the water injection system. **Produced Water Re-injection Feasibility Studies** Large volumes of seawater will be needed for pressure maintenance and the design team investigated if produced water could be used to satisfy a portion of those needs. Several risks arise when mixing produced water with seawater and injecting into a producing formation that need to be well understood before committing to produced water re-injection: • Compatibility of seawater and produced water with each other and the reservoir • Potential to "plug" the formation • Potential for injection pressures to increase with produced water / seawater mix compared to seawater only injection • Potential for bacterial contamination of the producing formation The proceeding sections summarize the studies completed to date, and further work to be completed. **Injectivity** Water injectivity (the ability to inject water into the producing formation) can be impaired over time by injecting produced water with higher concentrations of suspended solids and even relatively low concentrations of oil-in-water. Both of these would increase the risk of plugging pore throats in the near-well region where the injected water first enters the formation. In turn, such plugging may accelerate the rate of fracture growth and extend fractures beyond desired boundaries, leading to a potential loss of conformance and thereby reduced effectiveness in supporting reservoir pressure. Thermal effects of PWRI may also influence water injectivity since PWRI is likely to raise the injected water temperature (compared to seawater-only) and thus increase the fracture extension pressure, leading to a reduction in injectivity index.

	An injectivity study was conducted to assess the required injection pressure to achieve fracture injection for all potential injection wells in Hebron and how the injection requirements may change PWRI versus seawater injection. The injectivity study found that PWRI is technically feasible from an injectivity standpoint; however, there are several vulnerabilities that require additional operational data to confirm. A key area of risk is that fracture pressure will increase through time with PWRI, and increasing fracture pressures can lead to a greater risk for loss of fracture containment during injection. **Scaling** Both seawater and produced water are a complex solution of dissolved components (many types of "salts"). Upon mixing, the positive and negative ions in each must reach a new balance and sometimes they combine to form a solid that precipitates out of solution. Some of these chemical reactions take time to occur and precipitation can occur during injection process, as pressure and temperature changes take place. The rock fractures and pore spaces can then get plugged by these solids and hinder or prevent future injection. The only way to obtain a clear answer on the compatibility of Hebron produced water with seawater from the Grand Banks is to mix the two waters in a laboratory study and observe what happens under different temperature and pressure conditions. Such a definitive study cannot be done as yet, since there are no production wells available to sample. The produced water at the Hebron Platform will be a mix of produced water from several different reservoirs and, therefore, is not presently available for study. However, the Project does have small samples of what is now "aged" water produced from individual reservoirs. These samples were obtained during production testing of individual wells from individual reservoirs in the late 1990s. These are now considered "aged" samples and, although ionic composition is the same, the potential loss of volatile organics and possible changes in organic composition could alter ionic reactions when mixed with seawater. Using these samples, the Project has proceeded with a small-scale study to obtain a preliminary understanding regarding the compatibility of the two waters. The results of this small-scale study suggest with low certainty that mixing produced water and seawater is possible. However, further investigation is required, using samples of Hebron produced water from actual production wells, to confirm and validate these preliminary compatibility test results. **Souring (bacterial contamination)** In the oil producing reservoir, bacteria are present. Hydrogen sulphides (H_2S) act as an energy source and VFAs are the nutrient source. An increase in growth of bacteria could result in a plugging of the formation, or souring of the reservoir. Levels of souring are dependent upon VFA concentration in formation water. An initial study of Pool 1 (Ben Nevis reservoir) souring susceptibility was conducted in 2005, using a range of levels of souring nutrients (VFAs) in formation water. Pool 1 predictions indicate potential for substantial total-wellstream mass of H_2S, and that the sulphide content forecast for mixed produced water / seawater injection is up to 50 percent higher than that for seawater-only injection. PWRI is likely to increase the souring susceptibility of Pool 1 verses seawater only injection; however, further studies are required to determine the effects and extent of souring from PWRI and if mitigations are available to control bacterial contamination, and prevent reservoir souring. **Disposal Reservoir** An evaluation was made to identify non-producing subsurface formations that could potentially serve as repositories for produced water. Ideally, such formations would be relatively thick and laterally continuous with high capacity for accepting a large

	volume of fluid, and would provide minimal potential for migration of injected fluid into other formations, or for entering subsurface faults that are conductive in character. Screening of wireline well logs and mud logs revealed only one prospective nonproducing formation that would merit quantitative analysis of its potential water storage capacity. A unit of porcelaneous mudstone (also known as the Tilton Member) exists in the Paleocene section approximately 300 m above the top of the Ben Nevis formation in the Hebron initial development area, and this unit was subjected to preliminary investigation as a possible storage compartment for Hebron produced water. Screening-level calculations were performed to estimate the thickness trend, average net-to-gross, average porosity and, subsequently, the net pore volume of this formation within the Hebron Unit boundary. Results indicated that the porcelaneous mudstone unit is predicted to have far too little storage capacity to accept the forecasted volume of produced water over the life of the Hebron Project (an estimated 366 million m^3 plus additional produced water if future expansions are developed). A screening assessment of the implications for topside facilities design indicated a requirement for additional dedicated pumping facilities and associated piping, additional well slots, and increased power generation capacity. This would exacerbate the weight, cost and operational challenges already inherent in offshore processing of a heavy crude and result in increased carbon dioxide emissions (approximately 150,000 tonnes of carbon dioxide equivalents) released into the atmosphere annually (4.5 million tonnes over 30 years). The overall conclusion of the Project's evaluation is that disposal of produced water into Hebron non-producing formation(s) is not feasible when considering technical and economic factors. The operator's preferred approach is re-injection into the producing formation when all operational, technical, environmental, regulatory compliance, and economic factors are considered. **Plan for Completing further Produced Water Re-injection Feasibility Assessment** In order to complete an assessment of PWRI and ensure all risks are understood, additional formation water samples are required. This can only be completed post-start-up and analyses will include measuring produced water compositions for each distinct hydrocarbon resource and determining the degree of intra-reservoir variability in water compositions. Produced water from a few geographically-distributed wells is likely to provide the highest-confidence data. Further testing of produced water is required to confirm the scaling tendency / severity of seawater / produced water for both in-situ reservoir conditions and for operating conditions of wells / facilities. The concentration of VFA nutrients in produced water is needed for better forecasting of souring behaviour and additional measurements of variability will aid in characterizing the effects of mixed produced water / seawater. Further testing is also required on the reservoir rock properties, and some fresh core material will be acquired in select new wells to enable lab displacement measurements of mixed-produced water- / seawater- waterflooding. **Topsides Facilities** The Hebron Topsides facilities include the best commercially proven water treatment technology and equipment for offshore applications. Heavy oil separation challenges warrant a robust produced water treatment system that includes hydrocyclones, CFUs, and degassing drum. In addition, Hebron will include Vessel Internal Electrostatic Coalsescer technology, which minimizes emulsion layer thickness and creates a better defined oil / water interface, helping to mitigate oil carry-under from separators to the produced water treating system.

	Pre-investment has been made in the water injections system to allow for PWRI to be initiated at a later date. Design elements include: • System designed to inject at predicted pressures required for PWRI • Inclusion of manifolds to blend produced water with seawater make-up, • Injection pump seals designed for the fine particles in produced water (a specialist application) • Include space and connections for the future installation of the low pressure incremental equipment required to route produced water into the water injection system (i.e., low pressure booster pumps and filters) **Summary** ExxonMobil is committed to adopting PWRI for routine operations once it is demonstrated that the associated risks are acceptable. The Produced Water management strategy will be to operate with marine discharge of produced water at start-up using the best proven treatment technology available today. Hebron will switch to PWRI for routine operations, if testing and studies demonstrate that the risk and impacts of PWRI are understood and acceptable. The option will be preserved to return to marine discharge if unexpected complications arise with PWRI (e.g., loss of oil recovery, reservoir souring, scaling, plugging). The Hebron water injection system will be designed to inject at predicted pressures required for PWRI, and include pre-investment for potential establishment of PWRI (space and connections for additional PWRI equipment). A post-start-up study and testing plan will be developed to address uncertainties.

EMCP Comment 9: C-NLOPB 7

9-C-NLOPB 7	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-16, Third Bullet
Preamble:	The CSR states that the details regarding produced water re-injection feasibility will be addressed in the Development Plan. The Scoping Document clearly states that the “Means for reduction, reuse and recovery of wastes beyond those specified in regulations and guidelines, including an evaluation of the applicability of “best available/practicable technology” (e.g., cuttings reinjection and produced water re-injection) to the project”.	
Request 7-Sep-10	The CSR should include an evaluation of produced water re-injection.	
EMCP Response 30-Nov-10	Please refer to the response to EMCP Comment 8: C-NLOPB 6.	
Follow-up Comment 28-Jan-11	See Response to ExxonMobil Comment 8.	
EMCP Response 18-Mar-11	The response to this comment is addressed under Comment 8: C-NLOPB 6.	
Follow-up Comment 20-Apr-11	See C-NLOPB Response to EMCP Comment 8: C-NLOPB 6.	
EMCP Response 17-Jun-11	See preceding response.	

EMCP Comment 10 C-NLOPB 8

10-C-NLOPB 8	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-16, Fourth Bullet
Preamble:	The flare will dispose of associated gas from the low pressure separator when the low pressure compressor is down for maintenance. Flaring of low pressure gas tends to produce black smoke.	
Request 7-Sep-10	The CSR should discuss flaring of low pressure gas in the air quality section and the mitigations that could be implemented to reduce or eliminate black smoke from flaring operations.	
EMCP Response 30-Nov-10	**Section 2.6.4.2 will be revised as follows at the end of the fourth bullet ("Vent and flare system:"):** The Hebron flare system design is not yet complete. The flare system will implement a design that uses appropriate, available, proven technology to minimize smoke production.	
Follow-up Comment 28-Jan-11	Proven technology implies the proposed design utilizes flare technology currently in use. Since the technology is in use, there should be information available on its performance. This data could be used to predicate emissions from the flare when the low-pressure compressor is down for maintenance. The proponent should also qualify what is meant by minimize smoke production. Does minimize mean there will black smoke and if so what intensity and flow can be expected and how these periods may affect air quality.	
EMCP Response 18-Mar-11	The fact that technology exists does not imply that one has been selected. The complete flare package will not be selected until detailed design (2012). On a preliminary basis, it is anticipated the HP flare will use a sonic flare tip, sized to accommodate the maximum HP flare system relief event. Sonic flare tips reduce noise, smoke and light discharge relative to pipe tips. Less-than-maximum rate events have not yet been fully detailed, and the impact of these low-rate cases on performance has not been established. The Hebron HP flare stack will be purged with nitrogen (with natural gas backup), substantially reducing the probability of smoke formation from continuously purging the HP flare stack with natural gas.	
Follow-up Comment 20-Apr-11	The proponent is reminded that a further review of the technologies employed and that they are reasonable to minimize emissions to as low as reasonable practicable, will be applied at the development plan stage.	
EMCP Response 17-Jun-11	Noted.	

EMCP Comment 11: EC 2

11-EC 02	**EA Reference:**:	Section 2.6.4.2 Process Systems Page 2-17
Preamble:	Part of the process description identifies the venting of gases from near atmospheric systems. There is no description of the magnitude, composition or significance of these gases, either in this or the air quality section.	
Request 7-Sep-10	The proponent is asked to comment on the composition, magnitude and significance of the gases being released through these vents.	
EMCP Response 30-Nov-10	**The following text will be added to Section 2.6.4.2:** Design definition of utility systems, such as atmospheric tanks, is not well developed at this conceptual engineering phase. Definition will increase as engineering progresses. However, the low pressure atmospheric tanks that will be vented generally contain low vapour pressure sources (*e.g.*, diesel, methanol) or non-hydrocarbon sources (*e.g.*, glycol, fresh water, drill water, potable water. Most	

	venting will occur during tank transfers and tank breathing. Vented volumes are expected to be minimal.
Follow-up Comment 28-Jan-11	The Proponent has indicated that they are still too early in the design stage to provide quantitative detail regarding process system venting and flare design. EC is satisfied with this response at this stage; however, we would like to see these items identified for further review when the detailed design is available.
EMCP Response 18-Mar-11	Noted.

EMCP Comment 12: DFO 1

12-DFO 1	**EA Reference:**	2.8 Hebron Project: Construction and Installation
Preamble:	The CSR does not provide sufficient information regarding the spoils disposal area within the nearshore project area. Fish habitat information within the proposed spoils disposal area is required in order for DFO to determine if it is likely to result in a HADD.	
Request 7-Sep-10	Provide information on the proposed spoils disposal area including, but not limited to, location and fish habitat information.	
EMCP Response 30-Nov-10	The disposal area in Great Mosquito Cove is unknown at this time. Work is ongoing to identify an area that has the least potential for habitat disturbance and that can accommodate the volume of spoils to be disposed. Based on preliminary review of the bathymetry and fish habitat information for Great Mosquito Cove, a likely candidate area is located at approximately 40 to 45 m water depth on the south side of Great Mosquito Cove. EMCP will consult with DFO regarding the selection of the spoils disposal area. In addition, Transport Canada requirements regarding navigability of water channels will be included in the selection process. A general description of the habitat for Great Mosquito Cove was provided in Section 7.3.1.2 (a HADD Strategy will be submitted in December 2010). **The following text will be incorporated into Section 7.3.1.2:** In Great Mosquito Cove, the bottom characteristics of the original Hibernia bund wall disposal zone between pre-disposal (1995) and post-disposal (2005) have been compared and documented (AMEC 2005). The survey showed that in the area of the bund wall disposal, there are mounds of sediment at depths between 20 to 40 m and that fish habitat had changed relatively little since the 1995 data. Surficial substrates were covered with fines, primarily clay, and very occasional cobble and boulders were visible with coralline algae (AMEC 2005). Slightly more epifauna were observed in 2005, compared to 1995. Kelp (*Agarum* sp. and *Laminaria* sp.) was abundant in some areas and scarce to absent in other areas (AMEC 2005). A more recent remotely operated vehicle (ROV) survey in August 2009 (Stantec 2010) revealed that fine material was a frequent surficial substrate observed in the cove, switching to gravel and cobble towards the outer section of the cove. The fine material was generally found in the central areas of the cove in deeper water, which is approximately 15 to 18 m in the inner area of the cove and 30 to 33 m in the middle area of the cove. The deepest areas in the outer cove reach a water depth of about 60 m, but on average is approximately 33 m. Benthic habitat with solid substrate was generally observed more towards the shore and which may be comprised of boulder and rubble and/or mixed with gravel and cobbles. Habitat with bedrock substrate was most common in the outer section of the cove towards the north shore and which covered approximately 15 percent of the seafloor. The benthic macroflora were relatively sparse overall and ranged in cover from approximately 2 to 11 percent of the seafloor (Stantec 2010). Sour weed (*Dictyosiphon* sp.) was the predominate species but which decreased towards the outside area of Great Mosquito Cove where it was observed in equal proportion with	

	sea colander (*Agarum cribrosum*) and to some extent also the brown seaweed, *Laminaria longicruris*. The sessile benthic macrofauna observed in the ROV transects included sea urchins (*Stronglyocentrotus droebachiensis*), which were the most common, followed by seastars, sea anemones and scallops. Species diversity was more pronounced on hard substrate such as boulder, rubble, cobble and gravel. Winter flounder (*Pseudopleuronectes americanus*) and cunner (*Tautogolabrus adspersus*) were the principle fish encountered during the benthic habitat ROV survey in August 2009. The cunner was the most frequently observed fish and was equally observed among all types of substrate. Winter flounder were observed mostly on fine substrate, but were also observed on hard substrate towards the outer area of the cove. Atlantic wolffish, a federally listed Species at Risk (Schedule 1, special concern), was identified in Great Mosquito Cove during the ROV habitat surveys in August 2009. They were observed at a depth of approximately 35 m, in areas of 80 to 90 percent boulder habitat, which has been identified as potential spawning habitat (Barsukov 1959; Keats *et al.* 1985; Kulka *et al.* 2007).
Follow-up Comment 28-Jan-11	Information on the original Hibernia bund wall disposal zone should only be incorporated if this area will actually be used for spoils disposal associated with the Hebron project. In either case, the following text provided in the response by the proponent should also be included in the CSR: *"The disposal area in Great Mosquito Cove is unknown at this time. Work is ongoing to identify an area that has the least potential for habitat disturbance and that can accommodate the volume of spoils to be disposed. Based on preliminary review of the bathymetry and fish habitat information for Great Mosquito Cove, a likely candidate area is located at approximately 40 to 45 m water depth on the south side of Great Mosquito Cove. EMCP will consult with DFO regarding the selection of the spoils disposal area. In addition, Transport Canada requirements regarding navigability of water channels will be included in the selection process."*
EMCP Response 18-Mar-11	The text referencing the previous HMDC disposal area will not be included in the CSR **The following text will be included in the CSR:** The disposal area in Great Mosquito Cove is unknown at this time. Work is ongoing to identify an area that has the least potential for habitat disturbance and that can accommodate the volume of spoils to be disposed. Based on preliminary review of the bathymetry and fish habitat information for Great Mosquito Cove, a likely candidate area is located at approximately 40 to 45 m water depth on the south side of Great Mosquito Cove. EMCP will consult with DFO and other federal authorities regarding the selection of the spoils disposal area. In addition, Transport Canada requirements regarding navigability of water channels will be included in the selection process.

EMCP Comment 13: DFO 2

13-DFO 2	**EA Reference:**	Section 2.8 Hebron Project: Construction and Installation Page 2-20
Preamble:	Tables 2-6 and 2-7 indicate that dredging may be required for the tow-out from the deepwater site to the offshore location. The potential requirement for this dredging is not addressed in the environmental effects assessment.	
Request 7-Sep-10	Given there is a possibility that dredging may be required, it should be included in the environmental effects assessment.	
EMCP Response 30-Nov-10	Environmental effects associated with all dredging activities, including those in Bull Arm or along the tow-out channel, can be found in the following sections of the CSR (June 2010): • Section 7.5.1.1, Nearshore, page 7-46 • Section 7.5.1.1, Future Activities, Construction, page 7-48	

	• Table 7-10, page 7-49 • Section 7.5.1.2, Nearshore, page 7-49 • Section 7.5.1.2, Suspended Sediment, second bullet, page 7-52 • Section 7.5.1.2, Offshore, Suspended Sediment, page 7-55 • Section 7.5.1.2, Noise, page 7-56 • Section 7.5.1.4, Nearshore, page 7-60 • Section 7.5.1.4, Offshore, pages 7-61 and 7-62 • Table 7-11, pages 7-63 and 7-65 • Section 7.5.5.2 (Offshore Cumulative Environmental Effects), page 7-86 • Section 8.5.1.1, Fishing Gear, page 8-50 • Section 8.5.1.1, Catchability, page 8-50 • Table 8-15, pages 8-57 and 8-58 • Table 9-10, pages 9-42, 9-43 and 9-44 • Section 10.5.1.1, Offshore, page 10-36 • Section 10.5.1.3, Nearshore, Dredging, pages 10-51 and 10-52 • Section 10.5.1.3, Offshore, Dredging, page 10-53 • Table 10-10, pages 10-63 and 10-65 • Section 11.4.2.1, Change in Habitat Quantity, Nearshore, page 11-40 • Section 11.4.2.1, Change in Habitat Quality, Nearshore, page 11-41 • Section 11.4.2.1, Change in Habitat Quality, Offshore, page 11-42 • Table 11-4, pages 11-47 and 11-48 • Section 11.5.2.1, Change in Habitat Use, Nearshore, page 11-70 • Section 11.5.2.1, Change in Habitat Use, Offshore, page 11-70 • Table 11-10, pages 11-73 and 11-75 Note that details regarding dredging, such as timing or anticipated volumes in the tow channel from the deepwater site to the offshore location are not provided in the CSR. It is uncertain at this time whether dredging would be required. The need to undertake dredging in this area will be determined prior to the scheduled tow-out window.
Follow-up Comment 28-Jan-11	"*Dredging for tow-out from the deepwater site to the offshore location*" should be included as a project activity in Tables 7-9 and 7-11.
EMCP Response 18-Mar-11	Both Tables 7-9 and 7-11 have be amended to include potential dredging for tow-out from deepwater site to offshore location.

EMCP Comment 14: HC 1

14-HC 1	**EA Reference:**:	Section 2.8.1 Great Mosquito Cove: Drydock Construction Page 2-22, Table 2.5 – Potential Activities and Potential Discharges/Emissions/Wastes
Preamble:	Table 2.5 indicates that noise may be an issue during pre-construction and construction activities; however, noise with respect to nearby human receptors is not discussed further in the document. As such, Health Canada was unable to assess the potential noise impacts on nearby residents or other potentially sensitive human receptors during pre-construction and construction phases of the project on-land and in the nearshore.	

Request 7-Sep-10	a) Please provide a discussion about the locations and proximity of all potential noise-sensitive human receptors relative to the project area, and the identification of areas in which receptors could be considered to have a reasonable expectation of "peace and quiet" (i.e. "quiet rural areas"). The identification of sensitive receptors may include residences, daycares, school, hospitals, places of worship, nursing homes, and First Nations and Inuit communities. b) Please provide a discussion of the expected duration of construction activities. Note that Health Canada uses the *Alberta Energy and Utilities Board Noise Control Directive 038* (2007) for guidance on whether construction noise should be considered short-term with regard to the prediction of complaint levels. • If construction noise lasts for less than two months at receptors, it may be considered temporary, and community consultation is advised. • For construction noise at receptors with durations of less than one year (i.e. short-term), Health Canada advises that mitigation be proposed if the resulting levels are predicted to result in widespread complaints or a stronger community reaction, based on the U.S. EPA method (U.S. EPA 1974, Michaud et al. 2008). • For construction noise at receptors with durations of more than one year (i.e. long-term), for operational noise, and where noise levels are in the range of 45-75 dB at the nearest receptor, Health Canada advises that health impact endpoints be evaluated on the change in the percentage of the population (at a specific receptor location) who become highly annoyed (%HA). Health Canada suggests that mitigation be proposed if the predicted change in %HA at a specific receptor is greater than 6.5% between project and baseline noise environments, or when the baseline-plus-project-related noise is in excess of 75 dB. c) If health effects due to noise are predicted, Health Canada advises the identification of mitigation measures to limit noise, which typically include community consultation programs. In some situations where a specific type of mitigation is not technically or economically feasible, community consultation has achieved success in limiting the number of noise-related complaints. <u>Noise References</u> Alberta Energy and Utilities Board. 2007. Energy Resources Conservation Board - Directive 038: Noise Control. Revised edition. www.ercb.ca/docs/documents/directives/Directive038.pdf Michaud, D.S., Bly, S.H.P. and Keith, S.E. 2008. Using a change in percent highly annoyed with noise as a potential health effect measure for projects under the Canadian Environmental Assessment Act. Canadian Acoustics, 36(2):13-28. U.S. EPA. 1974. Office of Noise Abatement and Control. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. www.nonoise.org/library/levels74/levels74.htm
EMCP Response 30-Nov-10	a) Airborne noise was considered in the scoping of the work but not specifically addressed in the environmental assessment. The reasoning for screening out the noise effects for the operational, offshore component remains valid, and is self evident; the separation of over a hundred kilometers from the nearest sensitive receptors. Considering the routine movements of supply vessels and relatively infrequent helicopter traffic, island effects of the project are nominal. Construction activities occur within Bull Arm, but were considered to have sufficient buffer distance that quantitative assessment was not conducted. The construction site in Bull Arm is over 4 km from the nearest residences of any type in Sunnyside to the north northwest, with screening occurring due to topography between the construction and the community. Receptors in the community of Arnold's Cove to the

	West-southwest are over twice that distance and enjoy line-of-sight and vegetation screening. b) The overall scheduled construction will occur over a long-term period, as defined by Health Canada, but the sound levels will remain far below the lower threshold for community annoyance. A simulation with Cadna (a noise modeling software) shows that, even with an assumed 36 pieces of construction equipment distributed from supply boat height of 4 m to crane height of 50 m, all with sound power levels exceeding 100 dBA, levels at Sunnyside would not exceed about 20 dBA due to the assumed construction. There are no known residences or sensitive receptors closer to the centre of construction. c) The community will be informed about the project, and mechanisms will be in place to handle concerns or complaints from the public. A community liaison will be on site throughout construction.

EMCP Comment 15: EC 3

15-EC 03	**EA Reference:**	Section 2.8.2 Gravity Base Structure Construction at Drydock Page 2-22
Preamble:	Section 3.1.1 of the Scoping Document includes ocean disposal of berm material and potential disposals from dredging activities to facilitate GBS tow operations. The CSR document does not indicate that a disposal site has been selected to receive the material from the berm and the clearance dredging. Selection and assessment of a disposal site will be a requirement for a disposal at sea permit application. Delaying site selection until permit application could also have project scheduling implications.	
Request 7-Sep-10	The proponents should indicate a potential disposal site location or locations in order to properly assess the associated environmental effects.	
EMCP Response 30-Nov-10	Please Refer to Response for EMCP Comment 12-DFO 1	
Follow-up Comment 28-Jan-11	The proponent has indicated that the precise location of an ocean disposal site (or sites) is not known at present and this is reasonable given the nature of the project. The CSR has satisfactory descriptions of the general areas in which these sites might be located and has provided discussions of the expected environmental effects and mitigations. If an application is made for a disposal at sea permit under these circumstances, the information in the CSR, together with details provided in the permit application, may prove sufficient to satisfy the requirements of an assessment which is triggered by the permit application. The proponent's response to Comment 15 is satisfactory.	
EMCP Response 18-Mar-11	Noted.	

EMCP Comment 16: DFO 3

16-DFO 3	**EA Reference:**	Section 2.8.3 Deepwater Site Construction Page 2-23
Preamble:	Section 2.8.3 states that "*It is anticipated that existing deepwater moorings will be used; however additional moorings may be required.*" There is no information provided on these moorings.	
Request 7-Sep-10	a) Specify whether these moorings are located on land or in water. If located in water, provide a description of existing and new moorings, including but not limited to location, general design, construction method, mitigation measures to protect fish and fish habitat, etc.	

	b) Given that the construction of new moorings is a possibility, it should be included in the environmental effects assessment.
EMCP Response 30-Nov-10	**The following text will be added to Section 2.8.3:** The requirement for additional moorings will be determined at the FEED stage. If additional moorings are required at the deepwater site, they may be constructed on land. The Environmental Protection Plan for Bull Arm includes mitigation measures for any land based construction. At the Topsides pier, temporary underwater moorings (or anchors) may be required to position the heavy lift vessel for Topsides tow-out. Details regarding the requirement for moorings, or the type of moorings that may be required are unknown at this time, as the Project is in the early stages of Project design. However, the Hebron HADD Strategy addresses all potential activities at Bull Arm, and any effects on fish habitat at this site, will be included in the fish habitat compensation plan, if warranted. Appropriate sections of the CSR will be updated (*i.e.*, Project activity tables) to include the possible temporary moorings at the Topsides pier.

EMCP Comment 17: EC 4

17-EC 04	**EA Reference:**:	Section 2.9.2 Operational Support Page 2-30, Table 2-9
Preamble:	In the March 2009 project description (Tables 2.1-4 and 2.1-5) the potential use of a waste incinerator is mentioned. The CSR has numerous mentions of waste treatment, but does not provide any specifics. Air emissions from an incinerator are not mentioned in the CSR.	
Request 7-Sep-10	Could the proponent confirm that an incinerator is no longer part of the project? If an incinerator is to be included in the project, the emissions should be identified and included in the analysis.	
EMCP Response 30-Nov-10	An incinerator is no longer part of the proposed Project.	

EMCP Comment 18: C-NLOPB 9

18-C-NLOPB 9	**EA Reference:**:	Section 2.9.6.3 Geotechnical Surveys Page 2-36
Preamble:	These surveys assist in the positioning of wells, pipelines and production facilities.	
Request 7-Sep-10	Some general information should be provided as to how these surveys are conducted.	
EMCP Response 30-Nov-10	**The following description will be included in Section 2.9.6.3** Substrate properties often need to be characterized prior to installation of any equipment on the substrate (such as the Platform and flowlines). Geotechnical investigations primarily involve the physical collection of sediment samples, and may also include collection of geophysical data (*i.e.*, side-scan sonar), as described in Section X.X. Methods to collect sediment samples include drilled boreholes and grab samples. Boreholes are drilled at each of the potential site to an approximate depth of 30 m below seabed. Due to the shallow nature of most boreholes, they are usually entirely in soils (unconsolidated sands, silts, and clays) and will not penetrate hydrocarbon-bearing formations. Cuttings will be expelled at the seafloor. Approximately 1 m^3 cuttings is generally generated per borehole. The major concerns associated with drilling activities in the marine environment are siltation of the water column and mortality and/or change in habitat quality of marine species by smothering. Noise associated with drilling is also a potential concern for	

	marine wildlife, particularly marine mammals. In addition, birds may be attracted to drilling platform lights.
Follow-up Comment 28-Jan-11	The reference to Section x.x should be complete.
EMCP Response 18-Mar-11	The referenced section is Section 2.9.6.1.

2.3 Response to Section 3 Comments

EMCP Comment 19: EC 5

19-EC 05	**EA Reference:**:	Sections 3.1.1.1 Wind Climatology & 3.1.2.1 Waves Pages 3-1 & 3-9
Preamble:	The data sources in these sections for the nearshore were incompletely described (and in Oceans 1.1.1 and 1.1.3).	
Request **7-Sep-10**	a) For each data source, please give the lat/long, exposure, elevation (land station) or water depth (wave buoy), and years of coverage. This information in needed for interpretation of differences in measurements. b) Are the names Bull Arm Oceans and Mosquito Cove used interchangeably when referring to the Oceans Ltd. Weather station (Bull Arm Oceans in tables, but Mosquito Cove in text and figures)? c) Could an example of an extreme winter storm during the 1995-1997 interval, when there are local measurements available, be added to this section?	
EMCP **Response** **30-Nov-10**	a) **The following table will be included in the CSR:**	

Source	Period	Location	Elevation (m)	Depth (m)
M12874	January 01, 1954 to December 31, 2005	47.70°N -53.80°W		140.89
Environment Canada Bull Arm	June 08, 1994 – May 28, 1997	47.82°N -53.90°W	13.7	
Oceans Bull Arm (Wind)	January 26, 1995 to May 27, 1997	47.82°N -51.86°W	10.0	
Oceans Bull Arm (Wave)	May 15, 1995 to January 31, 1996	47.82°N -51.86°W		155.00
Argentia, NL	January 01, 1953 to May 25, 1970	47.30°N -54.00°W	13.7	
	May 01, 1976 to October 31, 1986	47.30°N -54.00°W	15.5	
	January 01, 1987 to July 26, 2006	47.30°N -54.00°W	15.0	
Arnold's Cove, NL	July 01, 1971 to July 01, 1993	47.78°N -54.00°W	15.2	

b) Bull Arm Oceans and Mosquito Cove both refer to the same weather station. The CSR will be updated to ensure consistency of terms.

c) The highest wind speed of 27.8 m/s recorded at Bull Arm occurred on February 14, 1995. During this event, a mid-latitude low pressure system tracked eastward across Newfoundland, and deepened rapidly as it moved over the cold North Atlantic ocean. During this same event, the Oceans Ltd. weather station reported wind speeds of 15.9 m/s. Unfortunately, the waverider buoy at Bull Arm was not reporting during this event.

EMCP Comment 20: EC 6

20-EC 06	**EA Reference:**:	Section 3.1.1.3 Tropical Systems Page 3-6
Preamble:	The distance chosen to find tropical systems that passed near Bull Arm, listed in Table 3-4, should be expanded, so that the list would include Hurricane Michael, 20 October 2000. Michael brings the peak wind speed for October at the MSC50 data point near Bull Arm (Table 3-2), and Michael is given as an example of an extreme tropical storm in the Oceans report (1.1.2).	
Request **7-Sep-10**	a) Include Hurricane Michael in Table 3-4 b) There are contradictory sentences about the definition of the wind speeds in Table 3-4, in the text, 3.2.1.7, and in the Oceans report (1.1.6 and 1.29), that need to be corrected.	

EMCP Response 30-Nov-10	a) Table 3-4 and Figure 3-5 will be revised to include Hurricane Michael. b) **The following text in the CSR is the correct information:** Section 3.1.1.3: It must be noted that the values in Table 3-4 are the maximum 1-minute mean wind speeds occurring within the tropical system at the 10-m reference level as it passed. Section 3.2.1.7: It must be noted that the values in Table 3-29 are the maximum 1-minute mean wind speeds occurring within the tropical system at the 10-m reference level as it passed. **Therefore, the following text will be deleted from the text:** Section 3.1.1.3: Wind speed in Table 3-4 refers to the maximum sustained wind recorded during the life of the tropical hurricane and not the wind speed at the time it passed. Section 3.2.1.7: Wind speed in Table 3-29 refers to the maximum sustained wind recorded during the life of the tropical cyclone and not the wind speed at the time it passed.

EMCP Comment 21: EC 7

21-EC 07	**EA Reference:**:	Section 3.1.1.3 Tropical Systems and 3.1.2.2 Waves Pages 3-6 & 3-9
Preamble:	In 3.1.1.3, the description of peak measurements in Hurricane Luis, which made landfall near Argentia on 11 September 1995, includes the peak wind speed at the MSC50 grid point location, but not the peak wind and wave measurements from the local weather stations and buoy.	
Request 7-Sep-10	Include the peak wind and wave measurements from the local weather stations and buoy.	
EMCP Response 30-Nov-10	**The following will be added to Sections 3.1.1.3 and 3.1.2.2:** During this same event, the Oceans Ltd. weather station at Bull Arm only recorded wind speeds of 8.7 m/s. This may be the result of a number of factors, including local effects and distance of the site from the storm centre. Significant wave heights measured by the waverider buoy peak near 0.5 m shortly after the storm passed.	

EMCP Comment 22: EC 8

22-EC 08	**EA Reference:**:	3.1.2.2 Waves and 3.1.3 Wind and Wave Extremes Pages 3-9 & 3-22
Preamble:	The analysis uses MSC50 wave hindcast data for a grid point location that is adjacent to land, for one of its primary sources of wave data.	
Request 7-Sep-10	a) The text should indicate that caution is needed in using this data given limits of the model resolution and the proximity to land. This caution should also be noted in the Oceans and AMEC reports. b) Clarity would be improved if important information on extremes, results of a 1992 extremal wave analysis for Bull Arm, were moved from 3.1.2.2 to section 3.1.3, Wind and Wave Extremes, 3.1.3.2 Waves. The analysis method should be described briefly, to allow comparison with the extremal analysis method used in this CSR.	
EMCP Response 30-Nov-10	a) **The following text will be added to the end of paragraph 1.** Caution should be taken with respect to this grid point however due to it's proximity to land and the resolution of the MSC50 model. b) The section on page 3-14 of the June 2010 CSR titled "Additional Waves Estimates" (including Table 3-7) will be moved from Section 3.1.2.2 to the end of Section 3.1.3.2. The 1992 extremal analysis for Bull Arm was performed by Noble Denton and as such, it is inappropriate to comment on the analysis method.	

EMCP Comment 23: EC 9

23-EC 09	**EA Reference:**:	3.1.3 Wind and Wave Extremes, 3.1.3.1 Wind Page 3-22
Preamble:	This subsection gives extremal analysis results based on the MSC50 grid point data and adjusted to 10 minute and 1 minute sustained winds at 10 m.	
Request 7-Sep-10	Given the height of the planned structure, and the increase of wind speed with height, it could also be useful for design to give equivalent estimates of the wind speed at a height relevant for the structure topsides.	
EMCP Response 30-Nov-10	See response to EMCP Comment 26: EC 12.	

EMCP Comment 24: EC 10

24-EC 10	**EA Reference:**:	Section 3.1.4 Sea Ice and Icebergs (nearshore) Section 3.2.3 Sea Ice and Icebergs (offshore) Section 13.3.6 Effects of the Environment on the Project: Sea Ice and Icebergs (nearshore) Section 13.4.6 Effects of the Environment on the Project: Sea Ice and Icebergs (offshore)
Preamble:	Errors and inconsistencies are noted throughout the text.	
Request 7-Sep-10	Revise the text, figures and charts in accordance with the guidance provided in Appendix A – Environment Canada.	
EMCP Response 30-Nov-10	Noted. Responses to comments in Appendix A are provided in Appendix A.	
Follow-up Comment 28-Jan-11	See EC Comments on Appendix A for Response.	
EMCP Response 18-Mar-11	These comments are addressed in Appendix A.	
Follow-up Comment 20-Apr-11	Environment Canada is satisfied with this response, providing the information to EC once the detailed design process has advanced is acceptable. Clarification to comment (received May 12, 2011): 1. Regarding graph 3-14: In the column to the right, the title should be “Derived ice thickness based on the medium ice type” (max cm for category) 2. Regarding Figure 3-13: After rechecking the data, the figure refers to CIS atlas for the period 1971-2000, not CIS charts for the 1983-2008 period. 3. Regarding Figure 3-25: The data doesn’t agree with CIS ice charts from 1978-2008. Maybe the reference to the CIS charts (1978-2008) could be removed.	
EMCP Response 17-Jun-11	**1) The table will be amended.** 2) Figure 3-13 cites the Source as Canadian Ice Service 2001, which is the CIS atlas for the period 1971-2000. From list of references: CIS (Environment Canada Canadian Ice Service). 2001. *Sea Ice Climatic Atlas: East Coast Canada, 1971-2000*. Ottawa, ON. **3) The figure referenced should be Figure 3-35. The reference to CIS (1978-2008) will be removed**.	

EMCP Comment 25: EC 11

25-EC 11	**EA Reference:**:	3.2.1.2 Wind Climatology Page 3-32
Preamble:	This section presents the monthly mean and maximum wind speed statistics for both the MSC50 grid point and several offshore platforms presented separately, and gives the platform anemometer heights, all useful information.	
Request 7-Sep-10	a) To improve the utility of Table 3-23, maximum wind speeds, it would be appropriate to adjust the MSC50 values from a one-hour mean maximum to an expected 10-minute mean maximum, to make them more comparable to the maximum 10-minute sustained winds reported by the platforms (as is done in the section on Wind Extremes). This would also be appropriate for the MSC50 maximum wind speeds in Subsection 3.1.1.1, Table 3-2, for the nearshore, to compare with the maximum reported 10-minute means from the weather stations. b) The offshore platforms listed in Table 3-23 include Glomar Grand Banks and GSF Grand Banks. Positions and periods of coverage are given in the Oceans Report, Table 1-8. Please confirm whether these two periods were from the same platform, with different names at different times, and if those records could be combined.	
EMCP Response 30-Nov-10	a) Maximum wind speeds from the MSC50 dataset were converted from 1-hour maximum to 10-minute maximums, as indicated on page 3-33 (first paragraph) of the June 2010 CSR. **The following text will be added to the CSR as the second paragraph on page 3-33:** Winds speeds from MSC50 data set are 1-hour averages while the MANMAR data sets are 10-minute average winds. For consistency, wind speeds from the MSC50 data set have been adjusted to 10-minute maximum wind speeds. b) These two periods were for the same platform, under different names.	

EMCP Comment 26: EC 12

26-EC 12	**EA Reference:**:	3.2.1.2 Wind Climatology and 3.2.2.6 Wind and Wave Extremes Pages 3-32 & 3-56
Preamble:	When using winds from different sources, it is advisable to adjust winds for height, in order to reduce (although not eliminate) uncertainty when interpreting the data.	
Request 7-Sep-10	Given the large height differences involved between platform anemometers and 10 m, and the presence of both unstable (winter) and stable (spring and summer) conditions, it would be advisable to use a surface layer model that accounts for atmospheric stability, to adjust from one height to another (e.g. Cardone et al. 2004 and Bourassa et al. 1999, with software at: http://www.coaps.fsu.edu/~bourassa/BVW_html/bvw_docs.shtml). References: Bourassa, M.A., D.G. Vincent, W.L. Wood. 1999. A flux parameterization including the effects of capillary waves and sea state. *J. Atmos. Sci.*, **56**, 1123-1139. Cardone V.J., A.T. Cox, E.L. Harris, E.A. Orelup, M.J. Parsons and H.C. Graber. 2004. Impact of QuikSCAT Surface Marine Winds on Wave Hindcasting. *8th International Workshop on Wave Forecasting and Hindcasting*, *Oahu, Hawaii, November 14-19, 2004.* [http://www.waveworkshop.org/]	
EMCP Response 30-Nov-10	The MSC50 dataset compiled by Environment Canada, under contract to Oceanweather, is the most comprehensive wind dataset available. When performing this analysis, Oceanweather validated their models using Canadian Marine Environmental Data Service (MEDS) data, which incorporated wind and wave measurements from all platforms on the Grand Banks. This validation showed excellent agreement with the modelled MSC50 data with a bias of 0.04 and Scatter Index of 0.10 for wind speeds. In addition, a quantile-quantile comparison of wind speed show excellent agreement from the 1st to the 99th percentiles and the extreme	

	storms represented by the 99.1 to 99.9 percentiles (Swail *et al.* 2006). In addition, Swail *et al.* (2006) concluded "*the wind and wave data are considered to be sufficiently high quality to be used in the analysis of long return period statistics, and other engineering applications.*" Given the extensive research and the accuracy of the results with the MSC50 dataset, adjustment of platform wind speeds from anemometer height to 10 m is not necessary. Anemometer wind speeds are provided as is, to give representation of wind speeds at levels which would be of concern to the design of GBS.

EMCP Comment 27: EC 13

27-EC 13	**EA Reference:**:	3.2.1.7 Tropical Systems Page 3-41
Preamble:	In this section, Table 3-29 gives the strongest winds associated with tropical systems at the time they pass closest to the offshore project area.	
Request 7-Sep-10	a) It would be useful to give an example of a severe event when platform wind and wave measurements are available. b) The table indicates the winds are in m/s, however it appears the values are in knots. Also, the table caption refers to a different (incorrect) location than the text. c) The text (and also the Oceans report, 1.2.9) attributes the increase in Atlantic hurricane activity since 1995 to naturally occurring cycles in the tropical multi-decadal signal that typically last 20 to 30 years, referencing Bell and Chelliah (2006). This could give the impression that the increase would be expected to reverse. However, the paper by Bell and Chelliah did not describe the tropical multi-decadal mode or signal as a naturally occurring cycle, and it did describe notable differences between the earlier and the current period of higher activity. d) It should be noted that about one half of N Atlantic tropical cyclones transition to extratropical midlatitude storms, and about half of those reintensify (Hart and Evans 2001). This is important because the area of damaging winds and waves increases substantially. Reference: Hart and Evans, 2001: A Climatology of the extratropical transition of Atlantic tropical cyclones. Journal of Climate, 14: 546-564.	
EMCP Response 30-Nov-10	a) **The following text will be added to Section 3.2.1.7 of the CSR:** More recently, in 2006, Category 1 hurricane Florence began undergoing extratropical transition on September 13, 2006 near 40.5°N 57.9°W (about 420 nm south-southwest of Cape Race, Newfoundland. The system then tracked northeast, passing near Cape Race late on September 13, 2006, then across the Northern Grand Banks September 14, 2006. As this system passed, winds speeds of 23.1 m/s was recorded by the Cape Race weather station and 37.6 and 28.3 m/s were recorded by the Hibernia and Henry Goodrich platforms, respectively. b) **Wind speeds are in knots. Values will be adjusted.** Caption: **Table 3-29 Tropical Systems Passing within 370 km of 46.5°N 48.5°W, 1950 to 2009** Also, Table 3-29 will be updated to account for storms passing within 370 km of the site to correspond with the table (Table 3-4) for the Nearshore Project Area. Figure 3-23 will also be updated. c) **Text in Section 3.2.1.7 will be replaced with the following:** There has been a significant increase in the number of hurricanes that have developed within the Atlantic Basin within the last 15 years. This increase in activity has been attributed to the tropical multi-decadal signal (Bell and Chelliah 2006). As a result of the increase in tropical activity in the Atlantic Basin, there has also been an increase in tropical storms or their remnants entering the Canadian Hurricane Centre Response	

	zone and, consequently, a slight increase in the number of tropical storms entering the Grand Banks (Figure 3-23). It should be noted that the unusually high number of tropical storms in 2005 may be skewing the results for the 2005 to 2008 season. The average number of storms for the three year period of 2006 to 2008 is only 14.7, as opposed to 18.5 storms for the four-year period of 2005 to 2008. d) **The following paragraph will be inserted in the CSR:** A significant number of tropical cyclones which move into the midlatitudes transition into extratropical cyclones. On average, 46 percent of tropical cyclones which formed in the Atlantic transition into extratropical cyclones. During this transformation, the system loses tropical characteristics and becomes more extratropical in nature resulting in an increase in the area which produces large waves, gale to hurricane force winds and intense rainfall. The likelihood that a tropical cyclone will transition increases toward the second half of the tropical season, with October having the highest probability of transition. In the Atlantic, extratropical transition occurs at lower altitudes in the early and late hurricane season and at higher latitudes during the peak of the season (Hart and Evans 2001). Reference: Hart, R.E. and J.L. Evans, 2001: A Climatology of the extratropical transition of Atlantic tropical cyclones. Journal of Climate, 14: 546-564.

EMCP Comment 28: EC 14

28-EC 14	**EA Reference:**:	Section 3.2.2.1 Waves and 3.2.2.6 Wind and Wave Extremes Pages 3-46 & 3-56
Preamble:	This section benefits from the addition of analyses based on the past 10 years of measurements in this area, as well as from the MSC50 climatology.	
Request 7-Sep-10	a) It would be valuable to include some comparison to statistics derived for the earlier relatively continuous observation period on the Northern Grand Banks, from 1979 to 1988 measurements. b) This section (or supporting documents) would be more complete with a brief description of the each of instruments, methods of measuring waves, and methods of calculating significant wave height and wave period, when these differ among the different data sources. As well, this should include any significant changes over time in these details which might affect the wave climatology, such as described in the Oceans report for the Hibernia wave data sampling interval. c) As with the nearshore section, this section contains a description of the metocean extreme wave conditions developed by the ExxonMobil Upstream Research Company that would be more appropriately located in 3.2.2.6, Wind and Wave Extremes. There is a statement (also in the AMEC report) that the significant wave height values were first calibrated to Hibernia measurements. Please explain this. d) The monthly statistics for both Terra Nova (1999 to 2007, Tables 3-34 and 3-35) and White Rose (2003 to 2007, Table 3-36), seem to be based on incomplete data. The monthly means would be higher if the complete datasets were used. The reference for the Terra Nova dataset is DFO 2009b (in the AMEC report as DFO2009c), file WEL411, which does not cover the entire period indicated. There are additional DFO files for Terra Nova during this period (as well as more recent years, now up to 2009). Similarly, for White Rose, the data source is given as AMEC but the DFO file for White Rose for the same period, 2003-2007, seems to include more observations. The full available datasets should be used in the analysis, or there should be some explanation of why some data are excluded. e) What is the reason for using a different method of calculating the peak wave period for the Triaxys wave buoy than used by DFO, and why this is not the same as used for the Terra Nova buoy (Table 3-36 for White Rose notes that the peak wave period, Tp5, is calculated by the Read method)?	

	f) While this does not affect the CSR, please note that the list of wave sources in the Oceans report, Table 1.9, includes invalid dates for buoy 44153. Valid dates for the project area are October 1997 to March 1998 only, not starting in 1994 as indicated. This will affect the values in the Wave Climatology Table 1.12. The error arises due to the DFO wave archive structure, and past use of the same identifier for short term buoys moored in different locations.
EMCP Response 30-Nov-10	a) Statistics for the Hibernia 1980 to 1988 nine year wave time-series (Dal-Santo 1986; McClintock 1993) are provided in tables in response to EMCP Comment 28: EC 14 (b). This is a long data set that itself was compiled from different Grand Banks wave measurement programs and should be representative of those 'earlier' times. Otherwise, in terms of other 1979 to 1988 measurements, the comparison would involve bringing together, in some systematic fashion in order to produce meaningful information, all sorts of measurement program data for various locations and durations, and would take a greater additional effort. This effort, at the time, was what was accomplished with the Hibernia time-series. b) **A brief introduction / orientation for the reader on chronology of Grand Banks wave measurements will be added to Section 3.X.X.X. Updated text, tables and figures will be provided beginning with the last paragraph following Table 3-33, as follows:** • Physical monitoring data from offshore production activities on the Jeanne d'Arc Basin have been collected for more than 10 years. There are presently three oil-producing fields in the North Atlantic: Hibernia; Terra Nova; and White Rose (*e.g.*, Table 3-X (or Figure 3-25)). Water depths range from approximately 85 m at Hibernia to 95 m at Terra Nova to 120 m at White Rose. The Hebron Field is located in the Jeanne d'Arc Basin, approximately 9 km north of Terra Nova and approximately 35 km southeast of Hibernia. Numerous exploration drilling programs and associated oceanographic monitoring programs at these and other Grand Banks locations have also been completed from the late 1970s through to the present. Table 3-X presents a summary of selected sources available for comparison of Grand Banks wave conditions. A series of Hs and Tp monthly and annual, and annual Hs *vs* Tp bivariate statistics for these sources are presented in to Tables 3-Y to 3-Z. • A comparison of the MSC50 hindcast with these measurements is presented in Table 3-X, where mean and 95 percent upper limit (estimated, assuming a normal distribution, as mean +1.96 x standard deviation) are shown. • This is clearly not a complete list, nor exhaustive analysis or comparison; however, it focuses on providing a continuous record from the 1980s, together with record of the most recent measurements available from Hibernia, Terra Nova and White Rose. The history also shows the various wave instruments employed. **Table 3-X Grand Banks Selected Wave Measurement Sources**

Site	Instrument	Time Period	Description
Hibernia	Waverider buoy	1980-1988	Assembled from Waverider buoy measurements from drill sites near Hibernia. Waveriders are sea surface-following accelerometer buoys (twice integrated the measurements yield sea surface elevation, hence wave height). Gap filling was accomplished with a wind/wave correlation model, and (for 1985 to 1988 which saw substantially lower drilling activity) an operational wave hindcast model (McClintock 1993).
Hibernia	MIROS surface radar system	1998-1999	"The Hibernia platform-mounted MIROS Wave Radar system monitors sea state and surface currents. MIROS makes use of active microwave

			remote sensing techniques to collect sea state (waves and currents) information from the ocean surface. MIROS operates in C-band. The frequency of operation is 5.8 GHz and the corresponding wavelength is 5.17 cm. The sea surface is illuminated by the radar antenna pointing almost horizontally, with a grazing angle of some 10 degrees. MIROS scans a 180 degree swath of ocean extending some 100 metres out from the platform" (AMEC 2003)
Terra Nova	Waverider buoy	1999-2009	Datawell Waverider buoy as noted above for earlier Grand Banks exploration drilling.
White Rose	TRIAXYS directional wave buoy	2003-2007	Similar and acceptable wave measurement as per Waverider: has three accelerometers, three rate gyros. Benefits include directional wave information and rugged buoy design as a practical benefit.

Notes:
Hm0, significant wave height, is estimated from the spectral moment, m0
Tp, peak period, is defined as $1/f_p$ where f_p is the frequency at which the wave spectrum has its maximum value
These parameters correspond to VCAR, Characteristic significant wave height, and VTPK, wave spectrum peak period, as reported by DFO (2010b)
The reader interested in details of these and other particular wave instrumentation and/or data measurements should consult the appropriate data repositories (*e.g.*, DFO 2010a) and end-of-well or annual oceanographic data reports (*e.g.*, from Operator or C-NLOPB library).

Table 3-X Monthly and Annual Significant Wave Height and Peak Period Statistics at Hibernia for January 1980 to December 1988, and January 1998 to December 1999

Month	Significant Wave Height (m)			Peak Wave Period (s)		
	Min	Mean	Max	Min	Mean	Max
Jan	0.5	4.0	13.7	3.3	11.0	18.2
Feb	0.0	3.1	11.4	2.0	10.3	22.7
Mar	0.1	2.8	9.1	3.0	10.4	21.5
Apr	0.7	2.8	9.4	3.3	11.1	23.0
May	0.1	2.1	6.4	3.3	9.6	23.1
Jun	0.5	1.8	5.2	3.3	8.9	23.0
Jul	0.1	1.6	6.4	3.4	8.5	22.6
Aug	0.1	1.7	5.8	3.3	8.7	22.9
Sep	0.0	2.5	9.9	2.0	10.2	23.1
Oct	0.1	3.2	13.0	3.3	10.4	21.8
Nov	0.4	3.3	11.5	3.8	10.3	21.4
Dec	0.1	3.8	13.8	3.3	10.8	21.7
Year	0.0	2.7	13.8	2.0	10.0	23.1

Source:
1980-1988 (McClintock 1993)
1998-1999 (DFO 2010a; Hibernia WEL IDs: 407 (MIROS))
Note: Data sampled at 3 hour intervals during 1980 to 1988, and at 20 minute intervals during 1998 to 1999.

Table 3-X Annual Significant Wave Height vs. Peak Wave Period at Hibernia for January 1980 to December 1988, and January 1998 to December 1999

Peak Period (s)	Significant Wave Height (m)							
	0-2	2-4	4-6	6-8	8-10	10-15	Total	% Total
2-4	189	215	1	0	0	0	405	0.6
4-6	2,076	853	17	3	3	0	2,952	4.0
6-8	5,392	4,927	371	18	5	2	10,715	14.5
8-10	10,129	9,345	2,643	209	14	9	22,349	30.2
10-12	5,505	12,723	3,663	735	121	33	22,780	30.8
12-14	1,761	5,143	1,777	498	191	47	9,417	12.7
14-16	717	1,948	834	138	71	7	3,715	5.0
16+	512	720	125	20	0	5	1,382	1.9
Total	26,281	35,874	9,431	1,621	405	103	73,715	99.6
% Exceed	35.5	48.5	12.7	2.2	0.6	0.1	99.6	0

Source:
1980-1988 (McClintock 1993)
1998-1999 (DFO 2010a Hibernia WEL IDs: 407 (MIROS))
Note: Data sampled at 3 hour intervals during 1980 to 1988, and at 20 mininute intervals during 1998 to 1999.

Table 3-X Monthly and Annual Significant Wave Height and Peak Period Statistics at Terra Nova for July 1999 to September 2009

Month	Significant Wave Height (m)			Peak Wave Period (s)		
	Min	Mean	Max	Min	Mean	Max
Jan	1.5	4.0	12.5	4.6	10.0	18.2
Feb	1.0	3.8	14.6	4.2	9.8	16.7
Mar	0.8	3.3	9.4	4.4	9.6	16.7
Apr	0.6	2.6	7.1	3.7	9.3	14.3
May	0.6	2.2	6.3	2.9	8.5	14.3
Jun	0.6	1.8	6.5	3.0	7.9	14.3
Jul	0.6	1.5	4.1	3.2	7.8	14.3
Aug	0.5	1.8	8.0	3.2	8.0	25.0
Sep	0.7	2.3	10.4	2.8	9.0	18.2
Oct	0.8	3.0	10.4	3.9	9.7	18.2
Nov	1.0	3.0	10.2	4.0	9.6	18.2
Dec	1.2	3.8	11.7	4.2	9.8	14.3
Year	0.5	2.7	14.6	2.8	9.1	25.0

Source: DFO (2010a)
Terra Nova WEL IDs: 411 (G-90), 426 (F-88), 436 (G-90), 437 (L-98), 438 (C-69), 439 (F-100), 448 (FPSO)
Note: Data sampled at 20 minute intervals until February 2000, and subsequently at 30 minute intervals.
Data gaps include parts of September-October 2002; January-April 2004.

Table 3-X Annual Significant Wave Height vs. Peak Wave Period at Terra Nova for July 1999 to September 2009

Peak Period (s)	Significant Wave Height (m)							
	0-2	2-4	4-6	6-8	8-10	10-15	Total	% Total
2-4	144	0	0	0	0	0	144	0.1
4-6	6,408	1,946	1	0	0	0	8,355	5.0
6-8	23,999	16,389	972	7	0	0	41,367	24.7
8-10	18,866	27,159	5,439	377	9	0	51,849	30.9
10-12	9,315	31,157	12,115	2,364	415	30	55,396	33.0
12-14	799	4,110	2,414	470	124	46	7,963	4.7
14-16	337	1,193	801	285	64	6	2,686	1.6
16+	3	54	10	7	3	0	77	0.1
Total	59,871	82,008	21,751	3,510	615	82	167,837	100
% Exceed	35.7	48.9	13.0	2.1	0.4	0.1	100	0

Source: DFO (2010a)
Terra Nova WEL IDs: 411 (G-90), 426 (F-88), 436 (G-90), 437 (L-98), 438 (C-69), 439 (F-100), 448 (FPSO)

Table 3-X Monthly and Annual Significant Wave Height and Peak Wave Period Statistics at White Rose for October 2003 to August 2007

Month	Significant Wave Height (m)			Peak Wave Period (s)		
	Min	Mean	Max	Min	Mean	Max
Jan	1.5	4.2	11.2	5.6	11.4	16.7
Feb	1.4	3.5	9.4	5.0	11.0	16.7
Mar	1.2	3.5	10.0	5.0	11.6	16.7
Apr	0.8	2.6	7.1	4.6	10.5	16.7
May	0.6	2.2	5.9	3.5	9.7	16.7
Jun	0.7	1.8	6.8	3.2	8.6	16.7
Jul	0.6	1.4	3.5	3.3	8.3	16.7
Aug	0.7	1.8	7.5	3.5	8.9	16.7
Sep	0.7	2.4	10.2	4.4	10.3	16.7
Oct	0.9	3.0	12.2	4.8	11.1	16.7
Nov	1.1	3.2	11.2	4.8	11.4	16.7
Dec	1.4	3.4	11.1	4.8	10.7	16.7
Year	0.6	2.7	12.2	3.2	10.2	16.7

Source: DFO (2010b)

Note: Data sampled at 30 minute intervals. Data gaps include parts of February-May 2004; August-September 2004; February 2006; January-February 2007;

Table 3-X Annual Significant Wave Height vs. Peak Wave Period at White Rose for October 2003 to August 2007

Peak Period (s)	Significant Wave Height (m)							
	0-2	2-4	4-6	6-8	8-10	10-15	Total	% Total
2-4	32	0	0	0	0	0	32	0.1
4-6	1,366	212	0	0	0	0	1,578	3.1
6-8	4,656	2,689	51	0	0	0	7,396	14.4
8-10	6,161	5,101	499	8	0	0	11,769	23.0
10-12	4,379	10,420	2,379	314	13	0	17,505	34.1
12-14	873	4,400	1,748	395	95	3	7,514	14.7
14-16	325	2,290	1,267	291	79	19	4,271	8.3
16+	100	333	381	160	56	10	1,040	2.0
Total	17,892	25,445	6,325	1,168	243	32	51,105	99.7
% Exceed	34.9	49.6	12.3	2.3	0.5	0.1	99.7	0
Source: DFO (2010b)								

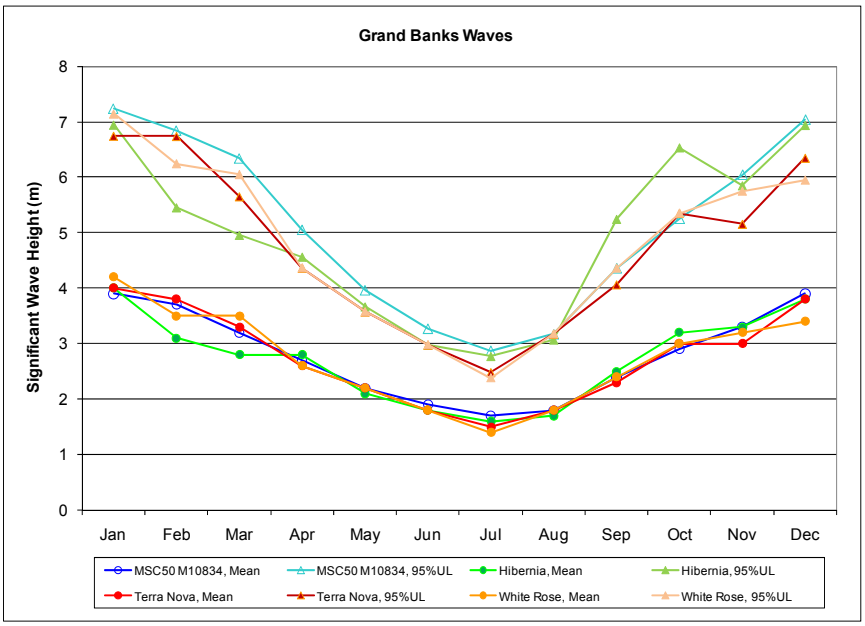


Figure 3-X Significant Wave Height Comparison: MSC50 Grid Point M6010834 Hindcast, and Hibernia, Terra Nova, and White Rose, Measurements.

The following references will be added to the CSR:

AMEC. 2003. *Hibernia Platform 2002 Environmental Report Volume I Oceanographic Report*. AMEC Earth & Environmental report prepared for Hibernia Management and Development Company Ltd., St. John's, NL.

McClintock, J. 1993. *Time-Series Extension and Wave Persistence Analysis of a Continuous Hibernia Wind and Wave Time-Series*. Seaconsult Report prepared for Hibernia Management and Development Company Ltd., St. John's, NL.

Dal-Santo, R. 1986. *Development of a Continuous Five-Year Time-Series of Winds, Waves and Currents at Hibernia*. Seaconsult Report prepared for Mobil Oil Canada Ltd.

Internet Sites

DFO (Fisheries and Oceans Canada, Integrated Science Data Management (ISDM)). 2010a. *Waves: Search For Wave Data Available On-line*. URL (user may search by data ID, e.g., WEL, or with a map at URL): http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/waves-vagues/search-recherche/index-eng.asp

DFO (Fisheries and Oceans Canada, Integrated Science Data Management (ISDM)). 2010b. *Waves: CSV Format Description*. URL: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/waves-vagues/formats/csv-eng.htm

c) Regarding "…significant wave height values were first calibrated to Hibernia measurements…" URC scaled the MSC50 values based on an analysis they did with Hibernia wave measurements. The following is from (ExxonMobil Upstream Research Company 2009):

> "**Extreme Wave Criteria**: The hindcast wave data have been previously calibrated based on measurements at Hibernia from 1999 through 2005 (Berek and Wang 2009). The following calibrationi s used:
>
> $H_{s,calibrated} = 1.0507 * H_{s,hindcast} - 0.4793$
>
> Where H_s is the significant wave height. The calibration leads to a reduced operational criteria and increased extreme criteria."

d) A new version of the Waves section is provided (at end of Table 3-X). Also, please note that:

- an updated data set for Terra Nova has been compiled for the period 1999 to 2009, now including seven WEL sets.
- no additional White Rose waves were found beyond 2003 to 2007 in WEL449. As the Comment seems to suggest there are additional data post-August 2007, we request that if there are any, please identify.
- Hibernia has been added to the Operator record. In addition to the 1980 to 1988 record, there is also WEL407 for Hibernia production 1998 and 1999 (other Hibernia platform data do not appear to be online).

e) This question is resolved with inclusion of statistics based on DFO 2010, where Tp is peak period, defined as $1/f_p$ where f_p is the frequency at which the wave spectrum has its maximum value; however, the description provided below is for possible general interest:

> T_{p5}, peak period as computed by the Read method and is available for TRIAXYS wave buoy (used at White Rose, 2003-2007). The Read Peak Period is reported by the TRIAXYS as part of its analysis because it can remove ambiguities caused by seas with multi-modal peak periods. The Read Peak Period (T_{p5}), is determined from calculating the average frequency (f_{p5}) as follows:
>
> $$T_{p5} = 1/f_{p5}$$
>
> where
>
> - $f_{p5} = \sum_i f_i (S_i / S_{\max})^5 \Big/ \sum_i (S_i / S_{\max})^5$
> - and the summations are for the low frequency to the high frequency bands;
> - f_i is the frequency in band i ;
> - S_i is the spectrum estimate at frequency i ; and

- S_{max} is the maximum spectrum estimate or energy of peak frequency.

T_{p5} has less statistical variability than the peak period (T_p) because it is based on spectral moments. For the White Rose deployment, AMEC found T_{p5} yielded a consistently smoother estimate of peak period.

Note: Section number 3.2.2.1 is used twice, for "Bathymetry" and "Waves".

f) An analysis of the valid dates above show that the data is only valid for the month of November. The remainder of the data has been either flagged as erroneous or occurs is below 1.0 m indicating the possibility of ice present. Therefore, wave observations from buoy 44153 have been removed from the tables. The new tables are provided below:

Table 3-X Locations of Wave Observations

Location	Latitude	Longitude	Period
Terra Nova	46.4°N	48.4°W	July 13, 1999 - March 31, 2007
Ocean Ranger	46.5°N	48.4°W	December 04, 1980 – February 09, 1982
Hibernia	46.7°N	48.7°W	January 01, 1998 - December 08, 2004
Hibernia	46.7°N	48.7°W	January 01, 2004 - December 31, 2008

Table 3-X Combined Significant Wave Height Statistics (m) for the MSC50 Data Set

Month	MSC50 Grid Point 10632	Terra Nova	Hibernia (1998-2004)	Hibernia (2005-2008)	*Ocean Ranger*
January	3.9	4.1	4.0	3.9	5.2
February	3.7	3.9	3.7	3.4	4.4
March	3.2	3.4	3.6	3.1	4.7
April	2.7	2.6	2.8	2.3	3.7
May	2.2	2.2	2.3	1.8	1.7
June	1.9	1.8	2.0	1.8	1.5
July	1.7	1.5	1.6	1.6	1.8
August	1.8	1.7	1.9	1.8	1.8
September	2.4	2.3	2.3	2.4	3.8
October	2.9	3.0	2.6	3.2	3.0
November	3.3	3.2	3.2	2.9	4.8
December	3.9	3.7	3.8	3.6	4.6

Follow-up Comment 28-Jan-11

EC-14-a and b. The inclusion of additional information and revised/updated wave statistics as requested is appreciated. ICOADS was used as the source of platform wind data. **REQUEST**: Please explain why the presumably more complete archives of the operator or C-NLOPB (please describe) are not used for the analysis of platform winds, for the more long-term platforms. It should be noted that use of the ICOADS trimming flags, both the standard (as indicated in the Oceans Ltd report) and even the enhanced, will exclude a significant percentage of valid extreme wind observations measured by platforms. This flagged data should be considered in future analyses. Note that in the two tables in this response for wave data from Hibernia, it may not be appropriate to combine the 1988-1989 wave radar data with the earlier wave buoy data as the two different observation systems give somewhat different wave distributions. This should be considered for future analyses.

28-EC-14-c. **REQUEST**: Please include a full reference for Berek and Wang 2009, given the important result that increases the extreme wave criteria. Also please

	elaborate on the source of the wave data that was used to calibrate the MSC50 significant wave heights. 28-EC-14-d. The response asked about White Rose data post August 2007 – however the original comment did not intend to imply data existed beyond that date but that within the 2003-2007 period there were additional observations. These seem to have been accessed in the revised tables given in this response. The response also says that other Hibernia platform data do not appear to be online. While the MIROS wave radar data do not seem to be archived at ISDM, the wave radar is apparently still in use. It was presumably the source of the wave data included in the ICOADS archive for the Hibernia GBS, with results given in the response to section f. **REQUEST**: Please clarify the source of the later wave data in the MANMAR reports from Hibernia archived in ICOADS, and explain the reason that operator or C-NLOPB archives are not accessed for the platform wave data, when it is not available in the ISDM archives. 28-EC-14-f. The response indicated that data from buoy 44153 when it was deployed near Hibernia, winter 1997/1998, was not used because much of the wave data are flagged as erroneous. This flagging was because of a wave processing error in the onboard wave processor which affected the band-averaged spectral data from which ISDM calculates significant wave height (archived as VCAR), but the error did not affect the buoy-reported significant wave height, archived in ISDM as VWH$. The VWH$ values are useable and may be helpful for any further analysis undertaken for the area.
EMCP Response 18-Mar-11	**28-EC-14-a and b**: MANMAR data obtained directly from the platform and archived by Oceans Ltd., not ICOADS data, were used for the analysis of platform winds. While these data, in theory, should be similar, the ICOADS dataset should not be referenced as the source of the wind data. There was no mention of using ICOADS data for winds in this report. **28-EC-14-c**: The cited reference is: Berek, E. P., Wang, W., Update of Metocean Criteria for Hibernia OLS Rebuild, June 1, 2009 memorandum to Lisa Snow. **28-EC-14-d**: The MIROS wave radar is the source of all wave observations from the Hibernia platform, including the later wave data in the MANMAR reports from Hibernia. Oceans Ltd. is responsible for archiving and quality controlling all MIROS wave data from the Hibernia platform and, as such has access to all wave data including those in the C-NLOPB archives. Since this data had not been quality controlled at the time of the report nor had it been made available in the ISDM and C-NLOPB archives, it was still considered proprietary to Hibernia Management and Development Corporation and therefore was not used in this report. **28-EC-14-f**: Noted.
Follow-up Comment 20-Apr-11	EC 14 a and b, on the Offshore Wind Climate Clarification on the source for the platform winds being Ocean Ltd archives, rather than ICOADS as assumed, is acknowledged. **Request**: Specify, in the revised CSR, the source for the platform winds (Oceans Ltd archives, based on MANMAR data), since this was not indicated. This should also specify that MANMAR refers to reports generated in ship code format (World Meteorological Organization (WMO)-FM13) for transmission on the Global Telecommunications System (GTS). EC 14 c and d, on the Offshore Wave Extremal Analysis 1) The cited reference (Berek and Wang 2009) was provided as requested, although it only states that it was a memo, and does not give number of pages. This was cited in the Nov. 2010 response to request for information about how the MSC50 hindcast significant wave heights (Hs) were calibrated to Hibernia measurements, prior to development of the design wave criteria (as described in CSR Section 3.2.2.1 Waves, referencing ExxonMobil Upstream Research Company (2009)). The Nov. 2010

	response gave the calibration equation derived by Berek and Wang 2009 ($H_{s,calibrated}$ = 1.0507*$H_{s,hindcast}$ – 0.4793). Only the first 2 years of the detailed Hibernia wave radar measurements are available on the Integrated Science Data Management (ISDM) online archive at Fisheries and Oceans Canada. The Nov 2010 response indicated that the Hibernia wave radar data are considered proprietary and are not being provided to ISDM, even though ISDM is the repository for the detailed wave measurements provided by wave buoys at the other sites on the Northern Grand Banks. Thus most of the detailed wave radar data, on which the calibration equation was based, are not available and are of unknown quality. **Request:** a) Include the calibration equation and its reference in the revised CSR in the section on wave extremes, along with the information that the calibration was based on MIROS Wave Radar measurements from Hibernia, rather than nearby wave buoy measurements. b) Include in the revised CSR or a background supporting document, validation information (or a published reference), if available, for the Hibernia MIROS wave radar measurements compared to nearby wave buoy measurements. If not available, it may be advisable to consider such comparisons for any further more detailed design studies. c) Complete the CSR Reference for ExxonMobil URC (2009) to indicate that it is a Memo dated 2 September 2009, 91 p. (as indicated by the Oceans Ltd and AMEC (2010), AMEC (2010) report). 2) The Nov 2010 response states that the calibration leads to a reduced operation criteria and increased extreme criteria. However the CSR extremal analysis in Section 3.2.2.6 and the Oceans Ltd and AMEC (2010) report-Oceans Ltd (2010), which appears to be based on MSC50 data without the Berek and Wang calibration, gives 100-yr extreme significant wave heights that are slightly higher: 15.1 m or 15.8 m, depending on the method, compared to 14.8 m from ExxonMobil URC 2009. **Request:** In the revised CSR, please indicate the level of uncertainty or confidence interval for the extreme wave estimates, given the different results presented in the CSR and its sources. 3) The CSR gives a Table 3-33 Wave Height Directional Weighting Factors, which the text says may be used to scale the extreme wave estimates for consideration of waves from a particular direction. The text says the directional factors account for the reduction in long period waves as they move over the relatively shallow sea bottom. However, it would not be appropriate to scale results for depth based on the MSC50 data since these are based on a wave model that includes the bathymetry and shallow water wave physics. **Request:** Please clarify in the revised CSR how these factors are intended to be used, or justify why they would be used with MSC50 derived wave statistics.
EMCP Response **17-Jun-11**	**The text in Section 3.2.1.2 will be revised as follows:** Low pressure systems crossing the area are more intense during the winter months. As a result, mean wind speeds tend to peak during this season. Mean wind speeds at Grid Point 10632 (approximately 5 km south of the Hebron Platform location) and in the MANMAR (refers to reports generated in ship code format (World Meteorological Organization (WMO)-FM13) for transmission on the Global Telecommunications System (GTS)) data sets peak during the month of January (Table 3-23). A description of the data sources used is provided in EMCP (2010). MANMAR data sets are 10-minute average winds. For consistency, wind speeds from the MSC50 data set have been adjusted to 10-minute mean wind speeds. The adjustment factor to convert from 1-hour mean values to 10-minute mean values is

	usually taken as 1.06 (US Geological Survey 1979). **Oceans Ltd. archives, based on MANMAR data, are the source for the Platform winds.** **Note that the citation to Oceans and AMEC (2010) has been revised as EMCP (2010) and the list of references cited have been revised as follows:** EMCP (ExxonMobil Canada Properties). 2010. *Physical Environment Setting for the Hebron Nearshore and Offshore Project Areas*. Prepared by Oceans Ltd. (Physical Environment Setting for the Hebron Nearshore and Offshore Project Areas) and AMEC Earth and Environmental Ltd. (Physical Oceanography Setting for the Hebron Nearshore and Offshore Project Areas) in support of the Hebron Project Comprehensive Study Report. **1a)** The calibration equation and reference will be included in the appropriate section under Chapter 3. Regarding the MIROS Wave Radar data, our stated response in our March 2011 Response to Comments was: **28-EC-14-d:** The MIROS wave radar is the source of all wave observations from the Hibernia platform, including the later wave data in the MANMAR reports from Hibernia. Oceans Ltd. is responsible for archiving and quality controlling all MIROS wave data from the Hibernia platform and, as such has access to all wave data including those in the C-NLOPB archives. Since this data had not been quality controlled at the time of the report nor had it been made available in the ISDM and C-NLOPB archives, it was still considered proprietary to Hibernia Management and Development Corporation and therefore was not used in this report. As stated above, these data were not used in the report. Our November 2010 response did not state that the data were proprietary. Rather, our March 2011 response indicated that the data, as they have not been released to ISDM, are considered proprietary by Hibernia Management Development Company and not available to the Hebron Project, and therefore were not used in the report. **1b)** See above response regarding the Hibernia MIROS data. These data were not used in the report as it had not yet been released to ISDM. Regarding future environmental assessments, if such data are available, they will be considered, where appropriate to the scope of the environmental assessment. **1c) The reference will be revised as follows:** ExxonMobil Upstream Research Company. 2009. Hebron Project Metocean Design Criteria. Memo dated 2 September 2009. 91 pp. **2)** For the purposes of environmental assessment, the data presented provides an overview of the meteorological and oceanographic conditions for offshore Newfoundland. It is likely that the data are within the confidence interval for the extreme wave estimates. The differences described above result from differences in approach to extreme value analysis do not affect the overall environmental assessment. **3) The paragraph will be replaced with the following**: ExxonMobil Upstream Research Company also provides directional scale factors for extreme waves. Due to the fact that the various return period wave height values of Table 3-35 (Table 3-32 in June 2010 CSR) are based on observations from all directions, scaling factors were determined to enable estimation of extreme wave heights expected for a particular wave direction. The MSC50 Grid Point M10834 significant wave heights were segregated into eight 45° bins and a directional scaling factor was calculated for each bin. This was accomplished by dividing the maximum significant wave height for a given bin by the maximum significant wave height from all bins (directions), to yield eight directional factors (ExxonMobil Upstream Research Company 2009). These factors are reproduced in Table 3-36 (Table 3-33 in June 2010

	CSR) and could be applied to an extreme wave value such as those reported in Table 3-35 (Table 3-32 in June 2010 CSR). **The following sentence will be revised in Section 3.2.2.6:** "The adjustment factor to convert from **peak** 1-hour mean values to **peak** 10-minute mean values is usually taken as 1.06 (US Geological Survey 1979)."
Follow-up Comment **29-Jul-11**	a) The response was satisfactory. There is one additional request (sorry this was not noted earlier): Please clarify in the CSR (3.2.2.6) that the adjustment of one-hour means to 10-minute mean wind speeds is an adjustment for the peak one-hour mean to the peak reported 10-minute mean wind speed. b) The response clarifies that the wave radar data were not used directly. However, ExxonMobil URC (2009) estimates of design wave criteria for the Hebron Project were developed using a calibration equation based on the MIROS data, which cannot be independently assessed. It is regrettable that the Hibernia MIROS data are not generally available to the offshore environmental/scientific communities. These data could be used to enhance the understanding of differences or similarities between wave radar, wave buoy, and wave modelled data, and to improve knowledge of wave climatology in the area. The response to the EC 14 request for indication of the level of uncertainty or confidence interval for the extreme wave criteria (Section 3.2.2.1 and 3.2.2.6) was not satisfactory. The ExxonMobil URC (2009) 100-year return period estimate was 14.8 m. The Oceans Ltd (2010) analysis included estimates of 15.1 m and 15.8 m, depending on the method. The response indicated that differences in results arising from differences in approach do not affect the overall environmental assessment. However the request concerned estimates used for engineering design. An example of what was requested is the 95% upper limit given in Table 3-41 for extreme storm surge. Could the CSR include confidence intervals or at least some description of how the differences/range of results might be accounted for in the final design process?
EMCP Response **4-Aug-11**	a) The term *peak* has been added to the text. b) To clarify, it is our understanding that MIROS data is typically available to the public. However, the data in question, had not yet been released by the operator-HMDC, and therefore was not available. We are not stating that the data “are not generally available to the offshore environmental / scientific communities.” “The Oceans Ltd analysis resulting in a range of 100-year Hs of 15.1 to 15.8 m” is the result of using the "environmental contour analysis" method to develop a suite of Hs, Tp combinations which all have a 1% annual chance of being exceeded (and are hence all "100-year" events). From these multiple 100-year events, a design criteria is set based on a maximum response of the structure. It is our opinion that use of this analysis technique is quite unusual for this type of application. It is much more commonly used when setting design criteria for a floating system because it is not known a priori which combination leads to the maximum response. For fixed steel jackets and gravity-based structures in relatively shallow water, it is recognized that the design condition will be defined by the 100-year significant wave height, Hs. That assumption leads to the commonly-used, well established, approach to the development of design metocean loads: a peaks-over-threshold analysis of historic values of Hs (measured or hindcast). The results of this analysis of Hs lead to return period values of Hs and we determine associated values of Tp, water level, wind speed, etc., based on correlations. There are numerous assumptions made in environmental contour analysis. It is important to note that the Oceans Ltd value for the 100-year Hs using the traditional approach (also used by ExxonMobil URC) is 15.1 m versus URC's value of 14.8 m, a difference of only approximately 2 percent. There are numerous choices made by an analyst performing extreme value analysis to create this level of difference in our estimates.

Follow-up Comment **15-Aug-11**	**Offshore Wind Climate and the Offshore Extremal Wave Analysis** a) Please note that the comments referenced as EC 14 concern the Offshore Wind Climate and the Offshore Extremal Wave Analysis, not just the Offshore Wind Climate, as the heading for the response would suggest. b) On rereading part c of ECMP 28: EC 14 from Nov 2010, it is not clear if the additional information provided, about the adjustment of the MSC50 data used to develop the 100 year wave, was actually going to be included in the CSR. This information included the formula, the data source, and a reference for this method. This is an important modification and the additional information should be added to the CSR. c) The attempt at clarification about the release of wave radar data to CNLOPB and Fisheries and Oceans is appreciated. The situation is still not clear but may resolve in time. d) The response concerning the applicability to different platform types, of different methods used in the various extremal wave analyses, is appreciated. It would still be advisable to include in the CSR the uncertainty range for the 100 year wave value from the chosen method. However it is presumably included in the original report and available for use. e) For any further analysis that may be conducted, the proponent is advised to consider further examination of available wave data (from both radar and wave buoys) as it applies to adjusting the MSC50 wave heights prior to the extremal analysis. The equation used to adjust the MSC50 wave heights was based on wave radar data for which validation information is not widely available. It did not seem to make use of years of data from wave buoys considered the standard reference for other sources of wave information.
EMCP Response **18-Aug-11**	a) Acknowledged. b) As indicated in our June 17, 2011, Response to Review Comments, the CSR would include the information cited above. The July 2011 Track Changes version of the CSR, as provided to the C-NLOPB on August 2, includes this information. For clarity, page 3-58 from the July 2011 Hebron CSR - track changes revision is appended to these review comments. c) Acknowledged. d) Noted. e) Noted.
Follow-up Comment **24-Aug-11**	The proponent's responses were satisfactory. However, clarification is needed regarding the adjustment of peak values of sustained winds from one sampling period to another (mentioned in July 29 comments and August 4 responses). a) With regard to section 3.2.1.2, sustained winds are averaged over some period, such as one hour or 10 minutes. The adjustment is applied to peak or extreme values from one averaging interval to another, not to all values. This adjustment (reference US Geological Survey 1979) is applied in sections 3.1.3.1 (Nearshore Environment, Wind and Wave Extremes, Wind), 3.2.1.2 (Offshore, Wind Climatology), and 3.2.2.6 (Offshore, Wind and Wave Extremes). It appears that the adjustment was used incorrectly for part of section 3.2.1.2. Regrettably, this was not noticed earlier. The text in section 3.2.1.2 states that the "MSC50 one-hour average wind speeds have been adjusted to 10-minute mean wind speeds, for consistency with the observations from the platforms". It was assumed that the statement was applied only to the monthly maxima in Table 3-21 (and to the Extreme Value Estimates (sections 3.1.3.1 and 3.2.2.6)). However, it appears that the adjustment was inappropriately applied to the individual values used to calculate the MSC50 monthly means in Table 3-20 and the distributions in Figures 3-18 and 3-19. Revision of the table and figures may be required.

	b) In section 3.2.1.2, the phrase "to convert from 1-hour mean values to 10-minute mean values" should be corrected to read "to convert from peak 1-hour mean values to peak 10-minute mean values".
EMCP Response 26-Aug-11	a) The text on page 3-37 of the CSR "*For consistency, wind speeds from the MSC50 data set have been adjusted to 10-minute mean wind speeds.*" Has been replaced with "*For consistency, maximum wind speeds from the MSC50 data set have been adjusted to 10-minute maximum wind speeds.*" The changes have been incorporated (as shown below) into Table 3-25 (formerly Table 3-20 in the June 2010 CSR). **Table 3-25 Mean Wind Speed Statistics**

Month	MSC50 Grid Point 10632 (m/s)	Terra Nova FPSO (m/s)	Glomar Grand Banks[A] (m/s)	GSF Grand Banks[A] (m/s)	Henry Goodrich (m/s)	Hibernia (m/s)
January	10.9	14.5	12.9	13.7	15.2	16.0
February	10.8	13.9	11.9	12.9	14.9	15.4
March	9.8	13.3	11.9	13.6	13.6	14.6
April	8.3	12.0	11.4	11.3	12.6	13.3
May	6.9	10.7	9.7	11.1	11.7	12.1
June	6.5	9.3	9.4	8.3	11.2	11.4
July	6.0	8.9	9.5	9.2	10.9	10.8
August	6.4	9.6	8.4	9.1	9.8	10.5
September	7.5	9.9	10.3	9.3	10.3	11.2
October	8.8	11.0	12.8	9.7	12.0	13.0
November	9.5	12.7	11.0	11.6	12.7	13.5
December	10.5	15.0	12.6	13.0	14.5	15.5

[A] Glomar Grand Banks and GSF Grand Banks were the same platform, reporting at different periods under different names.

Note: The height measurements are collected is 139 m at Hibernia GBS, 50 m at Terra Nova FPSO and 82.5 m at GFS Grand Banks

The corresponding figures do not require revisions as they represent the unadjusted wind speeds.

b) The text in the CSR has been revised as recommended above.

EMCP Comment 29: C-NLOPB 10

29-C-NLOPB 10	**EA Reference:**	Section 3.2.2.6 Page 3-56
Preamble:		
Request 7-Sep-10	The description of the February 11, 2003 storm should include the wave conditions, for completeness.	
EMCP Response 30-Nov-10	**The following text will be deleted:** Rapidly deepening storm systems, known as weather bombs, frequently cross the Grand Banks. These storm systems typically develop in the warm waters of Cape Hatteras and move northeast across the Grand Banks. On February 11, 2003, wind speeds at Grid Point M10632 peaked at 29.9 m/s. Wind speeds of 49.4 and 52.5 m/s from the southwest were recorded by the Hibernia and the Henry Goodrich anemometers, respectively, as this system passed. During this storm, a low pressure developing off Cape Hatteras on February 10, rapidly deepened to 949 mb as it tracked northeast across the Avalon Peninsula around 18 GMT on February 11.	

	And the following text will be added: Rapidly deepening storm systems, known as weather bombs, frequently cross the Grand Banks. These storm systems typically develop in the warm waters of Cape Hatteras and move northeast across the Grand Banks. On February 11, 2003, wind speeds at Grid Point M10632 peaked at 29.9 m/s, while wave heights peaked four to five hours later at 13.6 m. Wind speeds of 49.4 and 52.5 m/s from the southwest were recorded by the Hibernia and the Henry Goodrich anemometers, respectively, as this system passed. During this same event, wave heights of 14.66 m were recorded over a 20-minute interval by a waverider buoy in the area. During this storm, a low pressure developing off Cape Hatteras on February 10, rapidly deepened to 949 mb as it tracked northeast across the Avalon Peninsula around 18 GMT on February 11.

EMCP Comment 30: C-NLOPB 11

30-C-NLOPB 11	**EA Reference:**	Section 3.2.2.6 Page 3-62
Preamble:	In the "Extreme Value Estimates…" section it is stated that the 100-year extreme Hs "corresponds with a Hs of 14.66 m recorded . . . on February 11, 2003".	
Request **7-Sep-10**	It should be explained how two unequal Hs values correspond, or the statement should be amended.	
EMCP Response **30-Nov-10**	**The following text will be deleted:** The annual 100-year extreme Hs was 15.1 m at Grid Point M10632. This Hs corresponds with an Hs of 14.66 m recorded over a 20-minute interval by a waverider buoy in the area on February 11, 2003. **And replaced with the following text:** The annual 50-year extreme Hs was 14.4 m at Grid Point M10632, while the annual 100-year extreme was 15.1 m. An Hs of 14.66 m recorded over a 20-minute interval by a waverider buoy in the area on February 11, 2003, lies somewhere between these extreme estimates.	

EMCP Comment 31: C-NLOPB 12

31-C-NLOPB 12	**EA Reference:**	Section 3.2.3.6 Page 3-76 ff.
Preamble:		
Request **7-Sep-10**	Given the variation in iceberg occurrence, the CSR should explicitly indicate what portion of the iceberg occurrence data will be used in generating design information for the platform, and give a rationale for this selection.	
EMCP Response **30-Nov-10**	**The first paragraph in Section 3.2.3.6 ends with "...sighted in the 1° grid containing the Hebron platform location has been 31." The following text will be added after this sentence.** Although the IIP database of icebergs drifting south of 48°N extends from 1900 to the present, significant changes in technology have improved the quality of the data over time. In particular, in 1983, the IIP began using Side Looking Airborne Radar (SLAR) for iceberg detection and the system was further enhanced in 1993 with the addition of Forward Looking Airborne Radar (FLAR). The iceberg design basis for Hebron is based on data from the 1984 to 2008 period.	

EMCP Comment 32: C-NLOPB 13

32-C-NLOPB 13	**EA Reference:**:	Section 3.2.3.6 Icebergs Page 3-76
Preamble:		
Request **7-Sep-10**	What is the design iceberg?	
EMCP Response **30-Nov-10**	**The following text will be included in Section 3.2.3.6:** The iceberg load for the Hebron GBS is calculated with a probabilistic simulation and, as such, there is no single "design iceberg". The design load is calculated from an energy approach in which the kinetic energy of the impacting iceberg is arrested by the work done in crushing the ice against the GBS. The key parameters that affect the load are the iceberg's mass, velocity, strength and local shape in the impact zone. These parameters are all described by statistical distributions, which allow for a wide range of possible scenarios that may lead to the design load. Based on this approach, the 10,000 year overall horizontal iceberg load on the pre-FEED GBS geometry is 517MN, and can, for example, be caused by a 3.13 million tonne iceberg with 250 m waterline length and drifting at a 0.72 m/s velocity. This load will be updated during FEED and detailed design when the GBS geometry is finalized.	
Follow-up Comment **28-Jan-11**	The treatment of “statistical information and probabilistic modeling” of loading scenarios may be reviewed during the technical review associated with the development plan or authorization.	
EMCP Response **18-Mar-11**	Noted.	

EMCP Comment 33: C-NLOPB 14

33-C-NLOPB 14	**EA Reference:**	Section 3.2.5 Page 3-89, Paragraph 2
Preamble:	The paragraph begins “An average of 400 icebergs per year (albeit highly variable) reach the latitude of the Grand Banks (Sonnichsen and King 2005).” The statement, even with qualifiers, is inconsistent with the discussion of iceberg occurrence numbers in Section 3.2.2.6.	
Request **7-Sep-10**	The inconsistency should be resolved.	
EMCP Response **30-Nov-10**	**Paragraph 2 in Section 3.2.5 will be revised as follows:** Between 0 and 2,202 icebergs reach the Grand Banks each year as recorded by Provincial Aerospace Limited and the International Ice Patrol. Bathymetric sheltering limits the number that can cross the banktop region, and enter the Hebron region. Sidescan sonar and multibeam bathymetry data from the bank top display frequent linear ice scour (or furrows) from grounded icebergs. In addition, icebergs calving or rolling, or remaining in one location for an extended period, can produce large semicircular pits (Lewis and Blasco 1990; Parrott *et al.* 1990). Scours mapped (with sidescan sonar) within the Hebron Project Area are indicated in Figure 3-46. Some of those evident are infilled with sand, and are likely old (although establishing absolute age of ice scour features is a challenge).	
Follow-up Comment **28-Jan-11**	The inconsistency noted was in the numerical difference in average occurrence rates provided in each section.	

EMCP Response 18-Mar-11	Section 3.2.3.6 references the same range of icebergs (0 to 2,202). To ensure accuracy, we will eliminate references to average numbers on the Grand Banks, but leave the average over the Hebron area, as these were verified for this study. **The first paragraph will be revised as follows:** According to the International Ice Patrol (IIP) and PAL, the number of icebergs reaching the Grand Banks each year varied from a low of zero in 1966 and 2006 to a high of 2,202 in 1984. Of these, only a small portion will pass through the Hebron Project Area. Over the last 10 years, the average annual number of icebergs sighted in the 1° grid containing the Hebron Platform location has been 31.

EMCP Comment 34: C-NLOPB 15

34-C-NLOPB 15	**EA Reference:**	Section 3.2.6 Page 3-91 – 3-93
Preamble:	The Climate Change section entirely omits any considerations of ice and iceberg coverage.	
Request 7-Sep-10	The Climate Change section should include a discussion, to the degree feasible, of implications of climate change upon occurrence of sea ice and icebergs at/near the project area.	
EMCP Response 30-Nov-10	**The following text will be added to Section 3.2.6:** Since the early 2000s, the number of observed icebergs has increased in the North Atlantic Ocean (Rudkin *et al.* 2005). This may be a result of increased sea and air temperatures, but may also be a product of improved technologies for observing glacial sources. Should sea and air temperatures increase north of the Grand Banks, the number of icebergs entering the project area would likely increase initially due to increased calving of glaciers and ice islands. The size and presence of the icebergs would eventually decrease due to melt as the bergs drifted into the warmer waters. Similarly, the number of bergs could decrease as the lack of pack ice that helps carry and sustain the bergs on the Grand Banks would decrease, providing no insulation for the icebergs in the warmer waters. Whether this effect would be cyclical or permanent, or if it will transpire at all, remains to be seen. There is currently no reliable way of predicting the future occurrence and movement of sea ice and icebergs.	
Follow-up Comment 28-Jan-11	No bibliographic entry for the "Rudkin et al 2005" reference in the response appears in the original nor in the response document and should be provided. The discussion still is very general and it is not obvious that any concerted effort was made to address the comment.	
EMCP Response 18-Mar-11	a) **The following will be added to the references**: Rudkin, P., T. King, F. Ralph and S.A. Stoermer. 2005. Provincial Aerospace Limited (PAL) Investigations into the Increased Sightings of Ice Islands in the North Atlantic. Port and Ocean Engineering under Arctic Conditions Conference (POAC '05), Potsdam, NY. b) The volume of iceberg production from the Greenland glaciers increases as the temperatures warm. Subsequently, the glacial acceleration results in thinning of the glaciers and leads to increased fracturing and the production of more icebergs, but they would be expected to have smaller drafts. However, the warmer sea water temperatures along the iceberg's drift path from the parent glacier to the Grand Banks increase the rate of iceberg destruction and reduces the arrival rate for icebergs at the Grand Banks. A competing effect is that years with substantive pack ice on the east coast of Canada tend to keep the sea water cool and thus allow more icebergs to reach the Grand Banks prior to melting. When this happened in 2008 and 2009, the Grand Banks iceberg population was still within the range of that observed in the past	

	decades. Competing factors could affect the Grand Banks iceberg environment, but present data do not suggest a substantial departure from that experienced in the past two decades. A more detailed analysis can be found in McClintock et al.(2007). Reference: McClintock, J., R. McKenna, and C. Woodworth-Lynas. May 2007. *Grand Banks Iceberg Management*. PERD/CHC Report 20-84. Report prepared for PERD/CHC, National Research Council Canada, Ottawa, ON. Report prepared by AMEC Earth & Environmental, St. John's, NL, R.F. McKenna & Associates, Wakefield, QC, and PETRA International Ltd., Cupids, NL.

EMCP Comment 35: EC 15

35-EC 15	**EA Reference:**:	3.2.6 Climate Change, 3.2.6.2 Waves Pages 3-91 & 3-92
Preamble:	The reference for Swail et al. (2006), mentioned in Section 3.2.6 is incorrect.	
Request **7-Sep-10**	Please give the correct reference for Swail et al. (2006).	
EMCP Response **30-Nov-10**	**This citation and reference should be:** Wang *et al.* (2004) Wang, X.L., F.W. Zwiers and V.R. Swail. 2004. North Atlantic Ocean wave climate change scenarios for the twenty-first century. *Journal of Climate*, 17: 2368-2383.	

EMCP Comment 36: EC 16

36-EC 16	**EA Reference:**:	Section 3.2.6 – Climate Change Page 3-91
Preamble:	While the proponent provides references and comments on storm activity and waves, there is little or no comment on extreme events related to increased storm activity such as heavy precipitation events. The proponent is using the length of the Construction and Operational Phase to discount the impact of 100-year extreme events. Even if the event has a return period of 100 years, that doesn't mean it couldn't happen next year.	
Request **7-Sep-10**	The proponent is asked to review current literature and incorporate extreme event values (particularly precipitation events) in their consideration of operations during both the onshore and offshore periods.	
EMCP Response **30-Nov-10**	Section 3 provides an overview of extreme events, including 100-year events, for the Nearshore Study Area and the Offshore Study Area. Section 13, Effects of the Environment on the Project, also discusses the potential environmental effects of extreme events, including tides, water levels and storm surges on the drydock and indicates that these extreme events will be considered in the design and operation of activities at Bull Arm. The Operator has not discounted the potential effect of 100-year extreme events, as is implied in the preamble. Furthermore, an environmental assessment is done at the conceptual level of project design. An evaluation of extreme design loads on the Hebron Platform, including those caused by potentially elevated precipitation rates and other documented metocean conditions will be conducted during the next stage of design, which is known as "Front End Engineering Design" or FEED. The contracts for both the gravity based structure FEED and the topsides FEED have only recently been awarded and are just now getting underway.	

EMCP Comment 37: EC 17

36-EC 17	**EA Reference:**:	Section 3.2.6.1 Sea Level Rise (Climate Change) Page 3-91
Preamble:	Section 5.3.1 of the Scoping Document states that the EA will consider the influence that noted environmental changes and hazards may have on the project. Sea Level rise information noted in the study has been superseded by newer work. More current research and recent indications note the rate of Greeenland & Antarctic land ice melt is occurring at a faster rate than previously predicted. Current research querying this increased melt rate indicate that by the year 2100, SLR could be as high as 1-2 metres, for example, *Rahmstorf et al. 2009.*	
Request **7-Sep-10**	The proponents should apply more recent research regarding sea level rise projections. Proponents can see latest research in article at this website: http://www.nature.com/climate/2010/1004/pdf/climate.2010.29.pdf Consideration of any adjustments to rig specifications and operations due to increases Sea Level Rise projections should be taken into account during the design stage of the project.	
EMCP Response **30-Nov-10**	**The last paragraph of Section 3.2.6.1 will be replaced with the following paragraphs:** More recently, Vermeer and Rahmstorf (2009) used a semi-empirical model to estimate sea level rise over the next century based on emission scenarios from the 2007 IPCC assessment. They derived a relationship between historical global temperature and sea-level rise, and used this to obtain revised sea-level projections. This semi-empirical method implicitly accounts for the effects of the recent rapid glacial melt, and differs from physical, more explicit methods, that generally have much greater complexity but are limited because physical processes like glacial melt are still not fully understood. According to Rahmstorf (2010), these new results have found wide recognition in the scientific community. Scientists are generally cautious about predictions of sea-level change, in part because ice sheet dynamics are complex and not well understood. In addition, some studies indicate that inter-annual variability in sea level could be due in part to long-term atmospheric states like the North Atlantic Oscillation. From the studies referenced above, estimates of the rise globally over the next 100 years due to global warming alone are from 5 cm to as much as 190 cm. However, over the time period of 2010 to 2050, the expected total rise has a central estimate of 45 cm and an upper limit of about 70 cm (based on a rate of 1.7 cm per year as per Vermeer and Rahmstorf (2009)). The basis of design for calculating loads due to increased water depth from sea level rise and wave motion are accounted for in the safety factors used to determine minimum deck height and wave crest heights. An evaluation of design loads on the Hebron Platform due to the metocean environment will be conducted during the next stage of design (FEED) and will account for metocean uncertainties. **The following references will be added:** Cazenave, A., K. Dominh, S. Guinehut, E. Berthier, W. Llovel, G. Ramillien, M. Ablain, G. Larnicol. 2008. Sea-level Budget over 2003-2008: A Reevaluation from GRACE Space Gravimetry Satellite Altimetry, and Argo. *Global Planetary Change*, 65: 83-88. Available at URL: http://etienne.berthier.free.fr/download/Cazenave_et_al_GPC_2009.pdf Rahmstorf, S. 2010. A new view on sea level rise. *Nature*, 4: 44-45. Available at URL: http://www.nature.com/climate/2010/1004/pdf/climate.2010.29.pdf Vermeer, M. and S. Rahmstorf. 2009. Global sea level linked to global temperature. *Proceedings of the National Academy of Science*. USA 106, 21527-21532. Available at URL: http://www.pnas.org/content/early/2009/12/04/ 0907765106.full.pdf+html	

Comment 38: EC 18

38-EC 18	**EA Reference:**:	Section 3.2.6.4 Summary (Climate Change) Page 3-93.
Preamble:	The proponent deems all the information it referenced as "inconclusive" when describing the potential impact of climate change on the project. Such a statement reflects the proponents' lack of desire to incorporate information in non-traditional ways into their project planning. Recent approaches, taken by professional groups such as Engineers Canada, are focusing on risk management techniques to incorporate ranges of projections effectively into design decisions.	
Request **7-Sep-10**	The proponent is asked to consider incorporating current climate change projections for extreme events, high waves and storm surge (on top of sea level rise) into both phases of this project by utilizing risk management techniques.	
EMCP **Response** **30-Nov-10**	The term "inconclusive" was used to describe the high degree of variability in projections of future metocean conditions and its possible effect on the Grand Banks. The Operator does not deem all climate change information as inconclusive, as is implied in the preamble. **The following text will be added to Section 3.2.6.4** **Climate Change** Climate is naturally variable and can change over a range of time scales. Short-term meteorological variations are largely a consequence of the passage of synoptic scale weather systems: low pressure systems, high pressure systems, troughs and ridges. Energetics of these features varies seasonally in accordance with the changes in the strength of the mean tropical-polar temperature gradient. Long-term changes occur in response to small and large-scale changes of atmospheric circulation patterns. In the past, changes in Northern Hemisphere atmospheric circulation patterns were mainly the result of changes in the North Atlantic Oscillation. While the North Atlantic Oscillation still has an effect on climate patterns, there is a general consensus amongst the scientific community that greenhouse gas emissions have played a significant role in the climate during the last 50 years. However, the high degree of naturally experienced climate variation makes the identification of trends that are a direct result of climate change uncertain (Environment Canada 1997). As the Operator, ExxonMobil does use risk management methods throughout the various aspects of its business, including facility design. The basis of design for calculating loads due to increased water depth from sea level rise and wave motion are accounted for in the safety factors used to determine minimum deck height and wave crest heights. An evaluation of design loads on the Hebron Platform, due to the metocean environment and associated uncertainties, will be conducted during FEED, and further refined during detailed design. **The following will be added to the references:** Environment Canada. 1997: *The Canada Country Study: Climate Impacts and Adaptation, Atlantic Canada Summary*. IPPC (Intergovernmental Panel on Climate Change). 2001. *Climate Change 2001: The Scientific Basis*. IPCC Third Assessment Report, Cambridge university Press, Cambridge UK.	

2.4 Response to Section 4 Comments

EMCP Comment 39: C-NLOPB 16

39-C-NLOPB 16	**EA Reference:**:	Section 4.1 Types of Environmental Effects Page 4-1
Preamble:	The social and economic benefits of the Project are analyzed in the Socio-economic Impact Statement (SEIS)/Sustainable Development Report, submitted in support of the Hebron Project Development Application.	
Request **7-Sep-10**	The reference to the SEIS is inappropriate without its inclusion. This SEIS has not been made available and the Development application has not been submitted.	
EMCP Response **30-Nov-10**	Noted. The sentence will be removed.	

Comment 40: C-NLOPB 17

40-C-NLOPB 17	**EA Reference:**	Section 4.3.2.1 Page 4-6
Preamble:		
Request **7-Sep-10**	The Offshore Affected Area and/or Study Area boundaries must be reconsidered, and if necessary amended, in light of results from revisiting the oil spill trajectory modelling work for the Project.	
EMCP Response **24-Feb-11**	The Study Areas for nearshore and offshore consider all Project-environment interactions and are compilations of the various Affected Areas as described in Section 4.3.2.1. The results of the oil spill model informed the selection of the Affected Areas and Study Areas; however, the model was not the sole determining factor in the delineation of these areas. The Affected Area is also dependent on the nature of the Project activity and the nature of the VEC being assessed. The environmental effects of an oil spill have been assessed within the geographic area indicated by the oil spill trajectory model probability contours. The geographic area is, therefore, defined as that area where there is a 1 percent or greater probability for a sheen (0.01 mm thick) to occur, in accordance with a 30-day model run. This approach to determining the geographic extent is conservative because the geographic extent for a slick of greater thickness or higher probability would be smaller. An assessment of potential environmental effects from accidental events will be provided, where applicable, for each VEC.	

EMCP Comment 41: C-NLOPB 18

41-C-NLOPB 18	**EA Reference:**:	Section 4.3.7 Step 7 – Cumulative Environmental Effects Page 4-17
Preamble:	Cumulative effects assessment must include a consideration of environmental effects that are likely to result from the proposed project in combination with other projects or activities <u>that have been</u> or will be carried out.	
Request **7-Sep-10**	The nearshore Study Area is the same as that for Hibernia, however, the residual impact of the Hibernia project is not mentioned.	
EMCP Response **30-Nov-10**	**The following paragraph will be added to Section 4.3.7** Results of the marine environmental effects monitoring (EEM) program conducted at Bull Arm from August 1991 to November 1997 indicated that the construction activities associated with the Hibernia GBS did not affect the marine environment beyond acceptable levels (*i.e.*, none of the null hypotheses developed for the marine EEM program were rejected) (LGL 1998).	

	The following reference will be added: LGL Limited. 1998. *The Hibernia GBS Platform Construction Site Marine Environmental Effects Monitoring Program August 1991 – November 1997*. Prepared for Hibernia Management and Development Company Ltd., St. John's, NL. xiv + 110 pp.

EMCP Comment 42: C-NLOPB 19

42-C-NLOPB 19	**EA Reference:**:	Section 4.3.7 Step 7 – Cumulative Environmental Effects Page 4-18 and 4-19, Table 4-4
Preamble:	Information in this table is dated (e.g. Offshore Oil Exploration Activities – there are three seismic programs proposed for offshore Labrador, not one)	
Request **7-Sep-10**	Table 4-4 should be reviewed and revised to incorporate the most recent information...	
EMCP Response **30-Nov-10**	Table 4-4 will be revised to reflect the most recent information (as of September 30, 2010)	

2.5 Response to Section 6 Comments

EMCP Comment 43: C-NLOPB 20

43-C-NLOPB 20	**EA Reference:**:	Section 6 Air Quality Page 6-1
Preamble:	Air quality is discussed in terms of the effects on local air quality. What is not discussed are the emissions from equipment and the federal government objectives to reduce emissions of Critical air contaminates, including greenhouse gases, from equipment.	
Request **7-Sep-10**	The CSR should address facility emissions in relation to the federal government's objectives and how they will be achieved. The CSR should address the use of ozone depleting substances (e.g. halocarbons) and why it would not be possible to use alternative substances. Mitigation to prevent the release of these substances should also be identified.	
EMCP Response **30-Nov-10**	Emission estimates of critical air contaminants from equipment are addressed and provided in Tables 6.9 and 6.20 and for greenhouse gas emissions in Tables 6.10, 6.16 and 6.17. The estimated emissions from the platform, and the ambient air quality in the region, meet the NAAQ objectives. The Hebron Project is in the conceptual stage of design. It is understood that the federal government is reviewing industrial emissions criteria. EMCP is a participant in the Base Level Industrial Emissions Equipments / Requirements (BLIERs) initiative, where performance levels for certain CACs may be implemented. EMCP expects to use non-halocarbon fire suppressants such as water / water mist and breathable, inert-gas based systems such as Inergen or FM 200. EMCP will endeavor to use non-ozone depleting substances where appropriate and proven technologies are available.	
Follow-up Comment **28-Jan-11**	The request is related to the emissions from equipment and not if emissions will meet ambient air quality standards. The question posed is how the proponent will reduce, minimize, emission from equipment, what mitigations and technologies are available to so that emissions from equipment are as low as possible.	
EMCP Response **18-Mar-11**	The largest potential to reduce emissions, comes from energy efficiency. Power generation is the largest source of emissions on the platform. As responded to in Comment EC-29 (September 7, 2010 Response), the Hebron facility will include energy efficient equipment: • 'Aero-derivative' type gas turbines will be used for power generation (high efficiency) • Waste Heat Recovery Units (WHRUs) will be installed on the main power generators. This equipment has heat exchangers to capture energy from the hot turbine exhausts and use the energy for the process heating systems on board. • Insulation will be applied to process piping, reducing heat loss and thus energy required to heat process streams. • Cross-stream heat exchangers will be installed to utilize the heat in the processed oil for warming process streams rather than burning additional gas for heating. These cross-stream exchangers also cool the stabilized crude, thus reducing the cooling medium circulation, seawater lift and their associated electrical and fuel demand. • Mechanical Variable Speed Drives (VSDs) will be installed on the water injection pumps (the largest single energy user). VSDs allow for pump power demand to be reduced, compared to a conventional fixed speed pump. This is the only Grand Banks application of this technology.	

Follow-up Comment 20-Apr-11	The proponent is reminded that a further review of the technologies employed are reasonable to minimize emissions to as low as reasonable practicable will be applied at the development plan stage.
EMCP Response 17-Jun-11	Noted.

EMCP Comment 44: HC 3

44-HC 3	**EA Reference:**:	Section 6 Air Quality Page 6-1 Air Emissions and Dispersion Modelling Study for the Hebron Project
Preamble:	In a review of National Pollutant Release Inventory (NPRI) for the Hibernia offshore platform, several polycyclic aromatic hydrocarbons (including acenaphthene, acenapthylene, fluorene, naphthalene, and pyrene), n-hexane, benzene, toluene, ethylbenzene and xylenes were reported to have been released to air in 2008 (Environment Canada, 2009). These substances were not specifically modeled in the Air Emissions and Dispersion Modelling Study[2] and it is unclear whether they were implicitly included as part of the total volatile organic compound (VOC) releases or whether they were not assessed. <u>Air Reference:</u> Environment Canada. 2009. National Pollutant Release Inventory, 2008 data. Hibernia (NPRI ID: 6096). http://www.ec.gc.ca/pdb/websol/querysite/facility_substance_summary_e.cfm?opt_npri_id= 0000006096&opt_report_year=2008	
Request 7-Sep-10	Please indicate whether or not these substances were included in the modeling assessment. If they were not, please provide a rationale as to why they were excluded, as several of these substances can act as respiratory irritants, and at least one (i.e., benzene) may be carcinogenic to humans via the inhalation route of exposure.	
EMCP Response 30-Nov-10	Individual VOCs were not modelled in this study only total VOCs. The Project is in the early stages of design, and the level of detail required to undertake individual VOC emissions is not available. Therefore, the emission factors for total VOCs were acquired from the US EPA AP-42, Section 3.1 Stationary Gas Turbines. Once the platform is operational, EMCP will report per National Pollutant Release Inventory, on VOCs and other releases, as required by legislation.	
Follow-up Comment 28-Jan-11	Given that the specific VOCs to be released are not known, it is unclear how the risk to human health from exposure to those substances will be evaluated. Please provide a discussion about the following: • Will VOCs be monitored as individual substances or as total VOCs? • If VOCs will be monitored as individual substances, how will the individual substances be determined? • How will VOCs be measured and reported (i.e. as releases in tonnes/year or as concentrations in mg/m^3)? • How will the health risk to humans (including workers and any other people in the area such as fisher people) be evaluated (e.g. comparison of emission concentrations to published toxicological reference values (TRVs) for human exposure/occupational exposure limits)?	
EMCP Response 18-Mar-11	Air dispersion modeling shows that ground-level concentrations meet ambient air quality objectives, which are much lower than acute toxicological levels. As stated in our response above, VOCs will be reported per the National Pollutant Release Inventory requirements.	

	EMCP has processes in place to assess and manage occupational exposures to relevant chemical agents, including but not limited to performing exposure monitoring of benzene, H_2S, total hydrocarbons. Qualitative and quantitative data is collected, based on worker groups, work tasks/activities. Data from worker exposure monitoring are reported back to workers in either mg/m^3 or ppm with respect to the occupational exposure limit (OEL) or threshold limit value (TLV) for the chemical agent monitored. Exposure control actions are implemented to minimize health risks in accordance with government regulations and Company policy.

EMCP Comment 45: HC 2

45-HC 2	**EA Reference:**:	Section 6.1.1 Environmental Assessment Boundaries - Spatial Page 6-1
Preamble:	re: Air Quality – On-land and Nearshore *Please note that Health Canada does not verify air quality modelling results and assumes that correct and accepted and/or validated methods were used. Health Canada relies on the expertise of Environment Canada for the review of air quality modelling results and the provision of related advice. If errors and/or gaps in the modelling are noted by Environment Canada, it is suggested that revisions be made to address them as indicated by Environment Canada. If the revised results differ from the originally submitted results, it is advised that the report be resubmitted to Health Canada for review.* Section 6.1.1 (Environmental Assessment Boundaries – Spatial) – The report states that "*professional experience indicates that the environmental effects of emissions in construction would disperse to within the range of normal background levels at this distance* [at the nearest residences]". The locations of the nearest residences and/or other potentially sensitive human receptors are not identified in the report.	
Request **7-Sep-10**	Please provide the locations and proximity of the nearest potentially sensitive human receptors in order for Health Canada to assess the potential for human health effects associated with air emissions as a result of construction activities on-land and in the nearshore.	
EMCP Response **30-Nov-10**	**Please refer to response to EMCP Comment 15: HC 1** The nearest community of Sunnyside is located over 4 km to the north northwest, and the community of Arnolds Cove over twice that distance to the west southwest. As the project is committed to providing a safe work environment for the workers, it was assessed that the effects in Sunnyside, the nearest location of residences, would be well within acceptable levels. The CSR concluded that the environmental effects on air quality will be not significant.	

EMCP Comment 46: EC 22

46-EC 22	**EA Reference:**:	Section 6.1.3 Administrative Page 6-4, Table 6-2 Dispersion Modelling Study, Table 2-1
Preamble:	There is a blank box in the column listing pollutants in Table 6-2. This should be sulphur dioxide as correctly noted in the Modelling Study. The table gives the impression that the averaging times given for both PM2.5 and ozone are applicable to both the Canada-wide Standards and the NL Ambient Air Quality Standards. They are only applicable to the Canada-wide Standards. The NL standard averaging times are 24 hours for PM2.5, and 8 hours for ozone as presented in the table. There is also a 1 hour ozone standard of 160 µg/m^3.	
Request **7-Sep-10**	This table should be corrected	

EMCP Response 30-Nov-10	Table 6-2 will be corrected.

EMCP Comment 47: EC 25

47-EC 25	**EA Reference:**:	Section 6.1.3 Administrative Page 6-4 Section 6.4.1 Change in Ambient Air Quality Page 6-16
Preamble:	The proponent describes the "tolerable", "acceptable", and "desirable" categories of the National Ambient Air Quality Objectives but does not identify which of these categories will be used in the determination of exceedances.	
Request 7-Sep-10	The proponent is asked to identify in the text that the modelling results (as identified in the tables further on) are the maximum "acceptable" objectives.	
EMCP Response 30-Nov-10	**The following text will be added to the CSR:** The modelling results were being compared to the maximum "acceptable" National Ambient Air Quality Objectives in order to determine potential exceedances.	

EMCP Comment 48: EC 23

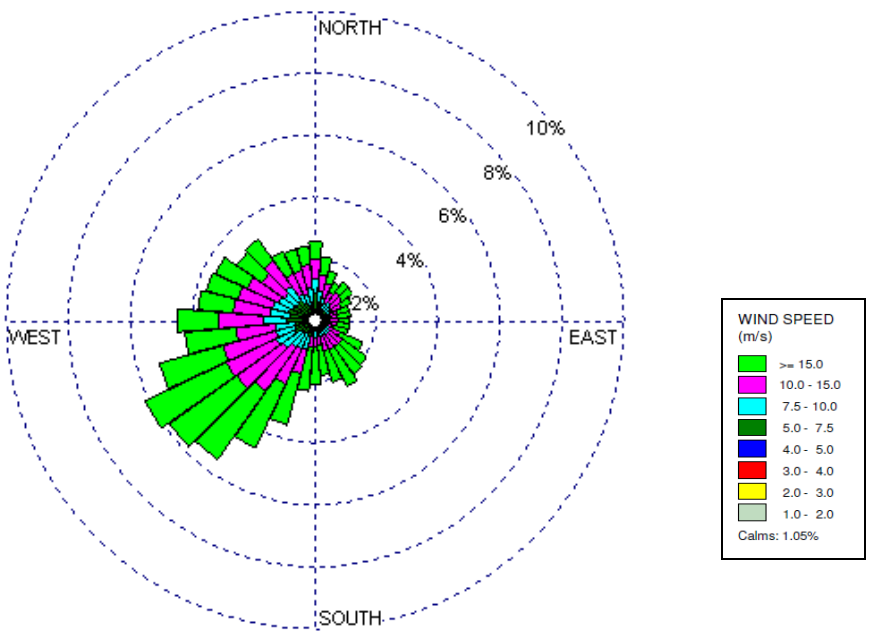
48-EC 23	**EA Reference:**:	Section 6.2.1.1 Air Quality Page 6-6, Table 6-3
Preamble:	It is not clear what the numbers in Table 6-3 represent. i.e. Are they the highest concentration for each time period over a year or longer, or some other metric (percentile, 4th highest).	
Request 7-Sep-10	The proponent is asked to confirm exactly what the values in the table represent and the time frame from which the data was selected.	
EMCP Response 30-Nov-10	The data represented in Table 6-3 were based on information available at that time. Since the CSR was completed and reviewed, more recent ambient air quality monitoring data was published by the NLDEC in June 2010, titled "2009 Ambient Air Monitoring Report". **These data have been summarized in Table 6-X (based on maximum annual values) and will be included in the CSR:**	

Table 6-X: Ambient Air Quality in and Surrounding the Nearshore Affected Area (Maximum Annual Values for 2009)

Pollutants ($\mu g/m^3$)	Time Frame (Max. Values)	Arnold's Cove	Come by Chance	Sunnyside
SO_2	1-hour	137.5	203.8	192.6
	24-hour	19.9	64.6	49.9
$PM_{2.5}$	24-hour	15.5	16.6	17.5
PM_{10}	24-hour	-	-	22.3
NO_x	-	NA	NA	NA

EMCP Comment 49: EC 19

49-EC 19	**EA Reference:**:	Section 6.2.2 Offshore Page 6-7
Preamble:	Indication given in the introductory paragraph that each platform would be downwind of each other less than 15 percent of the time.	
Request 7-Sep-10	The proponent is asked to provide a reference or to substantiate this statement.	

EMCP Response 30-Nov-10	The statement is an introductory one, based on observations of wind direction distributions for many stations where it can be observed that the prevailing wind direction is usually not as pronounced as is implied, although the prevailing quadrant may be dominant. The horizontal angular size of an elevated point source plume is about 10 degrees; it can be narrower, as in very stable conditions, when the plume generally remains elevated at distance, or it can be broader in strongly mixed conditions. To be more accurate, it is acknowledged that the solid angle of the plume also changes with distance due to a number of factors including wind shear, but the comment was not made at that level of detail. Given that the plume is of the order of 10 degrees, the question becomes how often a wind occurs with a direction that is within 10 degrees of an upwind/downwind pairing of source and receptor. If the wind direction were to be completely random, a specific 10 degree sector would occur with a frequency, f = (10/360)X100 percent = 2.8 percent. In any given location, the wind direction is not random, but shows a distribution that results from the overlay of local topography or surface temperatures, synoptic scale weather systems, and global circulation. For the wind dataset used in this assessment, the wind direction frequency distribution, or wind rose, is as follows, plotted according to 10 degree direction segments. No segment has a frequency greater than 10%, in agreement with the introductory statement. 

EMCP Comment 50: EC 26

50-EC 26	**EA Reference:**:	Section 6.3.2 Offshore Page 6-11 Section 6.5.1.2 Greenhouse Gas Emissions Page 6-18, Table 6-9
Preamble:	P. 6-11 states that natural gas use will release greater quantities of NOx than diesel and confirms this in Table 6-9 referencing the US EPA. AP-42, the US EPA's Compilation of Air Emission Factors, however, lists NOx emissions from the use of distillate fuel in turbines as being greater than that of natural gas.	
Request 7-Sep-10	The proponent is asked to confirm these emissions estimates and the reference.	

EMCP Response 30-Nov-10	Based on similar fuel usage, this is correct, that natural gas will release smaller quantities of NO_x, than diesel. The values that are presented in Table 6-9 for power generation on diesel vs. power generation on natural gas are based on actual fuel usage for the Project during the first year of operation (diesel) and peak operation (natural gas). The amount of fuel burnt during peak operation is estimated to be greater than that during the first year of operation and therefore a greater quantity of NO_x emissions are being reported.

EMCP Comment 51: EC 27

51-EC 27	**EA Reference:**:	Section 6.3.2 Offshore Page 6-11 Section 6.5.1.2 Change in ambient Air Quality Page 6-19, Table 6-10
Preamble:	P. 6-11 states that natural gas use will release lower quantities of CO_2 than diesel use, however, Table 6-10 lists the CO_2 emissions from natural gas as being far greater than from the use of diesel fuel.	
Request 7-Sep-10	The discrepancy between the text and the table should be addressed.	
EMCP Response 30-Nov-10	The text stated on page 6-11 is correct; generally natural gas use will release lower quantities of CO_2 than diesel use in terms of stationary gas turbines operating at similar rates and fuel usage. However, the data presented in Table 6-10 are based on two different operating scenarios, power generation during the first year of operation (diesel) and power generation during peak operation (natural gas). Refer to the response to EMCP Comment 50: EC-26 above, as well.	

EMCP Comment 52: C-NLOPB 21

52-C-NLOPB 21	**EA Reference:**:	Section 6 Air Quality Pages 6-11 and 6-12
Preamble:	Fugitive emissions are described as originating from back up or standby generators, loading of fuel, etc. Not all of the mentioned sources fit the National Pollution Inventories definition of fugitive emissions. Fugitive emissions, as define by NPRI, are air pollution derived from human activities that do not emanate from a particular point, such as an exhaust pipe or stack. They are releases to air that are not released through confined process streams. Roadway dust and volatile organic compounds (VOCs) from refinery valves are examples of fugitive emissions. These releases include fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc., evaporative losses from surface impoundments and spills, releases from building ventilation systems, and any other fugitive or non-point air emissions from land treatment, mine tailings, storage piles, etc.	
Request 7-Sep-10	The CSR should be reviewed in terms of what has been stated as being fugitive emissions in relation to the standard definition.	
EMCP Response 30-Nov-10	Fugitive emissions sources include facility flanges, valves and occur during connect / disconnect of hydrocarbon loading lines. The text in the CSR has been modified to reflect this definition. The number of flanges / valves have been modelled to provide an estimate of fugitive emissions. Refer to response to EMCP Comment 53: C-NLOPB 22.	

EMCP Comment 53: C-NLOPB 22

53-C-NLOPB 22	**EA Reference:**:	Section 6.3.2.2 Operations/Maintenance Page 6-12
Preamble:	It is concluded that minor amounts of TSP and VOC emissions will be emitted during various routine maintenance activities, including welding, machine oils and cleaning solvents. There will also be some fugitive emissions of VOCs and CACs from the loading and unloading of fuels and products, from storage tanks, and backup-generators. It has been stated that these emissions will be limited in quantity and therefore were not assessed further in the CSR. The CSR has not quantified fugitive emissions nor has it defined what is meant by limited in quantity.	
Request **7-Sep-10**	The conclusion reached in the CSR should be supported through references or calculations to show that such emissions are limited and, in relation to the federal clean air agenda, not significant. Management practices for fugitive emissions should be considered. CAPP's guidance for possible mitigative measures that could be applied should be considered.	
EMCP Response **30-Nov-10**	Conceptual level work to date has been based on using the CAPP Guidelines for estimating emissions due to fugitive sources (*e.g.*, valves, flanges, compressor seals, sampling connections, open-ended lines, PRVs). Fugitive emissions are calculated by combining factors and number of fittings. For Hebron, fugitive methane releases are estimated to be 1,346 tonnes/yr of CH_4 (or 28,266 tonnes/yr of CO_2e) using this method. Fugitive emissions of non-CH_4 VOCs were estimated by similar methodology, and maximum ground level concentrations during peak operation were predicted to be 2.94 mg/m^3. These estimated emissions fall within range of those reported in 2008 by the existing platforms (Hibernia – 1,664 tonnes/yr CH_4, White Rose – 1,430 tonnes/yr CH_4, Terra Nova – 1,489 tonnes/yr CH_4) under the NPRI and GHG Reporting systems. As well, once the Hebron Platform is operational, all emissions will be reported under both the NPRI and GHG Reporting systems. Fugitive emissions will also be managed consistent with the CAPP guidelines, Best Management Practice for Fugitive Emissions.	

EMCP Comment 54: C-NLOPB 23

54-C-NLOPB 23	**EA Reference:**:	Section 6.3.2.2 Operations/Maintenance Page 6-12
Preamble:	It is stated that during operation of the Platform there will be times when excess gas will be flared, for example, during well testing.	
Request **7-Sep-10**	What is the need to flare gas during well testing? What is the technical impediment to processing gas from well testing with that of production?	
EMCP Response **30-Nov-10**	**The following text:** "During operation of the Platform, there will be times when excess gas will be flared, for example, during well testing and during upset conditions, …" **will be amended to read as follows:** "During operation of the Platform, there will be times when excess gas will be flared, for example, during well cleanup and unloading after initial completion of a well, during upset conditions, and during background flaring.	
Follow-up Comment **28-Jan-11**	The proponent has not addressed the request; it has not stated why it is necessary to flare excess gas during well testing or what the technical impediments are to processing the gas and re-injecting it. Where capacity exists in the production train to capture reservoir gas, that capacity should be available for all normal course of business operations (e.g., cleaning up wells). This would apply to the test separator and associated equipment that is permanently installed on the installation. Flaring reservoir gas during well cleanup	

	where the facilities exist to capture and re-inject is both an environmental and resource conservation issue. Unless there is a risk-justification for flaring from well clean-up and testing, that gas should be captured and reinjected.
EMCP Response 18-Mar-11	Flaring will not occur during well testing. Flaring can occur during well unloading. Back pressure on the well needs to be relieved for it to unload. If this gas was routed to the compressors, the back pressure at the suction scrubbers would in effect "kill" the well and prevent it from unloading. With nitrogen available to lift the well in, the back pressure must be set to the lowest possible pressure to allow the well to unload; therefore, not all of the flow goes to the compressors, and some gas will need to be flared. The end result is that the Project can minimize but not eliminate flaring during unloading operations.

EMCP Comment 55: EC 24

55-EC 24	**EA Reference:**:	Section 6.3.2.1 Offshore Construction/Installation Pages 6-11 and 6-13 Air Emissions and Dispersion Modelling Study, Page 15, Table 6-2.
Preamble:	Pages 6-11 and 6-13 states that emissions other than those presented (i.e. loading and unloading) would be limited in quantity and are therefore not further assessed. However, Table 6-2 in the Dispersion Modelling Study uses values that for Hebron that are much smaller than those of the other three platforms. In the case of VOCs, this difference is in orders of magnitude.	
Request 7-Sep-10	The proponent is asked to confirm whether these differences are real, and if so to describe the changes in technology that would allow the emissions from Hebron to be so much less than those from the other facilities. If these emissions differences are not real (i.e., there are sources included in the estimates for the other operations that are not included in those for Hebron) then these other sources should be identified and included in the analysis.	
EMCP Response 30-Nov-10	The June 2010 CSR provided emission estimates for the Hebron Project based on the operation of stationary combustion equipment, and did not include VOC fugitive emission estimates. Therefore, the values reported appeared to be much lower than other operations. Air emission estimates were updated to include fugitive emissions (see Stantec October 2010). The revised air emission estimates, which are based on conceptual level work, shows that the VOC emissions are within the range of the existing platforms.	

EMCP Comment 56: C-NLOPB 24

56-C-NLOPB 24	**EA Reference:**:	Section 6.3.3 Summary Page 6-14, Table 6-8
Preamble:	Table 6-8 does not appear to list all of the major activities. For example, power generation and gas compression are not listed.	
Request 7-Sep-10	The table should be revisited and revised to include all the activities that may occur.	
EMCP Response 30-Nov-10	Table 6-8 will be updated.	
Follow-up Comment 28-Jan-11	The response is acceptable however, the completeness of the table will be reviewed when updated.	

EMCP Response

18-Mar-11

The revised Table 6.8 is provided below. 'Power Generation and Gas Compression' have been added under "Offshore Operations and Maintenance" section of the table.

Table 6-8 Potential Project-Valued Ecosystem Component Interactions: Air Quality

Project Activities, Physical Works Discharges and Emissions	Potential Environmental Effects	
	Ambient Air Quality	Greenhouse Gas Emissions
Construction		
Nearshore Project Activities		
Presence of Safety Zone (Great Mosquito Cove zone followed by a deepwater site Zone)		
Bund Wall Construction (*e.g.,* sheet/pile driving, infilling)	x	x
Inwater Blasting		
Dewater Drydock / Prep Drydock Area	x	x
Concrete Production (floating batch plant)	x	x
Vessel Traffic *(e.g.,* supply, tug support, tow, diving support, barge, passenger ferry to / from deepwater site)	x	x
Lighting		
Air Emissions	x	x
Re-establish Moorings at Bull Arm deepwater site	x	x
Dredging of Bund Wall and Possibly Sections of Tow-out Route to deepwater site (may require at-sea disposal)	x	x
Removal of Bund Wall and Disposal (dredging / ocean disposal)	x	x
Tow-out of GBS to Bull Arm deepwater site	x	x
GBS Ballasting and De-ballasting (seawater only)		
Complete GBS Construction and Mate Topsides at Bull Arm deepwater site	x	x
Hook-up and Commissioning of Topsides		
Surveys (*e.g.,* geophysical, geological, geotechnical, environmental, ROV, diving)	x	x
Platform Tow-out from deepwater site	x	x
Offshore Construction / Installation		
Presence of Safety Zone		
OLS Installation and Testing	x	x
Concrete Mattress Pads/Rock Dumping over OLS Offloading Lines	x	x
Installation of Temporary Moorings	x	x
Platform Tow-out / Offshore Installation	x	x
Underbase Grouting	x	x
Possible Offshore Solid Ballasting	x	x
Placement of Rock Scour Protection on Seafloor around Final Platform Location	x	x
Hookup and Commissioning of Platform	x	x
Operation of Helicopters	x	x
Operation of Vessels (supply, support, standby and tow vessels / barges / diving / ROVs)	x	x
Air Emissions	x	x
Lighting		
Potential Expansion Opportunities		
Presence of Safety Zone		
Excavated Drill Centre Dredging and Spoils Disposal	x	x
Installation of Pipeline(s)/ F lowline(s) and Testing from Excavated Drill Centre(s) to Platform, plus Concrete Mattresses, Rock Cover, or Other Flowline Insultation	x	x
Hook-up, Production Testing and Commissioning of Excavated Drill Centres	x	x
Surveys (*e.g.,* geophysical, geological, geotechnical, environmental, ROV, diving)	x	x
Offshore Operations and Maintenance		
Presence of Safety Zone		

		Presence of Structures		
		Lighting		
		Maintenance Activities (*e.g.,* diving, ROV)	x	x
		Power Generation	x	x
		Gas Compression	x	x
		Flaring	x	x
		Wastewater (produced water, cooling water, storage displacement water)		
		Chemical Use / Management/Storage (*e.g.,* corrosion inhibitors, well treatment fluids)	x	
		Well Activities (*e.g.,* well completions, workovers)		
		WBM Cuttings		
		Operation of Helicopters	x	x
		Operation of Vessels (supply, support, standby and tow vessels / shuttle tankers / barges / ROVs)	x	x
		Surveys (*e.g.*, geophysical, 2D / 3D / 4D seismic, VSP, geohazard, geological, geotechnical, environmental, ROV, diving)	x	x
		Potential Expansion Opportunities		
		Presence of Safety Zone		
		Drilling Operations from MODU at Future Excavated Drill Centres	x	x
		Presence of Structures		
		WBM and SBM Cuttings		
		Chemical Use and Management (BOP fluids, well treatment fluids, corrision inhibitors)	x	
		Geophysical / Seismic Surveys	x	x
		Offshore Decommissioning / Abandonment		
		Presence of Safety Zone		
		Removal of the Platform and OLS Loading Points	x	x
		Lighting		
		Plugging and Abandoning Wells	x	x
		Abandoning the OLS Pipeline	x	x
		Operation of Helicopters	x	x
		Operation of Vessels (supply, support, standby and tow vessels, ROVs)	x	x
		Surveys (*e.g.*, geophysical, geological, geotechnical, environmental, ROV, diving)		
		Accidents, Malfunctions and Unplanned Events		
		Bund Wall Rupture	x	x
		Nearshore Spill (at Bull Arm Site)	x	
		Failure or Spill from OLS	x	
		Subsea Blowout	x	x
		Crude Oil Surface Spill	x	
		Other Spills (fuel, chemicals, drilling muds or waste materials on the drilling unit, GBS,Platform)	x	
		Marine Vessel Incident (*i.e.*, fuel spills)	x	x
		Collisions (involving Platform, vessel, and/or iceberg)	x	x
		Cumulative Environmental Effects		
		Hibernia Oil Development and Hibernia Southern Extension (drilling and production)	x	x
		Terra Nova Development (drilling and production)	x	x
		White Rose Oilfield Development and Expansions (drilling and production)	x	x
		Offshore Exploration Drilling Activity	x	x
		Offshore Exploration Seismic Activity	x	x
		Marine Transportation (nearshore and offshore)	x	x
		Commercial Fisheries (nearshore and offshore)	x	x

EMCP Comment 57: EC 28

57-EC 28	**EA Reference:**:	Section 6.5.1.1 Change in Ambient Air Quality Page 6-18 Dispersion Modelling Study, Page 7
Preamble:	The CSR notes that the sulphur concentration in the diesel fuel would be very low, and the Modelling Study lists this number as limited to 500 ppm by federal regulation. Technically, the Sulphur in Diesel Regulations apply to on and off road mobile engines that may not cover the generators (pending further design details) used in this project. As well, the limit is scheduled to be reduced to 15 ppm, possibly before the project is underway.	
Request 7-Sep-10	The proponent is asked to confirm that the sulphur concentration limit identified in the federal regulation represents the maximum limit that will be actually used in the project. If this is not the case, the proponent should specify the maximum sulphur limit that will actually be used, and if significant, carry out the appropriate analysis.	
EMCP Response 30-Nov-10	Standard commercially-available diesel or marine diesel fuel will be used throughout the commissioning and operation of the proposed Hebron Platform. The pending change in diesel fuel standards will result in limits of 15 mg/kg being in effect during the commissioning of the Project, representing a convergence of the limits in effect at the present time for on-road, off-road and marine diesel fuels.	

EMCP Comment 58: EC 31

58-EC 31	**EA Reference:**:	Section 6.5.2.1 Change in Ambient Air Quality Page 6-27, Table 6-15 Page 6-43, Table 6-25
Preamble:	The 1 hour maximum GLC for NOx is exactly the same in both the peak operation and cumulative scenarios. For most of the other pollutants, the cumulative GLCs are greater than those for peak operation. The dispersion modelling report does not give us access to the peak operation contours to better assess the likelihood (while recognizing that this is feasible) of these numbers being identical.	
Request 7-Sep-10	The proponent is asked to confirm that these numbers are actually identical and not a transcription error.	
EMCP Response 30-Nov-10	The maximum predicted 1-hour GLC at the maximum predicted grid receptor for NO_x was exactly the same for both the peak operation model run and the peak operation cumulative effect run. When additional sources in a new emission configuration do not alter the maximum concentration, it reflects the fact that the impacts of the added sources are not at the same location because of stack height and other release parameters.	

EMCP Comment 59: EC 29

59-EC 29	**EA Reference:**:	Section 6.5.3 Offshore Decommissioning and Abandonment Page 6-32, Table 6-18
Preamble:	The CSR states in table 6-18, and throughout the document that it will investigate the use of efficient/reduced emission technology and incorporate it where appropriate. The scoping requires a description of the potential means of reduction. Emission reductions can also be achieved through practices (i.e., leak detection and repair) as well as technologies and these should be identified as well.	
Request 7-Sep-10	The proponent should commit to reporting on the results of their investigations in order to meet the requirements of the scoping document and allow the reviewers to evaluate the application of best industry practices.	

EMCP Response 30-Nov-10	The largest potential to reduce emissions, particularly GHGs, comes from energy efficiency. Power generation is the largest source of GHGs on the platform. The Hebron facility includes several energy efficient technologies: • 'Aero-derivative' type gas turbines will be used for power generation • Waste Heat Recovery Units (WHRUs) will be installed on the main power generators. This equipment has heat exchangers to capture energy from the hot turbine exhausts and use the energy for the process heating systems on board • Insulation will be applied to process piping, reducing heat loss and thus energy required to heat process streams. • Cross-stream heat exchangers will be installed to use the heat from the stabilized oil for warming process streams rather than burning additional gas for heating. These cross-stream exchangers also cool the stabilized crude, thus reducing the cooling medium circulation, seawater lift and their associated electrical and fuel demand. • Mechanical Variable Speed Drives (VSDs) will be installed on the water injection pumps (the largest single energy user). VSDs allow for pump power demand to be tailored to pumping requirements, compared to a conventional fixed speed pump. This is the only Grand Banks application of this technology. The Hebron flare system will be purged with nitrogen gas, which reduces 'background' flaring volumes and hence GHG and Criteria Air Contaminant (CAC) emissions, versus other flare systems that use fuel gas to keep the flare header purged. Fuel gas will used for flare purge when the nitrogen system is unavailable. ExxonMobil adopts industry Best Practices in regards to leaks and emissions and is committed to No Spills. Leak detection is executed using a rigorous maintenance and inspection campaign. The Operator employs FIMS (Facilities Integrity Management System), which incorporates proactive procedures to identify and remediate leaks. This includes a corrosion monitoring program to identify components that need closer monitoring, preventative maintenance or remediation before any leakage could occur. A flange management system will be put in place and carried through engineering, procurement, construction, commissioning and the operating life of the facility. Flanges are the primary source of fugitive emissions leaks. The flange management system recognizes this and implements proactive management of flanges to ensure utmost quality control, alignment, fitting and monitoring over the life of the facility. Gas detectors are located around the facility to detect any leakage of gas. Assessment of other leak detection technologies will occur as the design matures.

EMCP Comment 60: EC 20

60-EC 20	**EA Reference:**:	Section 6.5.4.1 Change in Air Quality Page 6-35; Table 6-20
Preamble:	Air dispersion Modelling Emission Rates are indicated in the table header without an indication of units.	
Request 7-Sep-10	The proponent is asked to provide units for this table.	
EMCP Response 30-Nov-10	Table 6-20 will be updated to include the units of the emission rates.	

EMCP Comment 61: EC 30

61-EC 30	**EA Reference:**:	Section 6.5.4.1 Change in Air Quality Page 6-34; Table 6-22 Page 6-38
Preamble:	P. 6-34 alludes to the potential of an explosion or fire but states that the emissions would be marginally small, and does not provide any information on the frequency, magnitude, extent or duration of such an incident. The only analysis of an emergency event/upset conditions provided is for a relatively straightforward emergency flaring procedure.	
Request **7-Sep-10**	The proponent is asked to revisit the possibility of a catastrophic event and carry out an appropriate analysis of the possible frequency, magnitude, extent and duration.	
EMCP Response **30-Nov-10**	For air emissions, "upset conditions" are defined as process upsets that result in the routing of hydrocarbon to the flare. Emission estimates from upset conditions are provided in Section 6.5.4.1 of the CSR. These estimates are based on the operating experience of similar ExxonMobil-operated facilities.	
Follow-up Comment **28-Jan-11**	EC is looking for information related to emissions from upset scenarios of a more catastrophic nature (*i.e.* major blow out that might burn for some days).	
EMCP Response **18-Mar-11**	ExxonMobil has a mature Operations Integrity Management System (OIMS) that emphasizes relentless attention to Safety and Environmental Protection, and is designed to minimize and mitigate such catastrophic events from occurring. The probability of a fire occurring is predicted to be very low. The parameters of any catastrophic event are varied, numerous and unique. Therefore, it is not possible to predict emissions from such a variable event.	
Follow-up Comment **20-Apr-11**	The proponent was not specifically asked for an emissions prediction, but just for more information related to emissions from upset scenarios of a more catastrophic nature. This could take the form of a discussion highlighting the range of scenarios based on historic upsets - i.e. how long did these last until they were brought under control? What do we know about the ranges in both magnitude and constituents of the emissions in situations such as this? While recognizing that the probability of such an upset is very low, it is not zero.	
EMCP Response **17-Jun-11**	It is recognized that the probability of a catastrophic event is low and not zero. However, if such an event were to occur, the primary objective of EMCP would be to ensure the safety of its workers and bring the incident under control. The Operator is not aware of historical air emissions data from catastrophic events. However, it is expected that emissions from catastrophic events can be of an extremely wide range and type. Depending on well flow rate and duration, a blow-out could lead to the loss of thousands cubic metres of crude oil (see Section 14.1 for a listing of historical blow-outs). In the event of an extremely large release, there may be effects on the atmosphere due to the evaporation emissions of the volatile fraction. The emissions would be odorous and unpleasant, and would move downwind from the spill. In the event of a fire, the atmospheric effects could include copious amounts of smoke, containing products of incomplete combustion ranging from simple carbon rings to a variety of residuals from the constituents of the reservoir. Catastrophic events in which fire is involved produce substantial amounts of heat, so that the smoke and byproducts are, to a large extent, lifted by thermal buoyancy and dispersed in the atmosphere. For events that do not include fire, the spill of buoyant material will continue to evaporate into the atmosphere and move downwind due to shearing force of the wind superimposed on current movements. Releases to the atmosphere will cease after the product is either totally released, sinks due to depletion of the buoyant fraction, or disperses adequately.	

EMCP Comment 62: EC 21

62-EC 21	**EA Reference:**:	Section 6.5.5.2 Offshore Page 6-45, Table 6.26
Preamble:	Total of the four platform's CH_4 CO_2eq is greater than the provincial total after the inclusion of Hebron.	
Request **7-Sep-10**	The proponent is asked to reconcile this difference.	
EMCP Response **30-Nov-10**	The data currently represented in Table 6-26 are correct. The provincial total presented is a total for the Province of Newfoundland and Labrador and is based on the current GHG emission sources as reported to the Environment Canada GHG Reporting Program for the 2008 reporting year. It does not include the estimated GHG emissions from the operation of the proposed Hebron platform, but it does include the emissions of other, non-oil / gas project sources not shown in the table. The table is not a full balance sheet, and the provincial total is not the simple sum of the previous rows in the table. Once the estimated emissions of GHGs related to the operation of the proposed Hebron Platform are added to those reported for the other existing platforms the sum will increase accordingly.	

EMCP Comment 63: EC 32

63-EC 32	**EA Reference:**:	Section 6.7 Follow-up and Monitoring Page 6-47
Preamble:	The proponent has only stated its intent to report its emissions, while the scoping document clearly states that the methods for validating and monitoring emissions methods should be included. While the difficulties of carrying out ambient monitoring in this location are understood, there should be some description of the methodologies that will be used to estimate or measure emissions once the project is underway. Given the variation in emissions between this project and the others in the area, it is important that this be undertaken.	
Request **7-Sep-10**	The proponent is asked to describe the methodology that will be used to validate the emissions	
EMCP Response **30-Nov-10**	As stated in the response to EMCP Comment 55-EC 24, the air emission estimates that were reported in the 2010 CSR did not account for VOC fugitive emissions. The revised air emission estimates show that the air emissions from the Hebron Project are similar to existing offshore installations. **The following text will be added to Section 6.7:** Emission estimates are based on vendor specifications and EPA guidance. The values estimated will be validated against vendor guaranteed emissions performance data, which can only be obtained once the equipment is purchased. Once in operations, the Hebron Project will be required to report annually to the NPRI, and will do so using industry standard reporting procedures (*i.e.*, CAPP guidance on NPRI reporting; CAPP 2007-0009). This will also serve to validate the emission estimates used in the CSR.	

2.6 Response to Section 7 Comments

EMCP Comment 64: DFO 4

64-DFO 4	**EA Reference:**	7.3 Existing Conditions Page 7-3
Preamble:	The information provided on existing fish habitat in the nearshore area is not sufficient with regards to the CSR scoping requirements. A more detailed description of fish habitat is required for the Bull Arm project area. Page 7-4 indicates that *"…an extensive fish and fish habitat survey of Great Mosquito Cove was conducted for the Hebron Project in August 2009.*" However, none of this information appears in the CSR as the descriptions are based on earlier studies. Also, the information provided on fish species and their life history characteristics is not discussed in relation to the habitat present within the nearshore project area.	
Request **7-Sep-10**	a) Provide the August 2009 fish habitat survey of Great Mosquito Cove. b) Rather than providing general overviews of the life history characteristics of the species present, it should be linked to the habitat present within the nearshore project area itself.	
EMCP Response **30-Nov-10**	a) The August 2009 Fish Habitat Survey of Great Mosquito Cove will be provided to DFO b) *In addition, information contained within the Hebron Project Marine Habitat Survey, Great Mosquito Cove, Trinity Bay – Location of Hebron GBS Construction (EMCP 2009) and Fish Habitat Assessment in Great Mosquito Cove, Trinity Bay: An Overview of Available Fish Habitat and Resources in the Vicinity of the GBS Construction Site Location (LeDrew, Fudge and Associates 1990), will be incorporated in Section 7.3.1.2 after the last paragraph. Information from Section 7.3.1.4 will be incorporated into the expanded Section 7.3.1.2 and as such, Section 7.3.1.4 is removed. The first two paragraphs of Section 7.3.1.5 have been incorporated as appropriate in this section and are removed from Section 7.3.1.5. This information ties species to habitat found within the nearshore of Great Mosquito Cove. The overview of the life history of the species is provided after Section 7.3.1.2 for completeness and consistency.* Based on information collected for the Hebron Project Marine Habitat Survey, Great Mosquito Cove, Trinity Bay – Location of Hebron GBS Construction (EMCP 2009), revealed that fine material was a frequent surficial substrate observed in the cove, switching to gravel and cobble towards the outer section of the cove (see attached figure (new Figure 7-X)). The fine material was generally found in the central areas of the cove in deeper water, which is approximately 50 to 60 m in the inner area of the cove and 100 to 110 m in the middle area of the cove. The deepest areas in the outer cove reach a water depth of about 200 m, but on average is approximately 110 m Benthic habitat with solid substrate was generally observed more towards the shore and which may be comprised of boulder and rubble and/or mixed with gravel and cobbles. Habitat with bedrock substrate was most common in the outer section of the cove towards the north shore and which covered approximately 15 percent of the seafloor. A fish habitat assessment conducted in Great Mosquito Cove in November 1989 (LeDrew, Fudge and Associates 1990) noted that there were three fish habitats type identified by SCUBA surveys and one from camera photographs (based on Moyle and Cech 1982) within Great Mosquito Cove: nearshore rocky bottom; nearshore soft bottom; kelp beds; and deep-water rocky bottom. Three fish habitat types were identified in Great Mosquito Cove during marine baseline surveys (Mobil Oil 1990a). The communities were described as: • A shallow water (≤10 m depth), rocky bottom community dominated by polychaetes (fringed worms (*Dodecaceria concharum*) and paddle worms (*Eulalia viridis*)), chiton (*Tonicella rubra*), gastropods (limpets (*Acmaea testudinalis*) and *Puncturella noachina*), aeolidoid nudibranchs, and echinoderms (green sea urchin	

	(*Strongylocentrotus droebachiensis*), daisy brittle star (*Ophiopholus aculeata*) and boreal sea star (*Asterias vulgaris*)) • A nearshore midwater (10 to 12 m depth) community characteristic of mixed substrates and dominated by nematodes, polychaetes (scale worms (*Pholoe minuta*), *Microphthalmus sczelkowii* and *Harmothoe imbricate*) and thread worms (*Mediomastus ambizeta* and *Lumbrineris* sp.)), cockles (*Cerastoderma pinnulatum*), harpacticoid copepods (*Laophonte horrid*, *Ectinosoma* sp., and *Arthropsyllus serratus*), unidentified cytherid ostracods, cumacean (*Diastylis rathkei*), and gammarid amphipods (*Orchomenella minuta* and *Corophiium bonelli*) • A deepwater (>40 m depth) community characterized by a silty substrate and dominated by polychaetes (*Gyptis vittata*, *Prionospio steenstrupi*, *Aglaopphamus neotenus*, *Cossura longocirrata*, syllid species and unattached serpulids), pelecypods (*Crenella glandula* and *Thyasira gouldi*), cytherid ostracods, and cumacean (*Leucon* sp.) The nearshore rocky habitat (or shallow water rocky bottom community as described in Mobil Oil 1990a) was described as comprised of shallow waters generally less than 10 m in depth with steep slopes of loosely associated boulder and gravel with bedrock outcrops. This habitat type was found bordering the north and south shoreline of great Mosquito Cove (LeDrew, Fudge and Associates 1990). The 2009 fish habitat survey concurred with this assessment having found benthic habitat with solid substrate was generally observed more towards the shore, which may be comprised of boulder and rubble and/or mixed with gravel and cobbles. Bedrock substrate was most common in the Outer Area of the cove towards the north shore, which covered approximately 15 percent of the seafloor (EMCP 2009). The shoreline in Great Mosquito Cove is primarily comprised of hard substrate, the majority of which is anthropogenic (fill, concrete dock, and rip rap shoreline units) in the Inner and Middle Areas of the cove (EMCP 2009). Bedrock cliffs are dominant and mainly present along the north shore of the cove. The width of the shore and intertidal zone is relatively narrow because of the steep ramping of the shoreline and generally ranges from 2 to 5 m. The predominant macroflora observed along the shoreline is rockweed when present in the intertidal zone; with periwinkles the most common macrofauna observed along the shoreline followed by sea urchins, mussels and anemones (EMCP 2009). Nearshore rocky habitats in Trinity Bay are typically covered with kelp and coralline algae. Mussels, periwinkles (*Littorina* spp.), whelks (*Colus* spp.), urchins, brittle stars, hermit crabs (*Pagurus* spp.), rock crabs and sea stars are the most common macro-invertebrate species. Vegetation decreases with increasing depth, but patches of kelp and filamentous algae occur. The most common macro-invertebrates nearshore are sea urchins, sand dollars (*Echinarachnius parma*) and rock crabs. Coralline algae play an important role in nearshore ecology as habitat for invertebrates, as a food source for a variety of gastropods (Mandeveldt *et al.* 2006) and by limiting the re-colonization of kelp species that have been harvested by urchins (Bulleri *et al.* 2002; Bulleri and Benedetti-Cecchi 2006). The attraction of invertebrates to coralline algae beds results in the attraction of fish to feed in these areas. There has been little study of the role of coralline algae as fish habitat in the western North Atlantic. In nearshore rocky habitats, the common finfish species are gunnels (*Pholis nebulosa*), shannies (*Ulavaria subbifurcata*) and cunners (*Tautogolabrus adspersus*). American lobsters (*Homarus americanus*) are commercially fished from these habitats. The nearshore soft bottom habitat (most likely corresponds to the deepwater community described in Mobil Oil 1990) observed in Great Mosquito Cove in 1989 (LeDrew, Fudge and Associates 1990) was described as level bottomed, barren with gravel, sand and silt substrate at depths greater than 10 metres. It was noted that this habitat was relatively featureless with scattered small patches of kelp and included

	observations of sculpins and winter founder. The 2009 fish habitat survey found that cunner and winter flounder were the principle fish encountered during the benthic habitat survey (EMCP 2009) and were equally observed among all types of substrate. Winter flounder were observed mostly on fine substrate in the Inner and Middle Areas of the cove, but were also observed on hard substrate in the Outer Area of the cove. At water depths beyond 10 m on soft substrates, winter flounder (*Pseudopleuronectes americanus*) and various sculpin species are common; sea scallops occur in patches. Commercial fisheries in these habitats may include capelin (*Mallotus villosus*), herring (*Clupea harengus*), mackerel (*Scomber scombrus*), winter flounder, lumpfish (*Cyclopterus lumpus*) and lobster. The kelp beds noted in LeDrew, Fudge and Associates (1990) was described as level-bottom dense kelp stands at depth greater than 10 m. They noted the areal extent of the kelp stands in great Mosquito Cove is unknown. The 2009 fish habitat survey noted that benthic macroflora were relatively sparse covering 2, 11 and 9 percent of the seafloor in the Inner, Middle, and Outer Areas of Great Mosquito Cove (EMCP 2009). Sea colander accounted for 39 percent of the macroflora in the Middle Area and was the dominant species at 66 percent in the Outer Area. *Laminaria longicruris* was mainly observed in the Middle Area of the cove and comprised 22 percent of the macroflora present in this area (EMCP 2009). In addition to macroflora species that can be considered to be associated with "kelp beds", sour weed was the predominate species and comprised 98 percent of the macroflora in the Inner Area of the cove and was commonly observed on fine material, but also less common on hard substrate. The percentage of sour weed in the Middle and Outer Areas of the cove was 39 and 33 percent, respectively. Based on information from deep-sea camera photographs and grab samples (LeDrew, Fudge and Associates 1990), the fourth bottom type described is for a deep water rocky bottom at depths greater than 15 m. They noted that the extent of this habitat is unknown. The fish habitat survey conducted in 2009 noted that sessile benthic macrofauna observed in Great Mosquito Cove included sea urchins, which were the most common macrofauna, followed by starfish, sea anemones and scallops, and were generally observed on hard substrate, but were also observed on fine substrate. Species diversity was more pronounced on hard substrate such as boulder, rubble, cobble and gravel (EMCP 2009). Much of the substrate associated with the above species would fall into the deep water rocky bottom or the deeper depths of the nearshore rocky bottom habitat. Sea scallop (*Placopecten magellanicus*) and blue mussel (*Mytilus edulis*) beds have been recorded for the inner portions of Bull Arm (Osborne and Roberts 1983). An October 1989 survey of shellfish habitat in Great Mosquito Cove revealed no large beds of blue mussels (Newfoundland Geosciences Limited 1990). Adult sea scallops occurred sporadically in Great Mosquito Cove, but were more common along the southern shoreline. In Bull Arm, the following species of finfish are commonly found and commercially fished (DFO Coastal Resource Inventory website, accessed October 2009): cod (*Gadus morhua*), capelin, herring and mackerel. Greenland halibut (*Reinhardardtius hippoglossoides*) may be present in deeper water (200 to 300 m) outside Bull Arm. Other species include wolffish, eelpout (*Lycodes* sp.), lumpfish, skate (*Raja* sp.) and cunners. Great Mosquito Cove and "The Brood" in Bellevue are locally known as a spawning ground for herring and is commonly used for commercial harvest of herring and mackerel (see Section 8). Of particular interest and note is that the Atlantic wolffish, a federally listed Species at Risk (Schedule 1, special concern), was identified in Great Mosquito Cove to the south of the Outer Area during the ROV habitat surveys in August 2009. They were observed at a water depth of approximately 35 m, in 80 to 90 percent boulder habitat,

	which has been identified as potential spawning habitat (Barsukov 1959; Keats *et al.* 1985; Kulka *et al.* 2007). **The following references will be added to the CSR:** Barsukov, V.V. 1959, The Wolffish (Anarhichadidae). Zoologicheskogo Institute Akademii Nauk USSR Fauna:Fishes, 5(5):173 pp. [Translated for Smithsonian Institution and National Science Foundation, Washington, DC, by Indian National Scientific Documentation, New Delhi, 1972] Keats, D.W., G.R. South and D.H. Steele. 1985. Reproduction and egg guarding by Atlantic wolffish (*Anarhichas lupus*: Anarhichidae) and ocean pout (*Macrozoarces americanus*: Zoarcidae) in Newfoundland waters. *Canadian Journal of Zoology*, 63: 2565-2568. Kelly, J., R. Power, L. Noble, J. Meade, K. Reid, S. Kuehnemund, C. Varley, C. Grant, M. Roberge, E. Lee, and M. Teasdale. 2009. *A System for Characterizing and Quantifying Coastal Marine Habitat in Newfoundland and Labrador*. Draft report prepared by Fisheries and Oceans Canada. Kulka, D.W., D.C. Hood and J. Huntington. 2007. *Recovery Strategy for Northern Wolffish (Anarhichas denticulatus) and Spotted Wolffish (Anarhichas minor), and Management Plan for Atlantic Wolffish (Anarhichas lupus) in Canada*. Fisheries and Oceans Canada, Newfoundland and Labrador Region. St. John's, NL. x + 103 pp.

EMCP Comment 65: DFO 5

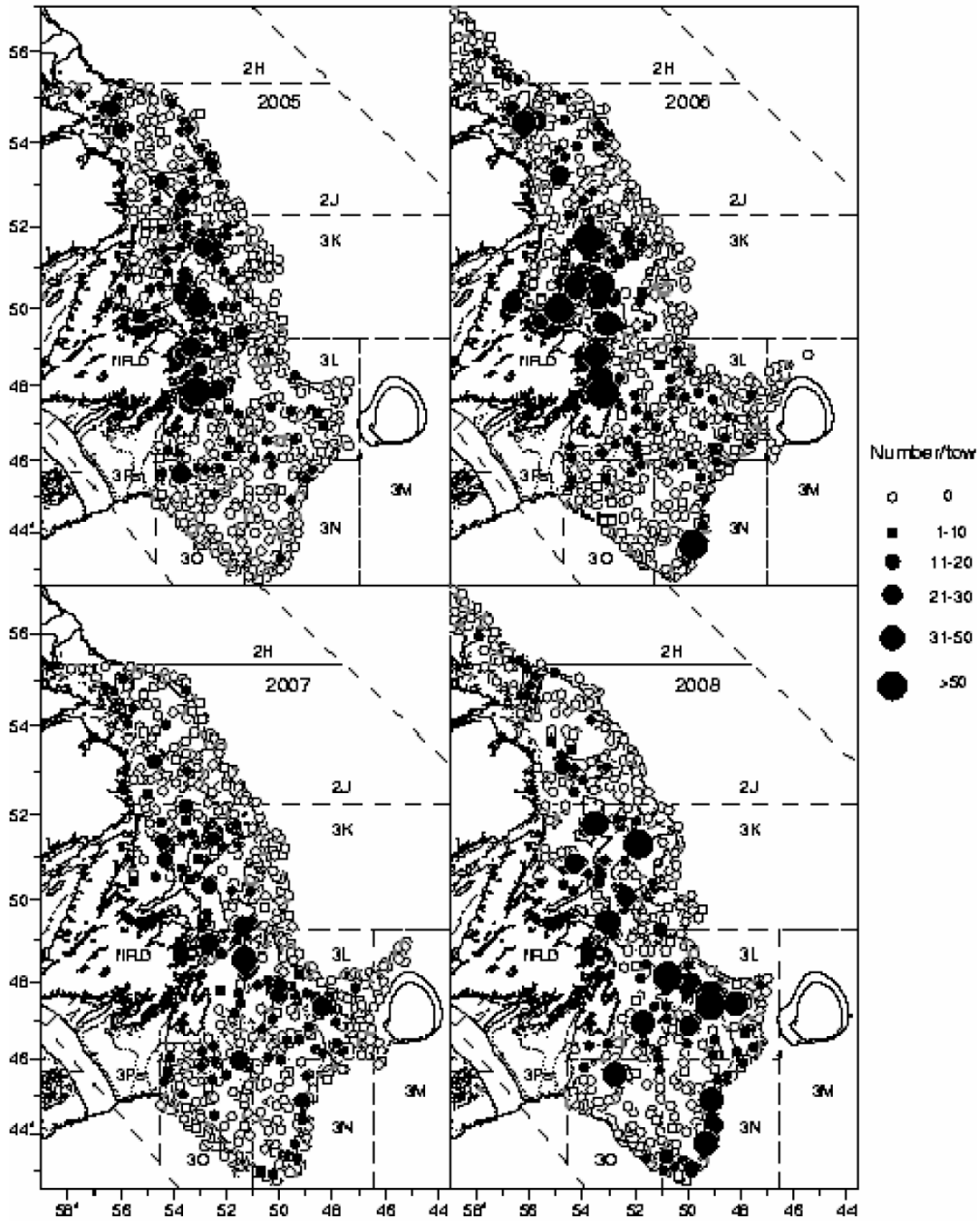
65-DFO 5	**EA Reference:**	7.3.1.5 Fish and Shellfish Page 7-7
Preamble:	Section 5.3.2.3 request the CSR describe the distribution/abundance of species in the study area. It is likely that American Plaice and Yellowtail Flounder would be found in the Nearshore Project Area.	
Request **7-Sep-10**	Confirm whether American Plaice or Yellowtail Flounder exist in the Nearshore Project Area.	
EMCP Response **30-Nov-10**	A review of the data contained within the Hibernia GBS Platform Construction Site Marine Environmental Effects Monitoring Program August 1991 to November 1997 (Christian and Buchanan 1998), Fish Habitat Assessment in Great Mosquito Cove, Trinity Bay: An Overview of Available Fish Habitat and Resources in the Vicinity of the GBS Construction Site Location (LeDrew, Fudge and Associates 1990), Hebron Project Marine Habitat Survey, Great Mosquito Cove, Trinity Bay – Location of Hebron GBS Construction (EMCP 2009) and Commercial Fisheries data for 3Lb (2004 to 2008) did not indicate the presence of American plaice or yellowtail in the Nearshore Project Area.	

EMCP Comment 66: DFO 6

66-DFO 6	**EA Reference:**	7.3.1.5 Fish and Shellfish Page 7-14
Preamble:	Section 5.3.2.3 request the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	This section should be revised as there are a number of inaccuracies and discrepancies, including: • Snow Crab occur in all major bays surrounding the island and also off Labrador, not just "*...from Fortune Bay to White Bay*" as indicated in the text. • The 170-380 m estimate is likely one taken from a reference for the Gulf of St. Lawrence. In Newfoundland and the Eastern Scotia Shelf, Snow Crab are captured at greater depths along the slope edges, 20-2000 m is a common estimate.	

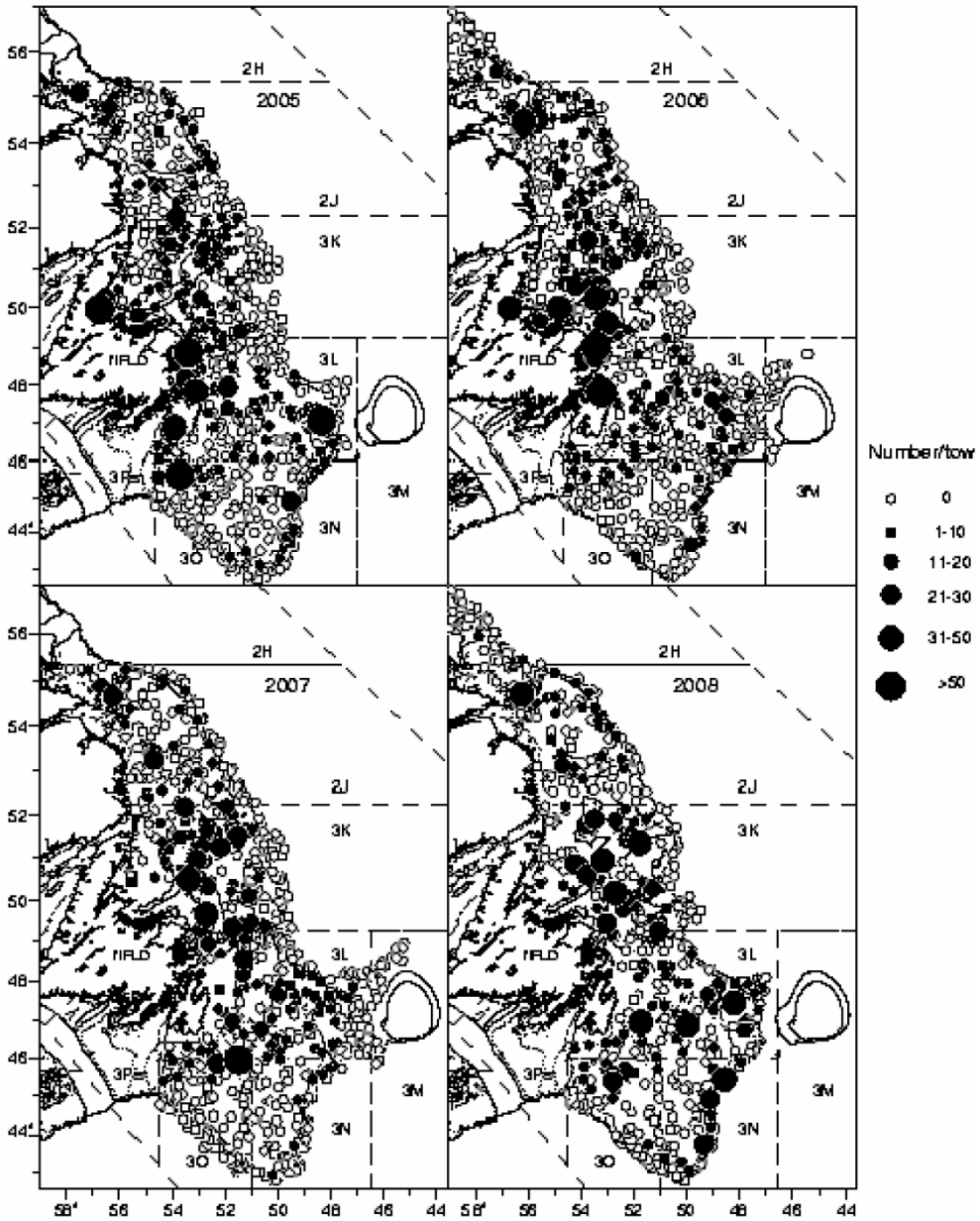
	• Although a statement is made that, "*The distribution of small crabs is not well documented…*", the distribution of small crabs is described in any of the most recent Canadian Science Advisory Secretariat (CSAS) Research Documents produced by DFO NL Region. • Contrary to the text provided, females carry fertilized eggs for 1-2 years, which is likely influenced by temperature (Sainte-Marie 1993; Moriyasu and Lanteigne 1998; Comeau et al. 1999). Sainte-Marie, B. 1993. Reproductive cycle and fecundity of primiparous and multiparous female snow crab, *Chionoecetes opilio*, in the Northwest Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci. 50(10): 2147-2156. Moriyasu, M. and Lanteigne, C. 1998. Embryo development and reproductive cycle in the snow crab, *Chionoecetes opilio* (Crustacea: Majidae), in the southern Gulf of St. Lawrence, Canada. Can. J. Zool. 76(11): 2040-2048. Comeau, M., Starr, M., Conan, G.Y., Robichaud, G. and Therriault, J-C. 1999. Fecundity and duration of egg incubation for multiparous female snow crabs (*Chionoecetes opilio*) in the fjord of Bonne Bay, Newfoundland. Can. J. Fish. Aquat. Sci. 56(6): 1088-1095.
EMCP Response 30-Nov-10	**Based on the comments above, Section 5.3.2.3 will be revised as follows:** In the nearshore environment, snow crabs are common in the estuary and the Gulf of St. Lawrence, around Cape Breton Island and in all major bays surrounding Newfoundland and Labrador. Snow Crabs feed on fish, clams, polychaete worms, brittlestars, shrimp, snow craps and other crustaceans (DFO 2008). Snow crabs live most commonly on muddy or sand-mud bottoms at temperatures ranging from -0.5°C to 4.5°C at depths 20 m to 2,000 m along slope edges off Newfoundland and the Eastern Scotia Shelf (Dawe and Colbourne 2002; Fisheries Resources Conservation Council (FRCC) 2005; DFO 2005b). The distribution of small crabs is not well documented but they are occasionally found with adults, or on gravelly bottom to mud bottom, usually in deeper waters as they reach maturity. Mating is thought to occur at the end of the winter or in the spring. Females carry the fertilized eggs for 1 to 2 years, which is likely influenced by temperature (Sainte-Marie 1993; Moriyasu and Lanteigne 1998; Comeau *et al.* 1999). References: Comeau, M., M. Starr, G.Y. Conan, G. Robichaud and J.-C. Therriault. 1999. Fecundity and duration of egg incubation for multiparous female snow crabs (*Chionoecetes opilio*) in the fjord of Bonne Bay, Newfoundland. *Canadian Journal of Fisheries and Aquatic Sciences*, 56(6): 1088-1095. Dawe, E.G., and E.B. Colbourne. 2002. Distribution and demography of snow crab (*Chionoecetes opilio*) males on the Newfoundland and Labrador Shelf. Pp. 577–594. In: A.J. Paul, E.G. Dawe, R. Elner, G.S. Jamieson, G.H. Kruse, R.S. Otto, B. Sainte-Marie, T.C. Shirley and D. Woodby (eds.). *Crabs in Cold Water Regions: Biology, Management, and Economics*, Proceedings of the 19th Lowell Wakefield Symposium, Ed. University of Alaska Sea Grant AK-SG-02-01, Fairbanks, AK. 866 pp. DFO (Fisheries and Oceans Canada). 2009. Assessment of Newfoundland and Labrador snow crab. *Canadian Science Advisory Secretariat Research Document*, 2009/045. Available at URL: http://www.dfo-mpo.gc.ca/csas-sccs/publications/sar-as/2009/2009_045-eng.htm. FRCC (Fisheries Resources Conservation Council). 2005. *Fisheries Resource Conversation Council. Strategic Conservation Framework for Atlantic Snow Crab*. Report to the Minister of Fisheries of Oceans. FRCC.05.R1 Moriyasu, M. and C. Lanteigne. 1998. Embryo development and reproductive cycle in the snow crab, *Chionoecetes opilio* (Crustacea: Majidae), in the southern Gulf of St. Lawrence, Canada. *Canadian Journal of Zoology*, 76(11): 2040-2048.

	Sainte-Marie, B. 1993. Reproductive cycle and fecundity of primiparous and multiparous female snow crab, *Chionoecetes opilio*, in the Northwest Gulf of St. Lawrence. *Canadian Journal of Fisheries and Aquatic Sciences*, 50(10): 2147-2156.
Follow-up Comment **28-Jan-11**	The proponent has neglected to address the third bullet. The revised text still claims that, "The distribution of small crabs is not well documented…", however, as indicated in our original comment, distribution of small snow crab (juveniles/adolescents) is documented in the CSAS Research Documents, which are produced in accordance with annual assessments of the species. The reference for the most recent CSAS Research Document is provided below. The CSR should be revised to include information from this document. E. Dawe, Mullowney, D., Stansbury, D., Hynick, E., Veitch, P., Drew, J., Coffey, W., Colbourne, E., O'Keefe, P., Fiander, D., Skanes, K., Stead, R., Maddock-Parsons, D., Higdon, P., Paddle, T., Noseworthy, B., and Kelland, S. 2010. An Assessment of Newfoundland and Labrador Snow Crab (Chionoecetes opilio) in 2008. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/016. iv + 183p.
EMCP Response **18-Mar-11**	**The following text will be added to Section 7.3.1.5 (Shellfish – Snow Crab)** Snow crabs live most commonly on muddy or sand-mud bottoms at temperatures ranging from -0.5°C to 4.5°C, at depths 20 m to 2,000 m along slope edges off Newfoundland and the Eastern Scotia Shelf (Dawe and Colbourne 2002; Fisheries Resources Conservation Council (FRCC) 2005; DFO 2005b). The distribution of small (pre-recruit) male crabs (Figure X.X) and large (exploitable) male crabs (Figure X.X) was analyzed based on the spatial distribution of catches from fall multispecies surveys (Dawe et al. 2010). The spatial distribution trends indicated that there have been gradual spatial shifts of densities for most size groups, as well as annual and area-specific changes in survey catch rates (Dawe et al. 2010). The following figures illustrate that there is significant overlap in the spatial distribution of large and small crabs with small crabs potentially covering slightly more area than the large crabs.



Source: Dawe *et al.* 2010

Figure X.X: Distribution of Small Male Crab from Fall Division 2J3KLNO Bottom Trawl Survey (2005-2008)



Source: Dawe *et al.* 2010

Figure X.X: Distribution of Large Male Crab from Fall Division 2J3KLNO Bottom Trawl Survey (2005-2008)

EMCP Comment 67: C-NLOPB 25

67-C-NLOPB 25	**EA Reference:**	Section 7.3.2.2 Page 7-17 and elsewhere
Preamble:	The description of substrate conditions in the Offshore Project Area relies heavily upon the references Chevron (2002) and Chevron (2003). They should be made available for examination/review as required.	
Request 7-Sep-10	Submit Chevron (2002) and Chevron (2003).	
EMCP Response	The reports have been submitted to the C-NLOPB.	

30-Nov-10	

EMCP Comment 68: EC 34

68-EC 34	**EA Reference:**:	Section 7.3.2.2 Habitat Page 7-17, Paragraph 3.
Preamble:	At Section 7.3.2.2, Page 7-17, paragraph 3, the text states "Eight of the twenty sediment samples taken throughout the Hebron Project Area were declared toxic using the Microtox™ test. None were declared toxic by the amphipod survival test. The Microtox™ test is known to be hyper-sensitive in substrates with less than 20 percent fines, which is the case in the Hebron Project Area (Chevron 2003)."	
Request **7-Sep-10**	(1) The text should state what is the criterion being used to judge a sediment sample being declared toxic. (2) Suggested text based on limitations of the test, the text should read something like "The Microtox™ test is known to be sensitive in substrates with more than 20 percent fines". This is based on information contained in Environment Canada Report EPS 1/RM/42 which could be referenced. (3) The proponent should reword and clarify the meaning of the last sentence.	
EMCP Response **30-Nov-10**	**The text will be modified to read as:** The Microtox™ test is known to be sensitive in substrates with more than 20 percent fines (Environment Canada 2002), which may be the case in the Hebron Project Area (Chevron 2003). None of the sediment samples were declared toxic by the amphipod survival test. **The following reference will be added:** Environment Canada. 2002. Environment Canada Report EPS 1/RM/142.	

EMCP Comment 69: DFO 7

69-DFO 7	**EA Reference:**	7.3.2.5 Fish and Shellfish Page 7-26
Preamble:	Section 5.3.2.3 request that the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	Although American Plaice is noted as the fourth most abundantly caught species during the Hebron biological survey, there is no species description provided. It is noted, however, that a description of this species is included in Section 11.3.1.2, which should be cross-referenced here. This section states that, "*Historically, the most abundant species in the area, and over the entire Grand Banks, were Atlantic cod and American plaice. However, in more recent years, these species have become uncommon on the northern portion of the Grand Banks.*" This statement is not accurate for American Plaice. While there are fewer plaice in NAFO Div. 3L than were present in the 1980s, this species is still not uncommon. For example, in Figure 7.5, plaice is the fourth most common species encountered by catch and in Table 7-7 it is ranked third by weight landed. Please revise accordingly.	
EMCP Response **30-Nov-10**	**The text will be revised as follows:** American plaice have been assessed as a species at risk (Threatened) by COSEWIC and are discussed in Section 11.3.1.2. Cross-reference to this section will be included in the introductory paragraph in Section 7.3.2.5. Fish species most likely to occur within the Offshore Project Area are those historically widespread over the Grand Banks. These species are yellowtail flounder, American plaice (described in Section 11.3.1.2), Atlantic cod (described in Section 11.3.1.1) and thorny skate. In more recent years, these species have been concentrated on the southern part of the Grand Banks. Monkfish (*Lophius americanus*), white hake,	

	Atlantic halibut, haddock and pollock (*Pollachius virens*) are mostly found in the warm waters of the Southwest Slope, whereas roundnose (*Coryphaenoides rupestris*) and roughhead (*Macrourus berglax*) grenadiers (both described in Section 11.3.1.6), Greenland halibut and redfish are commonly found in deeper water on the slope of the Grand Banks. Common epibenthic species in deeper areas include pink shrimp (*Pandalus borealis*), snow crab (*Chinocetes opilio*), witch flounder and redfish. The following paragraph will be revised: In general, the Offshore Project Area does not support a higher biomass of demersal fish relative to other areas of the Grand Banks (Kulka *et al.* 2003). Historically, the most abundant species in the area, and over the entire Grand Banks, were Atlantic cod and American plaice. In more recent years, Atlantic cod have become uncommon on the northern portion of the Grand Banks (NAFO 3L); however, while there are fewer American plaice than were present in the 1980s, this species is still not uncommon. Commercial fishing effort on the Grand Banks is currently focused on shellfish species, such as snow crab and shrimp.
Follow-up Comment **28-Jan-11**	It should be noted that the scientific name for Snow Crab is incorrect; the correct spelling is *Chionoecetes opilio*. This should be corrected in the next draft of the CSR.
EMCP Response **18-Mar-11**	Noted.

EMCP Comment 70: DFO 8

70-DFO 8	**EA Reference:**	7.3.2.5 Fish and Shellfish Page 7-28, Table 7-7
Preamble:	Section 5.3.2.3 request that the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	Information in Table 7-7 appears to be incorrect. Table 7-7 indicates that Yellowtail Flounder were not caught in the Study Area in 2007, however, distribution plots from 2007 (from the most recent assessments) depict Yellowtail Flounder throughout the Study Area at depths less than 93 m on the bank. Table 7-8 also contradicts Table 7-7 as values are reported for Yellowtail Flounder in 2007. Furthermore, values for American Plaice also seem low. The table indicates landed weight but should be revised to be weight caught as this information is from DFO research vessel surveys and not fishery related. Also the figures in the table need re-examination. For example, the table suggests there was 2,439,298 kg of Redfish caught in the in 2007 survey, which would be equivalent to 2, 439 metric tons (an incredibly high value for this fishery). Values for some of the other species are suspect as well. Perhaps there was some error in reading the data from DFO species catch weight. Please review this information.	
EMCP Response **30-Nov-10**	The table will be updated and text will be revised to reflect information in this table. Yellowtail flounder was captured in 2007 in both the Project and Study Areas. The Landed Weight will be revised to Weight Caught as suggested. All the information was reviewed and there were 2/19 values in the 2007 Study Area for redfish that accounted for 85 percent of the total weight caught (a value of 680,000 and 1,404,183). It is possible that there is an error with these two numbers. Removing these two values from the data set resulted in percentage catch for redfish of 28.5 (2007) as compared to 30.2 (2008). The table will be revised based on the removal of the two outlier values. American plaice values were correct for the dataset examined.	

Table 7-7 Species/Groups with Highest Catch Weights during DFO Research Vessel Surveys in the Hebron Offshore Project and Study Areas between 2007 and 2008 (Fish and Invertebrates)

Year	Offshore Project Area				Hebron Offshore Study Area			
	2007		2008		2007		2008	
Gear	Campelen 1800 Shrimp Trawl- Lined				Campelen 1800 Shrimp Trawl- Lined			
Total Weight Landed (kg)	142,650		24,672		1,246,944		966,930	
	Caught Weight (kg)	Percent of total (%)	Caught Weight (kg)	Percent of total (%)	Caught Weight (kg)	Percent of total (%)	Caught Weight (kg)	Percent of total (%)
Sand lance	125,963	88.3	1,984	8	100,683	8.07	96,805	10.01
Shrimp	1,958	1.4	980	4	361,865	29.02	152,784	15.80
American plaice	6,768	4.7	5,650	22.9	34,147	2.74	34,880	3.61
Snow crab	1,125	0.8	9,349	37.9	1,838	0.15	3,164	0.33
Unspecified invertebrate	2,658	1.9	NA	-	13,799	1.11	NA	-
Capelin	1,614	1.1	2,517	10.2	9,717	0.78	160,071	16.55
Sea urchin	1,218	0.9	364	1.5	1,094	0.09	4,896	0.51
Mailed sculpin	1,097	0.8	555	2.2	16,677	1.34	5,512	0.57
Toad crab	216	0.2	21	0.1	283	0.02	91	0.01
Comb- jelly	NA	-	2,520	10.2	255	0.02	2	< 0.01
Thorny skate	NA	-	400	1.6	80,340	6.44	146,340	15.13
Brittle star	NA	-	332	1.3	480	0.04	1,482	0.15
Deepwater redfish	NA	-	NA	-	355,115 [a]	28.48	291,632	30.16
Sea sponge	NA	-	NA	-	92,911	7.45	8,805	0.91
Greenland shark	NA	-	NA	-	100,000	8.02	NA	-
Roughhead grenadier	NA	-	NA	-	46,485	3.73	34,239	3.54
Greenland halibut	NA	-	NA	-	30,750	2.47	16,191	1.67
Yellowtail flounder	33	< 0.1	NA	-	505	0.04	10,036	1.04

Note [A]: 2 of 19 catch values for redfish were removed from data calculations as they were extreme outliers.

Follow-up Comment Track Changes CSR 01-Sep-11

Data provided for the Hebron Offshore Study Area for 2007 and 2008 in Table 7-8 (Page 7-37), does not appear to match the data provided in "*Hebron Project CSR: Consolidated Comments*" document (November 30, 2010 EMCP response). Please ensure this table is properly updated.

EMCP Response 08-Sep-11

DFO requested in April 2011, that EMCP incorporate the 2009 and 2010 fish catch data into the revised CSR. Upon receipt of the data, DFO advised Stantec, the primary author of the CSR, that there were additions to the data previously provided. In order to ensure all data were complete, Stantec re-requested the 2007 and 2008 data, to review it against the data presented in the CSR. It was discovered that there were some data that were inconsistent with the data presented in the December 2010 response. Hence Table 7-7 was revised and updated as presented in the August 2011 track changes version.

EMCP Comment 71: DFO 9

71-DFO 9	**EA Reference:**	7.3.2.5 Fish and Shellfish Page 7-30
Preamble:	Section 5.3.2.3 request that the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	This section states that, "*Halibut population estimates declined for many years, but a slight increasing trend has been observed more recently (Kulka et al. 2003).*" This information and reference is not considered "recent". More recent information exists which should be incorporated into the CSR.	
EMCP Response **30-Nov-10**	Based on the comments provided above, Section 7.3.2.5 will be revised as follows: Halibut population estimates declined for many years, **but industry / DFO surveys have more recently demonstrated relative population stability (Trzcinski *et al.* 2009).** Reference: Trzcinski, M.K., S.L. Armsworthy, S. Wilson, R.K. Mohn, M. Fowler and S.E. Campana. 2009. Atlantic halibut on the Scotian Shelf and Southern Grand Banks (NAFO Divisions 3NOPs4VWX5Zc) – Industry/DFO longline survey and tagging tesults to 2008. *Canadian Science Advisory Secretariat Research Document*, 2009/026.	

EMCP Comment 72: DFO 10

72-DFO 10	**EA Reference:**	7.3.2.5 Fish and Shellfish Page 7-31
Preamble:	Section 5.3.2.3 request that the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	This section should be revised as there are a number of inaccuracies and discrepancies, including: a) Although it states that, "*Snow crab are relatively sedentary and are not known to undergo seasonal or spawning migrations,*" it has been known for quite some time that Snow Crab undergo seasonal breeding migrations throughout the Gulf of St. Lawrence and Newfoundland (Ennis et al. 1988). b) Contrary to the statement, "*The spatial distribution of snow crab appears to be a function of their age, physical habitat and time of the year,*" the spatial distribution of Snow Crab may have nothing to do with age as we cannot age them. They also terminally molt at different sizes/ages, which introduces further uncertainty to the statement. c) Contrary to the statement, "*Recently-settled juveniles (<30 mm, carapace width) prefer a mud substrate…*" most appear to settle on shallow hard substrates (i.e., atop banks). Therefore, the following statement, "*Given the low percentage of fines in the substrate within the Offshore Project Area, it is not considered juvenile snow crab habitat*" is also incorrect. d) The exploitable biomass of Snow Crab in NAFO Div. 3L has changed drastically since the DFO (2005b) report referenced here. Since assessments of this species are carried out annually, it would be more appropriate to reference the most recent, 2010 DFO Science Advisory Report, which indicates that the exploitable biomass of Snow Crab is now increasing. Ennis, G.P., R.G. Hooper and D.M. Taylor. 1988. Changes in size composition of male crabs (*Chionoecetes opilio*) participating in the annual breeding migration in Bonne Bay, Newfoundland. *Canadian Science Advisory Secretariat Research Document*, 88(2): 14 pp.	

EMCP Response **30-Nov-10**	**a) and b) text in Section 7.3.2.5 in reference to Snow Crab will be revised as follows:** *Snow crabs are relatively sedentary and are known to undergo seasonal breeding migrations throughout the Gulf of St. Lawrence and Newfoundland (Ennis et. al 1988). The spatial distribution of snow crab appears to be a function of physical habitat and time of year....* c) **The following statement will be removed:** *Given the low percentage of fines in the substrate within the Offshore Project Area, it is not considered juvenile snow crab habitat.* d) **Paragraph 5 on Page 7-31 will be revised as follows:** *The exploitable biomass of snow crab (Dawe et al. 2010) in NAFO Division 3L (northern half of the Grand Banks) are uncertain with the exploitable biomass declining sharply in post-season trawls (3L Offshore). The 3L Offshore exploitable biomass has remained low in the trap survey but has since increased in the trawl surveys since 2006 (Dawe et al. 2010). The exploitable biomass in 3L Inshore has recently increased. The pre-recruit index has recently increased since 2006 with the 2008 index the highest since 1996 for 3L Offshore with recruitment prospects uncertain for 3L inshore (Dawe et al. 2010). The snow crab fishery occurs almost exclusively in water depths greater than 100 m (see Section 8.2.6.1).* **The following references will be added:** Dawe, E., D. Mullowney, D. Stansbury, E. Hynick, P. Veitch, J. Drew, E. Colbourne, P. O'Keefe, D. Fiander, K. Skanes, R. Stead, D. Maddock-Parsons, P. Higdon, T. Paddle, B. Noseworthy and S. Kelland. 2010. An assessment of Newfoundland and Labrador snow crab (*Chionoecetes opilio*) in 2008. *DFO Canadian Science Advisory Secretariat Research Document*, 2010/016: iv + 183 pp. Ennis, G.P., R.G. Hooper and D.M. Taylor. 1988. Changes in size composition of male crabs (*Chionoecetes opilio*) participating in the annual breeding migration in Bonne Bay, Newfoundland. *Canadian Science Advisory Secretariat Research Document*, 88(2): 14 pp.
Follow-up Comment **28-Jan-11**	The proponent has neglected to fully address part c) of this comment. The text still indicates that, "*Recently-settled juveniles (<30 mm, carapace width) prefer a mud substrate…*". As indicated in our original comment, most recently-settled juveniles appear to settle on shallow hard substrates. The text should be revised to reflect this information.
EMCP Response **18-Mar-11**	**The following sentence will be removed:** Recently-settled juveniles (<30 mm carapace width) prefer a mud substrate (Robichaud 1985; Brethes et al. 1987), whereas older juveniles (*i.e.*, 40 to 70 mm carapace width) occur in higher densities on substrates comprised of a mix of mud and rock or gravel (Coulombe *et al.* 1985; Dawe *et al.* 1988). **And replaced with:** Large male crabs are most common on mud or mud/sand substrates, while smaller crabs are common on harder substrates (DFO 2009). **The following reference will be added:** DFO (Fisheries and Oceans Canada). 2009. *Integrated Fisheries Management Plan: Snow Crab (Chionocetes opilio) Newfoundland and Labrador Region 2009-2011*. Available at: http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/snow-crab-neige/snow-crab-neiges2009-eng.htm

EMCP Comment 73: DFO 11

73-DFO 11	**EA Reference:**	Section 7.3.2.5 Fish and Shellfish Page 7-31
Preamble:	Section 5.3.2.3 request the CSR describe the distribution/abundance of species in the study area.	
Request **7-Sep-10**	This section states that, "*The most recent measure of the population of Greenland halibut on, and in the vicinity of the Grand Banks, indicates the exploitable biomass is currently at the lowest recorded level (Healey and Mahe 2005).*" The reference is an assessment of Greenland Halibut based on an age-based population model for the subarea 2 + Division 3KLMNO stock area, not just "*on, and in the vicinity of the Grand Banks*". It should also be noted that as the assessment of this resource occurs annually, a 2005 reference is quite dated. Information from more recent studies should be incorporated into the CSR.	
EMCP Response **30-Nov-10**	**The text will be revised as follows:** *The most recent assessment of Greenland halibut using the age-based population model for the subarea 2+ division 3KLMNO Stock Area, indicates the exploitable biomass has shown decreases over 2008-2010, as weaker year classes have recruited to the biomass (Healey et al. 2010).* **The following reference will be added:** Healey, B.P., J.C. Mahe and M.J. Morgan. 2010. An assessment of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO. *NAFO Science Council Research Document*, 10/40: 108 pp.	

EMCP Comment 74: DFO 12

74-DFO 12	**EA Reference:**	7.4.1 Nearshore Page 7-42
Preamble:	Section 7.4.1 outlines nearshore project activities that could potentially interact directly or indirectly with marine fish and fish habitat. This list of activities does not include upgrades to the terminal at Back Cove, which will be used for vessel docking during crew transport. During a recent visit to the Bull Arm site, DFO was informed that upgrades to the terminal would be required, which could result in a narrowing of the mouth of a stream which empties at the site.	
Request **7-Sep-10**	a) Provide details on the upgrades required at the Back Cove terminal. b) Proposed upgrades to the terminal should be included in the environmental effects assessment.	
EMCP Response **30-Nov-10**	a) The pier in Back Cove, which is the site of the ferry terminal to transport workers to the GBS in deep water site, will require upgrading. The details regarding the upgrades are unknown at this time, but likely will include a temporary replacement of the pier. Back Cove is included in the DFO HADD strategy, and, where impacts to fish habitat are identified in relation to construction activities, they will be included in the Fish Habitat Compensation Plan for Bull Arm. As more information becomes available during FEED, EMCP will consult with DFO regarding construction activities. Design changes or mitigations will be considered to reduce potential impacts to the stream. Currently proposed upgrades are within the tidal zone of the stream outflow. Section 2.8.3 will be updated indicating potential upgrades to Back Cove / Ferry Terminal site; Table 2-6 will include this as an activity. b) The list of activities in Section 7.4.1 will be updated to include upgrades to the ferry terminal in Back Cove. Appropriate subsections of Section 7.5.1 regarding environmental effects assessment will be updated to reflect the ferry dock upgrades.	

EMCP Comment 75: DFO 13

75-DFO 13	**EA Reference:**	7.5 Environmental Effects Analysis and Mitigation Page 7-46
Preamble:	Although the potential environmental effects listed within the tables in this section are fairly comprehensive, some effects have not been adequately described within the text. Thus, it is important that there is sufficient discussion within the text to support the claims made within the tables.	
Request **7-Sep-10**	Provide a more detailed explanation of environmental effects.	
EMCP Response **30-Nov-10**	**Additional information will be incorporated into the text under contamination (Pg 7-56). Section will be revised to incorporate information from the Terra Nova EEM programs as the Terra Nova environmental footprint has the greatest potential to overlap with that of the Hebron Project.** As summarized in Section 7.3.3.2, there are indications of previous drilling activities in the surficial sediments of the Offshore Project Area. Several metals were found to have concentrations above the median for the Offshore Project Area (Chevron 2003). The areal and temporal extent of discharged drill wastes (as measured by barium and total petroleum hydrocarbon (TPH) concentrations in sediments) tend to be related to differences in the number of wells and associated volume of discharges, mud types, current speed and direction, water depth and/or sediment mobility at the drilling location (Hurley and Ellis 2004). Hurley and Ellis (2004) also concluded that changes in the diversity and abundance of benthic organisms were detected within 1,000 m of drill sites, most commonly within the 50 to 500 m range of drill sites. The results were consistent for both literature (international) review case studies and for east coast offshore petroleum project EEM data. This scale of effects apply to wells discharging SBM or WBM and for multiple or single wells drilled at the same site. Beyond the bottom area covered by the cuttings pile, benthic communities generally returned to baseline conditions within one year after cessation of drilling discharges." The Terra Nova EEM program has conducted a baseline characterization in 1997 and has conducted six operational EEM programs to date. A review of the first five operational EEM programs for Terra Nova conducted in 2000, 2001, 2002, 2004 and 2006 found that total petroleum hydrocarbons were detected at 35 (2000) to 52 (2002) of the 53 stations (Petro-Canada 2001, 2002, 2003, 2005, 2007). Elevated hydrocarbon levels were detected above 4 mg/kg within 2 km (2000, 2002) to 3.5 km (2002) from the various Terra Nova drill centres. The maximum $>C_{10}$-C_{21} levels were 13.3 mg/kg at station 750 m from Northwest (NW) drill centre (2000); 28.6 near Northeast (NE) drill centre (2001); 925 mg/kg at 150 m from Far East (FE) drill centre (2002); 6.550 mg/kg at 150 m from FE drill centre (2004); and 980 mg/kg at 150 m from FE drill centre (2006). Barium levels at Terra Nova were slightly elevated compared to baseline conditions in 2000 with a maximum barium level of 230 mg/kg at 250 m from Southwest (SW) drill centre and the median barium level of 130 mg/kg (Petro-Canada 2001). Barium levels in 2001 (Petro-Canada 2002) were comparable to baseline conditions (1997 levels). Elevated barium levels were observed within 1 to 2 km of drill centres for 2002, 2004 and 2006 (Petro-Canada 2003, 2005, 2007). During these years the maximum barium concentrations were observed at 150 km from far east drill centre and were 2,200, 2,100 and 16,000 mg/kg respectively (Petro-Canada 2003, 2005, 2007). The Petro-Canada baseline amphipod survival had 1 of 54 samples that was considered to be toxic (Petro-Canada 1997). There were no toxic amphipod results for 2000, 2001 and 2002. In 2004 and 2006 (Petro-Canada 2005; 2007) amphipod survival had a toxic response within 150 m from the FE drill centre (station 30FE). In 2006 (Petro-Canada 2007), in addition to the toxic response within 150 m from the FE drill centre, there were two other toxic amphipod survival responses located at 1.08	

	and 1.28 km from a drill centre (W14). The hydrocarbon levels (>C_{10}-C_{21}) for the within 150 m from the FE drill centre (station 30FE) were 6,550 mg/kg in 2004 and 925 mg/kg in 2006. The benthic community structure in 1997 at Terra Nova was dominated by polychaetes, with good abundances of amphipods, bivalves, gastropods, echinoderms and anthrozoa and a similar relationship was observed in 2000 (Petro-Canada 1998, 2001). Potential enrichment of polychaetes (primarily of Spionidae family) was observed from 2001 through 2006 (Petro-Canada 2002, 2003, 2005, 2007). An inhibitory response on abundance and richness was observed within 150 m from FE drill centre (30 FE station) in 2002, 2004 with an inhibitory response in richness observed in 2006 for the 30FE station (Petro-Canada 2003, 2005, 2007). Inhibitory responses on amphipods were observed within 150 m from FE drill centre (30 FE station) in 2004 and 2006 (Petro-Canada 2005, 2007). The highest levels of barium, lead, manganese and strontium within the Offshore Project Area were found less than 750 m southeast of an abandoned oil well. These metals in other samples from the Offshore Project Area were well within the range from baseline and Year One of EEM programs at Terra Nova (Chevron 2003). Low-level fuel and lube range hydrocarbons were detected in 16 and 11 of 20 samples, respectively, during the sediment quality survey at Hebron (Chevron 2003). The median concentration of fuel range hydrocarbons was 0.81 mg/kg, while the median for lube range hydrocarbons was 0.75 mg/kg. Hydrocarbon concentrations were below 2 mg/kg in all samples. PAHs were not detected above an estimated quantification limits (EQL) of 0.05 mg/kg in any sediment samples from Hebron. These are not concentrations that are expected to cause hydrocarbon or barium contamination should they become suspended in the water column during offshore construction activities. Hebron plans to re-inject SBMs for drilling completed from the GBS and only release SBMs associated with satellite wells drilling from MODU in potential future well developments. The EEM programs from Hibernia have demonstrated that reinjection of SBMs reduces the contaminant footprint associated with the release of SBMs. Hibernia commenced cuttings reinjection in March 2001, with greater than 95 percent cuttings reinjection achieved by second quarter 2002. Since the installation of the cuttings reinjection systems, hydrocarbon and barium concentrations around the Hibernia platform have returned to near baseline conditions for most contaminants beyond 250 m from the platform.
Follow-up Comment **28-Jan-11**	This response is considered *inadequate*. This comment was intended to elicit a thorough description of the potential environmental effects within the text, based on the information provided in the tables of Section 7 as there are more environmental effects listed in the tables for various project activities than are discussed within the text. For example, although Table 7-11 indicates that a change in habitat use could result from the following 14 nearshore activities: bund wall construction, in-water blasting, drydock dewatering, concrete production, vessel traffic, lighting, re-establishment of moorings at the deep water site, dredging, bund wall removal/disposal, tow-out to deepwater site, completion of GBS construction and mating of topsides, hook-up and commissioning of topsides, surveys and tow-out from deepwater site, the text in Section 7.5.1.3: Change in Habitat Use (Nearshore) only details the following six nearshore activities as causing a change in habitat use: bund wall construction, in-water blasting, vessel traffic, lights, dredging and surveys. It should be noted that text does not need to be duplicated between sections; however, a cross reference should be provided.
EMCP Response **18-Mar-11**	The environmental effects assessment was developed in such a manner to try to be all-inclusive. The result of this inclusiveness has resulted in some of the activities noted in Tables 7.9 and 7.11 have implied environmental effects that in reality are covered off by another activity. A case in point, in-water blasting is noted as causing a

	change in Habitat Quantity. The potential use of in-water blasting would be associated with bund wall construction, bund water removal and preparation of the drydock area for which the environmental effects were discussed in Section 7.5.1.1. Thus, the discussion of the environmental effect with respect to in-water blasting was discussed in the greater context of the bund wall construction and preparation of the drydock area and not specifically with respect to in-water blasting. Another example relates vessel traffic, which has the potential to affect Habitat Quality by noise. The environmental effects of vessel traffic and noise are discussed in detail in Section 7.5.1.2. In Table 7.11, it is noted that the tow-out of the GBS to the deepwater site, completion of GBS construction and Topsides mating at the deepwater site, hook up and commissioning of Topsides and platform tow-out from the deepwater site all result in changes to habitat quality. The changes are directly related to the vessels which have been discussed in detail. **The following sentence in Section 7.5.1.2:** "Underwater noise created by blasting, sheet piling and vessel traffic can affect the physiology of fish and invertebrates." **will be modified to read:** Underwater noise created by blasting, sheet piling and vessel traffic (including vessel traffic associated with the tow-out of the GBS to the deepwater site, completion of GBS construction and Topsides mating at the deepwater site, hook up and commissioning of Topsides and platform tow-out from the deepwater site) can affect the physiology of fish and invertebrates. **The following paragraphs will be added to Section 7.5.1.2 Light Attraction:** Light attraction's primary environmental effects is related to habitat use (Section 7.5.1.3) but it can also affect habitat quality in that the light / dark cycle may be interrupted and fish and invertebrates in the area may not react in their normal manner. This has the potential to result in physiological stress, as light resulting in 24-hour light regime affects their normal circadian rhythm. The response of fish to changes in their circadian rhythm varies among species. Examples of the effects of a 24-hour light regime on fish species are provided to demonstrate the potential for physiological stresses. Night-time rest deprivation in zebra fish was found to result in a significant decline in daytime locomotor activity and in a heightened arousal threshold, compared to basal recordings (Zhdanova and Reebs 2006). Leonardi and Klempau (2003) demonstrated that the application of 24-hour light period for 60 days induced an increase of cortisol in trout that lasted up to two months after return to normal light regimes. The changes observed in fish towards the end of the two-month illumination period (increased haematocrit values and erythrocyte numbers) can be explained as a consequence of acute stress or, alternatively, as a stimulation of erythropoiesis by increased light exposure. Hemre *et al.* (2002) found that 24 hour light regime for Atlantic cod resulted in a delay in gonadal maturation and evident anaemia. The following references will be added: Leonardi, M. and A. Klempau. 2003. Artificial photoperiod influence on the immune system of juvenile rainbow trout (*Oncorhynchus mykiss*) in the Southern Hemisphere. *Aquaculture*, 221: 581-591. Hemre, G.I., G.L. Taranger and T. Hansen. 2002. Gonadal development influences nutrient utilisation in cod (*Gadus morhua*). *Aquaculture*, 214: 201-209. Zhdanova, I.V. and S.G. Reebs. 2006. Circadian rhythms in fish. *Behaviour and Physiology of Fish*, 24: 197-238. **The following revisions will be made to Section 7.5.1.3**. **The following sentence will be removed:** "Increased noise and activity levels due to dredging, bund wall, vessel traffic, blasting, lights and surveys (*e.g.*, geophysical, geohazard, geotechnical, environmental) during

	nearshore construction and installation activities may affect habitat use by causing avoidance or attraction of fish and invertebrates." **And replaced with the following paragraph:** Increased noise levels associated with dredging, bund wall construction and removal, vessel traffic (including vessel traffic associated with the tow-out of the GBS to Deepwater site, completion of GBS construction and topside mating at deepwater site, hook up and commissioning of topsides and platform two-out from deepwater site), blasting and surveys (*e.g.*, geophysical, geohazard, geotechnical, environmental) may affect habitat use by causing an avoidance of fish and invertebrates. Lights and related structures with light sources (including the floating batch plant for concrete production) may affect habitat use by providing an attraction of fish and invertebrates. Drydock dewatering may affect habitat use as there will be a loss of habitat quantity in this area. The habitat use environmental effects associated with noise and lights are discussed below. The effects of drydock dewater on habitat use is directly related to the temporary loss of habitat which triggers a HADD and are been discussed in Section 7.5.1.2.
Follow-up Comment **20-Apr-11**	EMCP Comment 75: DFO 13 This response is considered <u>inadequate</u>. As indicated in the previous two rounds of comments, information provided in the tables needs to be discussed in the text within Section 7.5. While the revisions provided in the proponent's most recent response addresses some of DFO concerns, further information is still required for some activities. These additional revisions may be addressed through new text or cross-referencing applicable information from other sections. The tables below outline the requested revisions, which have been made based on information contained in Tables 7-11 to 7-14. Note: Although the commitment made by the proponent to change the text in Section 7.5.4.1 to include the possible change in habitat quantity as a result of offshore spills is acceptable (see *"Hebron Project Comprehensive Study Report: Response to Review Comments, Part 1"* dated November 2010), Table 7-14 will also need to be updated to reflect this information.
EMCP Response **17-Jun-11**	**The tables (7-11 to 7-14) in Section 7 have been updated to reflect the comments.** These tables are provided in a revised (track changes) version of Section 7, which is enclosed with this response document. Table 7-14 has been updated to reflect noted comments and is enclose with this response document.
Follow-up Response **29-Jul-11**	This response is considered adequate, provided the following comments are addressed: The following revisions should be made to the updated Section 7.5 provided by ECMP **<u>Section 7.5.1.1</u>** a) As previously requested, the following text "…will be quantified and detailed within the Habitat Compensation Strategy report for the Hebron Project." in the first paragraph in the Nearshore section, should be revised as, "…will be quantified and detailed within the **HADD Quantification Report** for the Hebron Project" as HADD quantification will be detailed in a report separate from the Habitat Compensation Strategy. b) Text contained within the second paragraph of the Nearshore section leads the reader to believe that the upgrades to the Back Cove ferry terminal (pier) will be temporary in nature. It is our understanding that this will not be a temporary structure (i.e., less than 1 year duration). Please correct the text or provide clarification. c) The words "*to a small degree*" should be removed from the first sentence in the second paragraph of the Nearshore section as it misrepresents the effect the project footprint will have on habitat quantity.

	d) Text contained within the second paragraph of the Offshore section should be rearranged to clarify the relationship between the positive and negative effects of the project infrastructure on fish habitat. The paragraph should be revised as follows: *"There is currently no plan to trench the OLS, but to protect the line with rock cover and or concrete mattresses. The footprint of the OLS on the seafloor will restrict access by fish and shellfish to some habitat and may be declared a HADD of fish habitat by DFO and likely require a Section 35(2) Fisheries Act Authorization, requiring any loss of fish habitat to be compensated with the objective to achieve no net loss of productive capacity of fish habitat. However, the presence of unburied material over the OLS (i.e., concrete mattresses and rock cover) is expected to create habitat by increasing the amount of available hard substrate habitat that could be colonized by local flora and fauna, creating a reef effect for fish populations in otherwise barren sandy or soft bottom areas. Where flowlines and equipment are buried, the overlying sediments will provide habitat upon which benthic communities will recover.*" e) Text contained within the third paragraph of the Offshore section should be rearranged to clarify the relationship between the positive and negative effects of the project infrastructure on fish habitat. The paragraph should be revised as follows: "*Installation of the GBS will have a similar effect in that access to habitat under the GBS will be lost to fish and shellfish and may be declared a HADD of fish habitat by DFO and likely require a Section 35(2) Fisheries Act Authorization, requiring any loss of fish habitat to be compensated with the objective to achieve no net loss of productive capacity of fish habitat. However, colonization by invertebrates on the concrete GBS is expected.*" f) Text contained within the fifth and a portion of the sixth paragraph of the Potential Expansion Opportunities section should be rearranged to clarify the relationship between the positive and negative effects of the project infrastructure on fish habitat. The paragraph should be revised as follows: "*As with the nearshore, any offshore activities including excavated drill centre(s) and spoils disposal, the OLS or installations of pipeline(s) / flowline(s) (including related infrastructure such as concrete mattresses, rock cover or other flowline insulation) and testing from excavated drill centre(s) to the Hebron Platform may be declared to cause a HADD by DFO and require a Section 35(2) Fisheries Act Authorization and any loss of fish habitat will be fully compensated with the objective to achieve no net loss of productive capacity of fish habitat. The concrete mattresses, rock cover and other flowline insulations have the potential to provide new hard substrate habitat to be colonized and function as an artificial reef and would likely be colonized by sponges, anemones, brittlestars and seastars.*" g) Section 7.5.1.3 states that, "Drydock dewatering and the re-establishment of moorings at the Bull Arm deepwater site may affect habitat use as there will be a loss of habitat quantity in these areas". The effect of re-establishment of Moorings at the Bull Arm Deepwater Site on habitat quantity should be discussed in this section and noted in Table 7-11. **Section 7.5.1.2** a) The effects of Upgrades to the Ferry Terminal at Back Cove on habitat quality should be discussed in this section as well as indicated in Table 7-11. **Section 7.5.1.3** a) The reference to Section 7.5.1.2 made in the first paragraph of the Nearshore section should be Section 7.5.1.1. b) Reference to Upgrades to Ferry Terminal in Back Cove should be made in this section as its effect on habitat use is indicated in Table 7-11. c) As previously requested, please include "*Implement chemical selection management system*" and "*Adherence to regulatory limits with respect to discharges in*

	to marine waters" as mitigations in this section as they are included in Table 7-11 under Hook-Up, Production Testing and Commissioning of Excavated Drill Centres. **Section 7.5.1.4** a) While it is noted that Bund Wall Construction could cause fish mortality, it is not explained how this activity could potentially kill fish and invertebrates. As previously requested, please include this explanation. b) The following sentence should be added to the last paragraph of the Offshore section, "EMCP will consult with DFO prior to water extraction to ensure fish screens are adequately sized." c) As the installation of temporary moorings in the offshore may potentially affect habitat quality and use, the first three paragraphs of the Offshore section should be moved to either Section 7.5.1.2 or 7.5.1.3. **Table 7-11** a) As previously requested, "Bubble curtains, if required" should be removed as EMCP has already clarified that blasting would not be required for Bund Wall Removal. b) The effect of Platform Tow-Out / Offshore Installation on habitat quantity has been discussed in Section 7.5.1.2, therefore it should be re-entered as a potential environmental effect in Table 7-11. c) The effect of Excavated Drill Centre Dredging and Spoils Disposal on habitat quality has been discussed in Section 7.5.1.2, therefore it should be it should be re-entered as a potential environmental effect in Table 7-11. **Section 7.5.2.2** a) As previously requested, the effects of Well Activities on habitat quality should be discussed in this section as it is indicated in Table 7-12. **Section 7.5.2.3** a) As previously discussed, the effect of the following activities on habitat use should be discussed in this section. It is also noted that "Habitat Use" has been removed from Table 7-12 for these activities, please ensure that "Habitat Use" is included as a potential environmental effect for these activities. · Wastewater (produced water, cooling water, storage, displacement) · Chemical Use/Management/Storage (e.g., corrosion inhibitors, well treatment fluids) · Well Activities (well completions, work overs) · WMB Cuttings · WMB and SMB Cuttings · Chemical Use and Management (BOP fluids, well treatment fluids, corrosion inhibitors) b) This section states that the mitigation measures outlined in the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2011) will be applied. While this is correct, reference to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment* should also be included. This statement of practice should also be referenced in Table 7-12. **Table 7-12** a) As previously requested, "Change in Habitat Quality" should be removed from the potential environmental effects for Presence of Structures for the proposed project as well as the potential expansion opportunity. b) It is noted that "Potential Mortality" has been removed as a potential environmental effect for Surveys for both the proposed project as well as the potential expansion opportunity. As seismic surveys can result in mortality please ensure that "Potential Mortality" is included as a potential environmental effect.

	Section 7.5.3.3 a) As previously requested, the effects of Lighting on habitat use should be discussed in this section as it is indicated in Table 7-13. b) As previously requested, reference to Operation of Vessels (supply, support, standby and tow vessels/barges/ROVs) and Surveys (e.g., geophysical, 2D/3D/4D seismic, VSP, geohazard, geological, geotechnical, environmental, ROV, diving) should be made in this section as their effect on habitat use is indicated in Table 7-13. **Table 7-13** a) "*Change in Habitat Quantity*" should be removed from the potential environmental effects for Operation of Vessels. **Section 7.5.4.1** a) The following, "*In any case, the quantity of fish habitat affected by an accidental event resulting in a hydrocarbon release would be negligible*" should be removed or reworded to clarify the effect a spill would have on the quantity of fish habitat.
EMCP Response **4-Aug-11**	**Section 7.5.1.1** a) Text has been changed as noted above. b) Per EMCP discussions with DFO regarding the upgrades to the Back Cove pier, EMCP indicated that the original footprint of the pier will not be increased, based on current requirements, therefore, it is not anticipated that there will be any potential effects on Habitat Quantity. However, reference to potential impacts resulting from the upgrades / repairs to this pier will be addressed under Habitat Quality (*i.e.*, potential siltation). c) Text has been deleted d) The following text, which reflects the above comment, will be included in the CSR: *There is currently no plan to trench the OLS, but to protect the line with rock cover and or concrete mattresses. The footprint of the OLS on the seafloor will restrict access by fish and shellfish to some habitat and may be declared a HADD of fish habitat by DFO and likely require a Section 35(2) Fisheries Act Authorization, requiring any loss of fish habitat to be compensated with the objective to achieve no net loss of productive capacity of fish habitat. However, the presence of unburied material over the OLS (i.e., concrete mattresses and rock cover) is expected to create habitat by increasing the amount of available hard substrate habitat that could be colonized by local flora and fauna, creating a reef effect for fish populations in otherwise barren sandy or soft bottom areas. Where flowlines and equipment are buried, the overlying sediments will provide habitat upon which benthic communities will recover.* e) The following text, which reflects the above comment, will be included in the CSR: *Installation of the GBS will have a similar effect in that access to habitat under the GBS will be lost to fish and shellfish and may be declared a HADD of fish habitat by DFO and likely require a Section 35(2) Fisheries Act Authorization, requiring any loss of fish habitat to be compensated with the objective to achieve no net loss of productive capacity of fish habitat. However, colonization by invertebrates on the concrete GBS is expected.* f) The following text, which reflects the above comment, will be included in the CSR: *As with the nearshore, any offshore activities including construction of excavated drill centre(s) and spoils disposal, installations of pipeline(s) / flowline(s) (including related infrastructure such as concrete mattresses, rock cover or other flowline insulation) and tie-back from excavated drill centre(s) to the Hebron Platform may be declared a HADD of fish habitat by DFO and likely require a Section 35(2) Fisheries Act Authorization, requiring any loss of fish habitat to be compensated with the objective to achieve no net loss of productive capacity of fish habitat. Concrete mattresses, rock cover or other flowline insulation have the potential to provide new hard substrate*

	habitat to be colonized and function as an artificial reef and would likely be colonized by sponges, anemones, brittlestars and seastars. g) The Re-establishment of moorings at Bull Arm deepwater site will not affect fish habitat. All existing mooring locations are located on land. The re-establishment means that mooring chains will be hooked to the mooring point to a tension barge and from the barge to the GBS at the deepwater site. There is no interaction of the mooring chains with physical fish habitat (*i.e.*, seafloor); they remain in the water column. The reference to "re-establishment of moorings…affect habitat use as there will be a loss of…quantity…" will be removed from the CSR. **Section 7.5.1.2** a) Upgrades to the Ferry Terminal have been included in Section 7.5.1.2 **Section 7.5.1.3** a) The section reference has been revised. b) Upgrades to the Ferry Terminal have been included in Section 7.5.1.3. c) Change in Habitat Use is addressed in the CSR in terms of noise from Project Activities that has the potential to affect the behaviour of fish (*i.e.*, avoidance or attraction behaviours). The mitigations referred to above, are addressed in Section 7.5.1.2 in reference to potential changes in water quality. In addition, the activity "Hookup Production testing and commissioning of Excavated Drill Centres" has been changed to "Hook-up and Commissioning of Drill Centres". Production testing is an activity that occurs from the Platform, whereby any dicharges would be from the Platform. There are no production related discharges from a drill centre. **Section 7.5.1.4** a) The following text will be included in Section 7.5.1.4: *Bund wall construction may result in fish mortality due to the smothering of bottom-dwelling fish and invertebrates during the placement of the rock fill for the bund wall.* b) Upon clarification from DFO, the reference to the placement in the section should read Nearshore. Therefore, the following text will be included in Section 7.5.1.4 - Nearshore. *With regard to potential entrainment of fish during the dewatering of the drydock, EMCP will consult with DFO regarding the sizing of fish screens to ensure adequate water flow is maintained.* c) The potential effects associated with the installation of temporary moorings has already been addressed in Sections 7.5.1.2 and 7.5.1.3. **Table 7-11** a) Noted. Table 7-11 will be revised. b) Per clarification from DFO, the referenced section is 7.5.1.1. Table 7-11 has been amended per above comment. c) Noted. Table 7-11 will be revised. **Section 7.5.2.2** a) Discharges associated with well activities (*e.g.*, well treatment and completions fluids) are included in operational discharge streams (*i.e.*, produced water). Section 7.5.2.2-Liquid Discharges addresses all discharges associated with drilling and production. Therefore, any discharges from well activities are included in this discussion. In addition, chemicals used in during well activities will be screened in accordance with an approved chemical screening process. The activity "well activities" will be deleted from the assessment tables, as they are captured under the activity "waste water."

	Section 7.5.2.3. a) Change in Habitat Use is addressed in the CSR in terms of noise from Project Activities having the potential to affect the behaviour of fish (*i.e.*, avoidance or attraction behaviours). The above listed activities have a greater likelihood to affect Habitat Quality, and not Habitat Use, and are therefore addressed under Habitat Quality. Table 7-12 will reflect potential effects on Habitat Quality, but not Habitat Use. b) Reference to the Geophysical, Geological, Environmental and Geotechnical Program Guidelines (C-NLOPB 2011) is intended to imply that all mitigations listed in these guidelines, including the Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment as appended, be applied, where applicable to program activities. However, for clarity, the reference to the Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment will be included in Section 7.5.2.3 and the appropriate effects assessment tables in Section 7.5. **Table 7-12** a) Noted. The above referenced text has been removed from Table 7-12. b) Noted – the change has been corrected. The Table includes Potential Mortality as an environmental effect. **Section 7.5.3.3** a) This section has been updated to include lighting as a potential effect. Section 7.5.1.3 is cross-referenced for a discussion on the potential effects of lighting to ensure the document is concise and informative for the reader. b) The above referenced "activity list" is all inclusive for each activity discussed. However, during decommissioning and abandonment, it is not anticipated that geophysical, seismic, geohazard, geological, geotechnical, environmental, surveys will be undertaken. To address the potential for vessel activity the following text has been included in Section 7.5.3.3: *The noise and underwater activity required during possible removal of subsea structures (e.g., OLS, flowlines and wellhead, operation of vessels, diving programs, ROV surveys) and lighting will be similar in nature to those of construction, but of less magnitude and geographic extent. Potential effects of noise, underwater activity and lighting on fish habitat use are discussed in Section 7.5.1.3.* **Table 7-13** a) Noted. The text has been deleted from Table 7-13. **Section 7.5.4.1** a) The following text will be added to Section 7.5.4.1 to clarify that, in the absence of spill countermeasures there is a potential for shoreline oiling, hence potential for effects on fish habitat, should an accidental event occur. *Therefore, for nearshore and offshore areas, it is predicted that fish habitat quantity could be affected by an accidental event. The quantity of fish habitat that may be affected by an accidental event would be examined as part of an post-spill environmental effects monitoring program in the event of an accidental event.*
Follow-up Comment **15-Aug-11**	**Section 7.5.1.1 (29-Jul-11 Follow-up Comment)** b) This response is considered adequate provided the following comment is addressed: If the ferry pier remains in the same footprint as the existing infrastructure, it does not need to be discussed in Section 7.5.1.1 as it will not affect habitat quantity. Table 7-11 should be updated as well. Also, if an increase in footprint is not anticipated, reference should be made in Section 7.5.1.2 to adherence to DFO's Marine Wharf Repair/Reconstruction Operational Statement. This Operational Statement can be found at: http://www.dfo-mpo.gc.ca/habitat/what-quoi/os-eo/nl/pdf/mwharf-eng.pdf.

	g) This response is considered adequate provided the following comment is addressed: The clarification provided in the response regarding what is meant by "re-establishment of moorings at the Bull Arm deepwater site" should be included in the CSR. **Section 7.5.1.4 (29-Jul-11 Follow-up Comment)** b) This response is considered adequate provided the following comment is addressed: The text provided by EMCP in their response leads the reader to believe that DFO is concerned about appropriate sizing of fish screens because of maintenance of adequate water flow, when in fact DFO is concerned with preventing the entrainment and/or impingement of fish. Please reword this text. **Section 7.5.2.3 (29-Jul-11 Follow-up Comment)** b) This response is considered adequate provided the following comment is addressed: The proponent's response indicates that the text in Section 7.5.2.3 will be revised to include a reference to the *Statement of Canadian Practice on Mitigation of Seismic Noise in the Marine Environment*, however as previously requested, Table 7-12 should also include a reference to this document as mitigation when conducting surveys. **Section 7.5.3.3 (29-Jul-11 Follow-up Comment)** b) This response is considered adequate provided the following comment is addressed: If geophysical, seismic, geohazard, geological and geotechnical surveys are not proposed for decommissioning and abandonment, they should be removed from Table 7-13. It is advised that environmental surveys may be required during decommissioning and abandonment and therefore should be included in the proposed text for Section 7.5.3.3.
EMCP Response **18-Aug-11**	**Section 7.5.1.1 (29-Jul-11 Follow-up Comment)** b) Based on current Project requirements, it is not envisioned that upgrades to the ferry pier will increase the footprint. However as work continues at Bull Arm and planning for construction at the deepwater site progresses, upgrades to the ferry pier may be required, including a potential footprint increase. Detailed planning for these activities have not commenced and, therefore, additional details cannot be provided. For clarity within the CSR, potential upgrades to the ferry pier and potential effects on fish habitat will be included in Section 7.5.1.1, and addressed in Table 7-11. The following text will be added to Section 7.5.1.1 (refer to the attached page 7-55 from the August 2010 revision to the CSR). *Upgrades to the Back Cove ferry terminal may be required. Based on current project design it is not anticipated that these upgrades will include a change in the overall the footprint of the pier. However, as project design evolves and work begins at the deepwater site, there may be requirements to alter the footprint of the ferry pier. Upgrades to the ferry pier will be designed to avoid potential impacts to the adjacent stream. If changes are made to the footprint of the ferry pier, the quantity of fish habitat available for use may be affected by the covering and/or smothering of existing habitat. Mitigation measures outlined in DFO's Marine Wharf Repair / Reconstruction Operational Statement (http://www.dfo-mpo.gc.ca/habitat/what-quoi/os-eo/nl/pdf/mwharf-eng.pdf) will be implemented. .*

	In addition, potential effects on Habitat Quality and use are discussed in Sections 7.5.1.2 and 7.5.1.3, respectively. These changes can be seen in the track changes version of the CSR (August 2011) provided to the C-NLOPB on August 2, 2011. The author should refer to pages 7-55, 7-59, 7-60, 7-70 and Table 7-11. In addition, reference to the above DFO operational statement will be included in Section 7.5.1.2 (refer to attached page 7-62 from the August 2011 CSR showing the revised text). g) As described in our previous response, any additional moorings will be constructed on land, and these moorings do not interact with fish habitat (quantity, quality, use, or mortality). Therefore all references to these interactions have been removed from the CSR (Section 7.5.1 and Table 7-9 and 7-11). However, for clarity within the CSR, the description of these moorings will be included to provide the reader with an understanding of what is meant by the mooring points. The following text "*mooring chains will be hooked from the mooring point to a tension barge and from the barge to the GBS at the deepwater site; there is no interaction of the mooring chains with fish habitat (quantity, quality, use, or mortality*" will be included in the first paragraph of Section 7.5.1.1 (see attached page 7-55 from the updated August 2011 CSR). **Section 7.5.1.4 (29-Jul-11 Follow-up Comment)** b) The text has been revised to read as "*With regard to potential entrainment of fish during the dewatering of the drydock, EMCP will consult with DFO regarding the sizing of fish screens.*" (refer to attached page 7-73 showing revised text in August 2011 CSR). **Section 7.5.2.3 (29-Jul-11 Follow-up Comment)** b) Table 7-12 had been modified. The reader is referred to Table 7-12 in the July 2011 Track Changes CSR, which was provided to the C-NLOPB on August 2, 2011. Note the reference under Potential Expansion Opportunities had not been changed in the version provided to the C-NLOPB on August 2, but has since been corrected to reference the "Statement". **Section 7.5.3.3 (29-Jul-11 Follow-up Comment)** b) The previous response indicated that the above referenced surveys would not likely be required during decommissioning and abandonment, with the exception of environmental, ROV and diving surveys. However, for clarity, the Sections 7.5.3.2 and 7.5.3.3 has been modified as follows (refer to attached pages 7-91 and 7-92 from the August 2011 CSR, which show the modified text). **7.5.3.2 Change in Habitat Quality** Project decommissioning and abandonment activities may affect fish habitat quality during the possible removal of subsea structures through vessel noise (associated with the operations of vessels including supply, support, tow vessels, barges) and suspended sediments. **In addition, noise maybe associated with surveys that may be required or undertaken as a part of the decommissioning and abandonment activities. Such surveys may likely include environmental, ROV and diving surveys; however, geophysical, geohazard and/or geological surveys may be undertaken if required.** The environmental effects of these activities are expected to be similar in nature to those of construction, but of less magnitude and geographic extent. Potential effects of noise and suspended sediments on fish habitat quality are discussed in Section 7.5.1.2. **7.5.3.3 Change in Habitat Use** Project decommissioning and abandonment activities could affect the behaviour of fish and invertebrates and therefore habitat use. The noise and underwater activity required during possible removal of subsea structures (*e.g.*, OLS, flowlines and wellhead, operation of vessels, diving programs, **surveys (as outlined in Section 7.5.3.2))** and lighting will be

	similar in nature to those of construction, but of less magnitude and geographic extent. Potential effects of noise, underwater activity and lighting on fish habitat use are discussed in Section 7.5.1.3. **7.5.3.4 Potential Mortality** Project decommissioning and abandonment activities have the potential to cause mortality of fish and shellfish during the possible removal of subsea structures (including the Hebron Platform and OLS loading points, if they are removed), **and during survey activities, as described above**. Activities will be similar in nature to those of construction, but of less magnitude and geographic extent. Potential for underwater construction activity to cause mortality of fish and shellfish is discussed in Section 7.5.1.4.
Follow-up Comment CSR Track Changes review 01-SEP-11	a) As previously requested in our April 20,2011 comments, the effect of rock scour around the GBS on habitat quantity should be discussed in Section 7.5.1.1 b) As previously requested in our April 20,2011 comments, reference to the use of fish screens as a mitigation during GBS ballasting should be made in Section 7.5.1.4 and Table 7-11 c) As previously requested in our April 20,2011 comments, the effect of bund wall rupture on fish habitat quantity should be discussed in Section 7.5.4.1.
EMCP Response 08-Sep-11	a) The text has been modified to read as (refer to revised CSR page 7-55, attached): *Installation of the GBS will have a similar effect, in that access to habitat under the GBS <u>and the area that may be covered by rock scour protection (if required)</u> will be lost to fish and shellfish and may be declared…* b) The following text has been added to the CSR (refer to page 7-73, and revised table 7-11, attached): *The GBS ballast water intake will include screens to reduce potential fish entrainment during ballasting.* c) The following text has been included in Section 7.5.4.1. In addition, Table 7-14 has been revised (refer to page 7-93, and revised table 7-14, attached). *If the bund wall were to break or rupture, fish habitat quantity could be affected by an increase in sedimentation or a smothering of fish habitat by bund wall material.*

EMCP Comment 76: DFO 16

76-DFO 16	**EA Reference:**	7.5 Environmental Effects Analysis and Mitigation Page 7-46
Preamble:	In Table 7-11 the use of "*bubble curtains, if required*" and "*Compliance with terms of Section 32 Fisheries Act Authorization (if required)*" are listed as mitigations during removal of the bund wall and disposal (dredging/ocean disposal). These mitigations are typically associated with in-water blasting, however, the CSR does not specify that in-water blasting will be used for bund wall removal and disposal.	
Request 7-Sep-10	Provide clarification on whether in-water blasting will be required for removal of the bund wall.	
EMCP Response 30-Nov-10	In-water blasting will not be required to remove the bund wall to flood the dry dock. The bund wall will be dredged for removal. Mitigations that may be employed, which are not listed in the table, would be siltation control measures. Table 7.11 will be updated to include sedimentation control measures for bund wall removal.	

EMCP Comment 77: DFO 17

77-DFO 17	**EA Reference:**	7.5 Environmental Effects Analysis and Mitigation Page 7-62
Preamble:	Table 7-11 lists installation of temporary moorings at the offshore project location as a project activity, however, there is no other information on these temporary moorings within the CSR.	
Request **7-Sep-10**	Provide details on the nature of these moorings.	
EMCP Response **30-Nov-10**	It is very early in the design to determine if temporary mooring will be required for the installation of the Hebron Platform at its offshore location. If temporary moorings are required, up to four lines (two in one direction, (*e.g.*, south), and one to each side (*e.g.*, east and west) will be installed prior to the arrival of the Platform. During the final Platform installation phase, these lines would be connected to the bow of towing tugs and when system is tightened up, the final positioning will be achieved by use of the tugs winches. The mooring lines may consist of a conventional drag embedded anchor (10 to 15 tonnes), short piece of chain and approximately 400 m of 64 mm steel wire rope buoyed at the surface. The anchors will be set approximately 1,000 m away from the final Platform location. It is assumed that the lines will be installed a couple of weeks prior to the final platform installation and removed immediately after completion of platform installation. Both installation and retrieval may be done by one or two towing tugs using conventional anchor handling methods.	
Follow-up Comment **28-Jan-11**	The response does not indicate whether the CSR will be revised to reflect the information provided. The text provided by the proponent in the response should be incorporated into the CSR.	
EMCP Response **18-Mar-11**	The text provided will be incorporated into Section 7.5.1.4 (Offshore) of the CSR.	
Follow-up Comment **20-Apr-11**	This response is considered <u>adequate,</u> <u>provided the following comment is addressed:</u> The proponent indicates that the text provided will be incorporated into Section 7.5.1.4, however as offshore temporary moorings would likely affect habitat quality and use, it would be better to include the revised text in Section 7.5.1.2 or 7.5.1.3.	
EMCP Response **17-Jun-11**	Noted. **The text will be included in Section 7.5.1.2 and cross-referenced in Section 7.5.1.3.**	

EMCP Comment 78: DFO 14

78-DFO 14	**EA Reference:**	7.5.1.1 Change in Habitat Quantity Page 7-49
Preamble:	The last paragraph of this section states that, "*In accordance with the DFO policy of no net loss of fish habitat, a habitat compensation program will be developed in conjunction with DFO as a mitigation measure for the net loss of fish habitat resulting from nearshore and offshore Hebron Project activities.*" Although DFO acknowledges the proponent's commitment to the development and implementation of a fish habitat compensation program, a fish habitat compensation strategy is required as part of this CSR.	
Request **7-Sep-10**	Provide a Fish Habitat Compensation Strategy	

EMCP Response **30-Nov-10**	The Fish Habitat Compensation Strategy will be submitted in December 2010.
Follow-up Comment **28-Jan-11**	This response is considered inadequate. While DFO acknowledges the proponent's commitment to the development of a Fish Habitat Compensation Strategy, it is necessary to include, at the very least, high level details on the potential compensation options to be implemented within the CSR. This is required as fish habitat compensation is considered a mitigation under CEAA (the single most important mitigation from the perspective of the Habitat Provisions of the *Fisheries Act*), which must be applied to ensure that any residual adverse environmental effects are not significant. Until such a time as that information is included in the CSR, DFO will be unable to make a determination of the significance of effects, with respect to the potential impacts on fish and fish habitat, within the context of CEAA. Additionally, DFO has provided further direction for the breadth and depth of information on a fish habitat compensation strategy, to be included in the CSR, to ExxonMobil in separate correspondence.
EMCP Response **18-Mar-11**	**The following information will be incorporated into the CSR** and is an excerpt from the Fish Habitat Compensation Strategy, which was submitted to DFO on December 22, 2010. With respect to the offshore Project area, it is predicted that the increased hard surface area afforded by structures (not including the Hebron Platform itself) and associated rock cover in the Hebron offshore production field will likely offset any footprint losses (including the base area of the Hebron Platform). Therefore, EMCP submits that HADD compensation will not be required for the offshore Project Area based on preliminary design of these elements. EMCP will provide DFO with a habitat quantification report for the offshore Project Area once final design details of these structures are available in order to make a final determination of whether HADD compensation may be required. With respect to the nearshore Project Area, a HADD compensation plan will be required, since installation of a bund wall and de-watering of the proposed drydock area to allow for construction of the GBS and some potential dredging (and blasting) of native sediments in selected locations within Great Mosquito Cove will likely be considered a HADD by DFO. As its preferred option for HADD compensation, EMCP is proposing to enhance fish habitat in GMC by re-locating bund wall material (*i.e.*, rock / cobble, 100 to 210 mm) along with dredged native sediments to featureless sedimentary areas of the sea floor, which currently have low commercial fish productivity. The re-located rock material will be deposited in closely-spaced piles (to maximize 'edge' effects) with the intention of creating 'artificial reefs'. In addition, local fishers have recommended that the rock 'reefs' be placed in shallow, sub-tidal areas of Great Mosquito Cove (<30 m water depth), which are adjacent to areas with bedrock, boulder and medium to coarse gravel substrates, which will provide access corridors to allow for development of juvenile lobsters into later life stages and ultimately into mature, commercial-size adult lobsters and facilitate the growth of kelp species that provide food and/or cover for a variety of fish and invertebrate species.
Follow-up Comment **20-Apr-11**	This response is considered adequate, provided the following comments are addressed: The proponent needs to make a commitment in the CSR that the correct substrate classes will be used to construct the proposed fish habitat compensation. The response provided by the proponent indicates that, "*rock/cobble 100 to 210 mm along with dredged native sediments*" will be relocated from the bund wall to create compensation habitat. However, the creation of productive fish habitat requires the addition of rocky materials that are clean and free of sediment and is a combination of equal portions of boulder (250-750 mm), rock (130-225 mm) and cobble (65-130 mm).

	If the proponent cannot provide the full range of substrate sizes indicated, then the artificial reefs may not meet their full productivity potential. There are also several inaccuracies related to the offshore project area that need to be corrected. The footprint of the OLS on the sea floor would in fact constitute a loss of fish habitat, therefore it is incorrect to say that, "*…increased hard surface area afforded by structures (not including the Hebron Platform itself) and associated rock cover in the Hebron offshore production field will likely offset any footprint losses…*" While the rock cover over the flowlines and the armouring around the Hebron platform may constitute fish habitat compensation, it would be contingent upon the size of rock material used and its benefit to species present within the area. Until DFO has received all information regarding the existing habitat and species within the area as well as details on the rock covering material, it cannot be concluded that this habitat creation will be sufficient to, "*offset any footprint losses*" within the offshore project area. In any case, it is incorrect to make the statement that, "*HADD compensation will not be required for the offshore Project Area*".
EMCP Response **17-Jun-11**	EMCP submits that HADD compensation may not be required for the Offshore Project Area based on preliminary design of these elements[1] and current understanding of the existing fish and fish habitat within the Offshore Project Area. EMCP will provide DFO with a habitat quantification report for the Offshore Project Area once final design details of these structures are available in order to make a final determination on HADD and fish habitat compensation requirements. With respect to the Nearshore Project Area, a HADD compensation plan will be required, since installation of a bund wall and de-watering of the proposed drydock area to allow for construction of the GBS and some potential dredging (and blasting) of native sediments in selected locations within Great Mosquito Cove will likely be considered a HADD by DFO. As its preferred option for HADD compensation, EMCP is proposing to enhance fish habitat in Great Mosquito Cove by re-locating bund wall material[2] to featureless sedimentary areas of the sea floor, which currently have low commercial fish productivity. The re-located rock material will be deposited in closely-spaced piles (to maximize 'edge' effects) with the intention of creating 'artificial reefs'. In addition, local fishers have recommended that the rock 'reefs' be placed in shallow, sub-tidal areas of Great Mosquito Cove (<20 m water depth), which are adjacent to areas with bedrock, boulder and medium to coarse gravel substrates, which will provide access corridors to allow for development of juvenile lobsters into later life stages and ultimately into mature, commercial-size adult lobsters and facilitate the growth of kelp species that provide food and/or cover for a variety of fish and invertebrate species.
Follow-up Comment **29-Jul-11**	This response is considered adequate, provided the following comments are addressed: It is incorrect to say, "*compensation may not be required for the Offshore Project Area*". Although components of the project may create sufficient habitat to offset the HADD, that created habitat is still considered fish habitat compensation which must be detailed and quantified in a Fish Habitat Compensation Plan, committed to in an Authorization and adequately monitored. A portion of EMCP's response should be reworded as follows:

[1] While the rock cover over the flowlines and the armouring around the Platform has the potential to constitute fish compensation, it would be contingent upon the size of the rock material and its likely benefits to species within the area.

[2] According to DFO guidelines, the re-located rock material should be clean and free of sediment and a combination of equal portions of boulder (250 to 750 mm), rock (130 to 225 mm) and cobble (65 to 130 mm). In addition to the bund wall material, there is also the possibility that some dredged native sediments would be available for incorporation into the proposed rock reefs if not taken to an onshore site for disposal / reuse.

	"*Therefore, EMCP submits that additional HADD compensation may not be required for the Offshore Project Area based on preliminary design of these elements1 and current understanding of the existing fish and fish habitat within the Offshore Project Area.*"
EMCP Response 4-Aug-11	Text has been modified CSR to reflect the above.

EMCP Comment 79: EC 36

79-EC 36	**EA Reference:**:	Section 7.5.1.2 Change in Habitat Quality Page 7 - 52 last line to Page 7 - 53, line 3.
Preamble:	a) At Section 7.5.1.2, sub section on Nearshore, sub-sub section on Contamination, starting on Page 7 - 52 last line the text states "During the EEM program, iron and manganese were the only elements recorded above the Maximum Allowable Effects Levels, the concentration level in sediments above which the frequency of associated biological effects are unacceptable." b) At Section 7.5.1.2, sub section on Offshore, sub-sub section on Contamination, on Page 7-56, the text states "Given that the metals concentrations reported are total concentrations, there is little risk that the metals will become highly bioavailable to filter feeding organisms should the sediments become suspended during offshore construction activities.".	
Request 7-Sep-10	a) For point # 1 above, please provide a reference for these Maximum Allowable Effects Levels, it is not clear what guidelines are being used for comparison with measured metal levels, or which organization has produced these guidelines. b) For point # 2 above, it is recommended that the proponent compare metal levels against CCME interim marine sediment quality guidelines provided in CCME (1999) as a more rigorous way to predict whether adverse biological effects are likely or not. Reference: Canadian Council of Ministers of the Environment (CCME). 1999. *Canadian Environmental Quality Guidelines*. Canadian Council of Ministers of the Environment, Winnipeg.	
EMCP Response 30-Nov-10	a) The Maximum Allowable Effects Levels (MAELs) that were used during the Hibernia GBS Construction Site Marine EEM programs (Christian and Buchanan 1998) were based on a variety of sources and regulations of the related time period. MAELs developed for Mussel and Sediments were based on the Canadian Fish Health Inspection / Food and Drug Regulations, FAO (1983), *Canadian Environmental Protection Act Ocean Dumping Regulations* (1988), Canadian Marine Environmental Quality Guidelines (1992), and the Environment Canada's Interim Sediment Quality Guidelines (ISQGs) (1995). MAELs for Mixed Function Oxygenase activity were developed based on recommendations from Dr. J. Payne. b) A review of section 7.3.2.2 found that the metal concentration for sediment samples collected at the Hebron site (Chevron 2003) were not above the ISQGs and Probable Effects Levels (PELs) as listed in the CCME interim marine sediment quality guidelines provided in CCME (1999). The sediment chemistry results below ISQGs and PELs at Hebron are consistent with the results of the Hibernia EEM program (HMDC 2007) and as such no adverse biological effects are expected from the chemicals listed in CCME interim marine sediment quality guidelines. Barium, the metal with the highest levels and which is associated with drill muds and cuttings has no published ISQG or PEL at this time. **The following reference will be added:** CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg, MB.	

EMCP Comment 80: DFO 15

80-DFO 15	**EA Reference:**	7.5.1.4 Potential Mortality (Nearshore) Page 7-60
Preamble:	Dewatering of the drydock will result in fish mortality, which is not included in the environmental effects assessment. During dewatering it is likely that fish will be stranded within the drydock area. Prior to dewatering, fish should be removed from the isolated drydock area and be relocated to a predetermined location within the nearby marine environment.	
Request **7-Sep-10**	a) Provide details of a fish recovery and relocation program. b) Fish mortality should be included as a potential environmental effect within the environmental effects assessment (text and tables). c) Make reference to the fish recovery and relocation program in the applicable mitigations column in Table 7-11.	
EMCP Response **30-Nov-10**	a) An environmental Protection Plan for Bull Arm is under development. The Plan will include a fish recovery and relocation program. The CSR will reference the EPP, specifically the relocation program as a mitigation for potential effects on fish for the dewatering of the dry dock. b) **Section 7.5.1.1 will include the following new text:** During the dewatering of the dry dock, a fish recovery and relocation program which will be included as part of the Environment Protection Plan (in progress) will be initiated. The goal of the program is to remove fish which would be stranded as a result of the dry dock dewatering and relocate them to the nearby marine environment. It is acknowledged that while every reasonable effort will be made to recover and relocate the stranded fish, a certain degree of fish mortality may occur. Note: during the construction of the Hibernia GBS, fish were not present within the drydock when it was dewatered. c) Table 7-11 updated to include the mitigation strategy Fish Recovery and Relocation Program	

EMCP Comment 81: EC 35

81-EC 35	**EA Reference:**:	Section 7.5.1.4 Potential Mortality Page 7-62, Table 7-11 – Environmental Effects Assessment: Construction and Installation
Preamble:	The selection of a suitable disposal site is an important aspect of effects mitigation. Another area of concern is raised by the presence of construction debris found during the 2005 survey of the berm disposal site.	
Request **7-Sep-10**	Proper disposal site selection should be included in Table 7-11 in association with these activities: 1) Dredging of Bund Wall and Possibly Sections of Tow-out Route; and, 2) removal of Bund Wall and Disposal. Removal of construction debris should be added to the list of mitigations in Table 7-11 under the activity “Removal of Bund Wall and Disposal”. <u>Typos</u> Table 2-2: Page 2-1 Well Treatment Fluids – under Attributes “fluids” is misspelled. Pages 10-60 and 10-61: Reference is made to Sections 10.5.1.5 and 10.5.1.6. The last section numbered in this sequence of Section 10 is 10.5.1.4. <u>References</u> Page 18-2. The citation is incorrect for AMEC Earth and Environmental Limited (2005a). The study was prepared for Environment Canada.	

EMCP Response 30-Nov-10	Table 7 will be revised to include new activities. The suggested edits / typo corrections will be made to the text.

EMCP Comment 82: EC 37

82-EC 37	**EA Reference:**:	Project Overview, and Section 7.5.2.2 Change in Habitat Quality Page 7-67
Preamble:	In the Project Overview the text states "and synthetic-based mud will be re-injected into the formation." This is better than regulated practice (NEB Offshore Waste Treatment Guidelines), and ExxonMobil Canada Properties should receive recognition and encouragement for this pollution prevention measure. However, this is not mentioned in Section 7.5.2.2 (starting on page 7-67), nor in Table 7.12 (starting on page 7-72). but should be discussed at these locations. Re-injection of SBM drill cuttings is feasible and important, as stated in Section 7.5.5.2 at page 7-84, paragraph 3, quoted here in full "At Hibernia, partial re-injection of SBM drill cuttings commenced in March 2000; full re-injection capacity began in September 2002. In the 2002 EEM field study, a substantial reduction in hydrocarbon concentrations in sediment was already observed."	
Request 7-Sep-10	Section 5.3.4.1, bullet 3 of the Scoping Document clearly states that the EA will consider discharges and emissions including "means for reduction re-use and recovery of wastes beyond those specified in regulations and guidelines". Re-injection of synthetic-based mud cuttings needs to be discussed in section 7.5.2.2.	
EMCP Response 30-Nov-10	**The second paragraph of Drilling Discharges Page 7-68 (Section 7.5.2.2) will be revised as follows:** SBM cutting reinjection will be undertaken for Platform drilling as a means of waste reduction. SBM cutting reinjection is not technically feasible for MODU drilling and SBMs will be discharged overboard after treatment in accordance with the OWTG. These estimates are based on preliminary analyses which will be updated during FEED and detailed engineering phases. Thicknesses of at least 1 cm are generally confined to within about 50 to 60 m of the GBS. These cuttings near the GBS are almost exclusively the fast-settling pebbles and sand (a very small percentage of the fines will drift for a time and ultimately settle near the GBS) whereas at distances greater than about 50 to 200 m, the deposits will be exclusively fines (see AMEC 2010a).	
Follow-up Comment 28-Jan-11	The response should be clarified as follows: "SBM cutting reinjection is not technically feasible for MODU drilling and SBM cuttings will be discharged overboard after treatment in accordance with the OWTG.	
EMCP Response 18-Mar-11	Noted. Text will be revised	

EMCP Comment 83: C-NLOPB 26

83-C-NLOPB 26	**EA Reference:**	Section 7.5.2.2 Page 7-70. final paragraph
Preamble:	The paragraph begins "All liquid discharges will adhere to the OWTG discharge limits and are subject to an Offshore Chemical Management System screening." OCMS screening typically is applied to chemicals/substances that are planned for use by an operator, most commonly as either drilling fluid or process chemical ingredients. It has not generally been used to characterize whole discharges (e.g., black or grey water, cooling water).	

Request **7-Sep-10**	The statement should be reconsidered and modified as necessary.
EMCP Response **30-Nov-10**	**The Statement will be revised to read as:** All liquid wastes discharges from the Hebron Project drilling and production operations will be discharged in accordance with the OWTG.
Follow-up Comment **28-Jan-11**	It may be better if, at the noted location and in addition to the OWTG reference, the reader was directed back to discussion in the appropriate sections for each discharge.
EMCP Response **18-Mar-11**	Noted. The CSR will be updated to provide cross references to appropriate sections.

EMCP Comment 84: C-NLOPB 27

84-C-NLOPB 27	**EA Reference:**	Section 7.5.2.4 Page 7-72, paragraph 2
Preamble:	The paragraph states that "Due to a larger average size and discharge rate, SBM cuttings stay closer to the well site and do not disperse as widely as WBMs and cuttings."	
Request **7-Sep-10**	The statement should be referenced, and re-evaluated to determine whether it likely is consistent with the fate of SBM cuttings treated and discharged consistent with the 2002 Offshore Waste Treatment Guidelines (e.g., from a "cuttings dryer").	
EMCP Response **30-Nov-10**	A reference associated with the statement would be CAPP (2001). **The following additional information is provided for further clarification of the above statement:** SBM cuttings do not tend to disperse like WBM cuttings do unless the fluid retention values are below 5 percent (CAPP 2001). Due to the fact that SBM related particles are not water miscible, they tend to aggregate, resulting in rapid fall velocities (CAPP 2001). Due to the rapid fall velocity, SBMs tend to fall through the water column faster, be deposited in smaller areas, and to accumulate in higher concentrations near the discharge point than would WBM cuttings (CAPP 2001). Fine suspended solids associated with WBMs are not trapped in agglomerations like fines associated with SBMs (CAPP 2001). This allows these WBMs fines to disperse in the marine environment and travel farther than fines in SBMs before contacting the seabed (CAPP 2001). The discharge of SBMs cuttings will be in accordance with the OWTG (2002).	
Follow-up Comment **28-Jan-11**	The response relies heavily upon the CAPP (2001) reference. CAPP (2001) originally was prepared in 1999-2000 as a submission to the review of the 1996 Offshore Waste Treatment Guidelines. Given that cuttings dryers were in limited use at that time, it is not entirely clear that the statements in CAPP 2001 corresponded to lower synthetic-on-cuttings values. The response should be re-examined.	
EMCP Response **18-Mar-11**	This response has been reviewed and is considered appropriate. Additional citations are provided that support the information and statements contained within our original response. SBM cuttings do not tend to disperse like WBM cuttings unless the fluid retention values are below five percent (Getliff *et al.* 1997; CAPP 2001). Due to the fact that SBM-related particles are not water miscible, they tend to aggregate, resulting in rapid fall velocities (CAPP 2001). Due to the rapid fall velocity, SBMs tend to fall through the water column faster, be deposited in smaller areas and to accumulate in higher concentrations near the discharge point than would WBM cuttings (CAPP 2001; Sayle	

	et al. 2002; CSA 2004; JWSL 2009). Fine suspended solids associated with WBMs are not trapped in agglomerations like fines associated with SBMs (CAPP 2001). This allows these WBMs fines to disperse in the marine environment and travel farther than fines in SBMs before contacting the seabed (CAPP 2001; Sayle *et al.* 2002; JWSL 2009). For MODU-based drilling, the discharge of SBM cuttings will be in accordance with the OWTG (NEB *et al.* 2010). **The following references will be added:** JWSL (Jacques Whitford Stantec Limited). 2009. *Cuttings Treatment Technology Evaluation*. Environmental Studies Research Funds Report (ESRF), No. 166. St. John's, NL. 100 pp. S. Sayle, M. Seymour and E. Hickey. 2001 (SPE). *Assessment of Environmental Impacts from Drilling Muds and Cuttings Disposal, Offshore Brunei*. CSA International Inc. 2004. *Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program*. Getliff, J., A. Roach, J. Toyo and J. Carpenter. 1997. *An Overview of the Environmental Benefits of LAO Based Drilling Fluids for Offshore Drilling*. Report from Schlumberger Dowell. 10 pp.

Comment 85: C-NLOPB 28

85-C-NLOPB 28	**EA Reference:**	Section 7.5.4.2 Page 7-78, final paragraph
Preamble:	The paragraph states that "Given the potential spill scenarios within the Nearshore and Offshore Study Areas. There is more potential for diesel to interact with the benthic community than crude oil."	
Request **7-Sep-10**	The statement should be justified and/or referenced.	
EMCP Response **24-Feb-11**	**This statement will be deleted.**	

2.7 Response to Section 8 Comments

EMCP Comment 86: HC 4

86-HC 4	**EA Reference:**	Section 8 Commercial Fisheries Page 8-1
Preamble:	Re: Recreational Fisheries The Scoping Document indicates that traditional, existing and potential commercial, recreational and subsistence fishing will be described. Scoping Document Table of Concordance indicates that this has been addressed in Section 8.3 of the Comprehensive Study. There was no discussion about traditional, recreational or subsistence fisheries in this section. Health Canada provides advice with respect to the ingestion of contaminated 'country foods', also known as traditional foods, which includes those foods trapped, fished, hunted, harvested or grown for subsistence or medicinal purposes, or obtained from recreational activities such as sport fishing and/or game hunting. Country foods do not include foods produced in commercial operations (*e.g.*, large farms, greenhouses).	
Request **7-Sep-10**	Please provide a discussion about traditional, recreational and subsistence fisheries in the nearshore and offshore areas and whether or not they may be adversely impacted as a result of project activities.	
EMCP Response **30-Nov-10**	**The following text will be added to Section 8:** **Nearshore** **Recreational and Subsistence Fisheries**. Nearshore Project Area fish harvesters and other local area industry experts stated that, other than the annual food fishery for cod, there are no other known or known potential recreational or subsistence fisheries in the Nearshore Project Area. This cod fishery has been limited to a few days a year, as determined by DFO and this is not expected to change during the life of the nearshore project components. **The following text will be added to Section 8:** **Offshore** **Recreational and Subsistence Fisheries**. There has been no subsistence or recreational fisheries in the Offshore Project Area. **The following text will be added to Sections 18.1 (Personal Communications) and 18.2 (References):** Len Knight, Area Chief, Resource Management, Fisheries and Oceans Canada, Eastern Newfoundland Larry Yetman, Resource Management Officer, Fisheries and Oceans Canada, Fisheries and Aquaculture Management Branch Derwin Temple, Nearshore Project Area Fisher, Sunnyside Clayton Warren, Nearshore Project Area Fisher, Chapel Arm Robyn Saunders, Petroleum Industry Liaison Keith Sullivan, Biologist / Market Analyst Bob Warren, Nalcor Fisheries Liaison Consultant, Chance Cove Brodie, W. 2005. A description of the autumn multispecies surveys in SA2 + Divisions 3KLMNO from 1995 – 2004. *NAFO Science Council Research Document*, 05/8. DFO (Fisheries and Oceans Canada). 2009. *Fishing for Data: The Multi-Species Survey*. Available at URL: http://www.dfo-mpo.gc.ca/science/Publications/article/2008/02-07-2008-eng.htm. Husky Energy. 2010. *Commercial Fisheries Risk Assessment for White Rose Field Area Assets*.	

EMCP Comment 87: DFO 19

87-DFO 19	**EA Reference:**	Section 8 – Commercial Fisheries Page 8-1
Preamble:	Scoping document requires CSR to provide a description of fisheries in Study Areas (including traditional, existing and potential commercial, recreational and subsistence). However, this section only identifies traditional and existing key species fisheries of significant value in the study areas.	
Request **7-Sep-10**	a) Study report to include potential commercial, recreational and subsistence fisheries. b) If not included, explain why.	
EMCP **Response** **30-Nov-10**	**The following text will be added to Section 8:** **Nearshore** ***Potential Commercial Fisheries***. The greatest potential for commercial fisheries in the future is a return of groundfish harvesting to levels approaching those of the past (for example, in the late 1980s cod harvesting in Trinity Bay (*i.e.*, Unit Area 3Lb) was an average of 7,774 tonnes a year (1986 to 1990), compared to the recent average (2004 to 2008) of 303 tonnes. However, a return of these quotas to such levels, or any significant increase in quota, is not likely during the timeframe of the nearshore project activities. In terms of other future commercial species, the FFAW marketing analyst was not aware of any new species with the potential to develop into a commercially harvested fishery. He noted that currently known species such as sea cucumber and whelk might be harvested in Trinity Bay in future. The Union's O&G Co-ordinator was not aware of any DFO or industry research designed to identify future commercially harvested species, and noted that the FFAW has not undertaken any research of this nature. DFO's Area Chief, Resource Management - Eastern Newfoundland, was not aware of any new potential species in the area that might qualify as an "emerging" commercial species, though, as noted above, whelk is one possibility for an increase in Trinity Bay. It was noted that billfish (also called Atlantic saury) are known to inhabit nearshore coastal areas and there have been incidental catches of this species in capelin and herring traps in Trinity Bay, and other inshore areas. Similarly, the Resource Management Officer of DFO's Fisheries and Aquaculture Management Branch was not aware of any emerging species or any fishery with the potential to be developed on a commercial basis. Nearshore Project Area fish harvesters and community-based industry experts were also contacted. The Newfoundland and Labrador Energy Corporation (Nalcor) Fisheries Consultant (formerly a full-time Project Area fisher) did not know of any underutilized species in the area other than whelk and sea urchins. Some Project Area fishers hold whelk licences but this species has not yet been fished extensively. Sea urchins have been harvested in the past but not for the last several years due to unfavourable market conditions and low prices. He noted that one Project Area fisher has been harvesting eels in the fall for the past few years. The Chair of the Sunnyside Fisher Committee notes that there are some signs of whelk, sea cucumbers and billfish in the areas in which he fishes, but none of these species are of commercial interest at the present. The Chair of the Norman's Cove – Chapel Arm Fisher Committee notes that, in the past, whelk have been harvested in parts of Trinity Bay, mostly in water depths greater than 100 fathoms (approx. 200 m). He notes that some of Project Area fishers hold whelk licences but so far this species has not been fished to any significant extent because fishers have not had to pursue this fishery in order to make their annual fishing income. Billfish have been fished in the past using traps, but price and market conditions were not sufficient to sustain this effort and it did not "take off". In the past, kelp laden with herring roe has been harvested after the annual herring spawn on grounds near Long Cove and Bellevue. Another species – known locally as "sea cats" – was harvested some years ago. This	

	species was apparently harvested for research purposes because it was said to contain a chemical similar to antifreeze. **The following text will be added to Section 8:** **Offshore** ***Potential Commercial Fisheries***. As with the Nearshore Project Area, the most likely new future fishery – from the perspective of current harvesting – is a return of groundfish harvesting, particularly cod and American plaice, though when this might happen is not known. DFO managers consulted noted that plaice stocks still have a long way to go before they were at a level where they could be harvested on a commercial basis. For other potential future fisheries there is very little information available. DFO conducts annual stratified random multi-species trawl surveys during the spring and autumn in the Newfoundland and Labrador Region (Brodie 2005; DFO 2009). One of the main objectives of these surveys is to determine the distribution and abundance of various groundfish and shellfish species. A recent study dealing with the potential effects of various types of fishing gears on sub-sea installations (Husky Energy 2010) identified an abundance of sand lance in the 3Lt region. These findings, based on an analysis of DFO research survey data from 2002 to 2008, might indicate some future commercial potential for this species. The same study indicated the presence of eelpout which, given the relatively large individual body sizes of this species, might make it attractive to commercial harvesters at some point in the future. Commenting on the potential for the commercial exploitation of eelpout, DFO managers agreed that this might be a possibility in the long term, but pointed out that other sources of marine protein would likely be explored before this species was used. Please refer to response to EMCP Comment 86: HC 4 for discussion on recreational fisheries.

EMCP Comment 88: DFO 20

88-DFO 20	**EA Reference:**	Section 8 – Commercial Fisheries Page 8-1
Preamble:	Scoping document requires CSR to detail traditional historical fishing activity – abundance data for certain species in this area, prior to the severe decline of many fish species (e.g., an overview of survey results and fishing patterns in the survey areas for the last 20 years). While there is some landings and value data presented as well as harvesting locations, theses are limited to the last 3-6 years.	
Request **7-Sep-10**	Please provide an overview of survey results and fishing patterns in the survey areas for the last 20 years	
EMCP Response **30-Nov-10**	**The following will be added before existing Section 8.1.3.4 (the section s following have been renumbered accordingly), within the nearshore fisheries section.** **8.1.3.4 Historical Overview of Regional Fisheries (Trinity Bay)** The fisheries in Trinity Bay have changed significantly since the mid to late 1980s, as the following graph (Figure 8-X) shows. This is largely the result of the collapse of several commercially important groundfish species stocks in the early 1990s and the subsequent declaration of a harvesting moratorium in 1992, virtually ending the directed fisheries for cod and some other species in most waters off Newfoundland and Labrador. From 1990 to its low point in 1996, the Trinity Bay (Unit Area 3Lb) cod harvest fell from 11,475 tonnes to under 75 tonnes, a drop of more than 99 percent. Similar relative levels of decline occurred in the Trinity Bay greysole flounder and turbot fisheries.	

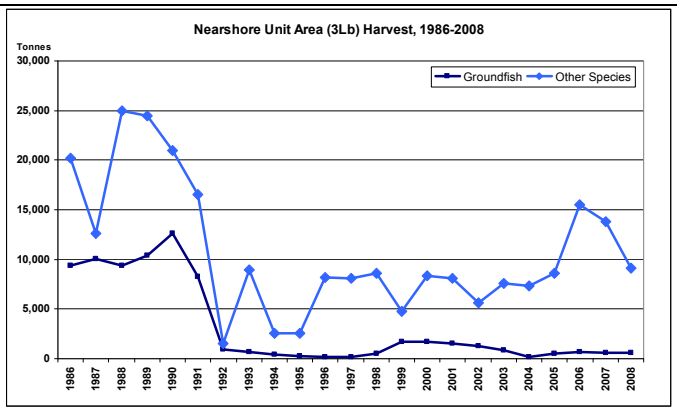


Figure 8-X Nearshore Unit Area (3Lb) Harvest, 1986 to 2008

The virtual disappearance of groundfish fisheries generated an increasing interest in and reliance on other species, mainly snow crab in this area. Between 1990 and its high point in 1995, the snow crab harvest in Trinity Bay increased by more than 200 percent, from 535 tonnes to 1,635 tonnes. Squid, capelin, herring and mackerel have continued to be the other principal fisheries (in terms of quantity) through this period, though landings have varied considerably from year to year depending on markets and resource availability.

Landings for individual species of significance in Trinity Bay for the 20-year period from 1989 to 2008 are illustrated in Figures 8-X to 8-X.

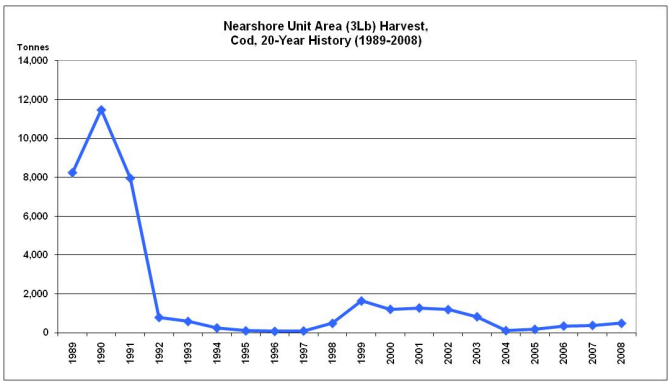


Figure 8-X Nearshore Unit Area (3Lb) Harvest, Cod, 20-year History (1989 to 2008)

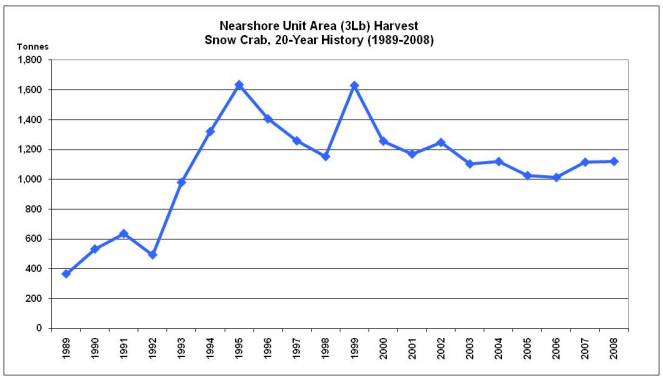


Figure 8-X Nearshore Unit Area (3Lb) Harvest, Snow Crab, 20-year History (1989 to 2008)

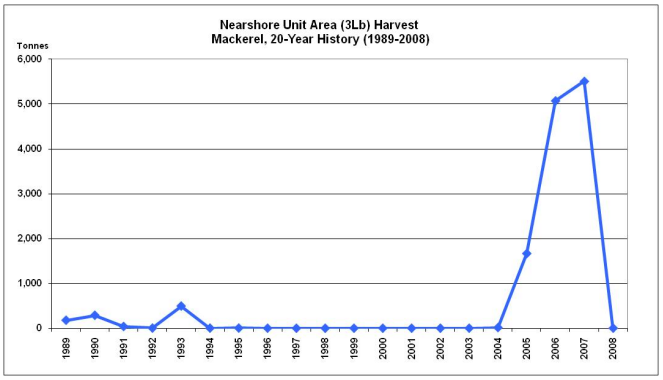


Figure 8-X Nearshore Unit Area (3Lb) Harvest, Mackerel, 20-year History (1989 to 2008)

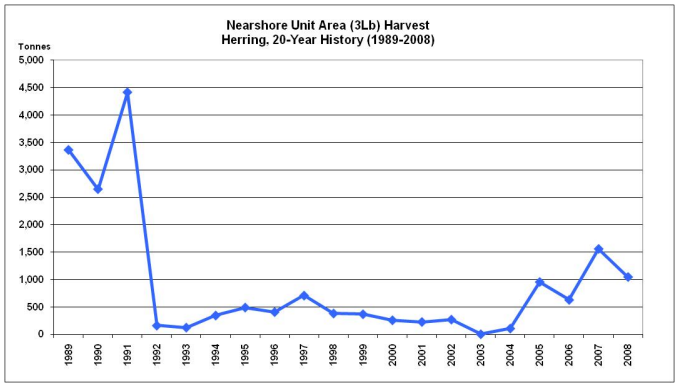


Figure 8-X Nearshore Unit Area (3Lb) Harvest, Herring, 20-year History (1989 to 2008)

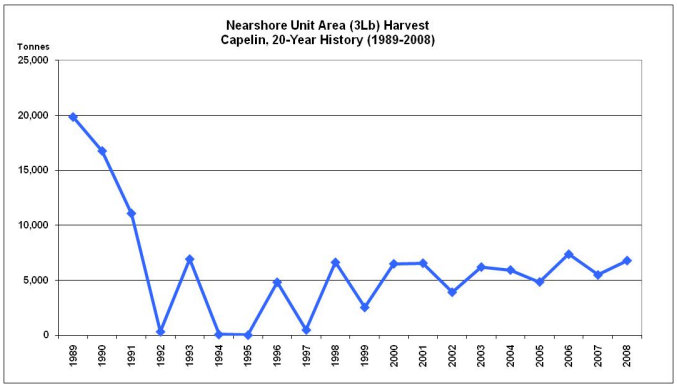


Figure 8-X Nearshore Unit Area (3Lb) Harvest, Capelin, 20-year History (1989 to 2008)

EMCP Comment 89: DFO 21

89-DFO 21	**EA Reference:**	Section 8 – Commercial Fisheries Page 8-1
Preamble:	Scoping document requires CSR to demonstrate consideration of underutilized species that may be found in the study area as determined by analyses of past DFO research surveys and Industry GEAC survey data, with emphasis on those species being considered for future potential fishers, and species under moratoria. This is not evident in the CSR.	

Request 7-Sep-10	Demonstrate consideration of underutilized species that may be found in the study areas as determined by analyses of past DFO research surveys and Industry GEAC survey data, with emphasis on those species being considered for future potential fishers, and species under moratoria.
EMCP Response 30-Nov-10	DFO trawl surveys are included in response to EMCP Comment 87: DFO 19.

EMCP Comment 90: DFO 22

90-DFO 22	**EA Reference:**	Section 8 – Commercial Fisheries Page 8-1
Preamble:	Scoping document requires CSR to detail program(s) for compensation of affected parties, including fisheries interests, for accidental damage resulting from project activities. While a Fisheries Compensation Plan will be established, it only states that the plan will be developed based on existing practice and industry-based guidance.	
Request 7-Sep-10	a) Identify what the plan will compensate and to whom. That is, who would be an "affected party" and if the plan will include compensation for accidental damage or other negative effect resulting from project activities. b) Although the plan is not yet developed, a summary of "existing practice" and industry-based guidance should be included.	
EMCP Response 30-Nov-10	EMCP is in the early stages of developing a Bull Arm fisheries agreement, which will be similar to the agreement in place during the construction of the Hibernia GBS. Elements of the Agreement may include communication protocols, vessel traffic management procedures and compensation to fishers directly affected by Project Activities during the construction of the GBS. Compensation for any accidental releases at Bull Arm will be captured in the oil spill response plan, which is under development. Project Area fishers sustaining gear or vessel damage as a result of contact with Project Activities will be compensated for any such demonstrated economic loss where it is directly attributable to Project activities. The principles and procedures for calculating and paying Project-related gear and vessel damage claims will be similar to those contained in existing programs such as those used by operators involved in offshore exploration activities (*e.g.*, seismic surveys). For accidental events in the offshore area, a compensation plan will adhere to the Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity (C-NLOPB and CNSOPB, 2002) and CAPP guidance "Canadian East Coast Offshore Operators Non-attributable Fisheries Damage Compensation Program" (2007). With respect to the offshore: In addition, under the Atlantic Accord Acts, Section 160, "actual loss or damage" is defined as including "loss of income, including future income, and, with respect to any aboriginal peoples of Canada, includes loss of hunting, fishing and gathering opportunities." Section 162 states that claims can be made for "all actual loss or damage incurred by any person as a result of the spill or the authorized discharge, emission or escape of petroleum" as well as for actual loss or damage and all such costs or expenses resulting from the escape of debris.	
Follow-up Comment 28-Jan-11	The response is considered adequate, provided that it is included within the CSR.	
EMCP Response 18-Mar-11	Noted.	

EMCP Comment 91: DFO 18

91-DFO 18	**EA Reference:**	Section 8.4.2 Potential Interactions (and Impact Pathways) Table 8-14 Potential Project-related Interactions with Commercial Fisheries Page 8-45
Preamble:	Section 5.3.3.3 requests that the environmental effects of the project fisheries be discussed. Section 8.4.1.1 indicates that fishers are concerned about effects of construction-related noise and light on fish behaviour in the nearshore however, lighting is not indicated as having a potential effect in Table 8-14 or included in Section 8.5 Environmental Effects Analysis and Mitigation.	
Request **7-Sep-10**	Please revise Table 8.14 and Section 8.5 to include the potential for lighting to affect fisheries.	
EMCP Response **30-Nov-10**	The effects of construction-related noise and light on fish behaviour in the nearshore are described in the Fish and Fish Habitat Section, Section 7.5.1.3 (and is included in Table 7-9)	

EMCP Comment 92: DFO 23

92-DFO 23	**EA Reference**	Section 8.5.1.1 Nearshore (Mitigations) Page 8-51
Preamble:	Section 5.3.3.2 of the scoping document request that the means by which adverse effects upon marine use may be mitigated through design or operation procedures. List below are operational regulations and procedures regarding the movement of vessel traffic inshore and offshore.	
Request **7-Sep-10**	This section should be revised to include the following mitigations: • All vessel traffic to be made aware of the provisions of the Eastern Canada Traffic Zone Regulations (ECAREG) and inshore High Level Traffic Zone practices and procedures. • All parties provide Canadian Coast Guard with required information for issuance of Notices to Shipping and Notices to Mariners in a timely manner. • Private floating and fixed Aids to Navigation be established in Trinity Bay approaches to Bull Arm. See below The following Aids to Navigation are recommended by Superintendent, Aids to Navigation, NL Region. 1. Floating aid identified as Bowers Ledge (TBU) North Cardinal Buoy with RACON. 2. Floating aid identified as Temples Knob (TB2) Starboard Hand Light Buoy 3. Floating Aid identified as Stanton Point (TB4) Starboard Hand Light Buoy 4. Floating Aid identified as The Hoof Port Hand Buoy 5. Fixed Aid – a sector light recommended at Ram Head. Item 4, The Hoof port hand buoy is already in place as a private AtoN. A tower is also in place to accommodate a sector light, item 5. Coast Guard would place, maintain and retrieve Aids on a cost-recovery basis from the project proponent.	
EMCP Response **30-Nov-10**	Advice noted; the Project will be looking at all vessel traffic and navigation aids requirements, related to both floating and fixed aids to navigation, as recommended by the Superintendent, Aids to Navigation.	

EMCP Comment 93: DFO 24

93-DFO 24	**EA Reference::**	Section 8.5.1.2 Offshore, Mitigations Page 8-53
Preamble:	Clarification of procedures is required regarding – Notice to shipping, Not mariners, Notice to Fish Harvesters.	
Request **7-Sep-10**	Please revise this section accordingly. Canadian Coast Guard will issue Notices to Shipping based on waterway conditions, exploration activities, or other short term operations. Notices to Mariners are written notices, usually based on a broadcast Notice to Shipping and also promulgated by the Canadian Coast Guard dealing with situations over three (3) weeks in duration. Notices to Shipping are broadcast by MF radio and Navtex and by VHF on the Continuous Marine Broadcast (CMB) while they are in force. Notices to Mariners are promulgated by written copy on a monthly basis. Notices to Fish Harvesters are promulgated by DFO Resource Management Branch. They are also broadcast by Coast Guard MCTS Centres on MF and on the CMB for a period of 24 hours. DFO also sends Notices to Fish Harvesters to CBC Radio for inclusion on the Fisheries Broadcast.	
EMCP **Response** **30-Nov-10**	**Point 2 in Section 8.5.1.2 2 will be revised as follows:** Relevant information about marine operations outside Safety Zones will also be publicized, when appropriate, using established communications mechanisms, such as the Notices to Shipping (Continuous Marine Broadcast and NavTex) and CBC Radio's (Newfoundland and Labrador) Fisheries Broadcast.	

EMCP Comment 94: C-NLOPB 29

94-C-NLOPB 29	**EA Reference:**	Section 8.5.3.1 Page 8-56, paragraph 2
Preamble:	The paragraph describes the difficulty in predicting, and possibly in quantifying, effects of an oil spill upon seafood market perceptions.	
Request **7-Sep-10**	The CSR should consider and describe whether any mitigation of, or response to, actual or potential market perception effects can be envisaged at the contingency planning stage.	
EMCP **Response** **30-Nov-10**	The Hebron Project is at the early stages of project development. Separate contingency plans will be developed for Bull Arm and offshore operations. Effective responses to mitigate market perceptions (publicizing the results of testing fish flesh for hydrocarbon presence or establishing taste panels to determine organoleptic effects) require that they be tailored to the specific circumstances of any actual spill and should consider such factors as the size and duration of the spill, the areas affected, the species affected, the time of year and clean-up or rehabilitation methods, as well as the type and characteristics of the markets (local or international, competing products). These factors will be considered in the development of the oil spill response plan for Bull Arm and the Offshore area.	
Follow-up Comment **28-Jan-11**	The response in the “Response to Review Comments” document is acceptable, however, it is not clear whether it will be inserted into the CSR, and if so, where.	
EMCP Response **18-Mar-11**	**The following text will be added to Section 8.5.3.1 of the CSR:** Effective responses to mitigate market perceptions (publicizing the results of testing fish flesh for hydrocarbon presence or establishing taste panels to determine organoleptic effects) require that they be tailored to the specific circumstances of any actual release and should consider such factors as the size and duration of the release, the areas affected, the species affected, the time of year and clean-up or rehabilitation methods, as well as the type and characteristics of the markets (local or	

	international, competing products). These factors are considered at the contingency planning stage.

2.8 Response to Section 9 Comments

EMCP Comment 95: EC 38

95-EC 38	**EA Reference:**:	Section 9.3.2.1 Data Sources and Survey Effort for Marine Birds in the Study Area Page 9-6
Preamble:	The following comments pertain to the clarity of the text for the above mentioned section and page of the CSR. Changes to text should be made as appropriate:	
Request **7-Sep-10**	It is not clear where the data come from and which data were used for the summaries that follow. The text should indicate that PIROP data were collected from 1984-1992, and ECSAS data from 2006-2009. Page 9-6 states "*Systematic marine bird observations (Tasker surveys; Tasker et al. 1984) were conducted on the northern Grand Banks and the adjacent Orphan Basin from 2004 to 2008.*". – CWS surveys were also systematic and also used the Tasker method. As currently written, it sounds as though this method is unique to these surveys. The text should be changed to clarify this. Page 9-6 also states "*Tasker surveys provide marine bird data as densities (numbers per km2). The offshore research and seismic-related cruises on which Tasker surveys and other marine bird observations were conducted are listed in Table 9-3. The geographic distribution of Tasker surveys in and around the Offshore Study Area is illustrated in Figure 9-4*." – to call these the Tasker surveys is misleading, as the other sources of data also come from survey methodology based on Tasker. Please remove "Tasker" from this description.	
EMCP Response **30-Nov-10**	On page 9-6, the change below will be made to indicate that the data shown in Figure 9-3 of the CSR includes PIROP data derived from seabird abundance maps, more specifically Figures 3.3, 3.7, 3.11, and 3.25 in Locke et al. (1994). Locke et al. (1994) does not include the specific years of data used to derive the seabird abundance maps so we cannot confirm the reviewer's comment that PIROP data were collected from 1984 to 1992. Figure 9-3 correctly indicates that the data shown are from Locke et al. (1994). Also, the change noted below clearly indicates that the ECSAS data include collected during 2006 to 2009 and that the systematic surveys were based on the Tasker method. "Tasker" was included in the description of the surveys conducted during seismic, CSEM, and research cruises to distinguish it from the PIROP survey type which provided estimates of number of birds per linear km vs. number of birds per square km. Rather than remove Tasker from the description on page 9-6, the changes made below acknowledge that the ECSAS data are also based on the Tasker method and allows for derivation of density estimates. **The following paragraph from draft CSR (page 9-6):** "Most of the information available up to 2000 was collected by the CWS through PIROP (Programme intégré de recherches sur les oiseaux pélagiques). Those data have been published for 1969 to 1983 (Brown 1986), and up to the early 1990s (Lock *et al.* 1994). In 2006, the CWS resumed surveying marine bird abundance and distribution and those recent data have become available (CWS 2009). The PIROP survey coverage within and around the Offshore Study Area is presented in Figure 9-3. PIROP marine bird data are of birds per linear kilometre. New survey protocols have been developed by CWS which permit the derivation of density estimates (Wilhelm *et al. in prep*.)." **Will be replaced with:** "Most of the information available up to 2000 was collected by the CWS through PIROP (Programme intégré de recherches sur les oiseaux pélagiques). Those data have been published for 1969 to 1983 (Brown 1986), and up to the early 1990s (Lock *et al.* 1994). The PIROP survey coverage within and around the Offshore Study Area	

	is presented in Figure 9-3, which is derived from maps in Lock et al. (1994). PIROP marine bird data are of birds per linear kilometre. In 2006, the CWS resumed surveying marine birds and those recent data have become available for the years 2006-2009 (CWS 2009). New survey protocols (see Wilhelm *et al.* in prep.) based on the Tasker survey method (Tasker *et al.* 1984) were used to collect these recent data, which allow for the derivation of density estimates.

EMCP Comment 96: EC 39

96-EC 39	**EA Reference:**:	Section 9.3.2.1 Data Sources and Survey Effort for Marine Birds in the Study Area Page 9-8, Table 9-3
Preamble:	Not clear from previous text section 9.3.2.1 which data this table is summarizing.	
Request **7-Sep-10**	Recommend adding a sentence in the Table heading to indicate sources of the data.	
EMCP Response **30-Nov-10**	Sources of data are included as footnotes to Table 9-3 (Sources: Lang and Moulton (2004, 2008); Moulton *et al.* (2005b, 2006b); Lang *et al.* (2006); Lang (2007); Abgrall *et al.* (2008a, 2008b, in prep.)).	

EMCP Comment 97: GF 7

97-GF 7	**EA Reference:**:	Section 9.3.2.2 General patterns of Marine Bird Occurrence in the Offshore Study Area Page 9-9
Preamble:	"*but generally in lower densities than on the shelf and slope; the deeper waters away from the shelf and slope are typically less productive*."	
Request **7-Sep-10**	Provide a reference for the sentence.	
EMCP Response **30-Nov-10**	**The following sentence will be deleted as it offers very little to the reader in the CSR contex**t: "However, a similar mix of species is expected to occur there, but generally in lower densities than on the shelf and slope; the deeper waters away from the shelf and slope are typically less productive."	

EMCP Comment 98: EC 40

98-EC 40	**EA Reference:**:	Section 9.3.2.2 General Patterns of Marine Bird Occurrence in the Offshore Study Area Page 9-10 and Table 9-4
Preamble:	The species and general monthly abundance expected on the Continental Shelf and slope waters of the Offshore Study Area are listed in Table 9-4.	
Request **7-Sep-10**	Sources of data listed at end of table do not cite CWS 2009, although was discussed in Section 9.3.2.1 as a data source. This source should be added. Murres are not scarce to uncommon on the Grand Banks according to CWS 2009. The survey results reported in CWS 2009 conducted from 2006-2009 indicate relatively high densities of murres year-round in the study area. The data show murres as common on the shelf during the non-breeding season, less common (but not scarce) during the breeding season. Brown 1986 also indicates relatively high densities for murres (*Uria spp*) in the study area during the non-breeding season (1-10 birds/km). Lock et al. 1994 also indicates relatively high densities of vulnerable species (Auks) in the study area. The densities of murres reported in the table should be changed as indicated.	

EMCP Response 30-Nov-10	**CWS (2009) will be added as a data source at the end of Table 9-4.** The presentation of seabird data in CWS (2009) does not permit a species-level assessment of relative abundance of murres, given that Common Murres and Thick-billed Murres are combined and Razorbill are grouped together with Atlantic Puffin, Black Guillemot and Unidentified Alcids. Although murres occur in low densities relative to species like Greater Shearwaters, it is agreed that the relative abundance status of Common and Thick-billed Murres should be increased and the following changes will be made to Table 9-4: • Common Murre and Thick-billed Murre will be combined into one group called Murre spp. • Murre spp. will be assigned "U-C" status for January, February, March, April, September, October, November and December; "S-U" status for May, June, July, and August • No changes are required for Razorbills

EMCP Comment 99: EC 41

99-EC 41	**EA Reference:**:	Section 9.3.2.4 Species Profiles Page 9-16, Table 9-6
Preamble:	There is an error in the number presented for Average Density of All Species from 5-8 November (458.7 is too high).	
Request 7-Sep-10	Please correct the number.	
EMCP Response 30-Nov-10	458.7 will be changed to 32.8.	

EMCP Comment 100: GF 8

100-GF 8	**EA Reference:**:	Section 9.3.2.4 Species Profiles Page 9-22
Preamble:	"*That number is low compared to the numbers of Leach's Storm Petrels seen from ships in the same area, and may have been a result of the tall height of observers off the water and the lack of persistent use of binoculars for scanning. Storm-Petrels are difficult to see because they are dark and fly very low over the water.*"	
Request 7-Sep-10	Should reference Ballie et al. 2005.	
EMCP Response 30-Nov-10	Baillie *et al.* 2005 will be added as the reference for these sentences.	

EMCP Comment 101: EC 42

101-EC 42	**EA Reference:**:	Section 9.3.2.4 Species Profiles Page 9-23 Pomarine Jaeger, Parasitic Jaeger and Long-tailed Jaeger
Preamble:	This section states: "…Like skuas, they are kleptoparasites, preying chiefly on Black-legged Kittiwakes and Arctic Terns."	
Request 7-Sep-10	The above sentence is misleading, however because they do not prey chiefly on kittiwakes and terns, but rather steal the prey of the kittiwakes and terns. Please rewrite this sentence.	

EMCP Response 30-Nov-10	**The following change will be made:** Sentence from draft CSR (page 9-23): "Like skuas, they are kleptoparasites, preying chiefly on Black-legged Kittiwakes and Arctic Terns." Change to: "Like skuas, they are kleptoparasites, primarily targeting the prey of Black-legged Kittiwakes and Arctic Terns."

EMCP Comment 102: GF 9

102-GF 9	**EA Reference:**:	Sections 9.4.1.1, 9.4.1.2, 9.4.1.3 Page 9-28
Preamble:	"*Lighting at night throughout the Project may attract marine birds, particularly the Leach's Storm-Petrel, which may strike vessels or platform infrastructure leading to injury, strandings, and mortality*."	
Request 7-Sep-10	Table 9-9, should identify mortality as source of effect from lighting as birds that hit structures can die (thus, infrastructure and lighting must both have mortality, not just infrastructure)**.**	
EMCP Response 30-Nov-10	As described in the CSR text, under certain conditions lights may attract some species of birds that then collide with the structures to suffer stranding or mortality. These events are not restricted to the offshore oil and gas industry but in general apply to most lighted structures on both land and sea. This issue has not been extensively studied in Newfoundland and Labrador waters with the possible exception of the bird standings' data collected on offshore seismic vessels. Based on these data, Leaches Storm-petrel is, by far, the most commonly involved species. Because this species spends most of its time in offshore waters, it is likely that most strandings involving this species would occur offshore. Table 9-9 will be amended to include potential mortality from lighting. As described in the CSR, EMCP will have a bird release program. Lighting is required for safety of personnel and safe navigation. The Project will evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected. Appropriate sections / text / tables of CSR will be updated to include this as a mitigation.	

EMCP Comment 103: C-NLOPB 30

103-C-NLOPB 30	**EA Reference:**	Section 9.4.2.4 Page 9-29
Preamble:	The paragraph states "An oil spill, although unlikely, could potentially occur. . ."	
Request 7-Sep-10	The reference to a spill being "unlikely" should be referenced or qualified or both.	
EMCP Response 30-Nov-10	The sentence will be revised as follows: An oil spill, although unlikely (See Section 14.1.4 for a summary of blowout and spill frequencies), could potentially occur during the construction, operation and maintenance, and/or decommissioning phases of the Project.	
Follow-up Comment 28-Jan-11	This response is not acceptable. The reference to a spill being "unlikely" presumably is intended to refer to large-volume spills and this distinction should be made clear. Experience indicates that small-volume spills cannot reasonably be considered unlikely. A word like unlikely must be qualified or bracketed (i.e. <10-3) and a term like spill must be bracketed (i.e. >10 litres). Spills will be reported on the C-NLOPB website and experience indicates that "small volume" spills are not unlikely. Words like "unlikely" will be seen in a much harsher light when reviewed in an operational context.	

	The CSR states, on page 14-13 "The C-NLOPB also provides a statistical record of spills of greater than 1 L but less than 1 barrel (159 L), and of spills of 1 L and less. These are presented in Table 14-13, but are not used for any predictive purpose." This issue is obviously not well understood by the proponent when statements like "an oil spill, although unlikely, could potentially occur" appear in the response to a question about the use of the term "unlikely" and data on spills <159 litres is deemed insignificant. The proponent should revisit 14-13 and make appropriate reference to data collected locally. From the CSR reported spill data 1997 to 2009: Spill size > 0 and < 1 litre = 213, Spill size ≥ 1 and <159 litres = 138 Spill size ≥ 159 but <999 litres = 19 Spills > 999 litres = 1 Total = 371 This number differs from the C-NLOPB published statistics. As well, the proponent seems to have excluded spills of synthetic based mud from some of the data. This is not appropriate as these are reported as spills of hydrocarbon and operators have been prosecuted for the discharge of synthetic based mud.
EMCP Response 18-Mar-11	**The text will be revised to read as:** "An oil spill could potentially occur…." Chapter 14 is being revised to address statistical inconsistencies.

EMCP Comment 104: EC 43

104-EC 43	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality Page 9-34 Lighting
Preamble:	There is very little information on the conditions favourable to bird strandings. More information of this type would be beneficial to our understanding of this phenomenon. CWS would like to see a commitment, not only to standardized searches and releases, but also to data collection regarding the meteorological and operational conditions experienced at the time of strandings.	
Request 7-Sep-10	Data regarding meteorological and operational conditions (*e.g.*, lighting, flares) should be collected and submitted to CWS along with all reports of strandings.	
EMCP Response 30-Nov-10	ExxonMobil Canada East, as part of its bird stranding and release program for Hebron, will adhere to the reporting requirements of the Bird Handling and Release Permit, as outlined in the "Report of "Live" Migratory Seabirds Salvaged Under The Authority of a Federal Migratory Bird Permit" form.	

EMCP Comment 105: GF 10

105-GF 10	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality, Offshore Lighting Page 9-36
Preamble:		
Request 7-Sep-10	Habitat quality can also be degraded for birds attracted to lights may be exposed to increased risk of predation by gulls.	
EMCP Response 30-Nov-10	Attraction to light and predation are more behavioural issues as opposed to habitat ones. Gulls do not normally feed at night (B. Mactavish, LGL, pers. comm.). If predation does occur, it is predicted to be relatively limited in scale, especially with a bird rescue program as mitigation, and captured within the CSR's prediction of mortality due to attraction to lights.	

EMCP Comment 106: C-NLOPB 31

106-C-NLOPB 31	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality, Offshore Lighting Page 9-36
Preamble:	"*Young-of the-year birds appear to be more susceptible to light attraction than are adults, but the extent of Storm-Petrel susceptibility is unclear*."	
Request **7-Sep-10**	Please provide the reference for this statement. Has the attraction issues associated with lighting and possible spectral mitigations been considered. Some relevant studies are: Marquenie, J., M. Donners, H. Pool, W. Steckel and B. de Wit. 2008 *Adapting the Spectral; Composition of Artificial Light To Safeguard the Environment*, as cited from Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications. 2008 Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand and J.M. Marquenic. 2008. *Green Light for Nocturnally Migrating Birds* as published in Ecology and Society 13(2):47 available at http://www.ecologyandsociety.org/vol13/iss2/art47/.	
EMCP Response **30-Nov-10**	**The sentence indicated in preamble will be replaced with the following:** "The largest Leach's Storm-petrel stranding events that have been recorded from seismic vessels in and near the Study Area have occurred at the time of year when the young have recently fledged (T. Lang, Biologist, LGL Limited, pers. comm., September 2010), but the extent of Storm-Petrel susceptibility is unclear. " The effects of lighting on birds was assessed and judged to be not significant. The references provided above and indeed which occur elsewhere, have focused primarily on passerines, which do not migrate through the Hebron Offshore Study Area. Regardless, there is potential for seabirds, particularly Leach's Storm-petrels, to be attracted to offshore lighting from the production installation as well as attending vessels. EMCP will investigate various lighting options as suggested in EMCP Comment 102-GF-9.	
Follow-up Comment **28-Jan-11**	This response is not acceptable concerning the discussion of spectral mitigation. The mitigations referred to (response to EMCP Comment 102) are not related to spectral mitigation. If EMCP does not want to consider spectral mitigation, they should answer "No" to the question asked. The proponent has discussed the non-applicability of the cited studies but has not proposed any alternative information. Was there absolutely nothing of relevance in the studies? Are there any alternative studies that might contain useful and relevant information? Has EMCP conducted a thorough literature review to determine that no research is available? If you have dismissed Poot *et al.* 2008, as a reference, why are you adding it in response to comment 107?	
EMCP Response **18-Mar-11**	EMCP has reviewed relevant literature regarding the spectral composition of lighting and bird attraction. There is some evidence that altering the spectral composition of lighting reduces the number of birds (primarily migrating passerines) attracted to lighted structures (*e.g.*, Poot *et al*. 2008). Other studies indicate that more research is required to develop evidence-based mitigation measures involving altering light signatures to minimize bird attraction (Rodríguez and Rodríguez 2009). The effects of lighting on seabirds was assessed and judged not significant. Available information on this topic is not conclusive, particularly for seabirds, therefore, EMCP has no plans to use spectral lighting. However, as indicated in our response to EMCP Comment 102: GF-9, EMCP committed to "evaluate use of shielding and deflectors with directional lighting to minimize attraction by lighting, and may incorporate such features where safety of operations and navigation are not affected."	

EMCP Comment 107: GF 12

107-GF 12	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality, Offshore Lighting Page 9-36
Preamble:	"*Other marine bird species, as well as migrating land birds, are also known to be attracted to lights on offshore oil and gas platforms at night, especially during foggy or overcast conditions. Birds could potentially injure themselves by flying into structures on the platform (Avery et al. 1978).*"	
Request **7-Sep-10**	Given that Dovekies are one of the most abundant species in the area at certain times of year, this discussion should be expanded to consider evidence from ships in Alaska of closely related Alcids flooding onto boats from lighting levels far lower than that of a platform (Dick and Donaldson 1978, Condor 80:235-236;) and specifically consider dovekies. Further, because Dovekies are highly vulnerable to oil pollution, a two-tiered effect should be considered here: birds attracted to the platform are more likely to experience oil pollution from discharges.	
EMCP Response **30-Nov-10**	While Dovekies were observed one time to circle the lighted Hibernia platform for hours (in Wiese *et al.* (2001)), EMCP is not aware of any large scale strandings or mortalities related to such events on the Grand Banks. There have been reports in other regions of mass strandings involving related species. For example, Dick and Donaldson (1978) interviewed the crew of an Alaskan crab fishing boat that experienced a mass collision with Crested Auklets (*Aethia cristatella*), a related species. It was estimated that about 1.5 tons of birds collided and landed on the brightly lit boat. The birds appeared to be disoriented by the bright overhead work deck lights although they only ran into the lower running lights because the birds were all flying close to the water. Poot *et al.* (2008) suggested using "bird friendly" green lights (as developed by Phillips) on offshore platforms in the North Sea to reduce or eliminate the disorientation to nocturnally migrating birds caused by white and red lights. However, it should be noted that the North Sea is not at all analogous to the Grand Banks in terms of numbers and types of species, distance to nearest land, and bird migration pathways. Routine platform discharges are not expected to produce sheens. Nonetheless, there has been a number of small petroleum spills on the Grand Banks (see Section 14 of the CSR). O'Hara and Morandin (2010) demonstrated that it only requires a small amount of oil (*e.g.*, 10 ml) to affect the feather structure of Common Murre and Dovekie. Such modifications to feather structure cause a loss of insulation, which in turn can result in mortality in the cold Northwest Atlantic environment. **The following references will be added:** Dick, M.H. and W. Donaldson. 1978. Fishing vessel endangered by Crested Auklet landings. *Condor*, 80: 235-236. O'Hara, P.D. and L.A. Morandin. 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. *Marine Pollution Bulletin*, 60: 672-278. Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenic. 2008. Green light for nocturnally migrating birds. *Ecology and Society*, 13(2): 47 available at http://www.ecologyandsociety.org/vol13/iss2/art47/.	

EMCP Comment 108: GF 13

108-GF 13	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality, Offshore Lighting Page 9-36
Preamble:	"*Foggy nights seem to attract more birds, and Leach's Storm-Petrels are more common in the Offshore Study Area during late summer to early fall*.**"**	
Request **7-Sep-10**	Given that data exist for: 1) the number of foggy nights the project will experience; 2) density of lesp in study area; and 3) past salvage information, a model should be developed to provide estimates of the number of birds which may be salvaged during the lifetime of the project (separate models for both development and production). Further, it should be noted that the salvage protocol and the past findings of the numbers of birds represents an underestimate of the number of birds effected by lighting as the salvage protocol only works for birds that hit and fall on the platform; it does not address birds that fall into the water.	
EMCP Response **30-Nov-10**	As described in the CSR, EMCP will have a bird stranding and release program. There are likely insufficient data and too many variables regarding this issue to produce a worthwhile model to determine the number of birds that may be salvaged. As noted above (see response to EMCP Comment 102-GF 9), local bird stranding data have been collected by marine mammal and seabird observers on seismic vessels that typically operate within a window of May to October. The numbers of stranding have been highly variable from a few birds to hundreds of storm-petrels. Some ships may have increased mortalities caused more from oily and or hidden crevices where stranded birds seek shelter and are not discovered in time to release alive, as opposed to simple attraction to light (T. Lang, Biologist, LGL Limited, pers. comm., September 2010). Most stranded petrels are released alive using CWS protocols.	
Follow-up Comment **20-Apr-11**	**(Refer to the November 26, 2010 EMCP response)** The proponent uses data from seismic surveys to support several of their responses regarding issue of attraction to light/flares. These data (e.g., T. Lang personal communication) should be summarized and presented in the EA (at the very least as an appendix), or the reports with the data should be readily available to the public (e.g., on C-NLOPB's website). Then when the proponent uses a phrase such as "large scale stranding" the public may have some understanding as to the scale at which they are referring (e.g., what constitutes a large scale stranding).	
EMCP Response **17-Jun-11**	The stranding data from the various seismic programs are typically included in the marine mammal observer reports submitted to the C-NLOPB and the bird data are submitted to CWS as a requirement under the Migratory Bird Handling Permit. These raw data, to date, have not been analyzed and formally reported either through scientific literature or government agency websites. Without formally analyzing the raw data, the following is a summary of observations taken during seismic programs. To date, the bird strandings in the Newfoundland offshore have been almost entirely Leach's Storm-Petrels. This is not surprising, given the huge numbers of this species in these waters, coupled with their relative inability to become airborne after landing on a ship or platform. Numbers of strandings per-day on seismic vessels have ranged from zero early in the season to tens of birds, mostly late in the season after fledging. On a Grand Banks seismic vessel, tens of birds in one night can be considered a "large scale stranding". The largest single stranding event observed by biologists on seismic vessels was 46 birds, all of which were released alive (LGL Limited, unpublished data). Monitoring of pelagic seabirds stranded (presumably due to light attraction) on board seismic vessels has been conducted by biologists during 14 seismic programs from 2004 to 2010 off both Newfoundland and Labrador. Seismic programs were initiated as early as 7 May and terminated as late as 8 November; however, most were	

	conducted during some portion of the months of June to September. In total, 758 nights were monitored during these seismic programs. The number of nights per week with strandings and the number of individuals stranded per night was greatest from late August to mid-October. This period coincides with the fledging of Leach's Storm-Petrels from Newfoundland colonies. Young of this species fledge from Great Island (Witless Bay), Newfoundland, as early as 10 September, but the majority fledges from mid-September to late October (Huntington *et al.* 1996). The mean fledging date is 25 September. In other areas of the North Atlantic, juveniles also account for most strandings of Leach's Storm-Petrels. For example, near a Leach's Storm-Petrel colony off Scotland, juveniles make up the large majority of birds stranded due to light attraction (Miles *et al.* 2010). However, in wintering areas, adults may also strand because of light attraction (Rodríguez and Rodríguez 2009). Visibility during nights when storm-petrels stranded on seismic vessels off Newfoundland and Labrador was usually reduced due to fog, rain or overcast conditions. This has been documented among other seabird species (Telfer *et al.* 1987; Black 2005). Strandings have also been noted to peak around the time of the new moon (*i.e.*, when moonlight levels are lowest (Telfer *et al.* 1987; Rodríguez and Rodríguez 2009; Miles *et al.* 2010)). The mitigation of releasing birds by experienced environmental observers, according to CWS protocols established by CWS and offshore operators, appears to reduce mortality to a few birds per seismic vessel per season. The reviewer is also referred to the November 2010 responses by EMCP to EMCP Comments 107: GF 12; 108: GF13; 111: GF16; 112: GF17; and 113: GF18. References Black, A. 2005. Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. *Antarctic Science*, 17: 67-68. Huntington, C.E., R.G. Butler and R.A. Mauck. 1996. Leach's Storm-Petrel (*Oceanodroma leucorhoa*). In: A. Poole and F. Gill (eds.). *The Birds of North America*, No. 233, The Academy of Natural Sciences and The American Ornithologists' Union. Philadelphia, PA, and Washington, DC. 32 pp. Miles, W., S. Money, R. Luxmoore and R. W. Furness. 2010. Effects of artificial lights and moonlight on petrels at St Kilda. *Bird Study*, 57: 244-251. Rodríguez, A. and B. Rodríguez. 2009. Attraction of petrels to artificial lights in the Canary Islands: effects of the moon phase and age class. *Ibis*, 151: 299-310. Telfer, T.C., J.L. Sincock, G.V. Byrd and J.R. Reed. 1987. Attraction of Hawaiian seabirds to lights: Conservation efforts and effects of moon phase. *Wildlife Society Bulletin*, 15: 406-413.

EMCP Comment 109: GF 14

109-GF 14	**EA Reference:**:	Section 9.5.1.2 Change in Habitat Quality, Offshore Lighting Page 9-37
Preamble:	"*EMCP will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999; Husky Energy 2008).*"	
Request **7-Sep-10**	Given that a new platform is being built, why not instead be at the forefront of new lighting technologies, which may reduce the need to recover birds? Such as shielding lights, changing light signature pattern, not having lights projected outwards (See Poot et al. 2008, Ecology and Society 13:47; Baccetti, N., Sposimo, P. & Giannini, F. 2005. Avocetta 29: 89-91; Rodriguez and Rodriguez 2009 Ibis 151:299). Workers should be required to cover their windows at night to reduce light pollution and all non-safety lights should be shielded wherever possible.	

EMCP Response 30-Nov-10	Refer to EMCP Comment 102-GF-9 for additional information regarding environmental effects of lighting on seabirds.

EMCP Comment 110: GF 15

110-GF 15	**EA Reference:**:	Section 9.5.1.4 Potential Mortality Page 9-41
Preamble:	"*The only routine Project construction/installation activity that is predicted to potentially result in mortality of marine birds is blasting in the nearshore*."	
Request 7-Sep-10	Given that birds may hit infrastructure due to lighting or experience predation due to attraction to the platform during installation, can experience mortality, this sentence is incorrect. (Table 9-10 notes potential mortality, therefore appropriate mitigation measures to PREVENT attraction and mortality should be required).	
EMCP Response 30-Nov-10	**The sentence in the preamble will be removed from the CSR.** The sentence in the preamble will be modified to remove "The only" and replace with "One" in the CSR. **The following sentence will be added immediately after the revised introductory sentence:** Collision with infrastructure is another potential source of mortality. This issue is mostly relevant to offshore operations and is discussed in Section 9.5.2."	

EMCP Comment 111: GF 16

111-GF 16	**EA Reference:**:	Section 9.5.2.2 Change in Habitat Quality - Flaring Page 9-45
Preamble:	"*As in the case of lighting (described above), EMCP will develop protocols for regular searches of birds that may become stranded on all vessels and facilities. Recovered birds will be released in accordance with standard protocols (Williams and Chardine 1999; Husky Energy 2008). Stranded bird reports will be provided to the CWS*."	
Request 7-Sep-10	In previous offshore oil and gas EAs in this region, other mitigation strategies have been noted on how to reduce the effects of flaring on marine birds. For example, Husky Oil Ltd (2001) noted they would attempt to "*schedule routine maintenance shutdowns to coincide with the time of maximum Storm-petrel local abundance…"* (pg 15). Assuming that shutdowns mean less chance of flaring, this mitigation should be required. Given that the Hibernia project exceeded their flaring quotas (e.g., C-NOPB 1999 Annual Report), the Hebron project needs to provide evidence that they will make every attempt to minimize flaring and provide details as to how this will be achieved. Further, there should be an analysis of past flaring for all production projects in the C-NLOPB's jurisdiction, the amount that they flared, when (seasonally) the flaring occurred and whether the flaring occurred at low lighting. A model should be developed to provide estimates of seabird mortality based on these data in conjunction with known seabird (lesp and dove) estimates.	
EMCP Response 30-Nov-10	With regard to flaring, the primary function of the flare system is to safely dispose of flammable gases during emergency events. The timing of emergency events is not at the discretion of the operator. **The following text will be added to Section 9.5.2.2**: During steady-state operations, it is estimated that the Hebron facility will have reduced flare emissions compared with existing operations. Flaring during platform start-up and early year operations will be greater than steady-state operations. Flare operating practices will be developed for the Operations Authorization and a flaring allowance established in consultation with the C-NLOPB.	

	With regards to effects of flaring on seabirds, Section 9.5.2.2 describes potential impacts from flaring on seabirds.

EMCP Comment 112: GF 17

112-GF 17	**EA Reference:**:	Section 9.5.2.4 Potential Mortality Page 9-47
Preamble:	"*As described above, the Leach's Storm-Petrel is the most likely marine bird species to be affected…*"	
Request **7-Sep-10**	This sentence should include Dovekies as an additional species also affected by gas flaring at night.	
EMCP Response **30-Nov-10**	There is little to no evidence to indicate that Dovekies vs. other seabird species are susceptible to mortality from flaring. Leach's Storm-petrels are known to regularly strand on vessels and hence, may be particularly attracted to lights from the flare. However, flares are quite noisy and this noise may deter birds. Also, the height of the flare (approximately 98 to 108 m above sea level) is much higher than the altitude that Leach's Storm-petrels (and Dovekies) typically fly (B. Mactavish, LGL, pers. comm.). **The following sentence will be added to page 9-47:** "It is unknown which seabird species, if any, are susceptible to mortality from flaring."	
Follow-up Comment **20-Apr-11**	**(Refer to the November 26, 2010 EMCP response)** The proponent notes "Also, the height of the flare (approximately 98 to 108 m above sea level) is much higher than the altitude that Leach's Storm-petrels (and Dovekies) typically fly (B. Mactavish, LGL, pers. comm..)". While this is an interesting observation, presumably, it was made during day light. Until there are detailed data on how birds are behaving at night around platforms, statements such as the one above only demonstrate how little is known. If there are data which can be presented, which were collected at night by repeatable methods, by all means, please present them.	
EMCP Response **17-Jun-11**	The Operator is not aware of any systematic studies of the behaviour of Leach's Storm-Petrels and Dovekies around flares. The above notwithstanding, EnCana is presently proposing a study of bird behaviour around platforms offshore Nova Scotia. The results from this study should provide valuable data regarding bird behaviour.	

EMCP Comment 113: GF 18

113-GF 18	**EA Reference:**:	Section 9.5.2.4 Potential Mortality Page 9-47
Preamble:	*There is currently no known mitigation for this potential effect, but flaring is expected to have minimal impact on marine birds over the duration of the Project*."	
Request **7-Sep-10**	See Comment 16 above regarding mitigation for flaring.	
EMCP Response **30-Nov-10**	See response to EMCP Comment 111: GF 16.	

EMCP Comment 114: GF 19

114-GF 19	**EA Reference:**:	Section 9.5.2.4 Potential Mortality Page 9-48
Preamble:	"*The Environmental Studies Research Find (ESRF) has commissioned a study on the effects of sheens on marine birds that has not yet been published*."	
Request **7-Sep-10**	This should not be used as an excuse for not including data collected by operators on the frequency, size and persistence of oil sheens in the C-NLOPB's jurisdiction. At the very least EMCP should be required to present data from Hibernia. Without these data, a worst case scenario must be assumed. Without these data, it is not possible for the public to draw its own conclusions about the potential effects of oil sheens associated with the project and to assess whether the EA is correct in its assessment of the effect. With regards to sheens, a published paper, resulting from ESRF funding mentioned above was released in April 2010, prior to the release of the CSR, and should be discussed: O'Hara and Morandin 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. Marine Pollution Bulletin 60: 672-278. General: in the White Rose Project CSR, an assessment of the level of certainty of the residual effect of the prediction and the likelihood of the effect occurring were provided for each predicted effect (I see EMCP has this step for overall). Why was this not done for this project? These are important steps as they provide the public with a rating of whether the prediction is a best guess, or whether the prediction is relatively certain. General: Despite the definition of a significant residual environmental effect changing from the number individuals in the area (see Husky Oil Ltd 2001) potentially effected to populations, and improved information on marine bird abundance in the study area, there are still no species specific models provided in areas where the impact could be assessed. This continues to be an on-going weakness for oil and gas production EAs.	
EMCP Response **30-Nov-10**	The above referenced ESRF project was published as a journal article and as an ESRF report (O'Hara and Morandin 2010). These publications were not available at the time of preparing the June 2010 CSR. This laboratory study by O'Hara and Morandin demonstrated that it only requires a small amount of oil (*e.g.*, 10 ml) to affect the feather structure of Common Murre and Dovekie. Such modifications to feather structure cause a loss of insulation which in turn can result in mortality in the cold Northwest Atlantic environment. The CSR concluded that, aside from accidental events (*e.g.*, oil spills) (see Section 14.1.3), sheens are unlikely to occur from routine Project operations. The level of certainty was determined for predicted residual environmental effects for each Project phase (Construction and Installation, Operation and Maintenance, Decommissioning and Abandonment, Accidental Events, Cumulative Effects). This is consistent with guidance provided by the CEA Agency (CEA Agency 1994) and represents a comprehensive level of certainty for each effect that occurs within that Project phase. A reasonable model of the number of seabirds that could suffer mortality from a major oil spill is impossible to determine with any accuracy or precision because of the numerous variables involved and the difficulty in confirming any such model. In the event of a spill, EMCP will implement a bird monitoring and recovery program. **The following reference will be added:** 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*. Prepared by the Federal Environmental Assessment Review Office.	

	O'Hara, P.D. and L.A. Morandin. 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. *Marine Pollution Bulletin*, 60: 672-278.
Follow-up Comment **28-Jan-11**	"*Each prediction did not have a corresponding level of probability of occurrence and scientific certainty*." The last offshore oil production project in 2000, the White Rose, did provide both of those evaluative criteria (probability of occurrence and scientific certainty) to EACH PREDICTION in the EA, not each phase. So I see this change as one which provides less detail rather than more.
EMCP Response **18-Mar-11**	The determination of significance, as presented in the CSR, follows CEA Agency guidance "Determining Whether a Project is Likely to Cause Significant Environmental Effects" (CEA Agency 1994). The likelihood of an effect (scientific certainty and probability of occurrence) is only considered for those effects that are deemed to be significant. Therefore, for marine birds, 'accidental events' was deemed to be a significant environmental effect, and the probability of occurrence and level of confidence is provided in Table 9-14. We have reviewed the effects assessment for each predicted environmental effect, and concluded that the residual environmental effects are not significant. This is consistent with our conclusion that effect of the Project on the environment, for each VEC, is not significant.
Follow-up Comment **20-Apr-11**	**(Refer to the November 26, 2010 EMCP response)** **Providing Scientific Certainty and Probability of Occurrence for Each Prediction** In the current EA, each phase, rather than each prediction is provided with a confidence level rating and scientific certainty. I am very concerned about the change in formatting between White Rose and Hebron EAs. This is the fourth development and production EA for this jurisdiction and each EA has a difference approach. One could argue that the different approaches are an improvement on the process. But I would argue that the change between the White Rose EA and the Hebron EA up reduces the available information rather than improves on the process. As the RA, the C-NLOPB should be ensuring consistency and improvement for each EA. This current change is not an improvement. The proponent's response, "This is consistent with guidance provided by the CEA Agency (CEA Agency 1994) and represents a comprehensive level of certainty for each effect that occurs within that Project phase." does not answer why there was a change. It is very important to understand which predictions do not have strong scientific certainty and link these predictions to a follow-up program. By providing an overall rating for each phase does not allow the C-NLOPB, as the RA to make these clear linkages; nor does it allow the public to understand how predictions were linked to follow-up programs. **Presentation of Oil Sheen Data** The data I was requesting are oil sheens which occur with the legal discharges of oil content of produced water. The proponent's response "The CSR concluded that, aside from accidental events (e.g., oil spills) (see Section 14.1.3), sheens are unlikely to occur from routine Project operations." does not address my request that oil sheen data are presented in the EA. To reach such a conclusion that something is unlikely to occur requires data. Based on past correspondence with the C-NLOPB, it is my understanding that the operators are required to collect such data. An EA where predictions are being generated based on data not presented is problematic.
EMCP Response **17-Jun-11**	Each Project activity for each phase of the project has been assessed and this assessment includes the required factors (*i.e.*, magnitude, duration, frequency, geographic extent, reversibility and ecological / socio-economic context) to determine significance of environmental effects, as described in Section 4 Environmental Assessment Methodology. The summary statement of residual environmental effects was based on the assessment of each activity and associated levels of confidence.

	While this approach appears to the reviewer to differ from the White Rose EA, the methodology is consistent with it and more recent environmental assessments. With respect to how predictions were linked to follow-up programs, such programs have been proposed for those VECs where interactions with the Project have been predicted. The rationale for the types of follow-up programs that have been proposed does not rely exclusively on the level of confidence, but rather on the collective experience of the offshore oil and gas industry in Newfoundland and Labrador. The requirement for a follow-up program is ultimately determined by the Responsible Authorities for this environmental assessment. The CSR includes spill data from the C-NLOPB website, including spills less than 1 L. However, sheening events are not specifically identified within this data set.

EMCP Comment 115: EC 45

115-EC 45	**EA Reference:**:	Section 9.5.2.4 Potential Mortality Page 9-48
Preamble:	The ESRF study on the effects of sheens on marine birds has been published.	
Request **7-Sep-10**	The information from the results of this study should be included in the CSR	
EMCP Response **30-Nov-10**	See response to EMCP Comment 114-GF 19.	

EMCP Comment 116: GF 20

116-GF 20	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-53
Preamble:	"*In June 1979, an oil spill occurred from the Ixtoc I off Texas…*"	
Request **7-Sep-10**	Ixtoc was not a spill, it was a blowout (and it was off Mexico, not Texas). This is an important distinction.	
EMCP Response **30-Nov-10**	**Sentence revised in CSR as follows:** "In June 1979, an oil blowout occurred from the *Ixtoc 1* in the Gulf of Mexico off Mexico."	

EMCP Comment 117: GF 21

117-GF 21	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-53
Preamble:	"*Birds living in coldwater environments, such as the Study Area, are most likely to succumb to hypothermia (Hartung 1995).*"	
Request **7-Sep-10**	**Wiese and Ryan 2003 should be cited here as well.**	
EMCP Response **30-Nov-10**	**The sentence will be revised as follows:** Birds living in coldwater environments, such as the Study Area, are most likely to succumb to hypothermia (Hartung 1995; Wiese and Ryan 2003).	

EMCP Comment 118: GF 22

118-GF 22	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-54
Preamble:	"*Oiled birds that are cleaned and released might not have high survival rates*."	
Request **7-Sep-10**	This section needs to be updated. There has been much discussion in the seabird community on this issue, particularly in the past 3 months. Michael H. Ziccardi is the director of the Oiled Wildlife Care Network at the Wildlife Health Center at UC Davis, is quoted as saying "Even in the best of circumstances, many oil-affected animals will die in the rehabilitation center. However, due to the evolution of professional oiled rehabilitation organizations over the past 30 years, survival is much higher than in the paSt. For spills that my organization, the Oiled Wildlife Care Network, manages for California, we successfully release, on average, 50 to 75 percent of the live animals collected." http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2010/06/23/EDFM1E32SQ.DTL#ixzz0rgxFIdJA Thus, Dr. Ziccardi is suggesting that the situation may not be as dire as we think when it comes to cleaning birds.	
EMCP Response **30-Nov-10**	EMCP agrees that advances have been made over the last 20 years in the survival rates of birds cleaned under laboratory conditions. Nonetheless, survival rates of 50 to 75 percent have not been proven on a large scale for Newfoundland and Labrador waters. Thus, EMCP stands by the original statement.	

EMCP Comment 119: EC 47

119-EC 47	**EA Reference:**:	Section 9.5.4.3 – Potential Mortality – Offshore Page 9-56
Preamble:	The fourth paragraph on page 9-56 states "It appears that direct, long-term sublethal toxic effects on marine birds are unlikely." Research has shown that oil components are eliminated relatively quickly from the internal tissues of birds. However, recent research has clearly demonstrated delayed toxic effects on the immune and endocrine systems and on reproductive behaviour and success of birds after brief exposure to oil.	
Request **7-Sep-10**	(a) The proponents should better describe the duration of sublethal toxic effects of oil exposure on the immune and endocrine systems and on reproductive behaviour and success of birds.	
EMCP Response **30-Nov-10**	It is unclear what literature the reviewer is referencing. EMCP predicts that regulated releases from routine discharges will not produce measureable effects on immune, endocrine or reproductive systems of seabirds. An accidental event such as a large oil spill, although unlikely to occur, could produce both lethal and sublethal effects as predicted in the CSR and could result in a significant effect on seabirds (see Subsection 9.5.4 for a detailed discussion of the effects of oil on seabirds).	
Follow-up Comment **28-Jan-11**	A review of the avian toxicology literature cited below demonstrates that the CSR statement "**It appears that direct, long-term sublethal toxic effects on marine birds are unlikely**" (made in section 9.5.4.3) is not scientifically accurate or defensible. The citations provided in that paragraph of the CSR are out-of-date. The entire paragraph should be re-written to reflect the literature below, or removed entirely. Alonso-Alvarez, C., Munilla, I., López -Alonso, M., Velando, A., 2007. Sublethal toxicity of the Prestige oil spill on yellow-legged gulls. Environment International 33, 773-781. Balseiro, A., Espí, A., Márquez, I., Pérez, V., Ferreras, M.C., García Marín, J.F., Prieto, J.M., 2005. Pathological features in marine birds affected by the Prestige's oil spill in the north of Spain. Journal of Wildlife Diseases 41, 371-378. Bernanke, J., Köhler, H.-R. 2009. The impact of environmental chemicals on wildlife vertebrates. Reviews of Environmental Contamination and Toxicology 198: 1-47.	

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EMCP Response **18-Mar-11**	**The following sentence will be deleted:** "It appears that direct, long-term sublethal toxic effects on marine birds are unlikely." **The following text will be added to Section 9.5.4.3 of the CSR:** The CSR predicted potential significant environmental effects on seabirds in the unlikely event of a major oil spill. Individual seabirds that come into contact with oil could suffer a variety of effects ranging from sublethal to lethal. If effects on individuals were extensive enough to cause large numbers of mortalities and/or severe sublethal effects on growth and reproduction, then effects could be measured at the level of populations. The duration of sublethal effects would likely vary by species, life stage, type and degree of exposure, and many other factors. The maximum duration of any effect at the individual level would be the life span of that individual. It is impossible to predict with any level of realistic precision how a range of sublethal effects might affect a particular population and thus, the conservative prediction was made that a large oil spill could significantly affect seabird populations. It also can be predicted that given the relatively large abundance and distribution of the seabird species in the Northwest Atlantic, no population would be extirpated and the affected colonies would likely rebound within several generations if environmental conditions were favourable.

	Bernanke and Kohler (2009) consider the effects of oil spills on seabird populations as "transient", with recovery times of 10 years, or possibly longer. Some sublethal effects reported in recent literature from two very large tanker spills include those briefly discussed below. Large numbers of seabirds suffered mortality after the *Exxon Valdez* spill in Cook Inlet, Alaska and the *Prestige* spill in Northwest Spain. Some reported sublethal effects of *Prestige* oil on birds included potential liver and kidney damage to Yellow-legged Gulls 17 months after the spill (Alonzo-Alvarez et al. 2007). Common Guillemots and razorbills (but not Atlantic Puffins) displayed brain acetylcholinesterase inhibition (Oropesa *et al.* 2007). Decreased breeding success at oiled colonies of European Shag (*Phalacrocorax aristotelis*) was reported by Velando *et al.* (2005). Elevated hydrocarbon-inducible cytochrome P4501A in Harlequin Duck (*Histrionicus histrionicus*) livers up to 20 years after the *Exxon Valdez* spill was reported by Esler *et al.* (2010). It should be noted that this measurement is a biomarker for exposure and not necessarily a deleterious effect *per se*. Iverson and Esler (2010), based on modelling, suggested a recovery time of 24 years for Harlequin Duck after the spill. In summary, it is possible that sublethal effects could persist for a number of years, depending upon generation times and the persistence of any spilled oil. Most seabirds are relatively long-lived. On the other hand, oil spilled on the Grand Banks, even if it made to the exposed coast, would likely not persist very long on Newfoundland's high energy rocky coastline. **The following references will be added:** Alonso-Alvarez, C., I. Munilla, M. López-Alonso and A. Velando. 2007. Sublethal toxicity of the *Prestige* oil spill on yellow-legged gulls. *Environment International*, 33: 773-781. Bernanke, J. and H-R. Köhler. 2009. The impact of environmental chemicals on wildlife vertebrates. *Reviews of Environmental Contamination and Toxicology*, 198: 2-47. Esler, D., K.A. Trust, B.E. Ballachey, S.A. Iverson, T.L. Lewis, D.J. Rizzolo, D.M. Mulcahy, A.K. Miles, B.R. Woodin, J.J. Stegeman, J.D. Henderson and B.W. Wilson. 2010. Cytochrome P4501A biomarker indication of oil exposure in harlequin ducks up to 20 years after the *Exxon Valdez* oil spill. *Environmental Toxicology and Chemistry*, 29(5): 1138-1145. Iverson, S.A. and D. Esler. 2010. Harlequin Duck population injury and recovery dynamics following the 1989 *Exxon Valdez* oil spill. *Ecological Applications*, 20(7): 1993-2006. Oropesa, A-L., M. Pérez-López, D. Hernández,, J-Pablo García, L-Eusebio Fidalgo, A. López-Beceiro and F. Soler. 2007. Acetylcholinesterase activity in seabirds affected by the *Prestige* oil spill on the Galician coast (NW Spain). *Science of the Total Environment*, 372: 532-538. Velando, A., D. Lvarez, J. Mourin, F. Arcos and I. Barros. 2005. Population trends and reproductive success of the European shag *Phalacrocorax aristotelis* on the Iberian Peninsula following the *Prestige* oil spill. *Journal of Ornithology*, 146: 116-120.

EMCP Comment 120: GF 23

120-GF 23	**EA Reference:**:	Section 9.5.4.3 – Potential Mortality – Offshore Page 9-57
Preamble:	Given that the EA discusses the lack of relationship between the quantity of oil spilled and the resulting mortality of seabirds in past oil spills, there should be a paragraph which discusses small spills known to originate from all production platforms in the C-NLOPB's jurisdiction, the frequency of these spills *and* follow-up on them especially regarding persistence & size. Information should be provided on whether attempts were made to contain/clean up small spills from platforms and how the impacts of these small spills on seabirds were assessed and by whom (i.e., CWS or operator). If data on estimated mortality associated with small spills were not obtained, it should be discussed why this was not possible.	
Request **7-Sep-10**	At the very least, EMCP should provide these data from the Hibernia Project. If these data are not presented, it should be stated why they are not presented. Further, there should be a citation on the impact of chronic oil pollution on seabird populations (Piatt et al. 1990. Effects of oil pollution on marine bird populations. In Effects of oil on wildlife, Research, Rehabilitation and general concerns. Proceedings from: The Oil Symposium, Herndon, Virginia, Oct 16-18 1990).	
EMCP Response **30-Nov-10**	The effects of chronic pollution on marine birds are discussed in the Sections 9.5.5.1 and 9.5.5.2 of the CSR. In addition, the frequency of spills associated with offshore oil and gas operations on the Grand Banks is addressed in Section 14.1.3. **The following sentence will be added at the end of the second paragraph on page 9-57**: Some researchers suggest that chronic oil pollution, acting in combination with other mortality factors, may affect seabirds at the population level (Piatt *et al.* 1990)	
Follow-up Comment **20-Apr-11**	**(Refer to the November 26, 2010 EMCP Response)** I requested that the following information be included in the EA "…paragraph which discusses small spills known to originate from all production platforms in the C-NLOPB's jurisdiction, the frequency of these spills and follow-up on them especially regarding persistence & size. Information should be provided on whether attempts were made to contain/clean up small spills from platforms and how the impacts of theses small spills on seabirds were assessed and by whom (i.e., CWS or operator). If data on estimated mortality associated with small spills were not obtained, it should be discussed why this was not possible." I understand that the oil spill section is forthcoming, but based on the proponent's response, I assume they will not be providing data on how spills were assessed: persistence & size (spatially, not quantity spilled), on whether attempts were made to contain/clean up small spills from platforms and how the impacts of these small spills on seabirds were assessed and by whom. Predicting future impacts without using past data is not good EA practice. If the proponent does not want to disclose those data, then they should just state it. However, as RA, I think the C-NLOPB should require the proponent to provide these very important and relevant data for this EA.	
EMCP Response **17-Jun-11**	All spills are reported to the C-NLOPB. Section 14.1.4 (Platform Spills Involving Small Discharges) discusses the probability of such spills (see Table 14-13) occurring. Spills <1 L are usually dissipated before spill containment equipment can be deployed. The operator, including our environmental contractors, are not aware of data collected on seabirds potentially affected by spills <1 L. The environmental assessment of accidental events is presented in Section 9.5.4. The conclusion of the effects of spills on seabirds was assessed as significant, but unlikely to occur.	

EMCP Comment 121: GF 24

121-GF 24	**EA Reference:**:	Section 9.5.4.3 – Potential Mortality – Offshore Page 9-58
Preamble:	"*Mitigation for accidental hydrocarbon spills will consist of following the protocols detailed in the spill response plan. The oil spill response plan is under development. Depending on the nature and tiered response required, mitigations include the provision for spill response equipment and the rescue and rehabilitation of oiled marine birds*."	
Request **7-Sep-10**	Spill Response plans should be a public document, which is included in the EA process prior to permitting the Hebron project. Further, spill response plans should include detailed information as to HOW the impact of all oil spills > 1 bbl will determine the impacts of seabirds in the spill area. These plans should be based on prior experience in the area and describe successes and failures at attempts to clean and contain spills.	
EMCP Response **30-Nov-10**	The Hebron Project is at the early stages of project design. Sections 14.4 and 14.5 describe the elements of the Hebron oil spill response plan (OSRP), but the plan itself is still being developed. The purpose of the OSRP is to describe response measures to be implemented in the event of a spill. The level of response required is dependent on the size of the spill event. In developing the OSPR, the plan will consider experience from other operators in the NL offshore, and will include provisions for monitoring and rehabilitation of oiled marine birds. The plan is submitted to the C-NLOPB for approval. The CSR addresses the environmental effects of spills on marine birds in Section 9.5.4.	

EMCP Comment 122: C-NLOPB 32

122-C-NLOPB 32	**EA Reference:**	Section 9.5.4.3 Page 9-58, paragraph 3
Preamble:		
Request **7-Sep-10**	While the detailed oil spill response plan required for the offshore portion of the Project likely will not be formally submitted for some time, greater detail than that presented in the cited paragraph should be available, and provided, in the CSR.	
EMCP Response **30-Nov-10**	EMCP acknowledges that the offshore oil spill response plan is under development; however, Section 14.6 of the CSR provides an outline of the oil spill response plan. **The following text will be at the end of the following sentence "…plan is under development":** "…however, Section 14.6 provides an outline of the proposed spill response plan for offshore operations. Depending on the nature.…"	

Comment 123: GF 25

123-GF 25	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-59, Table 9-13
Preamble:	Subsea blow-out predicted as reversible to marine bird populations.	
Request **7-Sep-10**	A prediction of a blow-out, which could last 36 months as being reversible to all seabird populations present in the study area is not substantiated. EMCP must discuss the potential effects of a blow-out separately and provide details on a worst case scenario and justify and provide species-specific population models which support this prediction**.**	
EMCP Response **24-Feb-11**	A blow-out that could last for 36 months is not a reasonable worst case scenario. The recent blow-out in the Gulf of Mexico was one of the worst blow-outs in history and lasted less than three months.	

	Accidental events including blow-outs are discussed in detail in Section 14. Additional modelling was conducted to represent blow-out scenarios for 30-day and 100-day durations (ASA 2010b). Based on the results of the spill trajectory modelling, it is predicted that a blow-out at the Hebron site could result in significant environmental effects on seabird populations. In the case of mortalities, effects are not reversible at the individual level but they are considered reversible at the population level. No oil spill, including major ones such as *Ixtoc 1* or *Exxon Valdez*, have caused irreversible declines in seabird populations. Effects of blow-outs are discussed in Subsection 9.5.4 of the CSR. It is not possible to provide realistic species-specific population models because of the lack of detailed data on bird distributions and the numerous variables involved in assessing the effects of an oil spill. For example, at the time of a spill, variables may include population sizes and their inherent variability from natural and anthropogenic causes, the specific behaviour, distribution and numbers of birds in time and space, sea and weather conditions, characteristics of the spill, and so forth. The CSR accounts for this uncertainty by predicting a significant effect on seabirds from an oil spill.

EMCP Comment 124: C-NLOPB 33

124-C-NLOPB 33	**EA Reference:**	Section 9.5.5.2 Page 9-61, final paragraph
Preamble:	The paragraph states "However, condensate from a deepwater blowout may be considerably reduced when it reaches the surface, and the wind and wave conditions typical of the Grand Banks will further aid in the dispersal of condensate."	
Request **7-Sep-10**	The relevance of condensate to the paragraph's discussion of oil blowout effects is unclear. This should be clarified or the statement removed.	
EMCP Response **30-Nov-10**	"condensate" will be replaced with "petroleum hydrocarbons" in this paragraph.	

EMCP Comment 125: C-NLOPB 34

125-C-NLOPB 34	**EA Reference:**	Section 9.5.7 Page 9-63
Preamble:		
Request **7-Sep-10**	a) The follow-up / monitoring discussion is weak and over-generalized. At the very least, monitoring of marine birds following an oil spill should be described or referenced, as it is elsewhere in the CSR document. The potential for marine bird observation programs associated with the Project to lessen uncertainty respecting potential spill effects, and potential effects of light/flare attraction, should be discussed further. b) It should be explained whether the marine bird observation program described in paragraph 3 for the MODU program also will be in place during the production platform's operation.	
EMCP Response **30-Nov-10**	a) The Hebron Project is at the conceptual design stage. Environmental effects monitoring programs, for the nearshore and offshore components of the project, are at the very early stages of development. Section 15 of the CSR outlines a proposed process to develop the EEM program. The EEM will be developed in consultation with stakeholders, including the public, regulatory agencies and scientific community. While it is stated in Section 9 that effects monitoring is not planned for marine birds, this statement reflects the conclusions reached in the CSR and refers only to routine operations. The final EEM design may include marine bird monitoring, however, that will be determined as the EEM design process progresses.	

	With regards to an oil spill EEM program, an EEM program specific to spill events will be developed as part of the oil spill response plan. The spill EEM program will include monitoring of marine birds. As described in Section 14, spill response is typically classified according the level of effort required. Each level or tier will have specific response requirements and, depending on the level, specific environmental effects monitoring requirements. **The following text will be added to Section 9.5.7:** EEM programs, for the nearshore and offshore components of the Project, are at the very early stages of development. Chapter 15 of the CSR outlines a proposed process to develop the EEM program. Based on the environmental effects assessment for marine birds, a marine bird EEM component is not contemplated at this stage. The EEM will be developed in consultation with stakeholders, including the public, regulatory agencies and scientific community. The final EEM design may include marine bird monitoring; however, that will be determined as the EEM design process progresses. In the event of a spill, and depending on the nature and size of the spill, marine bird monitoring will be implemented. The details regarding monitoring requirements and protocols will be outlined in the oil spill response plan and will be determined in consultation with the C-NLOPB and Environment Canada. b) EMCP supports initiatives such as the recent ESRF marine bird observation program and will investigate the development of a marine bird observation program from Hebron Project supply vessels, where space is available. MODU drilling programs typically engage a weather observer on staff to undertake dedicated marine bird and marine mammal observations. This position is not currently envisaged for the Hebron Platform, as all weather observations will be automated.

EMCP Comment 126: GF 26

126-GF 26	**EA Reference:**:	Section 9.5.7 Follow-up and Monitoring Page 9-63
Preamble:	"*A specific EEM program to verify the accuracy of assessment predictions and the efficacy of mitigation measures is not planned for Marine Birds*."	
Request **7-Sep-10**	a) This is unacceptable given that birds are a VEC and the most vulnerable to oil (and light) pollution. The EEM should at the very least include a verification of the accuracy of the assessment predictions for accidental spills. Further, EMCP should be required to contribute to the knowledge base on the effects of light and flares as they pertain to attraction. An automated radar system (such as "Merlin" Bird radar; see also Zaugg et al. 2008, Journal of the Royal Society Interface, 5:1041-1053; Hüppop et al. 2006 Ibis 148) should be required as part of the construction of the platform. b) General – the primary stakeholder, ExxonMobil is also the lead operator for the Hibernia Project. When members of the public, including NGOs who participated in EA reviews for Hibernia requested important information on oil spill pollutant data ExxonMobil choose not to disclose this information (Fraser, G.S. and J. Ellis 2008. Reply from Gail Fraser and Joanne Ellis to a letter from CNSLOPB. *Journal of Environmental Assessment Policy and Management.* 10 (4): 483). I request a statement from the EMCP that they have a commitment to disclosure, particularly around oil pollutant data.	
EMCP Response **30-Nov-10**	a) EMCP will include marine bird monitoring as part of its spill environmental effects monitoring program. See Response to EMCP Comment 125 C-NLOPB 34 for additional information. See earlier Response to EMCP Comment 109: GF 14 and Response to EMCP Comment 111: GF 16 regarding use of directional lighting.	

	b) With regard to the disclosure of oil spill data, EMCP is required to report all spills from its operations to the C-NLOPB. This data is reported to the C-NLOPB, as per the *Guideline for the Reporting and Investigation of Incidents* (C-NLOPB and CNSOPB 2009). The C-NLOPB publishes hydrocarbon spill data on its website.

EMCP Comment 127: EC 44

127-EC 44	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-58, Table 9-13
Preamble:	The numbers in the table need to be updated.	
Request **7-Sep-10**	Please make the following changes: Wadham Islands Arctic and Common Terns 184^{L} Funk Island: Northern Gannet 9987^{L} Black-legged Kittiwake 100^{N} * Cape Freels and Cabot Island Arctic and Common Terns Common Murre 10000^{L} Baccalieu Island: Northern Gannet 2254^{L} Black-legged Kittiwake 6456^{L} Common Murre 1697^{L} Thick-billed Murre216^{L} Razorbill 352^{L} Corbin Island: Herring Gull 50^{L} The corresponding totals at the bottom of the table need to be changed as well. *** N reference to be added:** Nettleship, D.N. 1980. A guide to the major seabird colonies of eastern Canada, CWS, Dartmouth.	
EMCP Response **30-Nov-10**	As confirmed with Environment Canada, the table referenced above should be Table 9-5 on page 9-13. Changes, which are mostly updated data from CWS (unpubl. data), will be made to the table.	

Comment 128: EC 48

128-EC 48	**EA Reference:**:	Section 9.5.4.3 Potential Mortality Page 9-58, Table 9-13 – Environmental Effects Assessment: Accidental Events
Preamble:	The table indicates that environmental effects from an OLS spill, subsea blow-out or crude oil surface spill could be of high magnitude, high geographic extent but moderate duration. If a large oil spill occurred during the marine-bird breeding season and the oil slick moved towards the Witless Bay bird colonies, a large proportion of the breeding birds could be oiled. Direct mortality along with prolonged sublethal effects on reproduction and health of the marine birds could have a drastic impact on the breeding population for many years.	
Request **7-Sep-10**	The proponents should more accurately assess the duration and reversibility of environmental effects of a major oil spill on local breeding colonies of marine birds.	

EMCP Response 24-Feb-11	In the event of a blow-out and depending on the time of year in which it occurs, different species of birds may be affected by oil that is predicted to move towards the Avalon Peninsula. During the summer months, nesting birds from the Witless Bay Islands' colonies (*i.e.*, murres, puffins, kittiwakes) use the inshore areas adjacent to the potentially affected shoreline for foraging or resting. Smaller numbers of nesting Herring Gull, Great Black-backed Gull and Black Guillemot will likely be present in the potentially affected area. In addition, birds that nest on Baccalieu Island forage in areas that may be affected by a blow-out. Large numbers of Greater Shearwater also forage in nearshore waters during the period of capelin spawning. During the winter months, large numbers of eiders (mostly Common Eiders with small numbers of King Eiders) occur in nearshore waters of the Avalon Peninsula and could be affected by a spill, if the oil comes ashore. Murres (mostly Thick-billed Murres) and Dovekies forage mostly offshore but could also occur in smaller numbers in nearshore waters. Regardless, these species of birds are particularly vulnerable to a blow-out during winter because they spend so much time on the water. Some of the birds in the potentially affected area may suffer immediate, lethal or sublethal effects (as previously addressed in Response to Comment 119: EC 47). If effects on individuals were extensive enough to cause large numbers of mortalities and/or severe sublethal effects on growth and reproduction, then effects could be measured at the population level. The duration of any sublethal effects would likely vary by species, life stage, type and degree of exposure, and many other factors. The maximum duration of any effect at the individual level would be the life span of that individual. It is impossible to predict with any level of realistic precision how a range of sublethal effects might affect a particular population and thus, the CSR predicted a significant residual adverse environmental effect on seabirds, if a spill were to occur. Based on previous studies of seabird populations relative to oil spills, effects are considered reversible at the population level. As described in Section 14, in the unlikely event that a blow-out occurs, a post-spill monitoring program will be undertaken to assess the environmental effects on the marine environment with a particular focus on marine birds.

EMCP Comment 129: EC 46

129-EC 46	**EA Reference:**	Section 9.5.7 Follow-up and Monitoring Page 9-63
Preamble:	The predictions of the CSR (i.e., that light attraction will be not significant) cannot be verified without a follow-up program. CWS is aware that there are no marine bird components in existing EEMs for drilling operations, but it would be valuable for marine bird monitoring to be incorporated into the EEM.	
Request 7-Sep-10	Include seabird monitoring in the EEM.	
EMCP Response 30-Nov-10	See response to EMCP Comment 125: C-NLOPB 34.	
Follow-up Comment 28-Jan-11	EC is concerned about the response to several comments which outline the need to include marine bird monitoring in the EEM. Although the response makes it clear that EEM planning is only in the beginning stages, the proposed text change to "**Based on the environmental effects assessment for marine birds, a marine bird EEM component is not contemplated at this stage**" is the core of our general concerns. EC recommends that marine bird monitoring for the following reasons: In the report, attraction to illumination on structures and vessels during all phases of the Project are predicted to be "…*low in magnitude, geographic extent, duration, frequency when mitigation measures are practiced*". Also, The effects of "…*accidents,*	

	malfunctions and unplanned events…" are predicted to be *"…significant…*", but "*…reversible at the population level*". An EEM that includes marine birds will determine the accuracy of these predictions. Specifically, more data on the distribution and abundance of marine birds in the vicinity of the study area are essential for assessing the accuracy of these predictions. Globally significant concentrations of marine birds are known to use the Grand Banks, and may concentrate in the vicinity of the proposed development site. Although there will be an emphasis on accident prevention, data on marine birds are required from the development site in order to assess risk and mortality should an accident occur.
EMCP Response **18-Mar-11**	In a letter received from the C-NLOPB (E. Young to H. Pillai, June 7, 2010), the C-NLOPB states "The requirement for a 'follow-up' program, as defined by CEAA, cannot be determined until the environmental assessment review is complete. The C-NLOPB will consult with ExxonMobil Canada Ltd. regarding the detail of any required follow-up monitoring program, as may be required". EMDC concluded in the CSR that an EEM program for marine birds was not contemplated based on the effects assessment and based on the statement above, the details of such a program will only be determined at the conclusion of the environmental assessment process. However, as stated in Section 14.6.4.1 (Table 14-21), protocols for marine bird monitoring during spill events will be established.
Follow-up Comment **20-Apr-11**	EMCP Comment 129: EC 46 Environment Canada is not satisfied with the response. The draft CSR indicates that "attraction to illumination on structures and vessels during all phases of the Project are predicted to be "*…low in magnitude, geographic extent, duration, frequency when mitigation measures are practiced*". To EC's knowledge, these effects have not been adequately demonstrated due to there being very little data worldwide on seabird attraction to platforms, and no studies in Atlantic Canada. It is our understanding that research is planned for the near future to assess attraction of sea birds to platforms in Nova Scotia, but has yet to be initiated. Environment Canada is satisfied that the detailed study design can be completed after the CEA Act section 38 decision is made, however, the need for, and the requirements of, any follow-up program in respect of the project is a clearly identified factor to be considered in the comprehensive study report. Environment Canada will not be able to exercise its section 38 decision making authority until this matter is resolved.
EMCP Response **17-Jun-11**	As stated previously, based on the Operator's assessment of environmental effects, an EEM program for seabirds may not provide sufficient evidence to determine environmental effects. However, EMCP is open to working with Environment Canada and other marine bird experts to develop a scientifically defensible research program regarding seabird attraction.
Follow-up Comment **29-Jul-11**	**Regarding Attraction of Seabirds to Platforms** Environment Canada is not fully satisfied with this response, however, the Proponent's recognition of the need to develop a scientifically defensible program regarding seabird attraction to platforms is encouraging and we are eager to work with the Proponent to better define the key elements of such a program as a means to resolve this issue.
EMCP Response **4-Aug-11**	EMCP is committed to undertaking a research program that, when designed, would provide scientifically defensible information regarding seabird attraction to offshore facilities. The following text will be included in the CSR. *In light of current knowledge of bird strikes associated with lighting on offshore platforms, EMCP commits to the development and implementation of a research monitoring program at the Hebron field location. This program will be designed to provide information regarding potential interactions between pelagic seabirds (significant concentrations hosted on the Grand Banks) and the Hebron platform. Information from the Hebron Platform site would provide additional data to allow assessment of risk and mortality regarding potential seabird attraction to offshore*

	structures. The program design would be developed in consultation with Environment Canada Canadian Wildlife Service and would be completed prior to platform start-up in 2017. It is anticipated that field testing could begin upon completion of platform start-up and commissioning activities offshore.
Follow-up Comment **15-Aug-11**	**Attraction of Seabirds to Platforms** This response is considered adequate, provided the following comment is addressed: A portion of EMCP's response should be reworded as follows: "The program design would be developed in consultation with Environment Canada's Canadian Wildlife Service, and would be completed prior to platform start-up in 2017. It is anticipated that field testing would begin upon completion of platform start-up and commissioning activities offshore."
EMCP Response **18-Aug-11**	The text will be revised to read as stated above. The complete response now reads as follows. For clarity, refer to attached page 9-69 from the August 2011 CSR showing the modified text *In light of current knowledge of bird strikes associated with lighting on offshore platforms, EMCP commits to the development and implementation of a research monitoring program at the Hebron Field location. This program will be designed to provide information regarding potential interactions between pelagic seabirds (significant concentrations hosted on the Grand Banks) and the Hebron Platform. Information from the Hebron Platform site would provide additional data to allow assessment of risk and mortality regarding potential seabird attraction to offshore structures. The program design would be developed in consultation with Environment Canada's Canadian Wildlife Service, and would be completed prior to platform start-up in 2017. It is anticipated that field testing would begin upon completion of platform start-up and commissioning activities offshore.*
Follow-up Comment 24-Aug-11	EC is satisfied with the changes made by the proponent. It was noted that the wording in the response was correctly modified from "Environment Canada Canadian Wildlife Service" to "Environment Canada's Canadian Wildlife Service". This change should also be reflected in the Draft CSR
EMCP Response 26-Aug-11	Noted. The change has been made to the CSR

2.9 Response to Section 10 Comments

EMCP Comment 130: DFO 25

130-DFO 25	**EA Reference:**	10.3.1.2 Fisheries and Oceans Canada Cetacean Sightings Database, Page 10-10
Preamble:	Section 5.3.2.4 request the CSR describe the distribution/abundance of species utilizing the study area.	
Request 7-Sep-10	Lawson and Gosselin 2009 should also be referenced in this section as it includes effort measures and density estimates in a stratum that borders the western edge of the operational study area. Lawson, J.W. and Gosselin, J-F. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey: A Component of the 2007 TNASS. Canadian Science Advisory Secretariat Research Document. 28p + vi.	
EMCP Response 30-Nov-10	**Section 10.3.1.2 will be updated as follows:** Lawson and Gosselin (2009) provide preliminary abundance estimates of three mysticete and four small odontocete species based on aerial survey data collected off the south and northeast coasts of Newfoundland. It is difficult to EMCP Comment on the distribution and relative abundance of cetacean species near the Hebron Study Area vs. adjacent areas given the nature of the report. Overall densities (uncorrected for availability and perception biases) off the south coast of Newfoundland (0.002 cetacean sightings/km^2) were much higher than those (0.0005 cetacean sightings/km^2) off the northeast coast (Table 3 in Lawson and Gosselin (2003)). The south coast survey stratum is adjacent to the western portion of the offshore Hebron Study Area. Overall, preliminary abundance estimates (uncorrected) for cetaceans off the south and northeast coasts of Newfoundland including 95 percent confidence intervals in parentheses are as follows: • Humpback whale 1,427 (952 to 2,140) • Minke whale 1,315 (855 to 2,046) • Fin whale 890 (551 to 1,435) • White-beaked dolphin 1,842 (1,188 to 2,854) • White-sided dolphin 1,507 (968 to 2,347) • Common dolphin 576 (314 to 1,056) • Harbour porpoise 1,195 (639 to 2,235)	

EMCP Comment 131: DFO 26

131-DFO 26	**EA Reference:**	Section 10.5 Environmental Effects Analysis and Mitigation Page 10-47
Preamble:	Section 5.3.3.1 of the scoping document requests that the proponent discuss the means by which potentially significant effect may be mitigated through design and/or operational procedures. Section 10.5.1.2 of the CSR describes the environmental effects of surveys, in particular seismic surveys, on habitat quality for marine mammals and sea turtles. While this section does make reference to the *Statement of Canadian Practice with Respect to the Mitigation of Sound in the Marine Environment* (SOCP) it accurate only provides a limited discussion of associated mitigations.	

	For example, the SOCP states that monitoring should be carried out by a qualified Marine Mammal Observer, not a "*dedicated environmental observer*" as specified in the text on Page 10-47 of the CSR. Please be advised that the SOCP specifies the mitigation requirements that must be met during the planning and conduct of marine seismic surveys, in order to minimize impacts on life in the oceans. These requirements are set out as minimum standards, which will apply in all non-ice covered marine waters in Canada
Request **7-Sep-10**	Provide all mitigation measures as stipulated in the SOCP that will be implemented to minimize any adverse effects on fish, marine mammals and sea turtles.
EMCP Response **30-Nov-10**	As noted on page 10-47 of the CSR "…mitigation measures will follow those outlined in the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (C-NLOPB 2008)." The Operator is committed to implementing these mitigations, and has committed as such in the CSR. While the CSR lists only a few of the mitigations from the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment*, the intent is that all applicable mitigations be implemented. The CSR makes reference to numerous guidelines, regulations and operating practices throughout the report in reference to applicable mitigation measures for project activities. Examples from these references are provided for discussion purposes, and are not meant to be exclusionary. During seismic programs, program specific mitigations will be developed, and will include all applicable mitigations listed in the "Geophysical, Geological, Environmental and Geotechnical Program Guidelines" (C-NLOPB 2008), including those listed in the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment*. . **The following text will be modified:** As indicated in the C-NLOPB *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2008), mitigation measures will follow those outlined in the *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (C-NLOPB 2008), but not limited to: • Ramp-up of the airgun array over a minimum of 20 minutes • Monitoring by a trained marine mammal observer • Delay of ramp-up if any marine mammal or sea turtle is sighted within the 500 m safety zone • Shutdown of the airgun array when a Schedule 1 endangered or threatened marine mammal or sea turtle is sighted within the 500 m safety zone

EMCP Comment 132: C-NLOPB 35

132-C-NLOPB 35	**EA Reference:**	Section 10.5.4.3 Page 10-75 – 10-76
Preamble:		
Request **7-Sep-10**	The applicability to the Hebron Project of the references to "condensate" is unclear and should be clarified.	
EMCP Response **30-Nov-10**	"Gas / oil condensate" and "condensate or oil" will be replaced with "petroleum hydrocarbons" in this section.	

2.10 Response to Section 11 Comments

EMCP Comment 133: DFO 27

133-DFO 27	**EA Reference:**	Section 11.1.3 – Administrative Page 11-3
Preamble:	There are several errors in the text about SARA that need to be addressed.	
Request **7-Sep-10**	a) The purpose of SARA as stated is not entirely correct. Replace text "management of other species to prevent from becoming at risk" with "manage species of special concern to prevent them from becoming endangered or threatened. b) There is reference made to Schedules 2 and 3 of SARA. Note that there are no species left to be reassessed on Schedule 2 and many of the Schedule 3 species have also been re-assessed. c) Section 32 of SARA as worded in this section is incorrect – it does not include critical habitat. Section 32 prohibits the killing, harming harassing, capturing, taking, etc. of an extirpated, endangered or threatened species. Section 33 deals specifically with damage and destruction of residences and Section 58 deals with the destruction of critical habitat. The text should be revised accordingly. d) The 3rd paragraph lists existing recovery strategies/mgmt plans. The Recovery Strategy for North Atlantic Right Whale should also be included.	
EMCP Response **30-Nov-10**	a) Although the existing statement in the CSR is consistent with statements published on the *SARA* registry website, **the text in Section 11.1.3 will be revised as follows** to address the reviewer's comment: The objective of *SARA* is to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and to manage species of special concern to prevent them from becoming endangered or threatened. b) As indicated in Table 11-2, there are Schedule 2 and Schedule 3 species that may be present in the Study Area. The Harbour Porpoise and Sowerby's Beaked Whale remain on Schedule 2 and Schedule 3, respectively and have not been assessed since 2006. The statement in the CSR remains valid. c) **Section 11.1.3 will be revised to accurately reflect the relevant sections of SARA as noted. The new text reads as follows:** Section 32 of *SARA* prohibits the killing, harming, harassing, capturing or taking of an individual of a wildlife species that is listed as extirpated, endangered, or threatened. Section 33 prohibits the damage or destruction of the residence of an endangered, threatened or extirpated species. Section 58 prohibits the destruction of critical habitat of any listed endangered or threatened species, or of any extirpated species for which a recovery strategy has been recommended. *SARA* defines critical habitat as the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified in the species' critical habitat in the recovery strategy or in an action plan for the species. d) The CSR will be edited to include the North Atlantic right whale to the list of species with recovery strategies**.**	
Follow-up Comment **28-Jan-11**	As a point of clarification, Schedules 2 and 3 of SARA contain species which had been assessed by COSEWIC prior to their adoption of new criteria in 1999. When SARA was proclaimed in 2003, the species in Schedule 2 and 3 were to be re-assessed by COSEWIC using the new criteria. Harbour Porpoise has since been re-assessed by COSEWIC in 2006 using the new criteria (as special concern) and is in the SARA listing process. Sowerby's Beaked Whale has also been re-assessed by COSEWIC in 2006 using the new criteria (as special concern) and is in the SARA listing process. For further information on Schedules 2 and 3 of SARA, please refer to the following link to the SARA Public Registry: http://www.sararegistry.gc.ca/species/default_e.cfm	

	(click "View Schedule 2" or "View Schedule 3" and see the explanatory note at the top of these pages).
EMCP Response 18-Mar-11	Noted.

EMCP Comment 134: DFO 28

134-DFO 28	**EA Reference:**	Section 11.3 - Existing Conditions Page 11-5
Preamble:	There are several items that need to be addressed or revised in Table 11.2.	
Request 7-Sep-10	a) For American Plaice it should be noted that it is the Newfoundland and Labrador population being referred to. b) It is not necessary to refer to the COSEWIC status of species which are listed on Schedule 1 of SARA. c) Earlier in the document (Table 7-2), it mentions that redfish may occur. Since Table 11.2 includes species assessed by COSEWIC, then it should be updated to include Deepwater and/or Acadian Redfish (as applicable) as both these species have been recently assessed by COSEWIC. For Deepwater Redfish, the Gulf of St. Lawrence/Laurentian Channel population was assessed as endangered and the Northern population was assessed as threatened. For Acadian Redfish, the Atlantic population was assessed as threatened and the Bonne Bay population was assessed as special concern. d) Earlier in the document (Section 10.3.3) it mentions that Loggerhead Sea Turtle may occur. This species was recently assessed by COSEWIC as endangered. Table 11.2 should be updated to include this.	
EMCP Response 30-Nov-10	a) Table 11-2 will be revised to reference the Newfoundland and Labrador population for American Plaice. b) Comment noted; however, for consistency in presentation, this text shall remain in spite of its redundancy. c) Table 11-2 will be updated to include the relevant populations of Deepwater Redfish and Acadian Redfish as noted (they are assessed and managed as one population but the Study Area would have Acadian redfish (Atlantic population) and deepwater redfish (northern population)) and text will be added in Section 11.3.1. d) Loggerhead Sea Turtle will be added to Table 11.2 and text will be added in Section 11.3.2.	

EMCP Comment 135: DFO 29

135-DFO 29	**EA Reference:**	Section 11.3.1.1 – Atlantic Cod Page 11-6
Preamble:	Cod was recently re-assessed by COSEWIC and the information in this section needs up-dating.	
Request 7-Sep-10	Revise text to indicate that the Laurentian North population is now assessed as endangered, not threatened.	
EMCP Response 30-Nov-10	Text in Section 11.3.1.1 will be revised to show update in COSEWIC status as of April 2010.	

EMCP Comment 136: DFO 30

136-DFO 30	**EA Reference:**	Section 11.3.1.3 – American eel Section 11.3.1.6 – Grenadier Section 11.3.1.8 – Blue shark Section 11.3.1.11 – White shark Section 11.3.2.4 – Killer whale Section 11.3.2.5 – Harbour porpoise
Preamble:	The same comment applies to all of the above sections. The wording used to describe COSEWIC assessments is inaccurate.	
Request 7-Sep-10	COSEWIC does not "list" species. Where the document indicates that a species is "listed by COSEWIC" the wording should be changed to indicate that a species is "assessed by COSEWIC as…"	
EMCP Response 30-Nov-10	Text will be revised throughout to Section 11.3 as requested.	

EMCP Comment 137: DFO 31

137-DFO 31	**EA Reference**	Section 11.3.2. – Marine Mammals and Sea Turtle Species at Risk, Page 11-25
Preamble:	The recovery strategies published for marine mammals and sea turtles are listed in this section.	
Request 7-Sep-10	It should be noted that there is also a recovery strategy published for the North Atlantic Right Whale.	
EMCP Response 30-Nov-10	**Section 11.3.2 will be revised to reference the recovery strategy for the North Atlantic Right Whale (Brown et al. 2009).** **The following reference will be added:** Brown, M.W., D. Fenton, K. Smedbol, C. Merriman, K. Robichaud-Leblanc and J.D. Conway. 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 + 66 pp.	

2.11 Response to Section 12 Comments

EMCP Comment 138: DFO 32

138-DFO 32	**EA Reference:**	Section 12.4.1 Near shore (Project-Valued Ecosystem Component Interactions), Page 12-13
Preamble:	The scoping document requires the CSR to discuss the environmental effects of the project on sensitive areas. The first paragraph in this section states that, "*These potential effects are fully considered and assessed in the respective VECs (i.e., Marine Fish and Fish Habitat, Marine Birds)*", which implies a complete assessment of all relevant species that may be affected by the development. However, this may not be the case. There are several large (>1000 m^2) productive eelgrass meadows within a 20 km radius of the Bull Arm site. The head of Bull Arm itself is particularly productive, through the presence of eelgrass nursery meadows, pebble-cobble areas, and extensive kelp and algae species, all of which provide cover for a variety of ground fish species, particularly juveniles of several prominent marine commercial species.	
Request **7-Sep-10**	Please revise this section to include the species to be affected by the impacts on these sensitive areas.	
EMCP Response **30-Nov-10**	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 and herring spawn in eelgrass. The environmental assessment of accidental events on marine fish species in the nearshore includes a discussion applicable to most species and is detailed in the Marine Fish VEC in Section 7.5.4. In addition, it is acknowledged that the environmental effect from an accidental event on the habitats is rated as significant.	
Follow-up Comment **28-Jan-11**	The adequacy of this response cannot be assessed until additional oil spill trajectory modelling is received by the department. However, it should be noted that demersal juvenile Atlantic Cod are also likely to be present in eelgrass and should be included in the assessment.	
EMCP Response **18-Mar-11**	Demersal juvenile Atlantic cod presence will also be included in the list. Revisions to Chapter 12 have been undertaken to reflect the results of the revised spill trajectory modelling.	
Follow-up Comment **20-Apr-11**	This response is considered <u>adequate, provided the following comments are addressed:</u> Based on the new information provided in the Bull Arm Nearshore Spill Trajectory Modelling Report, Table 7-14 (Page 7-18 of the "*Hebron Project Comprehensive Study Report*", dated June 2010) appears to have some inaccuracies. Under "*Nearshore Spill*", both the magnitude and geographic extent appear to be understated. Many of the spill trajectory outcomes provided in the new report consisted of hundreds of kilometres of shoreline, which included shallow nursery habitats. The spill model also includes trajectories which appear to encompass several significant habitat areas in some of the stochastic scenarios. The ratings for magnitude and geographic extent should be re-evaluated and revised based on information provided in the new spill model. ExxonMobil's response states that, "*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 and herring spawn in eelgrass.*" Although it is correct that pelagic juvenile Atlantic cod could be present between June and October, it is the recently post-settled demersal juvenile life stage that would be of greatest concern for this species. Please make the appropriate revisions based on this information.	

EMCP Response 17-Jun-11	**Table 7-14 will be revised as noted above.** **The existing text in Section 12.3.1.1 will be revised as follows:** 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. **And the existing text in Section 12.4.1 will be revised as follows:** 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 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.

EMCP Comment 139: DFO 33

139-DFO 33	**EA Reference:**	Section 12.4.1 Near shore (Project-Valued Ecosystem Component Interactions) p. 12-13
Preamble:	The last paragraph on this page states that, "*There is potential for eelgrass beds to be physically affected by an accidental oil spill in the near shore environment during construction, which could result in a change in habitat quality and mortality of individual plants.*" This statement understates a more serious concern, which would be the disruption or destruction of a significant portion of an entire eelgrass meadow. This should also be addressed in Table 12-2 and the environmental effects analysis.	
Request 7-Sep-10	Please revise this section to include the impact an entire eelgrass meadow. IN additional please revise the Section 12.4.3 Summary to reflect these changes.	
EMCP Response 30-Nov-10	According to the literature (Den Hartog and Jacobs 1980; Jewett and Dean 1997; Dean *et al.* 1998), it is unlikely that the entire meadow will be destroyed; it suggests recovery of the eelgrass within two to three years. The environmental effect was not understated as is has been predicted that such an environmental effect could be significant. **The sentence will be revised to the following:** There is potential for eelgrass beds to be physically affected by an accidental oil spill in the near shore environment during construction, which could result in a potential widespread die-off of individual plants.	

Follow-up Comment **28-Jan-11**	The adequacy of this response cannot be assessed until additional oil spill trajectory modelling is received by the department. However, it should be noted that the last part of the sentence should read, "*…which could result in a potential widespread die-off of meadows as well as individual plants.*"
EMCP Response **18-Mar-11**	**The sentence will be revised as follows:** There is potential for eelgrass beds to be physically affected by an accidental oil spill in the nearshore environment during construction, which could result in a potential widespread die-off of meadows as well as individual plants.

2.12 Response to Section 13 Comments

EMCP Comment 140: C-NLOPB 36

140-C-NLOPB 36	**EA Reference:**:	Section 13.4.6 Sea Ice and Icebergs Page 13-7
Preamble:		
Request **7-Sep-10**	What is the duration of the data set that sea ice is based on.	
EMCP Response **30-Nov-10**	The duration of the data is 1983 to 2008 inclusive (CIS Ice Charts). **The text in Section 13.4.6 will be revised as follows:** The Hebron location has experienced sea ice incursions at a rate of one in every four years, with a peak of 14 percent probability centred on two periods, the first in the last week of February and the second on the first week of April. The duration of the incursions vary from a low of one week to a high of seven weeks. Of the 11 years that ice was present, the average duration was three weeks. These statistics are based on Environment Canada CIS's Sea Ice Charts (1983 to 2008). The number of icebergs drifting south of 48°N each year has varied from a low of zero in 1966 and 2006 to a high of 2,202 in 1984, with the average over the last 20 years (using 1989 to 2008 PAL data) ranging between 725 to 752 icebergs. Of these, only a small proportion has passed through the Offshore Project Area. Over the last 10 years, the average annual number of icebergs sighted in the Hebron Offshore Project Area has been 31. The majority (73 percent) of the icebergs south of 48°N fall within the small to medium categories.	
Follow-up Comment **28-Jan-11**	**Response to Comment 140 (p.95 of 152) (pdf p.97):** **The response to comment 140 is incorrect and does not incorporate the requested changes made by CIS on this issue.** The proposed response contains phrases "The duration of the data is 1983 to 2008 inclusive (CIS Ice Charts)." and "These statistics are based on Environment Canada CIS's Sea Ice Charts (1983 to 2008)." These have not been corrected to 1971-2000 as requested. **Regarding this issue, CIS commented that** "After reviewing the data in your graphs (Figures 3-13 and 3-14), it appears that you used the Ice Atlas data from 1971-2000 and not the 25-year 1983-2008 chart data that you mention in the text. **This needs to be corrected in the text and in the Sources listed under the Figures.**"	
EMCP Response **18-Mar-11**	Years 1983 to 2008 are from CIS Ice Charts. Figures 3-13 and 3-14 are derived from Canadian Ice Service 2001. Figure 3-14 will be revised to include: Source: Canadian Ice Service 2001. Section 3.1.4: Does reference 1983 to 2008 from CIS Charts.	

2.13 Response to Section 14 Comments

Comment 141: C-NLOPB 37

141-C-NLOPB 37	**EA Reference:**:	Section 14 Accidental Hydrocarbon Spill Events Page 14-1
Preamble:		
Request 7-Sep-10	a) Statistical background data and its treatment should be in one section and exposure calculations should be in a different section (i.e. Drilling, Production / Maintenance). b) There does not appear to be a discussion of small (<1 bbl) spills.	
EMCP Response 24-Feb-11	a) The statistical background data are used in determining exposure calculations. These exposure calculations are discussed in Sections 14.1.1.1 (Blow-outs during Drilling) and 14.1.1.2 (Blow-outs during Production and Workovers). b) The historical record small spills in NL waters, with categories for "Spills Greater Than 1 L and Less Than 159 L (1 bbl)" and "Spills of 1 L and Less", for the years 1997 through 2009, is presented in Table 14-13. **The text on page 14-13 (June 2010 CSR) will be revised as follows:** The C-NLOPB also provides a statistical record of spills of greater than 1 L but less than 1 bbl (159 L), and of spills of 1 L and less. These are presented in Table 14-13. As in the previous category of spill size, a disproportionate number of these spills occurred in the first three years of operations, so it is reasonable to focus on the more recent years of production experience – *2000 to 2010*. For these years (*2000 to 2010*), there were a total of *452* producing well-years, with *86* spills in the 1 to 159 L category, and *218* spills less than 1 L. Note that the totals in Table 14.3 indicate all spills from 1997 to *2010*.	
Follow-up Comment 19-Apr-11	***C-NLOPB 37 a):*** 1) The original C-NLOPB comment was that "*Statistical background data and its treatment should be in one section and exposure calculations should be in a different section (i.e. Drilling, Production/Maintenance).*" EMPC responded that "The statistical background data are used in determining exposure calculations. These exposure calculations are discussed in Sections 14.1.1.1 (Blow-outs during Drilling) and 14.1.1.2 (Blow-outs during Production and Workovers)." Some additional detail or clarity may be appropriate here. 2) The proponent persists in using qualifying words (ex. unlikely, small) without defining them. This is inappropriate and can only lead to misunderstanding on the part of the public. For example, on page 14-1 the proponent says the following, "*An oil spill could also occur, although unlikely, during offloading and/or transfer of crude oil at the offshore loading system (OLS).*" However, the term " unlikely" is not defined in terms of a probability of occurrence either by activity or for the project life. These types of spills have occurred in C-NLOPB jurisdiction and are not considered a remote possibility by the C-NLOPB. 3) On page 14-7 the proponent writes that there is *"…an extremely low risk of a deep blowout…*" but has not defined what that means. The proponent's calculated probability of a deep blowout is "*9.6 x 10^{-3}, or a probability of 1-in-100*" on page 14-9, followed by "*…the chances of having an hydrocarbon discharge associated with the blowout are extremely low*." The proponent should either clearly define these qualifying words or delete them wherever they occur in relation to spills. 4) EMPC should consider bringing Table 14-3 data into tables in 14.1.1.1 and 14.1.1.2 separately for drilling and production phases (EMPC has improved this table… see EMPC response to comment 148).	

	5) Table 14-2 and Table 14-4 contain general information about spills from blowouts and should be discussed under 14.1.1 rather than 14.1.1.1. However, the information from 14-4 may be brought forward to separate tables under 14.1.1.1 ad 14.1.1.2. 6) In section *14.1.1.1 Blowouts During Drilling* on page 14-8 of the CSR the proponent, in the first paragraph starting on that page (line 5 of the text on that page), begins a discussion of the probability of accidental hydrocarbon spills associated with production, workovers and wireline operations. This discussion continues for 6 paragraphs, is followed by two paragraphs discussing blowout risks during drilling, and then another 3 paragraphs about risks during production. This jumble is difficult to interpret, especially since the discussion of blowout frequency during production and workovers belongs in 14.1.1.2. 7) Is the title of Table 14-7 meant to read "Deep" instead of "Shallow." The discussion in the last paragraph on page 14-7 suggests that Table 14-6 is derived from the data in Table 14-7 and, as such, Table 14-7 and its discussion should precede Table 14-6 and its discussion. 8) Section 14.1.1.2 repeats some of the background "production related" discussion provided in 14.1.1.1. EMPC should rewrite 14.1.1.1 and 14.1.1.2 so that the information is located in the appropriate sections. EMPC should review the production related discussion in 14.1.1.1 and 14.1.1.2 to ensure they are consistent and redundancy is removed. 9) The title of section 14.2 in inappropriate since "Major" is not a word defined by the proponent. The proponent should either use defined terms (see Table 14-2) or qualify the term major in the first sentence of this section (i.e. Major includes spills >1000 bbl) 10) In section 14.1.2, the proponent has relied heavily on MMS OCS data for frequency of spills >1000 bbl. Is there no information available from other sources (i.e. UK and Norwegian North Sea)? 11) The discussion in section 14.1.2 is all brought forward in terms of "spills/well-year" and it is unclear that this includes or excludes spills during drilling which have been expressed in "spills/well". 12) The use of "to present" in the table titles throughout 14.1 is inappropriate as there is some actual cut-off date that the proponent has used for this data. The reader is left to infer this date. 13) In section 14.1.4, the Table 14-14 is confusing and does not effectively summarize the data. The >150,000 bbl class of spills is omitted. It is unclear if the >10,000 bbl class includes the >150,000 bbl class (which it should if the >150,000 bbl class is omitted from the table). The some blowout frequencies are expressed in rate per well drilled while some blowout frequencies and the platform spills are expressed in rate per well-year. The conversion to annualized probability is not easily understood since the "probability over the project life column is omitted". Spills of less than 1 barrel and less than 1 litre are omitted from the table although they will be the most frequent incidents. 14) The last sentence of section 14.1.4 should be deleted. ***C-NLOPB 37 b):*** The original C-NLOPB comment was that "*There does not appear to be a discussion of small (<1 bbl) spills.*" EMPC responded that "The historical record small spills in NL waters, with categories for "Spills Greater Than 1 L and Less Than 159 L (1 bbl)" and "Spills of 1 L and Less", for the years 1997 through 2009, is presented in Table 14-13. **The text on page 14-13 (June 2010 CSR) will be revised as follows:** "The C-NLOPB also provides a statistical record of spills of greater than 1 L but less than 1 bbl (159 L), and of spills of 1 L and less. These are presented in Table 14-13. As in the previous category of spill size, a disproportionate number of these spills

	occurred in the first three years of operations, so it is reasonable to focus on the more recent years of production experience – 2000 to 2010. For these years (2000 to 2010), there were a total of 452 producing well-years, with 86 spills in the 1 to 159 L category, and 218 spills less than 1 L. Note that the totals in Table 14.3 indicate all spills from 1997 to 2010." The section 14.1.3 discussion of spills <1000 barrels is incomplete and the proponents proposed revision of February 22, 2011 is not sufficient. The probability of spills of size range ≤ 1 litre and 1 litre to <1000 litres should be explicitly stated in comparable units (spills/well-year). This information should be included in Table 14-14.
EMCP Response 29-Jul-11	1) Revised Section 14.1 should provide additional clarity. The data are presented in a manner to assess the probability of spills occurring during the life of the Hebron Project. 2) Qualifying words have been removed. 3) The phrase "**the chances of having an hydrocarbon discharge associated with the blowout are extremely low**" has been deleted. 4) The Table has been revised to include Duration and Intervention Method. 5) Table 14-4 provides a listing of small spills in the US GOM and is appropriate for section 14.1.2, which discusses small spills. 6) These paragraphs have been revised. 7) The text is correct as stated. Table 14-6 compares North Sea to U.S., establishing a lower rate for the North Sea and Canada (based on the two-barrier rule). Table 14-7 establishes a decline in rate over time and the subsequent paragraph confirms this and establishes the frequency number to be used for Hebron. 8) The text has been modified to address this comment. 9) The title of Section 14.1.2 has been changed to "Large," which is defined as > 1000 bbl. 10) The MMS OCS data set is more comprehensive than other data sets. Other sources of data do not provide the data to the same level of detail. U.S. statistics are appropriate as there is a comparable level of regulatory scrutiny, and similar practices to those in Canada. 11) The exposure variable used here is well-year, based on the MMS statistics. It does not include drilling-related spills. The text has been modified to note this. 12) Table titles (and data) have been modified to year-end 2010. 13) The table has been revised to include the smaller spill classes. The table summarizes the probabilities for blowouts and includes all spill class sizes. Spill statistics are compiled based on the activities ongoing on a Platform. For the Hebron Platform this includes drilling and producing operations. For drilling operations, blow-out probability estimates are typically expressed as rate-per-well-drilled. For producing operations, spill statistics are typically expressed as rate-per-well-year. For Platform spills, it includes all spill class sizes up to 10,000 barrels. Spills greater than 150,000 barrels are not included as it would duplicate the statistic for blowouts >150,000. See response to Comment C-NLOPB 37 b) (below) regarding very small spills. 14) The last sentence has been deleted ***C-NLOPB 37 b)*** The revised Section 14.1 includes a discussion of small spills referenced in the comment and the summary table (Table 14-15) includes the probability summary for small spills.
Follow-up Comment 16-Aug-11	***C-NLOPB 37 a)*** 2) Response not acceptable. The wording "…the chances of …are very small" has been retained on page 14-17.

	14) Response not acceptable. The sentence has not been deleted. It appears in Section 14.1.2.3.
EMCP Response 24-Aug-11	***C-NLOPB 37 a)*** 2) All instances of 'small,' where used to qualify spills, have been deleted. 14) The sentence now reads "For gas blow-outs that occur during production and workovers that involve some hydrocarbon discharge (>1 bbl), the statistic for Hebron becomes 200 well-years x 1.04 x 10^{-5} blow-outs/well-year, or approximately 0.001 percent probability over the 30-year life of the Project."
Follow-up Comment 30-Aug-11	I don't know where 1.04 x 10-5 blow-outs/well-year comes from. It doesn't match up to any other number in the report. The number in Table 14-15 is 2.8 x 10-5 blowouts per well-year and is not designated as "gas". EMCP should correct this number or clarify the source for this number. In addition, response is mathematically and statistically incorrect. To be responsive, EMCP should insert the following text (numbers corrected appropriately): For blow-outs that occur during production and workovers that involve some hydrocarbon discharge (>1 bbl), the likely number of occurrences is expressed as 200 well-years x 2.8 x 10-5 blow-outs/well-year = 0.0056 likely events.
EMCP Response 8-Sep-11	The value in the table 2.8x10^{-5} is the correct value. When the data was revised, the value 1.04 x 10^{-5} was not corrected to 2.8 x 10^{-5}. The value has been revised in the CSR; see page 14-11 in the attached revised Section 14.1.

Comment 142: C-NLOPB 38

142-C-NLOPB 38	**EA Reference:**:	Section 14 Accidental Hydrocarbon Spill Events Page 14-1
Preamble:	The probability plots for a spill at the Hebron project are presented.	
Request 7-Sep-10	a) The CSR should describe the spill scenario that the model was run on. b) Also in the last paragraph, "The Study" should be referenced.	
EMCP Response 24-Feb-11	**The following text will be added to Section 14.3** a) The Hebron Project modelled a number of scenarios all related to blow-out occurring either at the Hebron Platform or from a MODU under a future expansion opportunity. The scenarios presented in the spill trajectory model consider the rate at which oil could flow under a blow-out scenario; this rate was derived based on existing knowledge of well properties and reservoir data for the Hebron field. A blow-out from the platform (at approximately 70 m above mean sea level) was modelled at a rate of 5,600 m^3/d (approximately 35,000 bbl/d). A subsea blow-out was also modelled in consideration of potential drilling that may occur from a mobile offshore drilling unit (MODU) should expansion opportunities develop. A blow-out from a MODU (subsea blow-out) was modelled at a rate of 3,200 m^3/d (approximately 20,000 bbl/d). ExxonMobil's well control philosophy is focused on prevention using safety / risk management systems, management of change procedures, and global standards. ExxonMobil has a mature Operations Integrity Management System (OIMS) that emphasizes relentless attention to Safety, Well Control, and Environmental Protection. This includes proper preparation for wells (well control equipment inspections / tests), detecting the influx early, closing-in the well efficiently (personnel training / drills), and circulating out the kick with kill weight mud in a controlled manner. In the event of a blow-out, ExxonMobil's primary objective would be to stop the flow as quickly as possible. For both surface and subsea wells, this would involve shutting in at the wellhead and killing the well through the wellhead. Relief well drilling, and the subsequent dynamic kill, is considered a back-up strategy in the event shut-in and/or killing through the wellhead is not possible or is unsuccessful.	

	Two blow-out scenarios were included in the spill trajectory modelling: a platform case and a subsea case. In developing these scenarios the following factors were considered. **Platform Blow-out:** • For a blow-out through a surface wellhead, multiple options are available to stop the flow, depending on the magnitude and composition of the flow, configuration of the blow-out preventer (BOP), and the accessibility of the wellhead. If the wellhead is accessible, capping the well would result in a relatively short flow duration, as surface capping equipment, such as safety valves for inside pipe flow, are maintained on the rig and manual BOP closing is possible. Additionally, industry maintains surface capping equipment. Depending on the scenario, the duration to cap the well and stop flow may be within just a few hours, or if initial attempts are unsuccessful, is estimated at two to three weeks. If a fire renders the platform inaccessible, the most appropriate method to access the well would be evaluated given the condition of the platform and surrounding wells. • If Platform-based well interventions were not successful, the time it would take to secure a drilling unit locally, secure the required well equipment, mobilize the unit it to the Hebron location, and drill a relief well. This duration is estimated to be 100 days in the summer months and 120 in the winter months. If a MODU was sourced internationally additional time would be required. **Subsea Blow-out** • If the subsea wellhead is accessible and the drilling rig is intact, operational, and can work over the wellhead, the rig would be used to cap or kill the well. In this scenario, multiple options exist to kill the well, including wellbore intervention to perform a dynamic kill or to set a packer. In addition, using the existing BOP stack or a capping BOP stack to shut-in the well is also possible. If the drilling rig is intact and the wellbore is accessible, a dynamic kill could take place within days of the blow-out. If it is necessary to assemble and mobilize a capping stack and a second MODU, then a time period of approximately 60 days would be required. If a MODU is available locally and the rig stack can be used as a capping stack, this time period is reduced to 30 days. • If it is not possible to work over the wellhead, or if the wellhead is inaccessible, then a relief well will be required to kill the well. If a MODU was sourced locally, the time it would take to secure a drilling unit locally, secure the required well equipment, mobilize the unit it to the Hebron location, and drill a relief well. This duration is estimated to be 100 days in the summer months and 120 in the winter months. If a MODU was sourced internationally additional time would be required. As stated above, the probability of a blow-out from development drilling or production operations resulting in the need to drill a relief well is extremely low. Therefore, for the purposes of environmental assessment, the environmental impact analysis will focus on a 30-day platform blow-out at a rate of 5,600 m^3/d, and a 100-day subsea blow-out at 3,200 m^3/d. b) The Study will be modified to read **This Section**

Comment 143: C-NLOPB 39

143-C-NLOPB 39	**EA Reference:**:	Section 14 Accidental Hydrocarbon Spill Events Page 14-1
Preamble:	Blow-outs are described as lasting hours, days, or weeks. Blow-outs can last for months and in the Newfoundland and Labrador offshore, mobilization of a drilling unit can likely take weeks to arrive and begin drilling.	

Request **7-Sep-10**	The CSR should not only consider how long it may take to drill a relief well but also the time required to mobilize a rig.
EMCP Response 24-Feb-11	See response provided in 142-C-NLOPB 38
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was that "*The CSR should not only consider how long it may take to drill a relief well but also the time required to mobilize a rig.*" EMPC responded "See response provided in 142-C-NLOPB 38." The spill scenario described in the response to Comment 142 is based on a drilling rig being available locally. The implication from this statement is that the proponent will ensure it has access to a suitable drilling rig through out the life of the project. If a drilling rig will not always be available locally, the proponent should expand the scenario to include the time it would take to secure and for the rig to arrive at location and begin drilling a relief well.
EMCP Response 29-Jul-11	Neither the CEAA nor the RAs have prescribed a blowout scenario in support of environmental assessment. For the purposes of the Hebron Project CSR, the Operator selected a plausible low-probability spill scenario for the purpose of oil spill trajectory modelling. The Proponent concedes that different scenarios could be theoretically contemplated. However, we are confident that the scenario described represents a reasonable basis for undertaking an environmental assessment. The selected scenario should not be interpreted as commitment by the Operator to a specific response plan. The Operator intends to develop, in accordance with regulatory requirements, contingency plans to address offshore spill events.
Follow-up Comment 17-Aug-11	It is possible that there may not be a rig locally available to drill a relief well. EMCP should discuss the scenario where a drill rig would need to be brought in.
EMCP Response 24-Aug-11	As stated in Section 14.3.1, if a MODU was sourced internationally, in addition to the 100-120 day estimate for a locally sourced MODU, additional time would be required to drill the relief well. The following text will be included in the CSR to elaborate on the estimated time required to drill a relief well with an internationally sourced MODU. Section 14.3.1 – Platform Blow-out (second bullet): "If Platform-based well interventions were not successful…***If a MODU was sourced internationally, approximately 144 days in the summer months and 165 days in the winter months would be required to plan and execute the full relief well program***." Section 14.3.1 – Seafloor Blow-out (second bullet): "If it is not possible to work over the wellhead… ***If a MODU was sourced internationally, approximately 144 days in the summer months and 165 days in the winter months would be required to plan and execute the full relief well program***." Section 14.3.4 Summary: ***In situations where a MODU would need to be internationally sourced to drill a relief well (up to approximately 165 days to stop flow in winter months), a larger volume of oil would be potentially released into the water, if no other mitigations were implemented. The potential environmental impacts to Newfoundland waters and shores, including the Grand Banks, would be similar to the cases described above. Surface oil would take approximately 30 to 60 days to reach 40.00.0^{o}W, with less than 10 percent probability that small amounts of weathered oil will reach Newfoundland shorelines.***

Comment 144: EC 49

144-EC 49	**EA Reference:**:	Section 14 - Accidental Hydrocarbon Spill Events
Preamble:	Section 5.3.4.3 of the Scoping Document clearly states that the EA will consider quantification of risk of hydrocarbon / chemical spills of all volumes, from all facilities associated with the project. Section 14 highlights the potential for discharges from the OLS but none are discussed.	
Request 7-Sep-10	There have been at least 6 incidents in 2008-2009 of spills involving the OLS from the 3 active oil fields off Newfoundland. The proponent should quantify the risk associated with potential incidents involving the OLS.	
EMCP Response 24-Feb-11	**The following replaces Section 14.1.3, added / changed text is *italicized*.**	

14.1.3 Platform Spills Involving Small Discharges

Small spills occur with some regularity at offshore platforms. The data in Table 14-10 are derived from a more detailed table in MMS (1997) and covers small spills of all pollutants from facilities and operations on Federal OCS leases from the period 1971 to 1995. The spills involved various pollutants including crude oil, condensate, refined product, mineral oil and diesel. The period between 1971 and 1995 involved the production of 8.5 billion bbl of oil and condensate and 186,058 well-years of oil and gas production activity (MMS 1997). See Table 14-10 for the spill frequency.

Table 14-10 Frequency of Platform Spills in the Ranges of 1 to 49.9 bbl and 50 to 999 bbl (US OCS 1971 to 1995)

Spill Size Range	Number of Spills
1 to 49.9 bbl	1,898
50 to 999 bbl	90
Total volume of 1898 + 90 spills = 123,023 bbl	

There have been very few large spills related to development or production in Canadian waters, which has necessitated the use of US and world-wide statistics. However, there is a reasonably-sized database on small spill incidents in Newfoundland and Labrador waters. Spill statistics are maintained and reported by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) (C-NLOPB 2010).

Production in Newfoundland waters commenced in 1997 at the Hibernia location, with Terra Nova coming on stream in 2001 and White Rose in 2004. Using the well statistics on the C-NLOPB website, these three fields have a total of *472* producing well-years to the end of 2010. An overview of spill statistics for the Newfoundland and Labrador Offshore Area *are provided in Table 14-11 to 14.14. The spill incidents involving 1 bbl or more of hydrocarbon during that period are listed in Table 14-11. These spills include spills of crude, diesel and other hydrocarbons resulting from production and loading operations. Spills of synthetic-based muds (SBMs) are provided in [new] Table 14.14. As noted in Section 4.1.2, there was one crude spill of greater than 1,000 bbl, in 2004.*

Table 14-11 Frequency of Platform Spills in the Ranges of 1 to 49.9 bbl and 50 to 999 bbl (Newfoundland Waters, 1997 to present)

Spill Size Range	Number of Spills
1 to 49.9 bbl	*12*
50 to 999 bbl	*0*

A disproportionate number *(7 of 12)* of these spills occurred in the first three years of operations, so it is reasonable to focus on the more recent years of production experience (Table 14-12). For the years 2000 to *2010*, there were a total of *452* producing well-years.

Table 14 12 Frequency of Platform Spills in the Ranges of 1 to 49.9 bbl and 50 to 999 bbl (Newfoundland waters, 2000 to present)

Spill Size Range	Number of Spills
1 to 49.9 bbl	*5*
50 to 999 bbl	*0*

For the smallest size range, statistics from Newfoundland and Labrador operations can be used, but as there have been zero spills in the second category, US GOM statistics will be used. *Based on this, the frequency of spills in the range of 1 to 49.9 bbl is 1.1 x 10^{-2} (5/452), and for the range 50 to 999 bbl is 4.8 x 10^{-4} (90/186,058).*

This will change the entry in Table 14-14 (now Table 14-15), item 11:

11. Hydrocarbon spill 1 to 49 bbl	*1.1 x 10^{-2}*/well-year	200 well-years	one in *14*

Just considering spills from the offshore loading systems for all production facilities, from 1997 to 2010, there were 14 spills greater than 1 L. Of these, one was in the range of 1 to 49.9 bbl, none in the 50 to 999 bbl range, and none greater than 1,000 bbl.

Follow-up Comment 19-Apr-11	The original C-NLOPB comment was that "*There have been at least 6 incidents in 2008-2009 of spills involving the OLS from the 3 active oil fields off Newfoundland. The proponent should quantify the risk associated with potential incidents involving the OLS*." The proponent has not quantified the risk associated with spills from the OLS in units comparable to other parts of Section 14 (spills/well-year). They have not expressed a likelihood of such spills over the life of the project.
EMCP Response 29-Jul-11	OLS spills are now included in Section 14.1, but are not included in the "predictive" analysis. It is difficult to make predictive analyses with a very small data set (one spill greater than 1 bbl, zero spills greater than 1,000 bbls, and 14 spills greater than 1 l, as per C-NLOPB spill statistics up to 2010).
Follow-up Comment 16-Aug-11	Response not acceptable. The July 20th response and the text in the revised Section 14.1 are different (i.e. 14 spills greater than 1 l and 10 spills greater than 1 l).
EMCP Response 24-Aug-11	The reference to 14 spills in the Response Document was the cumulative total of all spills in the "greater than one litre" category up to 2010 and was not meant to be a contradiction to the text in Section 14.1. The text in Section 14.1.4 regarding number of OLS spills greater than one litre is correct.
Follow-up Comment 30-Aug-11	The intent here is to discuss spills from the OLS in use off Newfoundland and Labrador. I count 10 spills >1 litre from offloading systems to the end of 2009. The text in Section 14.1.4 regarding number of OLS spills greater than one litre is correct.
EMCP Response 8-Sep-11	The text in the August 2011 track changes version clearly shows that the text reflects the 10 spills> 1 litre. See page 14-14 in the attached revised Section 14.1.

Comment 145: EC 50

145-EC 50	**EA Reference:**: Section 14 - Accidental Hydrocarbon Spill Events
Preamble:	Section 5.3.4.3 of the Scoping Document clearly states that the EA will consider quantification of risk of hydrocarbon / chemical spills of all volumes, from all facilities associated with the project. Hydrocarbons must not be limited to crude oil, but also include synthetic / oil based drilling fluids and refined hydrocarbons.
Request 7-Sep-10	Releases of drilling fluids has been an issue in the past in the Newfoundland offshore, the proponent should quantify the risk associated with these potential incidents as well as with refined products as stated in the scope.

EMCP Response 24-Feb-11	**To be added as Section 14.1.4, with "Summary …" becoming Section 14.1.5:** *The C-NLOPB records spills of SBM and fluids, and these are summarized in Table 14-14 for the years 1997 through 2010. In the largest such spill to date, in 2004, approximately 96,600 L (608 bbl) of SBM were spilled from the diverter line of the GSF Grand Banks at the White Rose location. The spill frequency is calculated based on the 219 wells spudded during this period.* ***Table 14-14: Spills of Synthetic-based Muds, 1997 to 2010***

Spill Size Range	*Number of Spills*	*Frequency, per well*
>1 L	*36*	*0.16*
159 to 7,934 L (1 to 49.9 bbl)	*18*	*0.082*
7,935 to 159,000 L (50 to 999 bbl)	*5*	*0.023*
>159,000 L (1000 bbl)	*0*	*0*

Comment 146: C-NLOPB 40

146-C-NLOPB 40	**EA Reference:**:	Section 14.1 Hydrocarbon Spill Probabilities Page 14-2
Preamble:		
Request 7-Sep-10	Is the concept safety analysis (CSA) being prepared. The spill / blow-out frequency estimates from the CSR should agree with the CSA. The data on wells drilled with ExxonMobil as operator from 1999-2009 should be presented to give a snapshot of spill / blow-out performance.	
EMCP Response 24-Feb-11	a) The CSA and CSR have been reviewed to ensure there is consistency regarding frequency of spills / blow-outs. The spill probability analysis presented in the CSR is consistent with the probability analysis presented in the CSA. b) As reported by the C-NLOPB and C-NSOPB, since 2001, ExxonMobil drilling operations in eastern Canada have not had a reportable spill greater than 1 bbl for the 63 wells drilled in the region. There were 14 wells drilled with a jack-up drilling unit in Nova Scotia, 46 wells were drilled from the Hibernia Platform, and three wells were drilled from floating mobile offshore drilling units in Nova Scotia and on the Grand Banks. In the Newfoundland and Labrador offshore area, ExxonMobil has not had a crude spill greater than one litre associated with its drilling operations. ExxonMobil's well control philosophy is focused on prevention using safety / risk management systems, management of change procedures, and global standards. ExxonMobil has a mature Operations Integrity Management System (OIMS) that emphasizes relentless attention to Safety, Well Control, and Environmental Protection. This includes proper preparation for wells (well control equipment inspections / tests), detecting the influx early, closing-in the well efficiently (personnel training / drills), and circulating out the kick with kill weight mud in a controlled manner. Defining "blow-out" as an uncontrolled flow that was not brought under control using the rig's well control system, the last offshore drilling "blow-out" experienced by Exxon was in the GOM in 1983 (Penrod 52 jackup rig). The last offshore "blow-out" was experienced by Mobil in the North Sea in 1990 (*Maersk Vinlander* semisubmersible rig). Both were shallow gas "blow-outs" with no personnel injuries or release of liquid hydrocarbons to the sea. ExxonMobil has had other well control incidents, but were safely brought under control using well control equipment and procedures. None escalated into "blow-outs". Since the implementation of OIMS (circa 1992), neither Exxon nor ExxonMobil have experienced a "blow-out" during offshore drilling operations.	
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "Is the concept safety analysis (CSA) being prepared. *A) The spill/blow-out frequency estimates from the CSR should agree with the CSA.*	

	B) The data on wells drilled with ExxonMobil as operator from 1999-2009 should be presented to give a snapshot of spill/blow-out performance. Response a) is acceptable. The C-NLOPB will review CSR and CSA for consistency. Response b) should be incorporated into Section 14 of the CSR.
EMCP Response 29-Jul-11	A) Noted. We compared the probability analysis in both reports and offer the following comparison. A similar analysis on blowout frequency was undertaken in the Part 2 document of the Development Plan - the Concept Safety Analysis (CSA). There are some differences in the data presented in the CSA compared to the CSR, primarily related to a basic difference in their objectives. The purpose of the CSA is to provide a safety assessment, and therefore includes separate blowout frequencies for the drilling phase, the production phase, and for various unit well operations (i.e., completions, workovers, wirelining) during production. The main data source is IAOGP (2010), which summarizes North Sea and worldwide accident statistics. The focus of the accident analysis in the CSR was on the environmental threat of drilling and production operations, and provides estimated frequencies of spills during drilling and production operations. The frequencies are expressed for various spill sizes as spill magnitude and is of interest for spill impact assessment. IAOGP (2010) does not provide a breakdown of accidents by spill size, so various other data sources are used. The following provides a brief comparisons between the two analyses. **Accidents during Development Drilling**: Based on data in IAOGP (2010), the CSA estimates a blowout frequency of 4.8×10^{-5} per well drilled for Non-HPHT (high pressure, high temperature) Oil Wells. This compares well with the data presented in the CSR, based on Scandpower (2000) and Scandpower (2006); therefore, the same frequency is used in the CSR for the overall frequency of blowouts during development drilling. **Accidents during Drilling Categorized by Spill Siz**e: The data contained in IAOGP (2010) does not allow such a breakdown per spill size; therefore, the analysis in the CSR is based on the overall blowout record worldwide. This analysis is likely conservative, as it is not restricted to operations conducted according to what is referred to in the CSA as the North Sea Standard (which is observed in Canada) and does not reflect declining spill rates in recent decades. The data indicate a spill frequency during development drilling of 7.5×10^{-5} per well drilled with a spill volume of greater than 10,000 barrels, and 3.0×10^{-5} per well drilled for greater than 150,000 barrels. This is similar to the overall blowout frequency of 4.8×10^{-5} per well drilled and is likely conservative for the reasons stated above. **Accidents during Production Categorized by Spill Size**: The CSA contains data from IAOGP (2010) with accident frequencies per unit operation, but with frequencies expressed per operation (*i.e.*, per well completed, per workover, per wireline job). For the analysis in the CSR, the raw data in IAOGP (2010) is combined and averaged over the entire record of well years, and indicates a total blowout frequency of 1.85×10^{-4} blowouts per well year as a result of these unit operations. For production / workover blowouts per spill size, actual worldwide accident statistics are used to estimate 2.0×10^{-5} accidents per well-year with a spill volume of greater than 10,000 barrels, and 8.0×10^{-6} per well-year for greater than 150,000 barrels. Again, this probability is likely conservative for the reasons stated in the previous paragraph. B) The CSR will include the text, as referenced in the comment, in Section 14.

Comment 147: C-NLOPB 41

147-C-NLOPB 41	**EA Reference:**:	Section 14.1.1 Blow-outs Page 14-3, Table 14-2
Preamble:		
Request 7-Sep-10	Please provide the reference for the definitions in Table 14-2. Also, SI units (i.e. m^3) should be used and intervals should be reported as ranges (i.e. large = >1000 bbl to <10,000 bbl).	
EMCP Response 24-Feb-11	Table 14-2 provides a description of the sizes of oil spills discussed in the CSR. These size categories were established by the US Bureau of Ocean Energy Management, Regulation and Environment (formerly MMS) in its early work on spill risk (Anderson and Labelle 2001). **Table 14-2 will be revised as follows:** **Table 14-2 Definition of Hydrocarbon Spill Sizes**	

Hydrocarbon Spill Type	Spill Size	
	bbl	m^3
Extremely Large	>150,000	*23,850*
Very Large	10,000 to 150,000	*1,590 to 23,850*
Large	1,000 to 10,000	*159 to 1,590*
Small	1 to 1,000	*0.159 to 159*

Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*Please provide the reference for the definitions in Table 14-2. Also, SI units (i.e. m3) should be used and intervals should be reported as ranges (i.e. large = >1000 bbl to <10,000 bbl).*" The response should be incorporated into Section 14 of the CSR.
EMCP Response 29-Jul-11	The text (and table) have been incorporated into the CSR.

Comment 148: C-NLOPB 42

148-C-NLOPB 42	**EA Reference:**:	Section 14.1.1 Blow-outs Page 14-3, Table 14-3
Preamble:		
Request 7-Sep-10	Is this data set up to date? Table does not appear to be broken down by classes set out in Table 14-2.	
EMCP Response 24-Feb-11	**Table 14-3 will be updated as follows:** **Table 14-3 Historical Very Large Hydrocarbon Spills from Offshore Oil Well Blow-outs**	

Area	*Reported Spill Size (bbl)*	*Date*	*Operation Underway*	*Duration (days)*
Extremely Large Spills (>150,000 bbl)				
US, Gulf of Mexico (GOM)[A]	*4,000,000*	*2010*	*Exploration drilling*	*91*
Mexico (Ixtoc 1)[B]	*3,000,000*	*1979*	*Exploratory Drilling*	*293*
*Dubai****	*2,000,000*	*1973*	*Development Drilling*	*??*
Iran[C]	*see note*	*1983*	*Production*	*--*
Mexico	*247,000*	*1986*	*Workover*	*??*
Nigeria	*200,000*	*1980*	*Development Drilling*	*14*
North Sea / Norway	*158,000*	*1977*	*Workover*	*7*
Very Large Spills (10,000 to 150,000 bbl)				

Iran	*100,000*	*1980*	*Development Drilling*	*8*
US, Santa Barbara	*77,000*	*1969*	*Production (platform)*	*11*
Saudi Arabia	*60,000*	*1980*	*Exploratory Drilling*	*8*
Mexico	*56,000*	*1987*	*Exploratory Drilling*	*51*
US, S. Timbalier 26	*53,000*	*1970*	*Wireline*	*138*
US, Main Pass 41	*30,000*	*1970*	*Production (platform)*	*49*
Australia[D]	*30,000*	*2009*	*Development drilling (primarily gas)*	*74*
US, Timbalier Bay / Greenhill	*11,500*	*1992*	*Production*	*11*
Trinidad	*10,000*	*1973*	*Development Drilling*	*4*

Source: Gulf 1981, updated to present by reference to the Oil Spill Intelligence Report and other sources

[A] Varying estimates of spill volume, most recent estimate reported

[B] Spill volume widely believed to be underestimated

[C] The Iranian Norwuz oil well blow-outs in the Gulf of Arabia, which started in February 1983, were not caused by exploration or drilling accidents, but were a result of military actions during the Iraq / Iran war

[D] Currently under investigation, spill volume is best estimate and may be subject to revision

Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*Is this data set up to date? Table does not appear to be broken down by classes set out in Table 14-2.*" The response should be incorporated into Section 14 of the CSR.
EMCP Response 29-Jul-11	The text (and table) have been incorporated into the CSR.

Comment 149: C-NLOPB 43

149-C-NLOPB 43	**EA Reference:**:	Section 14.1.1.1 Blow-outs during Drilling Page 14-4, 1st paragraph
Preamble:		
Request 7-Sep-10	Please review for agreement with Table 14-3	
EMCP Response 24-Feb-11	**Section 14.1.1 (last paragraph) text will be revised:** Using the definition of "extremely large" spills (i.e., hydrocarbon spills 150,000 bbl in size or greater), there have been *six* such spills in the history of offshore drilling, two of which occurred during development drilling, and two of which occurred during production or workover activities; *and two occurred* during exploration drilling.	
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*Please review for agreement with Table 14-3.*" The response should be incorporated into Section 14 of the CSR.	
EMCP Response 29-Jul-11	The text has been incorporated into the CSR.	

Comment 150: C-NLOPB 44

150-C-NLOPB 44	**EA Reference:**:	Section 14.1.1.1 Blow-outs during Drilling Page 14-4
Preamble:		
Request 7-Sep-10	Data are poorly referenced. Please refer to Chevron work for that year. The data should be better documented or links to all base data should be provided for verification.	

EMCP Response 24-Feb-11	**The first two paragraphs of Section 14.1.1.1 will be replaced with following:** Spill frequencies are best expressed in terms of a risk exposure factor such as number of wells drilled. On a world-wide basis an estimated that 66,469 offshore development wells were drilled as of May 2010 (Deloitte 2010). There have been two extremely large spills during offshore development drilling, so the frequency up to the present is (2/66,469) 3.0 x 10^{-5} spills per well drilled or one such spill for every 33,000 wells drilled. A similar analysis can be done for very large spills. Up to the present, five development-drilling blow-outs have produced spills in the very large spill category (Table 14-3, including the recent incident in Australia). The spill frequency for these is (5/66,469) 7.5 x 10^{-5} spills per well drilled or one such spill for every 13,000 wells drilled. **The following reference will be added:** Deloitte Petroleum Services. 2010. *List of Offshore Petroleum Wells to May 31, 2010*. Report generated on request from Deloitte LLP. London, England. ***** **Note that this will change the calculations in the text (two bullet points, page 14-9):** • Predicted frequency of extremely large hydrocarbon spills from blow-outs during a drilling operation, based on an exposure of wells drilled: 40 x 3.0 x 10^{-5} = 1.2 x 10^{-3}, or a 0.12 percent chance over the drilling period • Predicted frequency of very large hydrocarbon spills from drilling blow-outs based on an exposure of wells drilled: 40 x 7.5 x 10^{-5} = 3.0 x 10^{-3} or a 0.30 percent chance over the drilling period ***** **This will also change the entries in Table 14-14 (now Table 14-15), items 4 and 5:** 4. Development drilling blow-out with hydrocarbon spill > 10,000 bbl | 7.5 x 10^{-5}/wells drilled | 40 wells drilled | one in 10,000 5. Development drilling blow-out with hydrocarbon spill > 150,000 bbl | 3.0 x 10^{-5}/wells drilled | 40 wells drilled | one in 25,000 **This will also change the text following Table 14-14 (now Table 14-15):** Over the 30-year life of the Project, the annual probability of this happening is *1-in-25,000* for the extremely large spill; and *1-in-10,000* for a very large spill.
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*Data are poorly reference. Please refer to Chevron work for that year. The data should be better documented or links to all base data should be provided for verification.*" The response should be incorporated into Section 14 of the CSR.
EMCP Response 29-Jul-11	The text has been incorporated into the CSR.

Comment 151: GF 27

151-GF 27	**EA Reference:**:	Section 14.1.1.1 Blow-outs during drilling Page 14-7
Preamble:	"The reason for this, according to Scandpower (2000), is that North Sea operators are required by law to always have two barriers during exploration and development drilling, and this is not the case in the US. Regulations similar to the North Sea's apply in Canada (i.e., two barriers), so it is fair to derive blow-out frequencies for Canada on the basis of North Sea statistics*."*	
Request 7-Sep-10	The specific guidelines for a two-barrier requirement in Canada should be referenced in this statement.	

EMCP Response 24-Feb-11	The following text will be added to Section 14.1.1.1 Section 36 paragraph (2) of the *Newfoundland Offshore Petroleum Drilling and Production Regulations* states that "After setting the surface casing, the operator shall ensure that at least two independent and tested well barriers are in place during all well operations." It is the Operator's intention to adhere to all requirements for Well Control and regulatory requirements.

Comment 152: C-NLOPB 45

152-C-NLOPB 45	**EA Reference:**:	Section 14.1.1.1 Blow-outs during Drilling Page 14-7, Table 14-7
Preamble:	The blow-out risk frequency for Hebron will be calculated as per Scandpower (2000) as the average of the four frequencies provided in Table 14-7 yielding an adjustment factor. The statistical basis for derivation of the adjustment factor is not explained or understood. The CSR should use a more rigorous statistical analysis to show a decreasing trend over time. The data set used for analysis ends at 2000. There is potentially 9 more years of data that could be included in the data set for analysis.	
Request 7-Sep-10	The CSR should expand the data set used for blow and spill analysis to include data as close to 2010 as possible. Also, the statistical analysis showing that population is different statistically should be provided.	
EMCP Response 24-Feb-11	**The last two paragraphs on page 14-7** The blow-out risk frequency for Hebron …… On the basis of the above analysis, ……. **will be replaced with:** A more recent analysis by Scandpower (2006), summarized in IAOGP (2010), confirms the reduced frequencies in recent years. The data, based on the 20-year record to 2005, indicate a deep blow-out frequency of *4.8 x* 10^{-5}. Using this figure results in a probability of one blow-out for every *21,000* wells drilled. For a drilling program involving 40 wells, this statistic yields a deep well blow-out probability of approximately *1-in-520*. ***** **This will change item 1 in Table 14-14 (now Table 14-15):** 1. Deep gas blow-out during development drilling | *4.8 x* 10^{-5}/wells drilled | 40 wells drilled | one in *16,000* ***** **This will also change 7th paragraph, page 14-9:** In summary, the probability of having a deep blow-out is a *0.02* percent chance (1-in-*520*), with virtually no chance of hydrocarbon release. During production, the risk of having a gas blow-out will decrease to a *1-in-1,300* chance per year; and gas blow-outs involving small amounts of discharged hydrocarbon (>1 bbl) would be expected once every 14,000 years. **The following references will be added:** Scandpower Risk Management AS. 2006. *Blow-out and Well Release Frequencies – based on SINTEF Offshore Blow-out Database, 2006*. Report No. 90.005.001/R2. IAOGP (International Association of Oil & Gas Producers). 2010. *Blow-out Frequencies*. Report No. 434-2.	
Follow-up Comment 19-Apr-11	a) The original C-NLOPB comment was "*The CSR should expand the data set used for blow and spill analysis to include data as close to 2010 as possible. Also, the statistical analysis showing that population is different statistically should be provided.*" Page 4 of the Scandpower (2006) report states; "The time period in focus is 01.01.84 - 31.12.03 for the frequency calculations." The proponent has improved the data set by	

	including two more years of data. There is potentially an additional 7 years of data that could have been included in the analysis. The proponent has not satisfactorily addressed the request to expand the data set to include data as close to 2010 as possible. b) The Scandpower report cited does not address, nor has the proponent in its response explained the statistical basis on which the adjustment due to trend is based. Without an understanding of the basis for trend adjustment based on years it is difficult to see how the formula can be used to show there is a decreasing trend. As per the request, the proponent should provide supporting information or conduct a documented statistical analysis to show a decreasing trend. A documented statistical analysis is one which shows the mathematical and statistical basis on which the analysis is based. c) The proponent states in their response that: "A more recent analysis by Scandpower (2006), summarized in IAOGP (2010), confirms the reduced frequencies in recent years." The proponent should reference exactly where in the cited documents that this conclusion is made. A definite conclusion of reduction of frequencies was not found in either document. d) Please properly reference where the statement: "The data, based on the 20-year record to 2005, indicate a deep blow-out frequency of 4.8 x 10^{-5}.", is in the reports. Whenever figures or statistics are quoted, they need to be properly referenced as to not only the source but also the page number in that source. The proponent states: "Using this figure results in a probability of one blow-out for every 21,000 wells drilled." What figure is being referred to and where does the one in 21,000 come from? e) How is the 1-in-520 probability derived? Either quote the source where the figure is obtained or show how the probability was derived. f) How did the proponent arrive at 1/16,000 for item one of table 14-5? g) What is meant by "virtually no chance of hydrocarbon release?"
EMCP Response 29-Jul-11	a) The data have been updated to include Scandpower (2006), as summarized in IAOGP (2010). The data are based on the 20-year record to 2005. These are the most recent data available, as referenced in the IAOGP (2010). b) Reference to this trend has been removed. The prediction is based on the 20-year record to 2005, summarized in IAOGP (2010). c) Reference to this trend has been removed. The prediction is based on the 20-year record to 2005, summarized in IAOGP (2010). d) **Reference**: International Association of Oil & Gas Producers. 2010. Blowout frequencies. Report No. 434-2. Page 3. The above reference will be noted in the CSR text as a footnote. One in 21,000 is the inverse of 4.8 x 10^{-5}, as stated in the text. e) One in 520 is 1-in-21,000 times 40 (wells), as stated in the text. f) The table has been revised to include the life of Project probability and not the annual probability. g) This text has been deleted.
Follow-up Comment 16-Aug-11	**a)** The proponent has adopted a probability of occurrence of 4.5 x 10 exp (-5) per well drilled (see page 14-10 of the CSR). This number is taken from the OGP Report No. 434-2 published March 2010 (see page 3 of that document) and is for operations of North Sea standard. This frequency is based on Scandpower Report No. 90.005.001/R2 published 2006. OGP Report No. 434-2, on page 7 and 8 states that the Scandpower Report No. 90.005.001/R2 uses the most recent 20 years of data available; that their report

	explains how the analysis is done; that they eliminate irrelevant incidents; and that they make an adjustment for trend over time. The proponent has indicated that the "reference to trend has been removed" and "prediction is based on the 20 year record to 2005..." but this is clearly not consistent with OGP document Report No. 434-2 which indicates that Scandpower adjusts for trend. C-NLOPB's April 19, 2011 comment indicated that Scandpower Report No. 90.005.001/R2 does not address, nor has the proponent explained, the statistical basis for the trend adjustment. **b)** The proponent has not indicated whether or not Scandpower Report No. 90.005.001/R2 is the most recent available from Scandpower (although OGP states that Scandpower reviews this data annually). The proponent should determine whether or not there is a more recent report available from Scandpower. **c)** Having the most recent Scandpower report in hand, the proponent should: (1) Determine the most recent probability of occurrence applicable; and (2) Either discuss the methodology used by Scandpower to adjust for trend (including the mathematical/statistical basis for determining the trend), or compare the adjusted and unadjusted frequencies to determine relevance.
EMCP Response 24-Aug-11	**a)** The "reference to trend has been removed" refers to an earlier version of the document, which included the use of an apparent decline in frequency that was not supported by any statistical analysis. As per the April 2011 comments, the use of and reference to this trend was removed. The document that is now referred to, Scandpower Report No. 90.005.00100, does indeed note that the data has an, "adjustment due to trend over time. " However, this simply refers to their updating of data to reflect the most recent set of 20-year data. The above-quoted statements are not inconsistent with the OGP document. **b)** The OGP report is the most recent available. Scandpower has been contacted to determine if a more recent version of their report is available, but the present indication is that the 2006 report is the most recent, although they do indeed review the data annually. **c)** The OGP report provides a good summary of the number of incidents and the exposure variable (depending on the application, the number of wells drilled, the number of well years, etc.) and makes a simple division to produce a frequency. There is no statistical manipulation of the data. Therefore, in reference to the above responses, the probability analysis included in the CSR is up-to-date and valid, based on the assumptions listed.
Follow-up Comment 30-Aug-11	The OPG report simply cites data from the 2006 Scandpower for standard North sea systems and SINTEF's analysis for non-North Sea Standard systems. As the Proponent uses the Scandpower data from the OPG report, the Proponent should just cite the Scandpower report from which the data is obtained. The proponent should also use the most recent Scandpower report which is 2010, and as needed update statistics, the discussion of the statistics and predicted effects to reflect the more recent data. The Proponent should also use Scandpower statistics that have not been adjusted for possible trends in this analysis.
EMCP Response 8-Sep-11	The Scandpower 2006 report is not the reference for the data in Section 14.1. Rather the CSR references the data from the IAOGP 2010 report, which in turn references the 2006 Scandpower data. To reduce confusion, reference to Scandpower 2006 has been removed and only IAOGP 2010 is referenced. EMCP and its contractors do not have access to the Scandpower 2006 report. The only data used in the CSR is that which is publicly available. The IAOGP 2010 was the most recent data available when Section 14.1 was developed, and still is the only up-to-date publicly available data. EMCP does not have access to the Scandpower 2010 report, as is it not publicly available. However, in support of its application for an Operations Authorization for

	platform drilling and production activities, EMCP will review any new publicly available spill frequency data and report its findings to the C-NLOPB.
Follow-up Comment 9-Sep-11	The reference and data used in the initial CSR submission, June 2010, was Scandpower 2000. A description of Scandpower's methodology for adjustment for trend is found at the bottom of page 14-7 of the CSR. EMCP's February 2011 response to the C-NLOPB's initial comment was to change the reference to Scandpower's 2006 report and add the 2010 OGP report. EMCP's latest response is "EMCP and its contractors do not have access to the Scandpower 2006 report." EMCP has referenced material in the CSR for which it has not read and not understood the basis on which the data contained in the report is derived. The referencing of material that was not reviewed, and the basis and validity of the data provided not understood, is not appropriate. The 2010 OGP report now referenced, repeats Scandpower's data. The data of the OGP report includes data that has been adjusted for trend. Section 4.1 of the OGP report states: "Scandpower [2] annually review the SINTEF database … They use the most recent 20 years 'data available. Their report explains how the analysis is done, however two key elements of this are: • Elimination of irrelevant incidents; and • Adjustment due to trend over time". The OGP report includes data that has been adjusted for trend; the data has been manipulated to adjust for trend; the data of the OGP report is not a simple division to produce a frequency. The proponent should understand how the data was derived and whether it is a valid statistical approach. When the CSR is submitted, EMCP should be satisfied that the CSR reflects the best available data for blowout frequencies. In support of the application for an Operations Authorization for Hebron the proponent should provide a revised blowout frequencies section of the CRS that reflect data available at the time of the application. This information should also be made available to the public.
EMCP Response 12-Sep-11	As discussed with C-NLOPB staff on September 12, 2011 regarding the recent comments on Section 14.1, the spill frequency data presented in the CSR represents the most recent publicly available data. The source of the spill frequency data for deep blow-outs is IAOGP 2010, as referenced in the CSR. No other source is used for this data set. EMCP is confident that the data presented in the report accurately represents the global spill frequency data available in the public domain. As indicated in our September 8, 2011 response, at the time of application for an Operations Authorization for platform drilling and production activities, EMCP will review any new publicly available spill frequency data and report its findings to the C-NLOPB.

Comment 153: C-NLOPB 46

153-C-NLOPB 46	**EA Reference:**:	Section 14.1.1.1 Blow-outs during Drilling Page 14-8
Preamble:		
Request 7-Sep-10	Previously mentioned statistical testing is required to allow use of 0.51 factor and 64% as a useable ratio.	
EMCP Response 24-Feb-11	**The second and third paragraph following Table 14-8, page 14-8:** Again, as was done earlier for ….. A certain percentage of the blow-outs .... **Will be replaced with:**	

	A more recent analysis by Scandpower (2006), summarized in IAOGP (2010), does not allow a comparison for each of the operations listed in Table 14-8, but confirms the overall blow-out frequency for production, wireline operations, completions and workovers in recent years. The data, based on the 20-year record to 2005, indicate an overall blow-out frequency for these operations of 1.85 x 10^{-4}, based on 33 incidents over 177,474 well-years. A certain percentage of the blow-outs involved some discharge of hydrocarbon. Of the 78 blow-outs that occurred during the four operations of production, wirelining, workovers and completions, only 12, or 15.4 percent, involved hydrocarbon (note that the average size of the 12 spills was only 72 bbl). Therefore, the frequency of blow-outs that produced a hydrocarbon spill from well blow-outs during the four above-noted operations is calculated to be 0.154 x 1.85 x 10^{-4} = 2.8 x 10^{-5} blow-outs/well-year. ***** **This will change items 2 and 3 in Table 14-14 (now Table 14-15):** 2. Gas blow-out during production | 1.85 x 10^{-4}/well-years | 200 well-years | one in 810 3. Blow-out during production involving some hydrocarbon discharge >1 bbl | 2.8 x 10^{-5}/well-years | 200 well-years | one in 5,300
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*Previously mentioned statistical testing is required to allow use of 0.51 factor and 64% as a useable ratio.*" See response to Comment 152.
EMCP Response 29-Jul-11	The reference "0.51 factor and 64%" have been removed.

Comment 154: C-NLOPB 47

154-C-NLOPB 47	**EA Reference:**:	Section 14.1.1.1 Blow-outs during Drilling Page 14-9
Preamble:		
Request 7-Sep-10	The calculations here may be supported in the data but the presentation is not easily followed (i.e. A table corresponding to classes in Table 14-2 with frequency numbers). The probability of a gas blow-out is 0.0234 over life of project. 1 in 1,300 per year is a bit disingenuous.	
EMCP Response 24-Feb-11	Table with historical frequency, Hebron exposure, and probability is presented as a summary, Table 14-14 (now Table 14-15). **The text on page 14-9, paragraph 5 will be revised as follows:** For gas blow-outs occurring during production and workovers, the statistic for Hebron becomes 200 well-years x 1.17 x 10^{-4} blow-outs/well-year, approximately a 1-in-1,300 chance per year, or approximately 2.3 percent probability over the 30-year life of the Project.	
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*The calculations here may be supported in the data but the presentation is not easily followed (i.e. A table corresponding to classes in Table 14-2 with frequency numbers). The probability of a gas blow-out is 0.0234 over life of project. 1 in 1,300 per year is a bit disingenuous.*" The EMCP response is responsive but the comments provided under C-NLOPB 37 may still apply.	
EMCP Response 29-Jul-11	Section 14.1 has been revised to reflect comments received.	

Follow-up Comment 16-Aug-11	See new comments provided on the revised Section 14.1.			
EMCP Response 24-Aug-11	See responses below, provided after each comment			
Additional comments on Section 14.1 (16-Aug-11)				
#	**Section**	**Subsection**	**Page**	**Comment**
1	**14**	**14.1**	**14-3**	Table 14-2 Typo: Note, line 4: "ferquencies".
			EMCP Response 24-Aug-11	The word has been corrected.
2	**14**	**14.1.1**	**14-4**	Last Paragraph - The proponent states "…"extremely large" spills two of which occurred during development drilling…" but Table 14-3 shows only one during development drilling.
			EMCP Response 24-Aug-11	Text has been corrected to "one of which occurred during development drilling…"
3	**14**	**14.1.1.1**	**14-4 & 14-5**	The proponent states "There have been two extremely large spills during offshore development drilling, so the frequency up to 2010 is (2/66,469) 3.0 x 10-5 spills per well drilled…" but Table 14-3 which only shows one extremely large hydrocarbon spill from a blow-out during development drilling. Likewise, on page 14-5, the proponent states "Up to 2010, five development-drilling blow-outs have produced spills in the very large spill category…" but Table 14-3 shows only 4 very large (including extremely large) hydrocarbon spills from a blow-out during development drilling.
			EMCP Response 24-Aug-11	Text has been corrected (as well as corresponding calculations) to align with number reported in Table 14-3.
4	**14**	**14.1.1.2**	**14-5**	The proponent states "…five very large hydrocarbon spills from blowouts during production and workovers (Table 14-3)" but, since Table 14-3 shows only 4 in the very large category it is not clear if this includes extremely large or not.
			EMCP Response 24-Aug-11	Text has been revised to include the correct number, **six**, in the very large category, which includes the extremely large category.
5	**14**	**14.1.1.3**	**14-5**	Paragraph 2 still refers to the 1979 Ixtoc I blowout as "the largest hydrocarbon spill in history". The statement should be revised in consideration of the 2010 Macondo blowout.
			EMCP Response 24-Aug-11	Reference to the Ixtoc spill in this example is valid. While it is no longer considered "the largest hydrocarbon spill in history, " it is a valid reference to identify the likely association of regulatory requirements and spill occurrences. The text "the largest hydrocarbon spill in history" has been changed to "*one of the largest hydrocarbon spills in history*."
6	**14**	**14.1.1.3**	**14-6**	Paragraph 2 says that "a spill of the magnitude of the Deepwater Horizon blow-out is unprecedented." Given that the Ixtoc I spill was of the same order of

				magnitude (although, perhaps, lesser in absolute volume) this statement could be improved upon.
			EMCP Response 24-Aug-11	The intent of the comment was to demonstrate that in more recent times, a blowout of this magnitude is unprecedented. The text has been modified to read as "*A spill of the magnitude of the Deepwater Horizon blow-out in recent years is unprecedented*."
7	**14**	**14.1.1.3**	**14-6**	In the bulleted list, where the proponent says "frequency" they mean something different. For example, the thing they've calculated in the first bullet is not "a 0.12 percent chance over the drilling period" but a deterministic expected occurrence of 0.12 spills for the 40-well drilling period of 30 years. Of course this is not a realistic number since the real occurrence must be expressed as a whole number (0,1,2…). The rate in "event per year" is more useful and would be 0.12 ÷ 30 or $4x10^{-3}$ events/year.
			EMCP Response 24-Aug-11	As discussed with the C-NLOPB staff, spill statistics will be expressed as a number of occurrences. For instance, using the following example from the CSR, spill frequencies will be stated as follows *Predicted frequency of extremely large hydrocarbon spills from blow-outs during a drilling operation, based on an exposure of wells drilled:* *$40 \times 1.5 \times 10^{-5} = 6.0 \times 10^{-4}$, or a 0.06 percent chance over the drilling period*
			Follow-up Comment 30-Aug-11	Replace text with the following: The likely number of extremely large hydrocarbon spills from blow-outs during drilling operations, based on an exposure of wells drilled is 40 x 1.5 x 10-5 = 6.0 x 10-4 events.
			EMCP Response 8-Sep-11	For section 14.1.1.3 The text has been changed to: (see page 14-6 in the attached revised Section 14.1) •Predicted frequency of extremely large hydrocarbon spills from blow-outs during a drilling operation, based on an exposure of wells drilled is 40 x 1.5 x 10-5 = 6.0 x 10-4. •Predicted frequency of very large hydrocarbon spills from drilling blow-outs based on an exposure of wells drilled is 40 x 6.0 x 10-5 = 2.4 x 10-3 •Predicted frequency of extremely large hydrocarbon spills from production/workover blowouts, based on an exposure of well-years is 200 x 8.0 x 10-6 = 1.6 x 10-3 •Predicted frequency of very large hydrocarbon spills from production/workover blow-outs, based on an exposure of well-years is 200 x 2.4 x 10-5 = 4.8 x 10-3.
			Follow-up Comment 30-Aug-11	Page 14-6 in the bulleted list: replace the word "frequency" with the word "number" in each bullet.
			EMCP Response 12-Sep-11	The text has been modified per the comment.

8	**14**	**14.1.2**	**14-7**	The proponent states that "The number of blow-outs from development drilling is 63 (with four blow-outs from sulphur drilling remove)…" but I count 87 (91 reported less 4 sulphur) from the "Totals" line in Table 14-4.
			EMCP Response 24-Aug-11	The number has been corrected to 87.
9	**14**	**14.1.2.2**	**14-10**	Last Paragraph - The proponent says that, based on Table 14-4 "55 blow-outs occurred during production, workovers and completions" then calculates the frequency of occurrence as "76 blow-outs ÷ 235,000 well years" while I count 78 blow-outs in Table 14-4, and so does the proponent in the third paragraph on page 14-11.
			EMCP Response 24-Aug-11	The number has been corrected to 78.
10	**14**	**14.1.2.3**	**14-11**	Where the proponent says the predicted number of deep blowouts is 1.92 x 10^{-3} events, the conversion to a probability of 1-in-520, is not particularly meaningful. It would be appropriate to say a probability of 6.4x10^{-5} events/year (based on 1.92 x 10^{-3} ÷ 30).
			EMCP Response 24-Aug-11	See response to Comment 7.
			Follow-up Comment 30-Aug-11	Replace text with the following: Based on a likelihood of 4.8x10-5 blowouts per well drilled and an exposure of 40 wells, the likely number of deep blowouts is 1.92 x 10-3 events.
			EMCP Response 8-Sep-11	The text has been revised to read as: There are an estimated 40 wells to be drilled for the Project, so the likely number of deep blow-outs during development drilling becomes 40 x 4.8 x 10-5 = 1.92 x 10-3. The text in the remaining paragraphs in this section have also been revised to read the same as the above phrase (see page 14-11 in the revised Section 14.1).
11	**14**	**14.1.3**	**14-12**	Regarding "large spills" - the proponent states "In addition to the five from blow-outs noted in Table 14-3" but this does not agree with Table 14-3 for spills >10,000 bbl.
			EMCP Response 24-Aug-11	The number has been corrected to **six** spills.
12	**14**	**14.1.3**	**14-13**	The final sentence of Paragraph 2 states that "spills occur less frequently in US waters compared with t e rest of the world". Either the reference/ justification for the statement should be provided, or the statement should be deleted.
			EMCP Response 24-Aug-11	The above statement has been removed from the CSR.
13	**14**	**14.1.6**	**14-16**	Table 14-15 should be modified to include annualized probabilities for each type of event.
			EMCP Response 24-Aug-11	Spills are now expressed as 'Probable number of occurrences (over life of project).'

14	**14**	**14.1.6**	**14-17**	2nd Paragraph -The proponent has said things like "…over the 30 year production period…one very large oil well blow-out expected every 7,500 years of production" which I think means that they calculated a probability of a very large spill from a production blow-out over the life of the project was 1.333x 10^{-4} events/year. That number can be calculated from line 6 in Table 14-15 if one divides the "life of project probability" (which is actually the probable number of occurrences for the project) by 30. This type of language (i.e. one event expected every 7,500 years) is not recommended, as it implies that the occurrence is expected once in 7500 years, whereas the reality is that the probability at any time is 1.333x10^{-4} occurrences/year.
			EMCP Response 24-Aug-11	The above referenced text used to describe probability of spills has been deleted. See response to Comment 7.
			Follow-up Comment 30-Aug-11	Comment: See comment on 7 and 10 above.
			EMCP Response 8-Sep-11	See revised table 14-15 (page 14-15), which is the summary for the spill statistics presented in Section 14.1.

Comment 155: C-NLOPB 48

155-C-NLOPB 48	**EA Reference:**:	Section 14.1.2 Page 14-11
Preamble:		
Request 7-Sep-10	*What is a "major" platform spill. Define "major" or use one of the classifications from Table 14-2.*	
EMCP Response 24-Feb-11	**Section 14.1.2 will be renamed as follows:** **Large** Platform Spills	
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*What is a "major" platform spill. Define "major" or use one of the classifications from Table 14-2.*" EMCP responded that "Section 14.1.2 will be renamed as follows: Large Platform Spills". Even with the use of "Large", the titles of 14.1.2 and 14.1.3 are not consistent with what they represent. Perhaps *Platform Spills >1000 bbl* and *Platform Spills < 1000 bbl* would be more appropriate	
EMCP Response 29-Jul-11	Noted.	

Comment 156: GF 28

156-GF 28	**EA Reference:**:	Section 14.1.3 Platform Spills Involving Small Discharges Page 14-13, Table 14-12
Preamble:	Nowhere in this section does the proponent discuss the accidental spills of synthetic-based drill cuttings or drilling fluids. Yet, spills of these substances, including some in the 50-99 bbl category, have occurred in the C-NLOPB's jurisdiction. Given the exchange with the C-NLOPB over the reporting of these types of spills and how they were not accounted for in past EAs, it is disappointing to see this information is not present (Fraser, G.S. and J. Ellis 2008. Reply from Gail Fraser and Joanne Ellis to a letter from C-NLOPB. *Journal of Environmental Assessment Policy and Management.* 10 (4): 475-481).	

Request 7-Sep-10	There must be a section that describes the discharge of these pollutants into the marine environment, even if they cannot be presented in terms of probability of occurrence, there should be a table that presents the spills associated with SBMs. In light of O'Hara and Morandin's (2010) work this is outright negligence by the proponents not include this information and by C-NLOPB to allow the draft CSR to go forward without this information.
EMCP Response 24-Feb-11	Refer to response to Comment 145-EC 50.

Comment 157: C-NLOPB 49

157-C-NLOPB 49	**EA Reference:**:	Section 14.3.5 Additional Modelling considerations Page 14-32
Preamble:	It is stated that blow-outs were model for 45 days.	
Request 7-Sep-10	Blow-outs should be modeled based on the actual time the well would be flowing oil and should continue until the well is killed or until the criteria for ending the model run is met.	
EMCP Response 24-Feb-11	See response to 142-C-NLOPB 38	

Comment 158: C-NLOPB 50

158-C-NLOPB 50	**EA Reference:**:	Section 14.3.5 Additional Modelling Considerations Page 14-33, Table 14-16
Preamble:	Column 2 of Table 14-16 is labeled "Flow M^3". Column 2 is the volume of the batch spill and not flow.	
Request 7-Sep-10	The labeling of this heading should re-examine and should coincide with what is in the column and the discussion on batch spills.	
EMCP Response 24-Feb-11	Oil spill trajectory modeling has been updated by Applies Science Associates, Inc. (ASA), to address review comments. There is no comparable table in the new report or corresponding summary section in the CSR.	

Comment 159: C-NLOPB 51

159-C-NLOPB 51	**EA Reference:**:	Section 14.4.5 External Assistance Relief Well Consideration Page 14-42
Preamble:	The process and time required to mobilize a drilling facility to drill a relief well is outlined. Obtaining a drilling rig is one aspect however there are additional considerations such as consumables and well components that will also be required to drill a relief well.	
Request 7-Sep-10	The CSR should outline how these items will be obtained.	
EMCP Response 24-Feb-11	ExxonMobil operates and maintains a world-wide drilling operation that encompasses a fleet of drilling units and drilling equipment inventory. Knowledge and awareness of ongoing operations is maintained company-wide. In the event a relief well is required and the required materials are not available in local stock, ExxonMobil will access this world-wide inventory to procure necessary materials to execute the required operations and/or will obtain the materials directly from vendors through our Global Procurement organization. The time to source these materials has been considered in the oil spill scenarios described in Comment 142-C-NLOPB 38.	

Comment 160: C-NLOPB 52

160-C-NLOPB 52	**EA Reference:**:	Section 14.6 Offshore Spill Response Operations Page 14-48
Preamble:	The CSR does not discuss how it intents to deal with wildlife such as birds, marine mammals or fish that have been affected by a spill.	
Request 7-Sep-10	The CSR should include a section on responding to and mitigating wildlife that is affected by an oil spill	
EMCP Response 24-Feb-11	In the event of a spill, as part of its oil spill response plan, EMPC will develop a wildlife recovery plan that will identify key sensitive areas, detail what will be done to protect those areas and, in the event of oil effects upon wildlife, what they will do to recover and rehabilitate oiled wildlife. Mitigation measures are discussed in relation to the environmental effects assessment of each VEC in the following sections: • Fish and Fish Habitat – Section 7.5.4; Table 7-14 • Commercial Fisheries – Section 8.5.3.1; Table 8-15 • Marine Birds – Section 9.5.4; Table 9-13 • Marine Mammals and Sea Turtles – Section 10.5.4; Table 10-13 • Species at Risk – Sections 11.4.3, 11.5.3 and 11.6.3; Tables 11-7, 11-13 and 11-19 • Sensitive of Special Areas – Section 12.5.1; Table 12-3	

Comment 161: EC 51

161-EC 51	**EA Reference:**:	Section 14.6.4.1 – Response Options Page 14-49
Preamble:	Section 5.3.6.5 of the Scoping Document clearly states that the EA should identify types and location of response equipment; and target times for equipment deployment. Section 14.6.4.1 states a contracted Response Organization will provide Tier 2/3 containment and recovery equipment but no time frame is provided.	
Request 7-Sep-10	There appears to be a lack of containment and recovery equipment as well as available offshore supply vessels capable of handling a Tier 2/3 spill response in a timely manner. How will the proponent address this issue? Mutual aid agreements can provide vessels but not in timely manner, a lack of dedicated response vessels in the offshore not tied to specific programs such as stand by, can create unnecessary delays in response. The oil fields are over 300 km from St. John's, NL, transits from port to the Hebron oil field can be over 18 hours one way not including port time for equipment to be loaded, vessels modified to handle and deploy the equipment How will the proponent address these issues and propose solutions to make response efforts much more timely and effective. Target times for equipment deployment need to be provided.	
EMCP Response 24-Feb-11	**The following text will be added to Section 14.6.4.2:** The Hebron Project is at the conceptual stage of development. The Oil Spill Response Plan (OSRP) has not been developed. The Hebron crude has a lower API than the crude of existing offshore Newfoundland operations, and is therefore a heavier product. In developing the Hebron offshore OSRP, as with existing offshore oil and gas OSRPs, the OSRP will outline a tiered response to oil spills. Depending on the size and nature of the spill (*i.e.*, Tier 1, 2 or 3), the OSRP will include the type and quantity of response equipment specific for Hebron crude. In addition, it will identify equipment that will be available within local, regional and global Response Organizations, and equipment that may be available through mutual aid agreements with other operators. For a Tier 2 or Tier 2 response, Hebron can request oil spill project management support through ExxonMobil corporate response organization. Estimated response times for deployment will also be identified.	

	The Hebron Project is aware of the recent initiative currently being undertaken between the existing Newfoundland and Labrador operators regarding the evaluation of the level of equipment and its capability to respond to oils spills on the Grand Banks. Existing Tier 2 oil containment equipment is being upgraded and supply vessels are being configured for quick installation of the equipment. Enhanced training for vessel crews will also be provided. During the development of the Hebron OSRP, the Hebron Project will consider the response equipment available, the time it will take to deploy, if it is capable of handling Hebron crude, and determine if additional resources are required. Tier 1 equipment will be available on-site and will be appropriate for Hebron crude. Current Tier 2 equipment readily available onshore consists of industry and Eastern Canada Response Corporation (ECRC) equipment. In addition, and if required, the Canadian Coast Guard has an inventory of oil spill response equipment stored at their depot in Mount Pearl, some of which is suitable for offshore use. ECMP will commit to continue working with other Grand Banks operators to enhance the existing pool of equipment based on the best available technology to support production operations. . In addition to maintaining and operating the producing operators' equipment, the Response Organization, ECRC (located in Mount Pearl) has its own open ocean containment and recovery equipment, temporary storage tankage, and oil transfer pumps. In addition to the equipment available for a Tier 2 response, it is likely that Tier 3 resources available to Hebron production operations will be sourced from agencies outside of Newfoundland and Labrador. Principle sources include: • The installation of diving and ROV systems to support production field maintenance programs • ECRC equipment in other eastern Canada depots (*e.g.*, Ocean Buster high-speed boom stationed in Quebec) • Equipment sources identified through the ExxonMobil Corporate response organization • OSR aerial dispersant capability based in Southampton, England • Appropriate oil spill response equipment secured from international Tier 3 response organizations by either ECRC and OSR through their membership in the Global Response Network Estimated response times will be outlined in the Hebron OSRP. Again, depending on the nature of the spill and the required response, response times will vary. Tier 1 resources will be available immediately at site. Sorbent boom can be deployed in less than one hour after the spill occurs. Other equipment can take up to three to six hours to deploy. Deployment time for Tier 2 resources will depend on their location and are staged for rapid deployment. Including mobilization and delivery of gear, and activation of necessary field personnel a Tier 2 response vessel could be ready to sail from St. John's within two to three hours. Fastest transit to the spill site from St. John's would be approximately 12 to 18 hours in good conditions. Response times for Tier 3 equipment will depend on source location. The Hebron Project will develop synergies with the Hibernia Project and will augment the current two standby vessel, one supply vessel arrangement supporting Hibernia. It is anticipated that in order to meet production and drilling operations for Hebron, an additional standby vessel and supply vessel will be added to the pool of resources. With regard to the availability of vessels, the industry has demonstrated that it can cope with unusual demands on vessel resources. During the spring of 2009, the core

	fleet was temporarily increased to a high of eighteen to meet the following demands: • The installation of diving and ROV systems to support production field maintenance programs • A heavy ice season that required vessels to be involved in increased ice management operations as well as unscheduled rig moves • The grounding of all helicopter traffic to and from the Grand Banks requiring that all personnel had to travel offshore by vessel • A high level of shipyard time for scheduled and unscheduled maintenance of vessels and platforms • The installation of diving and ROV systems to support production field maintenance programs To ensure that operations could continue, several additional vessels from throughout Atlantic Canada were also contracted. While not all of these vessels were capable of assuming full platform supply or standby duties, they were all useful. Through mutual aid agreements with the Grand Banks operators, vessel assignment during an oil spill response may be similar to the spring 2009 case. Vessels of opportunity may be sourced from existing operations, where available, or sourced regionally.

Comment 162: EC 52

162-EC 52	**EA Reference:**:	Section 14.6.4.1 – Response Options Page 14-49
Preamble:	Section 5.3.4.3 of the Scoping Document clearly states that the EA will provide Contingency Plans to be implemented in the event of a spill, including an analysis of the likely efficiency of spill response measures and any equipment upgrade or acquisition that may be required to support the Project.	
Request 7-Sep-10	Information has not been provided in the report to address the efficiency of any of the spill response options listed, whether there are any equipment upgrades or acquisitions needed to provide an appropriate and timely response to spills and releases of pollutants from the Hebron project. Therefore, more information is needed for review in order to meet the requirements of the Scope.	
EMCP Response 24-Feb-11	See response to Comment 161-EC 51.	

Comment 163: EC 53

163-EC 53	**EA Reference:**:	Section 14.6.4.3 – Response Methods Page 14-50
Preamble:	Section 5.3.4.3 of the Scoping Document clearly states that the EA will consider an analysis of the likely efficiency of spill response measures. Section 14.6.4.3 Response Methods lists chemical dispersion as a response option but no information on testing or whether chemical dispersion is a viable option for Hebron crude.	
Request 7-Sep-10	Information on chemical dispersant testing carried out on Hebron crude must be provided for review, as the limited information contained in Section 14.6.3 Characteristics of Spilled Crude Oil at Hebron suggests Hebron crude may not be suitable for chemical dispersion, more information is required on the physical and chemical properties of Hebron crude.	
EMCP Response 24-Feb-11	SL Ross 1999 provides an overview of the chemical properties of Hebron Crude (D-94) tested to determine the effectiveness of dispersants. In addition, the properties of Hebron Crude can also be found on Environmental Canada's database of crude oil properties (http://www.etc-cte.ec.gc.ca/databases/OilProperties/oil_H_e.html)	

	The most recent testing of the effectiveness of chemicals in the dispersion of Ben Nevis (Hebron) crude were conducted in 1999 and 2000 (SL Ross 1999 and 2000) using small volumes of oil and laboratory techniques. Tests were conducted on various levels of weathered oil at multiple temperatures and with several Dispersant to Oil Ratios (DOR). In these studies, it was difficult to simulate open ocean sea surface energies. The reported range of effectiveness is 0 to 60 percent. In cases of cold water, advanced weathering, and low DOR, the effectiveness of chemical dispersion appears to be low. After production operations commence, when suitable volumes of Hebron crude are available, additional tests will be required. Furthermore, research is needed to investigate the dispersibility of Hebron crude and pursue pre-approval for the use of dispersants as an oil spill countermeasure.

Comment 164: EC 54

164-EC 54	**EA Reference:**:	Section 14.6.4.4 – Availability of Containment and Recovery Equipment Page 14-50
Preamble:	Section 5.3.6.5 of the Scoping Document clearly states that the EA should identify types and location of response equipment; and target times for equipment deployment. The CSR does not indicate the proponent's timetable for deploying Tier 2 or Tier 3 equipment only to state Tier 1 capability will meet or exceed the current standard for production operators.	
Request 7-Sep-10	The proponent is requested to provide a copy of the standard it plans to meet for availability of equipment and spill response capacity for Tier 1, 2 and 3 spills for review.	
EMCP Response 24-Feb-11	See response to Comment 161-EC 51.	

Comment 165: C-NLOPB 53

165-C-NLOPB 53	**EA Reference::**	Section 14.6.4.4 Availability of Containment and Recovery Equipment, Page 14-50
Preamble:	The containment and recovery equipment available is discussed.	
Request 7-Sep-10	More detail should be provided as to what Tier 1 equipment will be available at site. The CSR should also outline what equipment is available onshore for Tier 2 and 3 spill responses and if that equipment is the best available for the Newfoundland and Labrador offshore environment, if there is sufficient equipment quality available to contain and recover oil in a reasonable period of time, and if that equipment is suitable for use with Hebron crude.	
EMCP Response 24-Feb-11	See response to Comment 161-EC 51.	

Comment 166: C-NLOPB

166-C-NLOPB 54	**EA Reference:**:	Section 14.6.4.5 Waste Hydrocarbon – Temporary Storage and Disposal Options Page 14-51
Preamble:	It is stated that "Most newly built vessels currently operating offshore Newfoundland are built to DNV oil-recovery standards." This statement is meaningless as not all vessels are built as pollution class vessels and there are older vessels that are not pollution class vessels.	

Request 7-Sep-10	It should be stated if the vessel used for the project would be pollution class and not allude to possibilities.
EMCP Response 24-Feb-11	ECMP will ensure that the core vessels chartered for Hebron operations meet current pollution class standards.
Follow-up Comment 19-Apr-11	The original C-NLOPB comment was "*It should be stated if the vessel used for the project would be pollution class and not allude to possibilities.*" Does "meet current pollution class standards" mean vessels will be certified to pollution class standard?
EMCP Response 29-Jul-11	The Operator will ensure that vessels contracted to provide platform stand-by duties have an oil recovery class notation.

Comment 167: C-NLOPB

167-C-NLOPB 55	**EA Reference:**:	Section 14.6.5 Investing in Industry Spill Response Capability Page 14-51
Preamble:	The CSR discusses what industry, specifically in relation to specific projects, is doing.	
Request 7-Sep-10	Plans and/or intentions for investing and improving spill response should be presented.	
EMCP Response 24-Feb-11	See response to Comment 161-EC 51.	

2.14 Response to Section 15 Comments

EMCP Comment 168: TC 2

168-TC 2	**EA Reference:**:	Section 15.3 Other Required Programs Page 15-7, Paragraph 2
Preamble:		
Request 7-Sep-10	A bullet should be added detailing that compliance monitoring will be required for any approvals issued under the NWPA. The Bullet should state: "**Compliance monitoring to ensure that the *Navigable Waters Protection Act* Conditions of Approval are implemented as outlined by Navigable Waters Protection Program of Transport Canada**".	
EMCP Response 30-Nov-10	**Section 15.3 of the CSR will be revised to include the following bullet:** • Compliance monitoring to ensure that the *Navigable Waters Protection Act* Conditions of Approval are implemented as outlined by Navigable Waters Protection Program of Transport Canada	

2.15 Response to Section 17 Comments

EMCP Comment 169: C-NLOPB 56

169-C-NLOPB 56	**EA Reference:**:	Section 17.2.2 Summary of Proposed Mitigation Measures Page 17-3, Table 17-2 Offshore Construction and Installation
Preamble:	The bullets list some of the mitigation outlined in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines.	
Request 7-Sep-10	For completeness, the following mitigation should be added: "Adherence to the Geophysical, Geological, Environmental and Geotechnical Program Guidelines".	
EMCP Response 30-Nov-10	The section on Offshore Construction and Installation, Table 17-2 in Section 17.2.2 of the CSR, does include the above suggested mitigation, as the last bullet of mitigations listed for the following VECs: • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles, and Marine Birds)	

EMCP Comment 170: TC 3

170-TC 3	**EA Reference:**:	Section 17.2.2 Summary of Proposed Mitigation Measures Page 17-3, Table 17-2, Third Column
Preamble:	Section 5 of the CSR indicates that public concerns were raised related to increase vessel traffic and the potential for floating debris at the near shore construction site. The NWPA protects the public's right to safe navigation. Given these public concerns, a mitigation bullet should be added to the Commercial Fisheries VEC regarding the NWPA.	
Request 7-Sep-10	Mitigation should state: "**Compliance with *Navigable Waters Protection Act* – Conditions of Approval**".	
EMCP Response 30-Nov-10	**The section on Offshore Construction and Installation, Table 17-2 in Section 17.2.2 of the CSR, will be revised to include the following bullet in the mitigations listed for Commercial Fisheries:** • Compliance with *Navigable Waters Protection Act* – Conditions of Approval	

EMCP Comment 171: C-NLOPB 57

171-C-NLOPB 57	**EA Reference:**:	Section 17.2.2 Summary of Proposed Mitigation Measures Page 17-4, Table 17-2 Potential Future Construction Activities
Preamble	The bullets list some of the mitigation outlined in the Geophysical, Geological, Environmental and Geotechnical Program Guidelines.	
Request 7-Sep-10	For completeness, the following mitigation should be added: "Adherence to the Geophysical, Geological, Environmental and Geotechnical Program Guidelines".	

EMCP Response 30-Nov-10	**The section on Offshore Construction and Installation, Table 17-2 in Section 17.2.2 of the CSR, will be revised to include the following bullet in the mitigations listed for Fish and Fish Habitat, Marine Birds, Marine Mammals and Sea Turtles and Species at Risk (Marine Fish, Marine Mammals and Sea Turtles)** • Adherence to the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines*

EMCP Comment 172: TC 4

172-TC 4	**EA Reference:**:	Section 17.2.2 Summary of Proposed Mitigation Measures Page 17-5, Table 17-2, Fourth Column
Preamble:	Mitigation states; "Adherence with all standard navigation procedures, Coast Guard requirements and navigation systems."	
Request 7-Sep-10	Given Transport Canada has responsibility for the *Canada Shipping Act* and the *Navigable Waters Protection Act*, TC suggest re-wording to: "Adherence with all standard navigation procedures, **Transport Canada requirements**, Coast Guard requirement and navigation systems".	
EMCP Response 30-Nov-10	**The section on Accidental Events, Table 17-2 in Section 17.2.2 of the CSR, will be revised to include the following bullet in the mitigations listed for all VECs** • Adherence with all standard navigation procedures, Transport Canada requirements, Coast Guard Requirements and navigation systems	

3.0 GOVERNMENT AGENCY GENERAL COMMENTS

3.1 Response to Environment Canada General Comments

173-EC	**Section 13.3.2** - There is a comment that *"site specific weather and oceanographic data are typically collected as part of the physical environment monitoring program, which will enhance the physical database for the area*"…This does not appear to be a firm commitment to actually perform the monitoring and to provide the data to appropriate bodies such as Environment Canada. Please review the wording and revise as appropriate.
EMCP Response 30-Nov-10	EMCP and the Project will adhere to the Operator requirements concerning the observing, forecasting and reporting of physical environmental data (*i.e.*, wind, waves, current, ice) as presented in the Physical Environmental Guidelines (NEB, C-NLOPB and C-NSOPB 2008).
174-EC	**Section 13.3.4** - In reference to storm surges, there is a mention of extreme water level being 1.52 metres above mean water level. Should this not be above highest astronomical tide, which would be significantly higher.
EMCP Response 30-Nov-10	No. As presented in Section 3.1.2.5, the Mean Water Level (MWL) for the Marex (1992) analysis is 2.24 m below the GULL benchmark and 0.96 m above CHS chart datum (Marex 1992). We acknowledge the text (taken Section 3.1.2.5) is not as clear as it could be in this section. Instead, **the second paragraph of Section 13.3.4 will be replaced as follows:** An estimate of 100-year maximum water level is +1.52 m above Mean Water Level (MWL) (Marex 1992). This includes the standard deviation of the MWL, the dominant (M2 and S2) tide, the 50-year storm surge and the standard deviation of the 50-year surge. A 100-year minimum water level of -1.20 m below MWL is similarly estimated. A more conservative estimate of extreme maximum water level would be +1.68 m above MWL taken as the sum of highest astronomical tide (HAT) (0.80 m above MWL) and the 100-year positive surge amplitude (0.88 m above MWL). Similarly, a more conservative estimate of extreme minimum water level would be -1.45 m below MWL taken as the sum of lowest astronomical tide (LAT) (-0.91 m below MWL) and the 100-year negative surge amplitude (-0.54 m below MWL) (Marex 1992).
175-EC	**Section 13.4.2** – In the discussion about the wave climate, there is a paragraph which describes when sea states would be below Beaufort Force thresholds. Have the winds speeds been looked at in terms of Beaufort wind categories and then the typical sea states that are associated with those wind speeds applied. This would not take into account any swell and therefore could be rather misleading.
EMCP Response 30-Nov-10	As noted in the Section 13.4.2 text, Beaufort Force (BF) sea state threshold conditions were analyzed. The analysis mentioned was of the nine-year Hibernia wind, wave, and current (for 5 year) time-series, where waves include swell. BF was assigned based on Hs, with the following mapping as a function of probable maximum height of waves: **Hs (m)** / **Beaufort Force Scale** <1.0 / 3 ≥ .0 and ≤1 5 / 4 >1.5 and ≤0.5 / >2.5 and ≤4.0 / 6 >4.0 and ≤5.5 / 7 >5.5 and ≤7.5 / 8 >7.5 and ≤10.0 / >10.0 and ≤1 .5 / 10 >12.5 and ≤16.0 / 11 >16 / The persistence analysis was then completed on the new BF variable.

	Last paragraph, p. 13-5, will be edited as follows: …seas *(including swell)* will persist below…

3.2 Response to Transport Canada General Comments

176-TC 5	1) In accordance with the *Navigable Waters Protection Act*, the proponent is required to submit an Application (s) for Project Review, complete with scaled drawings, for any new, repaired, altered, or rebuilt in-water works located at the near shore site. Complete applications are to be forwarded to: Navigable Waters Protection Program Transport Canada – Marine Safety P.O. Box 1300, St. John's, NL A1C 6H8 Tel: (709) 772-2284 2) The CSR indicates the proponent is aware of the various regulations under the *Canada Shipping Act* that apply to the project. The proponent, or any of the proponent's contractors, are encouraged to contact Transport Canada – Marine Safety at (709) 772-5166 should they have any questions regarding the *Canada Shipping Act*. 3) Throughout the CSR, the proponent indicates they will prepare a Vessel Traffic Management Plan to help mitigate interactions with project vessels and commercial fishing vessels. Transport Canada – Marine Safety would like an opportunity to review the proposed Vessel Traffic Management Plan. A copy of the plan can be forwarded to: Compliance and Enforcement Transport Canada – Marine Safety John Cabot Building, 10 Barter's Hill P.O. Box 1300, St. John's, NL A1C 6H8 Tel: (709) 772-5166
EMCP Response 30-Nov-10	Thank you for the contact information. EMCP will consult with Transport Canada on all aspects of the Project that fall within Transport Canada's authority.
Follow-up (General) Comment 28-Jan-11	Transport Canada would like to remind the proponent that mooring buoys are considered 'works' therefore the placement of moorings will be subject to review under the *Navigable Waters Protection Act* (NWPA). For further information, the proponent should consult the Transport Canada publication "An Owner's Guide to Private Buoys – TP 14799E" available in http://www.tc.gc.ca/eng/marinesafety/tp-tp14799-menu-634.htm.
EMCP Comment 18-Mar-11	Noted.
Follow-up Comment 29-Jul-11	TC has reviewed the revised Part 1 of the April comments to the CSR and noted that new mitigations were added on page 7-93 of the revised Chapter 7. The third mitigation measure added states: "*Adherence with all standard navigation procedures, Canadian Coast Guard requirements and navigation systems*." As advised in July 2010, Transport Canada has responsibility for the *Canada Shipping Act* and the *Navigable Waters Protection Act*, therefore, TC suggest re-wording to: "*Adherence with all standard navigation procedures, Transport Canada requirements, Canadian Coast Guard requirements and navigation systems.*"
EMCP Response 4-Aug-11	The mitigation measure, as identified on page 7-93, has been modified to read per Transport Canada's comment.

3.3 Response to Newfoundland and Labrador Department of Environment and Conservation General Comments

177-NLDEC 1	The following comments relate to the regulatory mandate of ENVC and the Pollution Prevention Division, Waste Management Section.
	• Operations in the near shore and marine environment will be regulated by the Canada-Newfoundland and Labrador Offshore Petroleum Board and the Federal Government.
	• As stated in the report, land-based activities in Bull Arm will comply with provincial legislation. The Department of Environment and Conservation (ENVC) requires an Environmental Protection Plan for the Bull Arm site. ENVC looks forward to assessing this plan as well as the following supporting documentation. The following documents were referenced in the Comprehensive Study Report.
	  • Waste Management Plan
	  • Oil Spill Response Plan
	  • Community Liaison Plan
	• While the EPP and other documents will require more detailed assessment, it is noted that the Bull Arm Fabrication Site was used for similar construction purposes in the past. Therefore, the environmental footprint of the Hebron Project is not expected to be significant from a near shore / land-based perspective.
	• It is encouraged that an oil spill response plan considers waste management issues and coastal zone impacts.
	• The near shore spill-modelling scenario refers to a diesel spill between 500 – 5000 gallons. It is agreed that the majority of modelling scenarios would result in spilled diesel remaining in the Bull Arm area. Diesel is a light end hydrocarbon and it is agreeable that impacts would be localized in nature.
	• The maximum impact that would result from an accidental event would be a spill of crude oil that reaches the coastline. Even in the offshore, a major spill of crude could eventually reach shorelines of NL. Once oil contaminates the shoreline, the magnitude of impacts and volumes of oily waste are significantly increased.

EMCP Response 30-Nov-10	Thank you for the information on ENVC's mandate and responsibilities. EMCP will consult with ENVC on all aspects of the Project that fall within ENVC's authority. An Environmental Protection Plan for the Bull Arm site will be submitted to the NLDEC.
178-NLDEC 3	The following comments relate to the regulatory mandate of ENVC and the Water Resources Division. The approvals and permits that WRMD would issue for this project are mainly related to the site infrastructure and construction of the dry dock. At this stage there has been limited information provided in this document to outline the site infrastructure requirements for this project. In addition, this may be the responsibility of Nalcor as they are the owners of the site. The following is a general list of permits/approvals which may be required by WRMD for site infrastructure and construction of the dry dock: The proponent will require approval from this Division under Section 39 of the *Water Resources Act* for the proposed development within Protected Water Supply Areas. Contact: Manager, Surface Water Section (709) 729-2535 The proponent must obtain a permit under Sections 36 & 37 of the *Water Resources Act* prior to the start of construction. Contact: Manager, Surface Water Section (709) 729-2535 The proponent must apply for a non-domestic drilled well permit under Section 58 of the *Water Resources Act* for the proposed drilled well(s) Contact: Manager, Groundwater Section (709) 729-2939

	The proponent must obtain a Water Use License from this Division for the non-domestic use of water. Contact: Manager, Water Rights Section (709) 729-4795 The proponent will require approval from this Division under Section 48 of the *Water Resources Act* before starting construction activities within 15 metres of any water body (including wetlands). Construction activities include all stream crossings, drainage works, fording and any other work such as landscaping, clearing or cutting of any natural vegetation within 15 metres of a body of water. Contact: Manager, Water Investigations Section (709) 729-5713 Any effluent or runoff leaving the site will be required to conform to the requirements of the *Environmental Control Water and Sewage Regulations*, 2003.
EMCP Response 30-Nov-10	Thank you for the contact information. EMCP will consult with ENVC's Water Resources Division on all aspects of the Project that fall within the Water Resources Division's authority.

4.0 ADDITIONAL DEFICIENCIES AND EDITORIAL COMMENTS FROM FISHERIES AND OCEANS CANADA

179-DFO	A) **4.0 Effects Assessment Methods** A1) 4.3.1 Step 1 – Scoping Issues and Selecting Valued Ecosystem Components; Page 4-4 Under the Fish and Fish Habitat section, the first bullet should read "*Provisions of the Fisheries Act pertaining to the* ***harmful alteration, disruption or destruction*** *of fish habitat….*"
	EMCP Response 30-Nov-10: The bullet in the CSR will be revised at noted.
	A2) 4.3.3 Step 3 – Definition of Significance; Page 4-10 Fish and Fish Habitat The definition of a significant adverse environmental effect is somewhat confusing. This definition should be revised to the following "…would be one that results in a residual effect (*i.e.*, harmful alteration, disruption or destruction of fish habitat) that is so large and/or the fish and fish habitat is of such importance that it cannot be adequately compensated for." This definition should also be revised in **Section 7.2 Definition of Significance p. 7-3, par. 2**
	EMCP Response 30-Nov-10: The suggested definition appears to address fish habitat only. However, the definition of "significant effect" for Fish and Fish Habitat considers two separate but related definitions for this VEC. It is necessary (and standard practice) to consider both Fish and Fish Habitat to adequately assess the Project effects to the VEC. The definition for a significant effect to fish is population-based, as are the definitions for the other biological VECs, and the definition for a significant effect to habitat is based on the no net habitat loss policy.
	Follow-up Comment 28-Jan-11: 4.3.3 Step 3 – Definition of Significance: Page 4-10 Fish and Fish Habitat DFO acknowledges that the definition of "significant effect" must address both fish and fish habitat; however, this comment was intended to address the fish habitat portion of the definition which is detailed in the following text, "*For potential environmental effects on marine fish habitat, a significant adverse residual effect would be one that results in an unmitigated or non-compensated net loss of fish habitat as required in a Fisheries Act harmful alteration, disruption or destruction (HADD) authorization.*" This text should be revised as follows, "*For potential environmental effects on marine fish habitat, a significant adverse residual effect would be one that results in a harmful alteration, disruption or destruction of fish habitat that is so large and/or the fish and fish habitat is of such importance that it cannot be adequately compensated.*"
	EMCP Response 18-Mar-11: Noted. The text will be revised.
	B) 7.0 Fish and Fish Habitat B1) Some fish species descriptions are absent from this section, but appear in later sections of the document, most specifically the Species at Risk section. These species should at least be cross-referenced here, so the reader can locate the information easily.
	EMCP Response 30-Nov-10: Cross-references have been added in Section 7 where species description appears in CSR.
	B2) It should be noted throughout the assessment of fish and fish habitat that stocks are interrelated (*i.e.*, have a connection with other areas), although knowing exactly what this connection is may be uncertain. It is also important to recognize that surveys are simply snapshots in time as fish tend to continually move in and out of areas.

	EMCP Response 30-Nov-10: The following statement will be added to Section 7.3 Existing Conditions: While reviewing information on fish and fish habitat, it is important to note that stock assessment surveys are snapshots in time and space since fish tend to continually move in and out of certain areas.
	B3) 7.3.1.5 Fish and Shellfish; Page 7-10 (Greenland Halibut) This section states that, "*Although Greenland halibut can be found in small numbers at depths of less than 100 m, most of them are caught near the sea bottom at depths of between 200 to 600 m. In the southern part of the range; however, they go as deep as 1,500 m*". This statement is not entirely accurate as, "*Greenland Halibut can be found at depths ranging from less than 100 m to deeper than 1,500 m*" and although they are predominantly considered a deepwater fish, they are generally found at all depths.
	EMCP Response 30-Nov-10: Based on the comments provided, the text will be modified as follows: Although Greenland halibut can be found at depths of less than 100 m, most of them are caught near the sea bottom at depths of between 200 to 600 m. In the southern part of the range they can be found at depths of 1,500 m.
	Follow-up Comment 28-Jan-11: 7.3.1.5 Fish and Shellfish: Page 7-10 (Greenland Halibut) The revised statement still fails to address the fact that Greenland Halibut can be found at depths greater than 1,500 m and while it is predominantly considered a deepwater species, it can be found at all depths. It is suggested that the statement be reworded as follows, "*Greenland Halibut can be found at depths ranging from less than 100 m to deeper than 1,500 m. While most are caught near the sea bottom at depths of between 200 to 600 m, they can be found at all depths.*"
	EMCP Response 18-Mar-11: Noted. Text will be revised.
	B4) 7.3.2 Offshore; Page 7-16 The second paragraph in this section states that, "*DFO RV data from 3Lt have also been reviewed along with relevant fish and fish habitat primary literature for the Hebron Offshore Study Area.*" In order to provide an accurate depiction of the species composition and abundance in the **Offshore Study Area**, surveys within other subdivisions of 3L and 3N, which fall within the Study Area should also be included. Depending on the findings, the assessment of impacts on fisheries may need to be revisited accordingly.
	EMCP Response 30-Nov-10: DFO RV data have been requested for 3N to compliment the 3L data that were reviewed for the Hebron Offshore Area. However, in absence of these data, a review of a recent Environmental Assessment completed for a similar study area (Christian 2008) was undertaken to ensure the assessment of the effects on fisheries was covered. The review of this document provided similar findings as are presented in this CSR and no changes are expected to be required with respect to the assessment of the effect on fisheries with the inclusion of 3N data.
	Follow-up Comment 28-Jan-11: 7.3.2 Offshore: Page 7-16 This response indicates that DFO RV data has been requested by the proponent for 3N, but was not received at the time the response was written. After consulting the DFO Request for Data Transfer records, it was noted that this information was provided to the proponent's consultant (LGL Limited) in March 2010 and September 2010. Please ensure that this information is incorporated into the next draft of the CSR.
	EMCP Response 18-Mar-11: Please note that these data were requested by Stantec Consulting Ltd. (EMDC's lead consultant for the CSR) on September 29, 2010, not LGL Limited as indicated above. After being redirected to another person on October 8, the same request was provided, along with a follow-up call on October 9, 2010, to discuss

	the information request. A response to this data request has not been received to date.
	Follow-up Comment 20-Apr-11: <u>7.3.2 Offshore</u>: Page 7-16 The DFO RV data for 3N was provided to Ms. Sandra Whiteway (Stantec) on March 30, 2011. This information should be incorporated into the next draft of the CSR.
	EMCP Response 17-Jun-11: This information has been incorporated into the revised CSR.
	<u>B6) 7.3.2.3 Plankton;</u> Page 7-18 The last paragraph in this section states that ichthyoplankton may include jellyfish and squid. This is incorrect as "*ichthyoplankton*" refers to fish eggs and larvae. While jellyfish and squid may have been found during ichthyoplankton surveys, they are not considered ichthyoplankton.
	EMCP Response 30-Nov-10: Jellyfish and squid have been removed from the list to avoid confusion.
	<u>B7 7.3.2.4 Benthos</u> Although the CSR mentions the numbers of trawls reporting a particular coral species, it would be beneficial to present this number in the context of the total number of trawls taken.
	EMCP Response 30-Nov-10e: The following text will be added to Section 7.3.2.4: During this period (2003 to 2008), there were 83 trawls conducted, with 64 of these trawls recording data on the corals species ranging from 0 to 132 corals per trawl. Six of the sixty-four had the number of corals species caught per trawl greater than three.
	B8) Page 7-20 This section refers to, "…*short-lived polychaetes, amphipods and cumaceans*". Please provide supporting reference(s).
	EMCP Response 30-Nov-10: The following reference will be added: Kenchington, E.L.R., J. Prena, K. Gilkinson, D.C. Gordon, K. MacIsaac, C. Bourbonnais, P. Schwinghamer, T.W. Rowell, D.L. McKeown and W.P. Vass. 2001. Effects of experimental otter trawling on the macrofauna of a sandy bottom ecosystem on the Grand Banks of Newfoundland. *Canadian Journal of Fisheries and Aquatic Sciences*, 58: 1043-1057.
	<u>B9) 7.3.2.5 Fish and Shellfish</u> More recent references than Methven 1999 exist on the diet of ground fish in the area. Since there has been a regime shift on the Newfoundland shelf over time, the most up to date information should be incorporated into the CSR. Information on the biology of a species, including feeding habits, can be found in the most recent CSAS or NAFO documents for that species.
	EMCP Response 30-Nov-10: Additional research has been conducted for supplementary information on the biology of species discussed in the CSR, focusing on feeding habits. However, there does not appear to be an abundance of updated references that provide additional data that conflicts with what has been reported previously. The CSR will be updated as relevant, including reference of Link *et al.* (2002) to update information on diet of yellowtail flounder and witch flounder. Reference: Link, J.S., K. Bolles and G.C. Milliken. 2002. The Feeding ecology of flatfish in the Northwest Atlantic. *Journal of the Northwest Atlantic Fisheries Science*, 30: 1-17.
	B10) Page 7-29 The second paragraph on this page states that, "*There are several other species that are so infrequent, there is little chance of an interaction with the Project.*" It is important to note that just because a species is infrequent, does not mean it is unimportant or does not need to be considered. In fact, the opposite may be true, particularly for some rare

	species and/or structural species such as corals and sponges. In addition, although plaice are no longer concentrated in Div. 3L (but are increasing slightly in the area), it does not mean they are infrequent. Notably, habitat in the area is very important to the recovery of American plaice.
	EMCP Response 30-Nov-10: Noted. Paragraph will be revised to read: The environmental effects of the Hebron Project are assessed for the principal fish species that occur within the Hebron Offshore Study Area. Some of the species considered in this assessment are less common than others in the Offshore Study Area for various reasons (*e.g.*, fluctuations in abundance, differences in habitat preference). Species at risk, such as American plaice, are specifically addressed in Section 11.3.1.
	B11) Page 7-32 (Greenland Halibut) The caption for Figure 7-6 references Yellowtail Flounder when it should in fact be Greenland Halibut.
	EMCP Response 30-Nov-10: The caption for Figure 7-6 will be updated to Greenland Halibut.
	B12) Page 7-33 (Greenland Halibut) The first paragraph on this page states that, "*Spawning occurs during the winter in the Davis Strait….*" This information should be checked against more recent references, as it may prove the statement to be inaccurate.
	EMCP Response 30-Nov-10: The CSR will be updated as follows: Spawning occurs from December to April in the north and August in the south with some evidence of year round spawning (Morgan *et al.* 2003). Morgan, M.J., W.R. Bowering, A.C. Gundersen, A. Hoines, B. Morin, O. Smirnov and E. Hjorleiffson. 2003. A comparison of the maturation of Greenland halibut (*Reinhardtius hippoglossoides*) from populations throughout the North Atlantic. *Journal of the Northwest Atlantic Fisheries Science*, 31: 99-112.
	B13) Page 7-33 (Yellowtail Flounder) Although it states that, "*Historically, their distribution has included the northern portion of the Grand Banks (Walsh et al. 2000) and, therefore may occur within the Offshore Project Area*", according to recent NAFO documents the distribution of Yellowtail Flounder, since their population increase in 2000, has been returning to its historical pattern and a greater proportion of the stock is found in Div. 3L.
	EMCP Response 30-Nov-10: The CSR will be updated as follows: Historically, their distribution has included the northern portion of the Grand Banks (Walsh *et al.* 2000); however, a more recent study shows increases in biomass in Division 3L which is thought to be the result of an extension of the range of yellowtail flounder with increasing stock size (Walsh *et al.* 2006). **The following reference will be added:** Walsh, S.J., M.F. Veitch, W.B. Brodie and E. Colbourne. 2006. Distribution and Abundance of Yellowtail Flounder (*Limanda ferruginea*) on the Grand Bank, NAFO Divisions 3LNO from Canadian bottom trawl survey estimates from 1984-2006. *Northwest Atlantic Fisheries Organization Scientific Council Research Document*, 06/41: 50 pp.
	B14) Page 7-40 (Redfish) It is likely that Figure 7-11 is inaccurate as Redfish are more common than indicated according to recent NAFO documents.
	EMCP Response 30-Nov-10: Acknowledged. A review of recent publications did not result in more recent figures. These figures illustrate the point that redfish distribution within the Hebron area is patchy and variable.

	B15) 7.4 Project-Valued Ecosystem Component Interactions; Page 7-41 In the interactions summary categories a "*Change in Habitat Quantity*" is noted as, "*Project activities that may result in physical alteration of fish habitat, and may be declared a HADD of fish habitat by DFO and require a Section 35(2) Fisheries Act Authorization.*" This should be revised to read "*Project activities that may result in* ***the harmful alteration, disruption or destruction of fish habitat****, and may be declared a HADD of fish habitat by DFO and require a Section 35(2) Fisheries Act Authorization.*"
	EMCP Response 30-Nov-10: The interaction summary definition for "Change in Habitat Quantity" will be revised as follows: Project activities may result in the harmful, alteration, disruption or destruction of fish habitat, and may be declared a HADD of fish habitat by DFO and require a Section 35(2) *Fisheries Act* Authorization.
	B16) Page 7-42 With regards to a "*Change in Habitat Quality*" it should be noted that this could be considered a harmful alteration or disruption of fish habitat and may be declared a HADD of fish habitat by DFO and require a Section 35(2) *Fisheries Act* Authorization.
	EMCP Response 30-Nov-10: The interaction summary definition for "Change in Habitat Quality" will be revised as follows: Project activities may result in the harmful, alteration, disruption or destruction of fish habitat, and may be declared a HADD of fish habitat by DFO and require a Section 35(2) *Fisheries Act* Authorization.
	Follow-up Comment 28-Jan-11: Page 7-42 The revision of this statement is acceptable; however, as per DFO's previous comment, the word "*destruction*" should be removed. It should be noted that a change in habitat quality would not constitute a destruction of fish habitat as by definition a "*destruction*" refers to any permanent change of fish habitat which completely eliminates its capacity to support one or more life processes of fish. Therefore a change in habitat quality would more likely result in a "*harmful alteration*", which is any change to fish habitat that indefinitely reduces its capacity to support one or more life processes of fish or a "*disruption*", which is any change to fish habitat occurring for a limited period which reduces its capacity to support one or more life processes of fish.
	EMCP Response 18-Mar-11: Noted. Text will be revised to delete "destruction" and replace with "harmful alteration or disruption".
	B17) Table 7-9 There are numerous instances where a change in habitat quality has been noted for a particular activity, however, DFO is of the opinion that no change in habitat quality will occur. Below is a list of these activities. This table, as well as other tables within this section should be updated to remove this environmental effect or a justification should be provided as to why the effect should remain. • Operation of vessels/vessel traffic • Lighting • Tow-out of GBS to Bull Arm deepwater site • GBS ballasting and de-ballasting (seawater only) • Complete GBS construction and mate topside at Bull Arm deepwater site • Hook-up and commissioning of Topsides • Various surveys • Platform tow-out to deepwater site. • Hook-up and commissioning of Hebron platform • Hook-up, production testing and commissioning of excavated drill centres

	• Presence of structures Since Table 7-11 noted that OLS installation and testing could result in potential fish mortality, then Table 7.9 should be updated to reflect this information as well. Since Table 7-12 indicates that the potential future operational activity of geophysical / seismic surveys could result in potential fish mortality, then Table 7.9 should be updated to reflect this information as well.
	EMCP Response 30-Nov-10: Tables 7-9, 7-11 and 7-12 in the CSR will be revised as per the reviewer's comments. Payne *et al.* (2008) concluded that seismic-related fish mortality is possible only in shallow, confined embayments.
	B18) 7.5.1.1 Change in Habitat Quantity (Construction and Installation); Page 7-47 The fist paragraph on this page states that, "*The footprint of the bund wall, the area of the dry-dock, the area to be dredged and the footprint of any at-sea disposal will be quantified and detailed within the Habitat Compensation Strategy report for the Hebron Project*." While this level of detail is not required in a Fish Habitat Compensation Strategy, a separate document detailing the HADD quantification should be submitted to DFO.
	EMCP Response 30-Nov-10: Noted. A fish habitat Compensation Strategy will be submitted and will provide an overview of the expected habitat alteration, disruption or destruction of fish habitat. Details regarding the quantification of fish habitat will be provided to DFO as part of the information requirements for the *Fisheries Act* authorization.
	B19) The second paragraph on this page states that, "*The bund wall footprint and the area to be drained for the dry-dock in Great Mosquito Cove may temporarily affect to a small degree, the quantity of available habitat for fish and shellfish for an estimated 24 months.*" While it is true that this change in habitat quantity will be temporary, it is important to note that construction of the bund wall and dry-dock dewatering may still constitute a HADD of fish habitat.
	EMCP Response 30-Nov-10: Noted.
	B20) 7.5.1.2 Change in Habitat Quality (Construction and Installation); Page 7-52 Two of the mitigation measures being considered to reduce sediment loading during construction are, "*Investigate the use of washed rock or in-water sediment control measures for fill material in the construction of the bund wall*" and "*Investigate technologies to reduce sedimentation during dredging operations*" There should be a commitment to implement, not investigate, these standard mitigations, which are commonly recommended by DFO for the protection of fish and fish habitat. Similar statements are made throughout the text and tables within this document. These statements should also be revised accordingly.
	EMCP Response 30-Nov-10: Sediment control measures are standard mitigations to implement for in-water work; however, the efficacy of some of these standard measures may not be understood for such an undertaking in Great Mosquito Cove. EMCP will implement proven sediment control measures. The statement in the CSR is meant that different measures will be investigated, and a proven method will be implemented.
	B21) Table 7-11 Although the following comments were made regarding information contained within Table 7-11 on page 7-62, they also pertain to the text portion of Section 7 and Table 7-9 on page 7-44. **Near shore Project Activities:** • **Presence of Safety Zone** The duration for presence of safety zone is noted as a "*2*" (1-12 months), it should in fact be a "*3*" (13-36 months) to correspond to the life of the project at the Bull Arm site.

	• **Dewater Dry-dock / Prep of Dry-dock Area** The text on page 7-47 states that, "*The bund wall footprint and the area to be drained for the dry-dock in Great Mosquito Cove may temporarily affect to a small degree, the quantity of available habitat for fish and shellfish for an estimated 24 months.*" However, Table 7-11 does not include habitat quantity as a potential environmental effect. It also rates the duration as "*2*" (1-12 months) when according to the text on page 7-47 it should clearly be rated as "*3*" (13-36 months). In addition, compliance to the Section 35(2) *Fisheries Act* Authorization and Fish Habitat Compensation should be included as mitigations. The environmental effects of dewatering the dry-dock should also include fish mortality. • **Concrete Production (Floating Batch Plant)** "*Concrete wash water containment and testing to meet applicable regulations*" is included as an applicable mitigation in the text on page 7-53. This should be added to Table 7-11. • **Dredging of Bund Wall and Possibly Sections of Tow-Out Route (May Require At-Sea Disposal)** Compliance to the Section 35(2) *Fisheries Act* Authorization and Fish Habitat Compensation should be included as mitigations for at-sea disposal. Section 7.4.1 (page 7-42) indicates that there may be possible blasting along sections of the GBS tow-out route to the deepwater site, however, there are no mitigations indicated in this table to offset the effects of in-water blasting. The mitigations section should be updated as applicable (*i.e.,* bubble curtains, compliance with Section 32 *Fisheries Act* Authorization, if applicable, *etc.*). • **Removal of Bund Wall and Disposal (Dredging / Ocean Disposal)** "*Implementation of in-water sediment control measures*" should be cited as a mitigation. • **GBS Ballasting and De-Ballasting (Seawater Only)** The environmental effects of GBS ballasting and de-ballasting (seawater only) should include habitat use. **Offshore Construction/Installation:** • **OLS Installation and Testing** The OLS installation is considered a permanent structure and as such the duration rating should be "*5*" (> 72 months). Compliance to the Section 35(2) *Fisheries Act* Authorization should be included as a mitigation. • **Concrete Mattress Pads/Rock Dumping Over the OLS Offloading Lines** As noted in Table 7-9, the environmental effects of placement of concrete mattress pads / rock dumping over the OLS offloading lines could result in potential fish mortality and change in habitat quality. These effects should be added to this table. The concrete mattress pads / rock dumping over the OLS offloading lines are considered permanent structures and as such the duration rating should be "*5*" (> 72 months). Compliance to the Section 35(2) *Fisheries Act* Authorization should be included as a mitigation. • **Platform Tow-Out / Offshore Installation** The environmental effects of offshore installation should also include potential fish mortality and change in habitat quality. The offshore installation is considered a permanent structure and as such the duration rating should be "*5*" (> 72 months). Compliance to the Section 35(2) *Fisheries Act* Authorization should be included as a mitigation.

	• **Placement of Rock Scour Protection on the Seafloor Around Final Hebron Platform Location** The environmental effects of placement of rock scour protection on the seafloor around the final Hebron platform location should also include potential fish mortality. The placement of rock scour on the seafloor around the final Hebron platform location is considered a permanent structure and as such the duration rating should be "*5*" (> 72 months). Compliance to the Section 35(2) *Fisheries Act* Authorization and Fish Habitat Compensation should be included as mitigations. **Potential Future Construction Activities:** • **Installation of Pipeline(s)/Flow line(s) and Testing from Excavated Drill Centre(s) to Platform Plus Concrete Mattresses, Rock Cover, or Other Flow lines Insulation** Installation of pipeline(s)/flow line(s) and testing from excavated drill centre(s) to platform plus concrete mattresses, rock cover, or other flow lines insulation are considered permanent and as such the duration rating should be "*5*" (> 72 months). Compliance to the Section 35(2) *Fisheries Act* Authorization should be included as a mitigation.
	EMCP Response 30-Nov-10: The requested edits have been made to Table 7-11 to improve consistency with the text. Note that there is no blasting associated with dredging along the tow-out channel. Section 7.4.1 (and throughout the CSR as necessary) will be revised to reflect this.
	B22) Page 7-61 The third paragraph states that, "*These studies indicate that dredging causes an initial reduction in the abundance, species diversity, and biomass of the benthic community and that substantial progress towards full restoration of the fauna and sediments can be expected within a period of approximately two to four years following cessation (Kenny et al. 1998; Sardá et al. 2000; Van Dalfsen et al. 2000).*" It should be noted that although this statement may be true for polychaetes *etc.*, it is not the case for long-lived species such as corals.
	EMCP Response 30-Nov-10: It is recognized that long-lived species such as corals, while unlikely to be present in the dredged area, may take longer to recover; the CSR text will be updated to reflect this.
	B23) Page 7-62 In the third paragraph it states that, "*The risk of mortality to sessile invertebrates from dredging will be reduced by having dredging contained to the smallest area possible and restricting dredge spoils disposal to a designated disposal area.*" The proponent should note that the disposal area should be determined though consultations with Federal Authorities, including DFO, to ensure the best location is chosen in order to minimize any adverse effects on fish and fish habitat.
	EMCP Response 30-Nov-10: Comment acknowledged. EMCP will consult with DFO regarding the location of the disposal area.
	Follow-up Comment 28-Jan-11: Page 7-62 While the proponent has acknowledged DFO's comment, there is no indication within the response that the text within the CSR will include the intent to consult with Federal Authorities, including DFO to ensure that the best location is chosen for the disposal area in order to minimize any adverse effects on fish and fish habitat. This text should be added to the CSR.
	EMCP Response 18-Mar-11: The CSR will be revised as follows: EMCP will consult with relevant federal departments regarding the location of the disposal area.

	B24) Table 7-12 Although the following comments were made regarding information contained within Table 7-12 on page 7-72, they also pertain to the text portion of Section 7 and Table 7-9 on page 7-44. • **Presence of Structures** The change in habitat quantity with regards to the presence of structures has already been considered in the environmental effects assessment for construction and installation (Table 7-11) and therefore does not need to be taken into consideration again under operations and maintenance. **Potential Future Operational Activities:** • **Presence of Structures** The change in habitat quantity with regards to the presence of structures is factored into the environmental effects assessment under construction and installation (Table 7-11) and therefore does not need to be taken into consideration again here.
	EMCP Response 30-Nov-10: Tables 7-9 will be updated in the CSR.
	Follow-up Comment 28-Jan-11: Table 7-12 Although the changes to Table 7-9 are acceptable, Table 7-12 and the corresponding text in Section 7 should also be revised as per DFO's previous comment.
	EMCP Response 18-Mar-11: Tables 7-9 and 7-12 and appropriate text will be updated in the CSR.
	B25) Table 7-13 • **Removal of the Hebron Platform and OLS Loading Points** As noted in Table 7-9, the environmental effects of removal of the platform and OLS loading points could also result in potential mortality. These effects should be added to this table. • **Surveys (Geophysical, Geological, Geotechnical Environmental, ROV, diving, etc.)** As noted in Tables 7-9 and 7-11, these activities would not result in potential fish mortality. This table should be updated to reflect the same information.
	EMCP Response 30-Nov-10: Table 7-13 will be updated in the CSR.
	B26) 7.5.4.1 Change in Habitat Quantity (Accidents, Malfunctions and Unplanned Events); Page 7-77 The first paragraph in this section states that, *"In the offshore, a spill of crude oil would dissipate through evaporation as well, but would have the potential to form tar balls and sink to the sea floor. In any case, the quantity of fish habitat affected by a spill would be negligible.*" Please provide a reference which supports this prediction (*i.e.*, formation and impact of tar balls).
	EMCP Response 30-Nov-10: Sentence will be reworded to read: In the offshore, a spill of crude oil would dissipate through a variety of different process including evaporation as well would have the potential to form tar balls (Iliffe and Knap 1979; Ramamurthy 1991; NRC 2003). Tar balls may be transported long distances from source and concentrating in convergence zones or shorelines (NRC 2003). The actual fate of the tar balls will be dependent upon their specific gravities, which are influenced by the amount of sediment and other extraneous materials incorporated into the tar balls. Tar balls and the PAHs associated with them have low bioavailability (Gustafsson *et al.* 1997; Baumard *et al.* 1999). The quantity of fish habitat that may be affected by an unplanned event would be examined as part of an environmental effects monitoring program in the event of an unplanned event.

The following references will be added:

Baumard, P., H. Budzinski, P. Garrigues, T. Burgeot, X. Michel and J. Bellocq. 1999. Polycyclic aromatic hydrocarbon (PAH) burden of mussels (*Mytilus* sp.) in different marine environments in relation with sediment PAH contamination, and bioavailabiliy. *Marine Environmental Research*, 47: 415-439.

Gustafsson, Ö., F. Haghseta, C. Chan, J. MacFarlane and P.M. Gschwend. 1997. Quantification of the dilute sedimentary soot phase: implications for PAH speciation and bioavailability. *Environmental Science and Technology*, 31: 203-209.

Iliffe, T.M. and A.H. Knap. 1979. The fate of stranded pelagic tar on Bermuda beaches. *Marine Pollution Bulletin*, 10: 203-205.

NRC (National Research Council). 2003. *Oil in the Sea III: Inputs, Fates, and Effects*. Committee on Oil in the Sea: Inputs, Fates, and Effects, Ocean Studies Board and Marine Board, Divisions of Earth and Life Studies and Transportation Research Board. National Academies Press. Washington, DC. 265 pp.

Ramamurthy, V.D. 1991. Effects of oil pollution on bio-ecology and fisheries on certain enclosed coastal regions of the Arabian Sea. *Marine Pollution Bulletin*, 23: 239-245.

C) 8. Commercial Fisheries

C1) 8.1.3 Administrative; Page 8-1

This section gives the impression that NAFO divisions and unit areas are defined by DFO, which is not the case. Suggest revising this section.

EMCP Response 30-Nov-10:

The text in Section 8.1.3 will be revised as follows:

Administrative boundaries for commercial fisheries are determined by DFO, which manages the fisheries resources in the area and is primarily responsible for scientific surveys within the area. These boundaries generally follow Northwest Atlantic Fisheries Organization (NAFO) Division and Unit Areas.

C2) 8.3.2 Offshore Fisheries; Page 8-14 Figure 8-5

NAFO unit area 3Na is mislabels as 3Lb.

EMCP Response 30-Nov-10: Corrected Figure 8-5 is provided as follows:

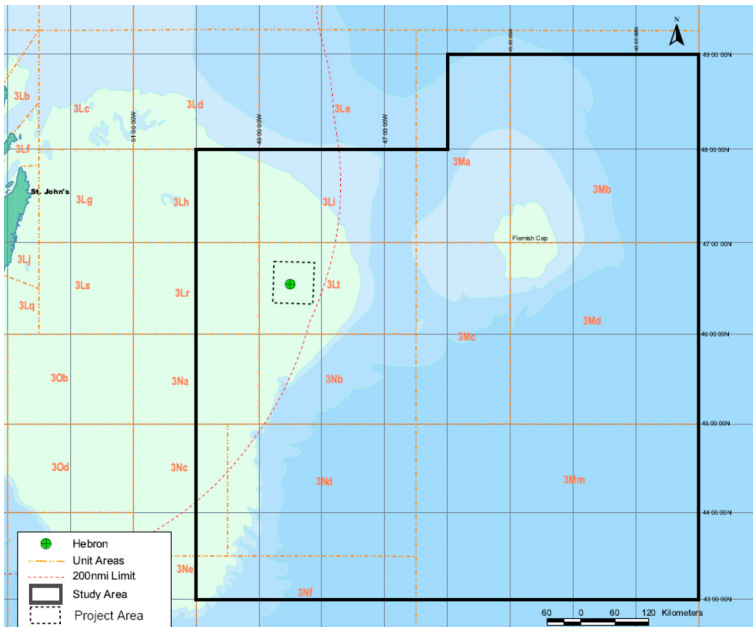


Figure 8-5 Offshore Study Area, Project Area and Other Zones

C3) 8.3.2.2 – Historical Overview of Regional Fisheries; Page 8-16

a) Please revise Committee on the Status of Wildlife in Canada to Committee on the Status of Endangered Wildlife in Canada.

b) This section states that "…COSEWIC listed the Atlantic Cod (Newfoundland and Labrador Population as an endangered species." Please be advised that COSEWIC assessed Atlantic Cod as endangered in 2003. Please revise accordingly.

EMCP Response 30-Nov-10

a) Text will be corrected to Committee on the Status of Endangered Wildlife in Canada.

b) Text will be changed to "…COSEWIC assessed the Atlantic Cod (Newfoundland and Labrador Population) as an endangered species…"

C4) 8.5.1.2 Offshore (Access to Fishing Grounds); Page 8-52

The lack of harvest activity within the proposed offshore safety zone over the last two decades is a function of a significant decline in the abundance of ground fish. In the event of an increase in the abundance of ground fish, reduced access to these fishing grounds may have economic impacts for ground fish licence holders.

EMCP Response 30-Nov-10. Acknowledged. However, it should also be noted that even in the years before the moratorium, Unit Area 3Lt was one of the least productive / harvested of all the Division 3L fishing areas (though geographically one of the largest) accounting for just 1.7 percent of the harvest by quantity in those years (see Table 8-X).

Table 8-X Pre-Moratorium Landings in Unit Area 3L

3L Unit Area	Tonnes (1984-1990 average)	% of total
3Lc	2,691	1.5%
3Lt	3,057	1.7%
3Lg	3,221	1.8%
3Le	3,308	1.9%
3Li	4,494	2.5%
3Lh	5,774	3.3%
3Ls	9,265	5.2%
3Lq	12,091	6.8%
3Lj	15,799	8.9%
3Ld	19,209	10.8%
3La	20,098	11.3%
3Lf	23,302	13.1%
3Lr	25,839	14.6%
3Lb	29,294	16.5%
3L Total	177,442	100.0%

D) 10.0 Marine Mammals and Sea Turtles

D1) 10.3.1.1 Recent Marine Mammal Monitoring in the Jeanne d'Arc Basin, Page 10-8

The last paragraph on this page states that, "There were no confirmed identifications of sperm whales…" However, DFO and others have made many sightings of sperm whales on the Grand Banks, including some in very shallow near shore waters, so the low number of these animals should be considered "unexpected". In addition, the most common cetacean sighted in association with offshore trawling operations in recent years are sperm whales. Thus, sperm whales are attracted to fishing operations on the Grand banks and may approach other vessels as a result.

EMCP Response 30-Nov-10: The text as written is accurate in that it is specifically referring to sightings made during seismic monitoring programs on the Jeanne d'Arc Basin. There were no sperm whale sightings made during these monitoring programs. However, it is recognized in Section 10.3.1.2 that sperm whales have been recorded and

	are included in DFO's cetacean database. Given that effort is not accounted for in the DFO database, it is difficult to comment on the relative abundance of a given species (*i.e.*, sperm whale) in the Offshore Study Area, particularly relative to water depth. **The following sentence:** "This was not unexpected given that the seismic programs occurred in relatively shallow shelf waters." **is replaced with:** "Perhaps with the exception of sperm whales, this was not unexpected given that the seismic programs occurred in relatively shallow shelf waters."
	D2) 10.3.2.2 Toothed Whales (Odontocetes) (Northern Bottlenose Whale), Page 10-20 It should be noted that there have been several northern bottlenose whale standings recently in coastal waters, including one in Terra Nova. It is likely these whales were chasing near shore squid.
	EMCP Response 30-Nov-10: The following paragraph from the CSR (page 10-20): Northern bottlenose whales have occasionally been observed in coastal eastern Newfoundland, although most records are based on carcasses that have washed ashore. Lien (1994) reported that northern bottlenose whales were entrapped in inshore fishing gear on two occasions from 1979 to 1990, and Sergeant *et al.* (1970) described a single northern bottlenose whale taken at the South Dildo, Trinity Bay, whaling station in July 1953. Apparently a second whale, associated with the one captured, remained free-swimming in the southern part of Trinity Bay for at least three additional days (Sergeant and Fisher 1957). There were no sightings of northern bottlenose whales reported in the DFO cetacean sightings database in the Nearshore Study Area (Table 10-6). Thus, it appears possible, but quite unlikely, that northern bottlenose whales will occur in the Nearshore Study Area. **Will be replaced with:** Northern bottlenose whales have occasionally been observed in coastal eastern Newfoundland, although most records are based on carcasses that have washed ashore. Lien (1994) reported that northern bottlenose whales were entrapped in inshore fishing gear on two occasions from 1979 to 1990, and Sergeant *et al.* (1970) described a single northern bottlenose whale taken at the South Dildo, Trinity Bay, whaling station in July 1953. Apparently a second whale, associated with the one captured, remained free-swimming in the southern part of Trinity Bay for at least three additional days (Sergeant and Fisher 1957). Recently, northern bottlenose whales have stranded in Bonavista Bay (2004) and the south coast of Newfoundland (2005) and it is suspected that the whales were pursuing nearshore squid (J. Lawson, pers. comm., October, 2010). There were no sightings of northern bottlenose whales reported in the DFO cetacean sightings database in the Nearshore Study Area (Table 10-6). It appears possible that northern bottlenose whales may occur in the Nearshore Study Area, but sightings would be considered rare.
	E) 11.0 Species at Risk E1) Since project activities will be occurring over a long time period (*e.g.* near shore construction up to 2016, offshore construction to 2017 and onwards), it is possible that during this timeframe more species could be added to Schedule 1 of SARA, new Recovery Strategies, Management Plans or Action Plans could be posted for listed species, critical habitat could be identified, COSEWIC will have assessed new species, *etc.* Many things could change that may affect a species status and the requirements for it under SARA. This will need to be taken into consideration by the proponent.

EMCP Response 30-Nov-10: The CSR includes COSEWIC-assessed species in the environmental effects analysis for Species at Risk. If species that were listed by COSEWIC become a *SARA*-listed species during the life of the Project, environmental effects have been assessed. EMCP will monitor the status of Species at Risk on a regular basis.

E2) 11.3.1.2 American Plaice; Page 11-10

Although the second paragraph states that, "*Females in spawning condition may be found throughout the Grand Banks (Morgan 2001), indicating the lack of a specific spawning ground",* the last paragraph states that, "*The Southeast Shoal and Tail of the Banks EBSA, proposed by DFO, is known as a spawning and nursery area for plaice."* The former statement is more accurate, as recent data has shown that it is unlikely that the Southeast Shoal is the only spawning ground for American Plaice, although they do spawn there. It is also possible that it is not a nursery area as previously thought, however, despite this the area still contains important habitat for American plaice.

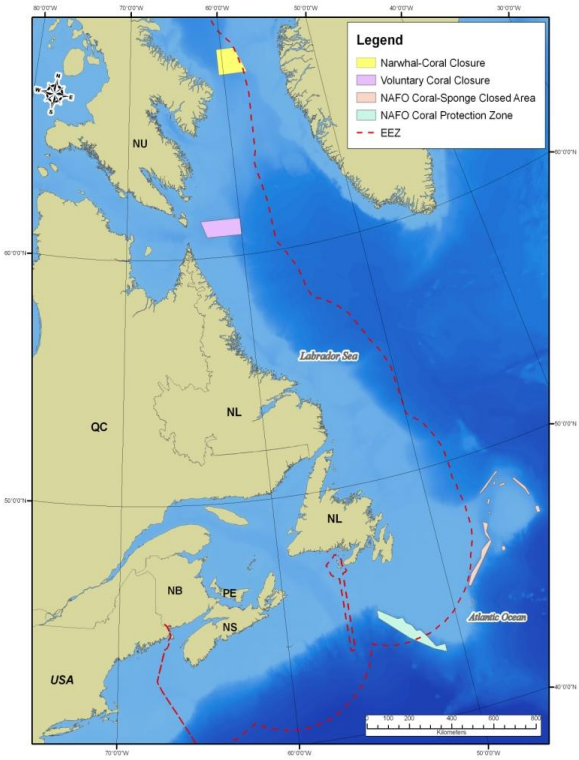
EMCP Response 30-Nov-10: The second paragraph remains unedited; the last paragraph on page 11-10 will be revised to read as follows:

The Southeast Shoal and Tail of the Banks EBSA, proposed by DFO, contains important habitat for American plaice.

F) 12.0 Sensitive of Special Areas; Page 12-3

F1) Figure 12-2 shows "Sponge / Coral Area" but does not note if this is an area where they are found, if these are VMEs (that is what is suggested in paragraph 3 on page 12-1 but not made clear), or closed areas. A map of NAFO Coral and Sponge closed areas and the NAFO Coral Protection zone exists. This data could be used to update Table 12-2. This may be less ambiguous than using "sponge / coral area". See attached map.

Also the green area, southwest of the Flemish Cap, is the Beothuk Knoll, as indicated by the map's legend. However, the Orphan Knoll also appears as a green area north of the Flemish Cap, but is not included within the map's legend.



	EMCP Response 30-Nov-10: Figure 12-2 will be revised to provide clarity as per the above comment.
	F2) 12.1.2 Administrative; Page 12-5 The following changes should be made. - Line 15 Some EBSAs **are** – change to – Some EBSAs **may be** - Line 16…other EBSAs **are** – change to - ..other EBSAs **may be** - Line 17….management implications **of the identification of** these…change to...management implications **for** these
	EMCP Response 30-Nov-10: These editorial changes will be made in the CSR.
	F3) 12.3.2 Offshore; Page 12-8 Please change where it says EBSAs **are** to EBSAs **may be** in lines 12 and 13
	EMCP Response 30-Nov-10: This editorial change will be made in the CSR.
	F4) 12.5 Environmental Effects Analysis and Mitigation This section notes that an oil spill in the Bull Arm area could adversely affect some capelin beaches or eelgrass habitat. However, relatively low levels of oil retained in inter-tidal or shallow sub-tidal sediments could potentially affect a variety of species. For instance, studies in the United States and Canada have noted that sub-lethal effects can be produced in flounder species chronically exposed to very low levels (≤ 3 ppm) of sedimentary PAH. This generalization would also hold true in the Offshore Project Area.
	EMCP Response 30-Nov-10: Section 12.5.1.1 (Nearshore, Eelgrass Beds), Page 12-18, the end of the first paragraph will be revised to include the following: 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. The conclusion that the potential environmental effect of an accidental fuel spill on eelgrass beds (and capelin beaches) will be significant remains unchanged.
	F5) 12.5.1.1 Near shore (Accidents, Malfunctions and Unplanned Events); Page 12-16 (Eelgrass Beds) a) The references, Fingas (2001) and Wright (2002) do not appear to be first-hand accounts, but rather reviews or information taken from technical manuals. Since neither appears to be the source studies, the references have not been cited appropriately. Please check these references and revise as appropriate. b) It should be noted that the recovery time of eelgrass is likely to depend at least partly upon the extent and duration of the exposure. Research on eelgrass disturbance and recovery in Newfoundland coastal waters suggests that eelgrass may recover from disturbance (i.e., physical removal) in 2-3 years (Laurel et al 2003 MEPS; Warren et al. in press JEMBE). However, in both of the above referenced studies, underground rhizomes remained intact after the disturbance, therefore only the removal of the above-substrate biomass (shoots and blades) was investigated. The recovery of eelgrass meadows would take much longer if any spill resulted in appreciable mortality of the underground rhizomes in affected eelgrass beds, perhaps as much as a decade or more based on studies of eelgrass expansion in Newfoundland coastal waters (Warren et al. in press), but certainly longer than 2-3 years as referenced in the CSR. Laurel, B.J., Gregory, R.S. and Brown, J.A. 2003. Settlement and distribution of Age-0 juvenile cod, *Gadus morhua* and *G. ogac*, following a large-scale habitat manipulation. Mar. Ecol. Prog. Ser. 262: 241-252.

	b) The fourth paragraph states that, "*The average density of eelgrass shoots and flowering shoots were 24 percent and 62 percent lower at oiled sites than at reference sites in 1990; however, no differences between oiled and reference sites were observed with respect to eelgrass biomass, seed density, seed germination or the incidence of normal mitosis in seedlings, and there were no signs of elimination of eelgrass beds*". This sentence is contradictory and should be revised.
	EMCP Response 30-Nov-10: a) M. Fingas is the author of Fingas (2001) and other than indicating that the information is in Section 13 ("Effects of Oil Spills on the Environment"), this is the source material. N. Wright's discussion paper (Wright 2002) is an abridged version of a larger discussion paper written in October 2001 for the Canadian Wildlife Service, but is still considered a source document for the information as presented in the CSR. b) **The text will be revised to include the following:** 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. **The following reference will be included in Section 18.2:** Laurel, B.J., R.S. Gregory and J.A. Brown. 2003. Settlement and distribution of Age-0 juvenile cod, *Gadus morhua* and *G. ogac*, following a large-scale habitat manipulation. *Marine Ecology Progress Series*, 262: 241-252. Note that the conclusion that the potential environmental effect of an accidental fuel spill on eelgrass beds indicates the beds will recover, but will, nonetheless, be significant remains unchanged. c) This is the information provided in the source material (Dean *et al.* 1998). **The text will be revised as follows:** 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. Note that the conclusion that the potential environmental effect of an accidental fuel spill on eelgrass beds (and capelin beaches) will be significant remains unchanged.
	Follow-up Comment 28-Jan-11: <u>12.5.1.1. Near Shore (Accidents, Malfunctions and Unplanned Events)</u>: Page 12-16 (Eelgrass Beds) With respect to part a) of this comment, it should be noted that any compilations or summaries of studies completed by others are not considered source material. As such, neither Fingas (2001) nor Wright (2002) constitute source material. Rather than cite the information contained in these 'compilation documents', the original study upon which a particular statement is based should be consulted and referenced appropriately. This is necessary to ensure that the conclusions of the original study are accurately represented, free from the potential biases of subsequent interpretations of the work. The correct sources for the information in question should be located, and the text updated as necessary. With regards to part c) of this comment, the reference provided by DFO in our original comment, Warren et al. in press JEMBE, is now published. The complete reference is provided below for your consideration.

	Warren, M.A., Gregory, R.S., Laurel, B.J. and Snelgrove, P.V.R. 2010. Increasing density of juvenile Atlantic (*Gadus morhua*) and Greenland cod (*G. ogac*) in association with spatial expansion and recovery of eelgrass (*Zostera marina*) in a coastal nursery habitat. J. Exp. Mar. Biol. Ecol. 394: 154–160.
	EMCP Response 18-Mar-11: a) Wright (2002) will be replaced with the following references: Dean, T.A. and S.C. Jewett. 2001. Habitat-specific recovery of shallow subtidal communities following the *Exxon Valdez* oil spill. *Ecological Applications*, 11(5): 1456-1471. Hatcher, A.I. and A.W.D. Larkum. 1982. The effects of short term exposure to Bass Strait Crude Oil and Corexit 8667 on benthic community metabolism in *Posidonia australis* Hook.f. dominated microcosms. *Aquatic Botany*, 12: 219-227. **c)** Noted.
	Follow-up Comment 20-Apr-11:
	EMCP Response 17_Jun-11:
	F6) Pages 12-18 to 12-20 (Capelin Beaches) Based on the spill trajectories, the CSR suggests that there is less than a 2% probability of a spill reaching the head of Bull Arm. This statement does not seem accurate given the coastal currents, wind conditions, proximity to the GBS fabrication site (~3 km in some cases), *etc.* Dispersal models tend to be highly dependent upon boundary conditions and assumptions, yet the supporting documentation on the model (prepared by AMEC), appears to contain no material to specifically address this. Due to the significance of any impact on near shore habitat, it is important to fully understand these aspects in order to effectively interpret the results of such models.
	EMCP Response 22-Feb-11: Applied Sciences Associates was contracted to run the oil spill trajectory modelling for revised blow-out scenarios in the offshore area and potential spills of diesel at Bull Arm. Additional information regarding the model can be found in ASA (2010a, 2010b).
	Follow-up Comment 19-Apr-11: This response is considered adequate.
	EMCP Response 29-Jul-11: Noted.
	G) 14.0 Accidental Hydrocarbon Spill Events G1) Given recent events in the Gulf of Mexico, it is strongly recommended that some discussion of these events be included in the CSR. Therefore, revisions to the text should reflect the possible ramifications of accidental hydrocarbon spill events in light of the new knowledge obtained from the Gulf of Mexico spill.
	EMCP Response 22-Feb-11: The recent events in the Gulf of Mexico have been discussed in the following sections of the CSR (June 2010): • Section 14.1.1, Table 14-3, page 14.3 • Section 14.1.1.1, Page 14-4, paragraph 3 • Section 14.1.1.2, page 14-10, paragraphs 4 and 5
	Follow-up Comment 19-Apr-11: This response is considered adequate, provided the following comments are addressed: As new information becomes available on the events in the Gulf of Mexico, it is important that ExxonMobil commits to taking this information into consideration during future plans concerning the protection of fish and fish habitat, as appropriate.

	EMCP Response 29-Jul-11: The Operator will review information that may be available regarding the Macando spill in the Gulf of Mexico and will consider this information, where appropriate, in terms of protection of fish and fish habitat in oil spill response planning for the Hebron Project.
	G2) 14.2.1 Model Set-up (Fate and Behaviour of Hebron Hydrocarbon Spills in the Near shore Study Area (Trajectory Modeling)); Page 14-15 The base model described in the CSR uses a release point 2 km south of the GBS fabrication site in Bull Arm. It is not clear as to why this distance from the development was selected. The modeled zone of impact in Bull Arm, given the above-mentioned displacement 2 km south of the Bull Arm fabrication site, does not cover two very prominent eelgrass meadows. Placing the modeled spill point at the GBS fabrication site may produce a very different prediction.
	EMCP Response 22-Feb-11: This is an error in the text. The release point for the spill trajectory modelling in Bull Arm is at the approximate location of the GBS deepwater site in Bull Arm.
	Follow-up Comment 19-Apr-11: This response is considered adequate.
	EMCP Response 29-Jul-11: Noted.
	H) 15.0 Follow-Up and Monitoring H1) 15.1.1 Proposed Offshore Environmental Effects Monitoring Program; Page 15-3 The second last paragraph in this section states that, "*A fish habitat compensation monitoring survey is conducted following completion of the compensation works to verify the amount and productivity of habitat created*." While this is correct, it should also be noted that compensation monitoring to determine the continued functioning of the habitat will need to be carried out for a period of time and at intervals agreed upon by DFO and the proponent. Timelines for monitoring will be included in the Fish Habitat Compensation Plan, which will be included as a condition of the Section 35(2) *Fisheries Act* Authorization. Please revise accordingly.
	EMCP Response 30-Nov-10: **Section 15.1.1 of the CSR text will be revised as follows:** In addition to the operational EEM program, EMCP is committed to a fish habitat compensation monitoring program. The details regarding fish habitat compensation monitoring will be determined in consultation with DFO.
	H2) 15.2.1 Near shore Environmental Compliance Monitoring; Page 15-5 Section 32 of the *Fisheries Act,* which prohibits the destruction of fish by any means other than fishing should also be included in the list of regulatory instruments as it may be applicable in relation to in-water blasting, if required.
	EMCP Response 30-Nov-10: **Section 15.2.1 of the CSR will be revised to include the following bullet:** • Section 32 of the federal *Fisheries Act*, which prohibits the destruction of fish by any means other than fishing
	H3) 15.2.2 Offshore Environmental Compliance Monitoring; Page 15-6 As an Authorization for Works or Undertakings Affecting Fish Habitat will also be issued under the *Fisheries Act* for project components occurring at the offshore project area, a reference to this Authorization should be made in this section as well.
	EMCP Response 30-Nov-10: **Section 15.2.2 of the CSR will be revised to include the following:** An Authorization for Works or Undertakings Affecting Fish Habitat will also be issued under the *Fisheries Act* for Project components occurring at the Offshore Project Area.

	H4) 15.3 Other Required Programs; Page 15-7 The third bullet can be removed as the information contained within the fifth bullet is more comprehensive. With regards to the fifth bullet, while this information is correct, it should also be noted that compensation monitoring to determine the continued functioning of the habitat will need to be carried out for a period of time and at intervals agreed upon by DFO and the proponent. Timelines for monitoring will be included in the Fish Habitat Compensation Plan, which will be included as a condition of the Section 35(2) *Fisheries Act* Authorization.
	EMCP Response 30-Nov-10: **Section 15.3 of the CSR will be revised to delete the following bullet:** • *Fisheries Act* habitat compensation monitoring requirements **In addition, this bullet will be revised as follows**: • Project activities affecting fish habitat evaluated as part of the fish habitat compensation program. All fish habitat compensation measures will be monitored to ensure no net loss of productive capacity in fish habitat. A fish habitat compensation monitoring survey is conducted following completion of the compensation works to verify the amount and productivity of habitat created. In addition, compensation monitoring to determine the continued functioning of the habitat will be conducted for a period of time and at intervals agreed upon by DFO and EMCP. The timelines for monitoring will be included in the Fish Habitat Compensation Plan, which will be provided as a condition of Section 35(2) of the *Fisheries Act.*
	I) 17.0 Summary and Conclusions I1) 17.2.2 Summary of Proposed Mitigation Measures; Table 17-2 Mitigations relating to fish and fish habitat for 1) offshore construction and installation and 2) potential future construction activities should include adherence to the Section 35(2) *Fisheries Act* Authorization and completion of associated fish habitat compensation and related monitoring.
	EMCP Response 30-Nov-10: **The section on Offshore Construction and Installation, Table 17-2 in Section 17.2.2 of the CSR, will be revised to include the following bullet in the mitigations listed for Fish and Fish Habitat** • Adherence the Section 35(2) *Fisheries Act* Authorization and completion of associated fish habitat compensation and related monitoring **The section on Potential Future Construction Activities, Table 17-2 in Section 17.2.2 of the CSR, will be revised to include the following bullet in the mitigations listed for Fish and Fish Habitat** • Adherence the Section 35(2) *Fisheries Act* Authorization and completion of associated fish habitat compensation and related monitoring

5.0 OTHER GENERAL COMMENTS

5.1 Response to Fish, Food and Allied Workers Union Comments

180-FFAW	Fundamentally, the overall project will impact fish harvesters both in Trinity Bay and the offshore. The nearshore component of the project will result in some loss of fishing grounds to harvesters in Trinity Bay. It needs to be noted that accessing alternate fishing grounds can be problematic when considering the traditional nature of the fishery in Newfoundland. Harvesters fish where their forefathers fished, particularly lobster grounds. Fishing alternate grounds generally means that they are infringing on another harvester's "territory". As well, commercial species are not distributed equally in bays and coves. Therefore, the impacts of project-related activities in the next few years will have an impact on many harvesters in Trinity Bay, that is, not just those in the communities adjacent to construction activities. All Trinity Bay harvesters will be subjected to increased risk of gear/vessel loss and damage, accidental spills, as well as reduced safety on the water, access to fishing grounds, and catch rates as a result of this project. As well, similar impacts will be faced by offshore harvesters with quotas to fish in NAFO Division 3L as offshore development begins.
EMCP Response 30-Nov-10	Effects of Project activities on commercial fisheries are addressed in Section 8. EMCP understands the concerns of fishers, and will continue to consult with fishers throughout the Project. A Project fisheries agreement for Bull Arm will be developed in consultation with Bull Arm and adjacent area fishers.
181-FFAW	Section 18.1, page 18-1. The correct title for Saunders, R. is Petroleum Industry Liaison.
EMCP Response 30-Nov-10	Noted. **Section 18.1 of the CSR will be revised as follows:** Saunders, R. Petroleum Industry Liaison, Food, Fish and Allied Workers Union, St. John's, NL.
182-FFAW 1	Establishing a Fisheries Liaison Committee with adequate fish harvester representation will be key in the coming months to enable appropriate consultation with affected harvesters as the project proceeds (Section 8.5.1.1). Involving harvesters in the development of an Environmental Effects Monitoring program prior to the start of construction at the site will also provide opportunity for collaboration (Section 15.1.1).
EMCP Response 30-Nov-10	Acknowledged. This is the plan for the Fisheries Liaison Committee. EMCP will design EEM Programs (both inshore and offshore) that will include input from leading experts in EEM programs, regulators and other affected stakeholders.
183-FFAW 2	Construction of the proposed Gravity Based Structure in Trinity Bay will have an impact on the environment in the bay and more specifically fish habitat. Concerns from fish harvesters have been duly noted in the report (Section 5.3.1.2) with respect to dredging, blasting, debris, discharges, dumping, accidental spills, construction related noise and lighting. It needs to be reiterated however that construction activity will also impact catchability, and therefore profitability, for fish harvesters.
EMCP Response 30-Nov-10	This potential is acknowledged in the document, in Sections 8.4.1 and 8.4.2, as well as in the environmental effects assessment discussions in Section 8.5.
184-FFAW 3	It should be noted that lobster catches have been on the increase in Trinity Bay (Lobster Fishing Area 6) over the past number of years (Section 8.3.1.6). Harvesters attribute increased catches to the conservation measures, such as v-notching, that they have been involved with since the mid-1990s. DFO statistical information up to 2009 has been based on buyer slips (lobster sales to buyers). A mandatory logbook was introduced for the 2010 lobster season, which will provide a more accurate representation of actual lobster catches in the ensuing years.

EMCP Response 30-Nov-10	Noted.
185-FFAW 4	The future fisheries (Section 8.4.1.2) section was nominal in the study report. Snow crab (Section 8.3.2.7) harvesters have been prospecting in recent years and have explored many new areas as the resource seemed to be moving further inshore. In 2010, harvesters are also reporting fishing in shallower depths for crab. Furthermore, the 2010 Science Advisory Report (in press) states a recent increase in the exploitable biomass of the 3LNO stock as well as increased recruitment that is expected to increase further over the next two to three years. As mentioned in the report, any DFO changes to quota area allocation boundaries would also impact fishing activity within the Jeanne d'Arc Basin of the Grand Banks. Lost harvesting grounds from the offshore component of this development could be more significant in the coming years (Section 5.3.2.2). The operator should consult with the fishing industry on a regular basis to keep up to date with snow crab fishing trends.
EMCP Response 30-Nov-10	Noted. This will be done through the various Project consultation / liaison mechanisms.
186-FFAW 5	Also with respect to future fisheries (Section 8.3.2.7), information presented at RAP meetings in 2009 and 2010 indicated that there are increasing signs of cod (Section 8.3.2.3) in the offshore with scope for more recovery. The 2010 Assessment of Northern (2J3KL) Cod (Science Advisory Report) noted that the annual DFO trawl surveys indicated an eight fold increase in the spawning stock biomass from 2004 to 2008. A commercial fishery for Atlantic cod on the Flemish Cap (an adjacent, NAFO-regulated stock) opened in 2010. The resumption of offshore groundfish fisheries would significantly alter fishing patterns and activities within the Jean d'Arc Basin of the Grand Banks and have an impact on fishing enterprises. Again, the fishing industry should be regularly consulted to keep apprised of fishing trends.
EMCP Response 30-Nov-10	Noted. EMCP will consult with fishers as the Project progresses.
187-FFAW 6	The establishment of a Safety Zone (Section 8.5.1.1) at the Great Mosquito Cove site, and later at the deepwater site in the bay will result in a loss of fishing grounds to harvesters in Trinity Bay. This is significant for inshore harvesters in Trinity Bay as previously discussed.
EMCP Response 30-Nov-10	Noted. As stated in Section 8.5.1.1, Project construction activities will affect access to some fishing grounds during certain activities. The Project Fisheries Agreement, which will be developed in consultation with fishers, will address these issues.
188-FFAW 7	While the designation of a traffic lane for project related vessels in Trinity Bay and the associated proposed provisions such as communication protocols and speed reductions in designated areas are essential mitigation measures to reduce interference with harvesting activities (Section 8.5.1.1) it should be noted that crab (pots) and cod (gillnets) are fished in deeper water, likely where the proposed Designated Traffic Lane will be re-established in Trinity Bay. Project-related vessels that enter the bay should be aware that there may be fishing ongoing in the Traffic Lane. Similarly, there is also the possibility for gear conflicts.
EMCP Response 30-Nov-10	Acknowledged and noted. Communication protocols and a vessel traffic management plan will be established and will include measures to ensure all users are aware of all activities that may be occurring in Bull Arm, and the traffic lane.
189-FFAW 8	The FFAW and its members are very concerned about the potential of aquatic invasive species, such as green crab, infesting our bays and coastal waters. The additional vessel traffic associated with the construction of the Gravity Based Structure in Trinity Bay may potentially lead to the introduction of unwanted aquatic invasive species. The green crab species that has become resident in areas of Placentia Bay for example has

	destroyed eel grass beds and competes with native crab and lobster species for food. The potential for the introduction of aquatic invasive species in the area was not mentioned at all in the Hebron Study Comprehensive Study Report document. The FFAW strongly encourages the company to consider and detail the mitigation strategies that the contracting marine vessel companies will need to follow to prevent the introduction of aquatic invasive species in Trinity Bay. Furthermore, the FFAW calls upon the various regulatory bodies to be very stringent regarding any ballast water exchange plans proposed by the company and ensure vessels follow proper ballast water management practices. As well, aquatic invasive species should be incorporated into the nearshore Environmental Effects Monitoring program.
EMCP Response 30-Nov-10	Marine vessels are regulated through the MARPOL Convention and the *Canada Shipping Act*. EMCP is in the early stages of developing the Bull Arm EEM design; however, it will be designed in consultation with regulatory agencies, the scientific community and key stakeholders, including the fishing industry.

5.2 Response to Alder Comments

190-Alder 1	The draft *Comprehensive Study Report (CSR) for the Hebron Development Project* breaks the Project Environment down in to near shore (construction) and offshore (operations) environments. The Near shore Study Area is where the platform will be constructed and the Offshore Study Area is where the platform will be installed for the purpose of bringing oil to the surface and storing it within the fixed structure. We find the scope of the project deficient in not including in the Project Environment the area pertaining to the transportation of the product from the production platform to the Newfoundland Transshipment Facility or to market. For example, Table 2-9 includes the offloading of produced crude as an anticipated activity but it does not include the "transportation of produced crude". We request that this omission be corrected. We do not find the coverage of this issue provided by 2.9.5 adequate.
EMCP Response 30-Nov-10	As stated in Section 2.9.5, the Hebron Project will ship the crude oil either direct to market, or to the Newfoundland Transshipment Terminal, using the fleet tankers currently in use for the Grand Banks offshore oil and gas operations. The Newfoundland Transshipment Terminal underwent environmental and regulatory reviews and more recently, Transport Canada undertook an in-depth risk assessment regarding tanker traffic in Placentia Bay.
191-Alder 2	Shore base support is vague on what areas other than St. John's are to be used. We request that any use of other areas such as Bay Bulls must be noted specifically and assessed as part of the project. Bay Bulls is of particular interest due to its proximity to the Witless Bay Ecological Reserve. We request that all onshore sites anticipated to be used by the Hebron Project must be identified and included in the scope of the project's environmental assessment.
EMCP Response 30-Nov-10	The Hebron Project is at the early stages of Project design. Details regarding the level of services required by the Project have not been determined. Supplies, services, and associated vendor sites will be selected through procurement processes and is premature to speculate on possible sites where activities may occur.
192-Alder 3	While the draft CSR states that, no new tankers will be added to the fleet of those presently servicing the offshore area near Hebron it must be assumed that the frequency of tanker traffic may increase. We request more detailed presentation of information on this traffic and a separate assessment of the cumulative risk of tanker accidents in Placentia Bay that may accrue from the addition of the Hebron Project.
EMCP Response 30-Nov-10	See Response to Comment 191-Alder 1. The Hebron Project is at the conceptual stage of engineering. Hebron production operations will not commence until 2017. By that time, it is projected that existing offshore production operations will be in declining production, based on existing forecasts. Therefore, the frequency of tanker traffic is not expected to increase.
193-Alder 4	We request that when using statistics to summarize data, which are not normally distributed that the use of means be replaced by the use of medians and whenever possible plots of raw data distributions are presented rather than only data summaries. For example, Figure 3-39 which depicts "average number of icebergs" is not useful in providing a true impression of the likely number of icebergs one might encounter.
EMCP Response 30-Nov-10	Generally summary statistics used provide an indication of the central tendency (whether this is a mean or a median) and the range of values typically observed. While it may be appropriate to present the median statistic when data observations or sample size is small, the mean parametric statistic is more appropriate for a measure of central tendency for the parameter when a larger number of observations are involved (*e.g.*, >50). When sample sizes are >50, the central limit theorem states that the observations will approximate a normal distribution around a mean value. In the case of large metocean data sets, such as for wind strength and significant wave height for example, including the data for iceberg observations as depicted in Figure 3-39,

	descriptive statistics of mean, standard deviation, minimum and maximum values are therefore more appropriate.
Follow-up Comment 28-Jan-11	It is interesting that EMPC has chosen an answer that refers to fundamental statistical theory. Indeed the central limit theorem implies that for any phenomema, where there are many repeated independent randon trials, the mean of the data (but not necessarily the data itself) will tend to become normally distributed [*i.e.*, the distribution of the means of various samples pulled from the data set is a normal distribution] as the number of trials increases. The observed data is distributed in accordance with some unknown distribution (although we may fit distributions of varying utility to it). A first concern regarding the answer given is that, for any one variable [*e.g.*, frequency of ice occurrence in a grid square], the process may or may not be random or independent for a given year. Secondly, the normalcy of the mean is not necessarily an indication of its appropriateness as a measurement of central tendancy of a distribution. A comparison of the mean and median is an excellent indicator of the centrality of both parameters. The mean is more sensitive to outliers than the median and their comparison is also a good indicator of the symmetry or skew of the data. Understanding variability is key to understanding the meaning of data. Rather than focusing on the central tendency, it may be more useful to think about the likelihood of a proportion of data falling inside or outside some boundary which determines the likelihood of an event being manageable or not.
EMCP Response 18-Mar-11	The data are presented to provide a general description of the environment for the area in which the Hebron Project will operate and are not intended to provide a statistical comparison of environmental data. The data presented are consistent with the approach used by oceanographers / meteorologists to describe large data sets and trends within these data.
194-Alder 5	With respect to marine birds, the draft CSR concludes that "*While there is no known mitigation, flaring is expected to have minimal effect on marine bird populations over the duration of the Project.* We are not convinced of the validity of this conclusion. We request that a detailed presentation of new research on this subject be required before the CSR is finalized including in the final CSR a detailed discussion of the evidence for the above conclusion.
EMCP Response 30-Nov-10	The CSR addresses potential effects from flaring on marine birds in Sections 9.5.2.2 and 9.5.2.4. In addition, further information is provided in response to EMCP Comments 111-GF 16 and 112-GF 17.
195-Alder 6	We also request that the study of the feasibility of the reinjection of Produced Water be required to be included in the final CSR.
EMCP Response 30-Nov-10	See response to EMCP Comment 8-C-NLOPB 6.
196-Alder 7	We request that the section of the final CSR addressing the "need for the project" include a discussion of the project in the context of green house gas emissions and Canada's energy policy and energy needs *i.e.*, define the project as an "energy project" rather than simply an oil project. Alternatives to the project should include a review of the assumption that there is a need to increase the supply of fossil fuels at this time.
EMCP Response 30-Nov-10	Energy policy is developed by federal and provincial governments. The Province of Newfoundland and Labrador's energy policy is outlined in the "Newfoundland and Labrador Energy Plan" and is available on the Government of Newfoundland and Labrador website (http://www.nr.gov.nl.ca/energyplan/EnergyReport.pdf). With respect to greenhouse gas emissions, these are addressed in Sections 6.2.1.2, 6.2.2.2, 6.5.1.2, 6.5.4.2 and 6.6.2 of the CSR.

5.3 Response to Health Canada Comments

197-HC	Health Canada has recently produced a document entitled "*Useful Information for Environmental Assessments*" (attached separately) which outlines information that would be beneficial to include in environmental assessment documents when Health Canada's advice is requested.
EMCP Response 30-Nov-10	Thank you for the information.

6.0 SUPPORTING DOCUMENT COMMENTS

6.1 Air Emissions and Dispersion Modelling Study (Stantec – June 2010)

198-EC 33	**EA Reference:**:	Dispersion Modelling Study Page 15, Table 6.2
Preamble:	The modelling scenarios are not adequately labelled in the second row of table 6.2. We believe they match, from left to right, the 5 scenarios described on P. 11.	
Request 7-Sep-10	Please confirm the modelling scenarios in Table 6.2.	
EMCP Response 30-Nov-10	Table 6.2 will be updated.	

	General Comments
199-NLDEC 2	• A) The use of AERMOD versus CALPUFF. CALPUFF is more suited for modeling of long-range transport and has been proven to work very well in the near field and near shore environments. AERMOD is supposed to be good out to 50 kilometers, but given the size of the domain (100 km x 65 km), AERMOD is stretching the limits of acceptability. It has been found that CALPUFF is the more accurate of the two models. • B) The surface meteorological data is taken from both Hibernia and St. John's by incorporating a "linear interpolation". The use of such a method would result in inaccuracies in model outputs. It implies that not all the hourly data required for input into AERMET is available. Please clarify if all the parameters needed to run AERMET are available from Hibernia (ceiling height and cloud cover in particular)? If not, how are they accounted for in the model description? Given these uncertainties, a recommended approach is to use output from a meteorological model such as NAM or GEM as the input into the dispersion model. • C) There is a possible error in the document. The model describes receptors, which are located at the same location as the emission sources (e.g., Hibernia, Terra Nova and White Rose). Please clarify how this arrangement can provide accurate data or if this is an editing error. • D) The NO2 / NO / NOx reduction methods were discussed but it never said which option was used. Please provide the option chosen so that modeling results can be put into perspective. • E) It is mentioned that the BPIP program was used to calculate effects of building downwash for "particulate sources". Does this mean that the downwash was not considered for gaseous emissions? In addition, BPIP is very sensitive to how inputs are entered. With the limited information provided, it cannot be determined whether BPIP will run accurately. • F) For particulate, only TSP was considered in the model. There is no mention of PM2.5, which is a primary particulate fraction of concern. There is minimal supporting information provided to validate the conclusions. The results indicate concentrations close to the provincial limits. It should be noted that if emissions exceed 50% of provincial limits, that the province could take action to request more detailed information or engage in monitoring of air emissions.
EMCP Response 30-Nov-11	• A) It is agreed that CALPUFF is the better of the two models for *long-range issues* but the issue here is not one of long-range impacts, as the concentrations of Project emissions are too low to be of concern at the distances where a transition from AERMOD to CALPUFF would be advisable. Turbines, proposed for use on the Platform, are used for electrical power generation within urban areas across Canada, for example, at Dartmouth and Toronto airports. Setting the domain at the limits

	used was done because the other projects represent the nearest fixed receptors, and to be in alignment with other component studies. An extensive comparison of CALPUFF, AERMOD and ISC3 models on gas turbine exhausts was undertaken and the results presented at the Guideline for Air Quality Models Conference in 2003 (presentation and animated simulations available upon request). This work confirmed the suggestion that CALPUFF is the better model in the far field, but also showed that AERMOD is a useful, and cost-effective tool in the near to medium range. It is recommended for like situations by the US EPA, and it was agreed in discussion with Environment Canada to be suitable for this application. • B) The interpolation involved the estimation of the in-between observations of the three-hour surface observations at Hibernia. This was done by vector time interpolation of the wind; that is, the wind was decomposed into easting and northing components, each of which were interpolated for the intervening hours, and then recombined for a wind with the correctly oriented direction. Interpolation of weather model data to the site was considered; it was rejected in this case in favour of the actual observations that became available, albeit with some compromise. • C) The study did not attempt to assess the contribution of each platform to itself, therefore the receptor coordinates were not designed to accurately locate the air intakes, for example, and the design was not sufficiently advanced to provide locations for the intakes on the Hebron structure. At the separation distances between projects, the difference between the concentrations at the coordinates used and the actual air intakes for the platforms will be not significant. • D) The modelling for this Project has been done using a worst-case analysis. This can mean an assumption of complete conversion of NO to NO_2, despite the fact that it may overestimate by an order of magnitude; however, in situations where such an approach shows an apparent exceedance, it is necessary to conduct a more realistic appraisal of the conversion rate. Unfortunately, offshore locations have limited ambient ozone data and it is therefore considered appropriate to use a conservative conversion rate that will approximate worst-case conditions, at least within the relative near-field where maximum concentrations are predicted. A conversion rate of 25 percent is adequately protective of the environment, and have used that in this assessment to account for the 10 percent of NO_x emitted as NO_2, plus a conservative additional 15 percent converted in the relative near field. • E) The BPIP program was applied for all pollutants, not just particulate matter. A typographical error appears to have changed “particular” to “particulate”. The study team is very familiar with the application of BPIP, but in this Project, as is often the case, the engineering design proceeds while the environmental assessment is being prepared. This is one of the best uses of an environmental assessment process, as the design adapts to reduce impacts. Accordingly, the air quality assessment, including BPIP, has been redone to address the design of the physical structure, and other changes that may arise due to load changes or equipment sizing. As standard practice, senior reviewers within the air quality group review all approaches and calculations are considered. The remodelling as of September 28, 2010, is in final data summary, and all model inputs have been through quality checks. Revised model inputs are primarily the turbine emissions, stack sizes and platform geometry. The results indicate compliance with all applicable standards. • F) $PM_{2.5}$ is becoming of more immediate concern, but emission factors are rarely available, and, 24 hour levels are regulated at 25 $\mu g/m^3$ by Newfoundland and Labrador, and the Canada Wide Standard is 30 $\mu g/m^3$. The emission factor for Total Suspended Particulate Matter includes the $PM_{2.5}$ fraction. Comparison of the model results with the criteria indicates compliance with both.
Follow-up Comment 28-Jan-11	**A)** NLDEC accepts response. **B)** The linear interpolation scheme used to estimate hours between three-hour surface observations is acceptable. However, the question of whether or not the

	meteorological parameters needed run AERMET are available from Hibernia was not addressed. It is quite likely that ceiling height and cloud cover data in particular, are not available from Hibernia but were obtained from St. John's airport. If so, then an explanation is required as to the appropriateness of merging Hibernia data with St. John's data and the effects this will have on the model outcomes. **C)** The response does not answer the question. In the report, the location of the Hibernia platform point source (669419 E, 5179807 N (page 14)) is identical to the Hibernia receptor location (pages 17 thru 27). For Terra Nova, the point source and the receptor are 1metre apart. In both instances, this implies the receptor is inside the stack, which clearly is illogical and will hence cause modelling anomalies. Please clarify if this is the case and how the results may be impacted. **D)** While it is appreciated that there is limited ozone data for the project area to determine a conversion rate from NO to NO2, assuming that a conversion rate of 15% is adequately protective of the environment is very subjective and likely an underestimation. Using the Plume Volume Molar Ratio Method (PVMRM) as the most advanced algorithm for NO to NO2 conversion in AERMOD, it can be readily shown, that based on the emission characteristics that were modelled, if, for example, a background ozone level of 20 ppb is assumed under D stability, the conversion rate is approximately 22% (excluding original 10% NO2 emission rate) about 1 kilometre from the source. Similarly, for example, if a background ozone level of 10 ppb is assumed under D stability, the conversion rate is approximately 32% approximately 2 kilometres from the source. Therefore while a 15% static conversion rate may be somewhat realistic in close proximity to the source, it may be inaccurate beyond 1 kilometre and hence not representative worst-case conditions. The proponent needs to re-evaluate the assumptions made and provide clarity to the potential impacts. **E)** NDOEC accepts Hebron's response regarding "particular" vs "particulate". With regard to the operation of BPIP, NDOEC does not question the proponent's ability to use the model. The question is whether the proponent is aware that how the data is entered into the model will dramatically affect the outcomes from, the model. For example, a simple 1-tiered 20m x 20m building with 1 stack entered as one building will give a different result that the same building entered as 2 adjacent 10m x 20m buildings. This compounding error within BPIP becomes magnified in situations where there are numerous adjacent structures and tiers. If the BPIP inputs were not entered correctly unrealistic results may occur. Can the proponent provide assurances that the downwash effects are accurately modelled and representative of the configuration of the Hebron platform? **F)** The model outcomes indicate that 24-hour TSP levels could reach 99.4 µg/m3 during peak platform operation. Based on the proponent's response, it is implied that because PM2.5 is a fraction of TSP, and TSP is compliant, therefore PM2.5 is compliant. This is illogical. If, for example, all the TSP is PM2.5, then regardless of which standard is used for comparison, the standard would be exceeded by a factor of 3 - 4. The proponent needs to provide assurance that the PM2.5 standards will not be exceeded.
EMCP Response 18-Mar-11	A. Noted. B. Cloud data are recorded at Hibernia under the MANOBS protocol in use at the site, and these data were purchased for use in this Project. C. Model-predicted concentrations at the discrete receptors representing other offshore platforms (Hibernia, Terra Nova, and White Rose) were calculated as part of the modelling assessment. For the reasons given in the previous response to this inquiry, the locations of these three receptors were selected based on these source locations (but at the stack base). The results for the Hebron-alone runs do not include contributions from the regional sources. The results for the cumulative cases were shown to be higher than the Hebron-alone runs at these locations, as

	anticipated (*i.e.,* the influence Hebron emissions at these locations is not substantive) and are thought to be representative, on a broad scale, of the probable worst-case cumulative conditions on the adjacent platforms. D. In the absence of ozone data in the vicinity of the Project, a 15 percent conversion rate from NO to NO_2 was assumed, and 10 percent of the NO_X emitted from the stack was assumed to be released as NO (for a total of 25 percent NO_2). As the highest predicted NO_2 concentrations occur within 1 km of the sources and are well below the NAAQO thresholds, the use of a 32 percent NO_2 to NO_X ratio would still result in predicted concentrations well below the ambient threshold values. At locations further afield, NO_2 concentrations gradually reduce to background and thus, the use of increasing higher NO_2 to NO_X rations would not affect the results of the assessment. E. As discussed in the previous response to this inquiry, the downwash parameters were estimated based on the best available information at the time of the assessment. The Hebron project is in the conceptual stage of design. Based on the information available at the time, the model accurately represents potential air emissions from the Project. Stantec, who carried out the air emission modelling, is aware of the sensitivities of the BPIP model. However, it is acknowledged that the detailed input information for BPIP was not available for other offshore structures, so that the predictions of the emission impacts of other structures on themselves in the cumulative table of concentrations should not have been included, as they would not have been predicted to an acceptable degree of accuracy. F. Test information on the PM2.5 emissions relative to TSP emissions are rare for gas turbines. It is logical that the PM2.5 fraction would be less than the TSP. England *et al.* (2002) reports both emission factors cites a measured ratio of PM2.5/TSP of 27.9 percent, and a ratio of PM10/TSP of 47.5 percent for gas turbine combustion of natural gas. **Reference:** England, G., O. Chang, and S. Wien. 2002. *Development of Fine Particulate Emission Factors and Speciation Profiles for Oil- and Gas-Fired Combustion Systems*. Annual Technical Progress Report No. 2, Prepared for National Petroleum Technology Office, Gas Research Institute, National Energy Technology Laboratory, US DOE, California Energy Commission, New York State Energy Research and Development Authority and American Petroleum Institutes by GE Energy and Environmental Research Corporation. February 14, 2002.
Follow-up Comment 20-Apr-11	**Item F)** Based on the response to item F (in previous March 2011 response), the proponent would calculate the maximum PM2.5 concentration to be 27.7 ug/m^3. This would be an exceedance of the standard (25 ug/m^3) in the *Air Pollution Control Regulations* if the province had jurisdiction in that regard. The current Canada-Wide Standard is 30 ug/m^3, and therefore the emissions would fall below that standard. The proponent should however, be cognizant of the fact that in 2012 / 2013 a new Canadian Ambient Air Quality Standard for PM2.5 is to be introduced and that their emissions may not be below this new standard. The proponent is therefore encouraged to take mitigative measures during the design phase of the project to limit PM2.5 during operation.
EMCP Response 17-Jun-11	The potential for changes to federal air emissions standards are noted.

6.2 Spill Trajectory Modelling for the Hebron Project

Comments on AMEC Earth and Environmental (April 2010) Spill Trajectory Modelling Report

200-EC 55	**EA Reference:**:	Spill Trajectory Modelling for the Hebron Project
Preamble:	The study considered two spill sites: a near shore site in Bull Arm in Trinity Bay where the Hebron platform will be built and an offshore site where the Hebron oil production will take place. The study used three oil spill models to conduct this modelling work: ADIOS, the weathering model developed by NOAA and is publicly available, AMEC model developed (and apparently used previously) by AMEC, and finally the Oil map model developed by Applied Science Associates. ADIOS was used to address the oil weathering, AMEC model was used for stochastic modelling, and Oil map was used for trajectory modelling at the offshore spill site using deterministic approach, three blow-out scenarios and three batch spill events. While the study showed a certain trend of the possible trajectory of spills and spatial distribution of the probability of oiling in Bull Arm in Trinity Bay and around the future offshore Hebron production site, the method used to conduct the modelling study is questionable as shown in the following comments. 1. The use of three different oil spill models to conduct this study is misleading and did not bring any benefit to the study, evaluation of the risk / impact associated with oil spills because: a) For the purpose of this study, trajectory modelling and tracking of the mass balance (weathering) should be integrated in the same model as in the Oil map model. The use of ADIOS model to address the weathering and AMEC model to predict the trajectory is not a correct approach as movement of the oil is strongly affected by its weathering states and vice-versa. b) The Oil map model is known to be oil spill software that can be used to conduct trajectory modelling in both deterministic and stochastic modes. Trajectory and weathering modelling are coupled in this model. c) ADIOS software model designed to estimate weathering and masse balance, but does not have any capability to model oil trajectory. d) From the description provided in the report, AMEC is not an oil spill model suitable for this study as described below. 2. Modelling results obtained with the AMEC model and related to probability of oiling are questionable for the following reasons: a) As described in the report, the AMEC model includes oil advection to hydrodynamic current and wind, evaporation and vertical dispersion only. Important processes such as spreading, emulsification and interaction with shorelines are not included. b) The trajectory of the slick is modeled by tracking the centre of the slick only. For large spills, spatial distribution of the probability of oiling obtained with such approach is not correct as the edge of large slicks may reach the shoreline but not its centre. In addition, the same reasoning applies for the time for oiling. Trajectory of oil slicks is commonly tracked using Lagrangian approach using thousands of particles or spillets. This method is used in Oil map software. c) The method used to model vertical dispersion is not based on state-of-the-art knowledge. Much better methods have been developed during the last two decades and were validated with several data sets. The method used is elementary and does not include the effects of oil type and weathering (increase of oil viscosity and emulsification, for instance) in a systematic way (use of appropriate behaviour models). 3. Hydrodynamic currents used to conduct the study in the Bull Arm site are based on one-point conditions and cannot represent the hydrodynamic of the entire modelling grid. In such complex domain, it recommended to use proper gridded current data, such as	

	those provided by the BIO finite element model for Northwest Atlantic area. Vector field of surface currents used in the simulations should be displayed on a couple of figures for illustration of both spill sites. 4. While it is recognized in the report (section 3.5 and 4.5) that there is a good chance that ice coverage at the two spill sites may be significant (50% or more) during the winter season, no modelling under ice condition was performed. The fate and weathering of an oil spill in ice-infested waters is known to be highly affected by ice. 5. A long series (hourly) of wind data (30 years) were used, which is very good to conduct the stochastic simulation, assuming that the data are of good quality. But, what is the rational of using 30 simulations per day? The fact that the number of simulations is greater than the number of data points (in a day), there will be duplicates of the extra simulations (in this case 6 per day). The result of this is that the simulations cannot be considered as independent and the resulting statistics (probability of oiling) become biased. 6. The maximum of the simulations was set between 7 and 45 days. We learned from many spills resulting from well blow-out (including the recent Gulf of Mexico spill) that the spill might last for months. The rationale for the simulation timeframe must be explained and in particular, how the modelling results obtained with such short period of time may be used to assess the risk of oiling? 7. The predicted 17% (section 14.2.3) of the evaporation of IFO 180 is questionable. One notes that the ADIOS model is known to overestimate evaporation of many oils under wind conditions. Revision is necessary. 8. The word "any" in the last paragraph of section 14.2.3 should be removed, as the modeling results cover a small portion only of all possible spill events.
Request 7-Sep-10	Redo the oil spill trajectory-modelling taking in to account the comments offered above.
EMCP Response 22-Feb-11:	AMEC 2009 has been superseded by ASA (2010a, 2010b). The above comments have been considered, where applicable, in defining the scenarios used in the revised oil spill trajectory modelling.

201-C-NLOPB Comment #	**Section**	**Sub-section**	**Page**	**Comment**
AMEC 2009 has been superseded by ASA (2010a, 2010b). The following comments have been considered, where applicable, in defining the scenarios used in the revised oil spill trajectory modelling.				
1	2	[N.A.]	1	"Experience with the AMEC model indicates that having at least 60 predictions yields good confidence in the overall resultant statistics for a given month" [Paragraph 3, line 10] A proper statistical justification for this statement should be provided.
2	2	2.1.2	3	The offshore model grid should extend westwards at least to the Avalon Peninsula, and preferably to the Burin, to properly delimit potential landfall areas.
3	2	2.3.1	6	Table 2-2: The source "Fisheries and Oceans Canada, 2009 is not in the Reference section.
4	2	2.3.2	13	<u>Vertical Dispersion</u>: It should be explained how the discussion in this section is relevant to Hebron crude oil. Has the dispersability of Hebron crude been tested using oil samples from the Hebron delineation-drilling program?

201-C-NLOPB Comment #	Section	Sub-section	Page	Comment
5	3	3.5	32	"Recovery of the remaining fuel may only be possible by restraining the sea ice using ice booms and removing the fuel when the ice melts." [Paragraph 1, line 2] The statement does not appear to consider the potential for in-situ burning to be employed.
6	3	3.6	32	The use of an artificial temporal cut-off for spill trajectories, in this case 30 days, is inappropriate. Rather, weathering calculations should form the basis for terminating trajectories that do not either reach shore or leave the model domain.
7	3	3.6.2	35	Paragraph 1, in its final sentence, mentions one trajectory, in April, that reached the head of Trinity Bay. However, other trajectories also appear to leave the model domain at its northern marine boundary: namely four in January and one in July. They also should be discussed.
8	4	4.2	45	The title of the subsection is "Fuel Spill Scenario". The scenarios should deal with Hebron crude oil, as it represents the principal risk exposure for oil spillage during the drilling and production phases of the project.
9	4	4.2	45	Paragraph 2 describes the 30-year wind time series that was used for the spill trajectory simulation. Past trajectory analyses for the northeast Grand Banks have indicated that shoreline contact was relatively rare. Therefore, a longer time series would give additional confidence that those relatively rare conditions had properly been captured, and should have been employed. The reason for not using the entire 52-year wind data set should be explained in light of this.
10	4	4.3.1	46	Paragraph 2: It should be explained why the particular 30 years 1976 through 2005 were chosen from the 52-year wind data set.
11	4	4.4	50	Paragraph 2 describes the choice of a single "representative" year of current data, 2005, to use as input to the trajectory modelling, that 7% of the 2005 data were missing, and that interpolation on these occasions was "not practical". The number of years that current data was available should be provided. The justification for the choice of 2005, the reasons why it was deemed representative, and why only one year of data was deemed sufficient, also should be provided. Additional justification for the lack of interpolation also should be provided.
12	4	4.6	51	Comments 2 and 6 also apply to this section.
13	4	4.6.2	66	Paragraph 2 concludes, with respect to Figures 4-5 through 4-16, that "An inspection of these graphs suggests there should be no shoreline impacts for any trajectories in any months."

201-C-NLOPB Comment #	Section	Sub-section	Page	Comment
				This cannot reliably be concluded from the graphs since the western boundary of the model domain ends east of the Avalon Peninsula, and a number of trajectories impinge upon the western boundary in virtually every month.
14	4	4.7	69	As indicated in comment 13, the conclusion stated in Paragraph 2, line 1 is insupportable.
15	4	4.8	70	The basis for selecting the spill scenarios described in this section should be explained.
16	4	4.8	70	The justification for ending the simulations after 30 days should be provided. They should end only when the oil has weathered / dispersed to an appropriately small fraction, when shoreline is reached, or when the remaining oil leaves the model domain.

Hebron Project Comprehensive Study Report: Spill Trajectory Modelling Reports (ASA 2011) - Comments from Regulatory Agencies

Environment Canada Review Comments - Nearshore and Offshore Spill Trajectory Modelling Reports

Environment Canada Comment 19-Apr-11	EMCP Response 20-Jul-11
1. The new modelling study was conducted using SIMAP software developed by Applied Science Associates, Inc. (ASA). This model responds to the requirements of the modelling needs much better than the one used in the previous study. Some documentation about the model was provided. Results were presented using color figures and tables.	Noted.
2. Both the stochastic and determinist modelling approaches were used to assess the impact, which is good and appropriate in this project.	Noted.
3. Wind and current data used to conduct the modelling work were similar to the ones used in the previous study. A hydrodynamic model for the Bull Arm site was developed in this new study. However, less analysis of the data was performed than in the previous study, especially for statistical analysis of wind data.	The statistical analysis of wind data from the previous study (Spill Trajectory Modeling for the Hebron Project, AMEC Earth & Environmental, 2009) was used to inform the present study about the wind climatology at the sites. Wind rose plots from the four seasons were prepared but not provided as part of the ASA technical report. These have been provided in a final version of the technical report.
4. The major concern of this new study relates to the duration of the simulations, particularly for offshore spills related to platform and subsea blow-outs. Results from these simulations are not adequate to assess the risk of shoreline oiling, for instance. For most of the scenarios for offshore spills, the simulations were stopped at the end of the spill period. The results of the simulations using the deterministic approach showed that 29 to 79% of the spilled oil remains on the surface at the end of the simulations. The fate of this oil should be tracked further in order to assess shoreline oiling properly. In addition to the oiling of the Newfoundland shorelines, there is a potential risk for oil to reach the European shores on the Atlantic side. Some recommendations to improve the simulations and the risk assessment study overall are proposed below. The content of the Executive Summary should be revised accordingly.	Extended period stochastic model simulations have been completed as follows: • 30 day blowout run for additional 200 days • 100 day blowout run for additional 200 days • 120 day blowout run for additional 200 days The results from these simulations provide a prediction of the fate of all oil remaining on the surface at the end of the blowout discharge. The attached document, “Addendum – Results from Simulations of Oil Spills at the Hebron Well Site” provides additional information regarding these extended run simulations. The results of these extended simulations (up to 10.5 months) demonstrate that: • Surface oil within the model domain decreases to zero within 2 to 4 months after flow stops • There is a low probaility for a small amount of oil (up to 0.7% of total oil spilled) to reach the Newfoundland shoreline as a 0.01 mm sheen between 22 and 275 days following start of flow.

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5. Two seasons, summer and winter, were selected to conduct the modelling work without any scientific justification. Wind data at both spill sites should be presented using monthly, or at least seasonal (four), wind rose. Presentation of wind data using annual wind rose is not appropriate for selecting the wind scenarios in this study. To determine the risks of various resources being oiled, modelling scenarios should be based on at least the seasonal wind rose*, i.e.,* need to consider four seasons wind and current conditions.	ASA analyzed the monthly wind roses presented in the previous modeling report (Spill Trajectory Modeling for the Hebron Project, AMEC Earth & Environmental, 2009) and agreed that the summer and winter months were best representative of wind conditions in the offshore. Selection of the summer and winter seasons was based on the plots of monthly wind roses from the previous modeling study. Seasonal wind roses have been included in the revised report. Wind climatology in the summer and winter are substantially different and warrant two sets of spill scenarios. Summer and winter seasons were selected because they exhibit winds with distinct patterns. Summer winds are predominately from the southwest while winter winds are of higher speed and come most frequently from the west. These two wind regimes represent end members of speed and direction while the spring and fall winds represent transitions between them. It is not necessary to simulate spills occurring in the spring and fall because those results would be contained within the summer and winter predictions for oil trajectory and fate. The oil spill modeling for Hebron sampled wind and current from all months of the year, even the spring and fall transitional seasons. This is possible because a spill simulation may start at the end of the summer season, and due to the length of the simulation, run into the fall, thereby sampling the wind and current conditions of that season. The revised oil spill trajectory report demonstrates this by comparing plots of the wind data from the entire 30 year wind record with plots of the wind data sampled by the stochastic model for each of the four seasons (Figures 3.1-1, 3.1-2 and 3.1-3). These wind plots clearly show that the 100 stochastic model simulations performed for each spill scenario adequately sampled the relevant environmental data.
6. The trajectory modelling summary is not representative of the new modelling study. Revision is necessary and recommendations are proposed below.	The spill trajectory modeling report will be revised to include, where appropriate, the responses to the comments.
7. The algorithm used to model oil-ice interaction is based on simplified assumptions that were introduced about three decades ago. Significant knowledge about oil-ice interaction has been gained since then. As such, the modelling results obtained with the SIMAP	The following text has been added to Section 2.6 of the offshore oil spill trajectory report: The SIMAP model algorithms are based on an early (1980's - 1990's) understanding of oil / ice interactions. Since that time various studies (mostly Norwegian) have improved our

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model when ice is present have high degree of uncertainty. This should be stated clearly in the report.	understanding of oil / ice interactions, but most of that work focused on developing oil spill response strategies, not oil spill model algorithms. The impediment to more robust simulation of the interactions of oil in ice is not a lack of understanding of those processes as much as it is a lack of data to define the characteristics of the ice over small spatial scales (centimeters to tens of meters) and short time periods (hours to days). A review of oil spill models by Reed, et. al. (1999) identified this as the overriding issue holding back realistic modeling of oil in ice: *"… the prognosis for improved representation of oil behavior in ice-infested waters remains bleak until our capability to model ice alone improves. … the processes governing oil behavior occur at scales of a few centimeters to a few tens of meters within an ice field. Ice model resolutions are typically at scales of kilometers, to account for effects at active boundaries, such that very crude, ad hoc parameterizations become necessary."* Reed, M., et. al., 1999. Oil Spill Modeling Towards the Close of the 20th Century: Overview of the State of the Art. Spill Science and Technology Bulletin, Volume 5, Number 1, pages 3-16.
8. For consistency with Section 14.3, a Summary Table for the modelling work for the Bull Arm site should be presented in Section 14.2 in Document 1. Both summary tables in Document 3 and 4 require revision as discussed below. The captions of the Tables should explain what the data in the Tables represent.	Summary tables will be included in Sections 14.2 and Section 14.3.
9. The entire Section 14.3.4 entitled "Trajectory Modelling Summary" in Document needs substantial revision. This section does not provide a representative summary of the modelling results. The section should be revised considering the additional comments provided in this review. For consistency, similar section should be added for the Bull Arm site, section 14.2.	Sections 14.2 and 14.3 are part of the Hebron Project Comprehensive Study Report. The purpose of these sections is to provide a summary of the modeling results presented in the spill trajectory modeling reports with a focus on the potential environmental effects associated with these low probability spill events. Detailed information regarding the model, its inputs, and results can be found in the specific modeling reports, and the reader is referred to these reports for more information. It is not the intent of Sections 14.2 and 14.3 to include all the information presented in these modeling reports.

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	Where warranted, Section 14.3.4 will be revised to reflect revisions made in the offshore modeling report.
Specific Comments	
1. The selection of the simulation period of 30 days is not justified. The only argument provided in page 2 of Document 4 mentioned "... a length of time sufficient to allow for all of the weathering processes to occur". This is a general statement that applies to any oil spills. It does not provide a justification based on the requirements of the study and the particularities of the spill scenarios. For proper evaluation of the environmental impact, all simulations related to the Bull Arm spill site should be run until the disappearance of the spilled oil from the sea surface.	All diesel spills show zero oil on the surface at the end of thirty days. IFO-180 spills in winter without ice and in the summer show that less than 3% of the 1000 m^3 remains on the surface, and all of this oil is in the open ocean outside Trinity Bay. The IFO 180 spill occurring in the winter with ice present shows about 8% of the 1000 m^3 remaining on the surface after 30 days. The oil remaining is outside of Trinity Bay in the open ocean.
2. The method used to correlate the Oceans Ltd wind data collected in Bull Arm to the data from the MSC50 grid node M13032 is not described. This information is needed to evaluate its validity. Also, why node M13032 was used instead of the nearest M12874 node?	The MSC50 wind time series from location M12874 was correlated with wind observations collected in Bull Arm by Oceans Limited in 1995-1997 to correct for speed and directions differences imposed by the geometry of the Bull Arm fjord (The ASA report incorrectly identifies the MSC50 location as M12032). The method used is the same method applied in the previous modeling study (Spill Trajectory Modeling for the Hebron Project, AMEC Earth & Environmental) and involves a small correction to the wind speed and direction. The correction method uses the relationship between speed at site M12874 and speed measured at the Bull Arm site to yield a linear regression equation for adjusting the MSC50 wind speeds. The adjustment of wind direction was done using a fixed correction based on the relationship between the directions at site M12874 and the Bull Arm observations (See AMEC, 2010 for details). From this analysis a 30-year wind time series specific to the Bull Arm spill site was produced and used in the oil spill model simulations along with data from the MSC50 sites in Trinity Bay. The revised report provides an expanded explanation of the wind correction method.
3. The hydrodynamic model at Bull Arm was validated using one comparison with observed water elevation only. This is the easy part in the validation process of a hydrodynamic model. It is not sufficient for the validation of	A comparison of the Bull Arm hydrodynamic model predictions of speed and direction with the speed and direction data collected by Seaconsult at the site of the Hibernia GBS in January and February 1991 will be carried out and is presented

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the model. The predicted currents should be compared with the existing current and circulation data for Bull Arm and Trinity Bay.	in the revised technical report. No current data from Trinity Bay have been identified for model comparison.
4. Tide currents and wind-driven currents in Bull Arm and Trinity Bay were modeled separately and then linearly added. This is not necessarily correct. Why wind effect was not model simultaneously with tide currents, as it commonly done in hydrodynamic modelling?	In hydrodynamic modeling studies of this kind, when the effects of wind forcing over the water surface are to be included, it is desirable to model the tide and wind effects simultaneously for the entire period being simulated. The present study utilized a wind dataset spanning 30 years, an extremely long time period over which to simulate a wind forced current. It was deemed not practical to do this because of the extraordinarily large file sizes generated during this process for such an extended time period. It is considered sufficient to utilize the scaling approach described above for the purposes of estimating the statistics of oil spill impacts.
5. A) In the oil spill model, tide currents are constructed based on the date and time of the simulation. However, average wind speed and direction occurring at that time were used. B) Furthermore, the average wind speed was not used explicitly, it was used to scale the current data modeled using a constant wind speed of 8 m/s. This is big and unrealistic simplification of the problem. Average wind and linear scaling do not represent the reality. It may produces a completely different trajectory than the real wind (time dependent), especially if the averaging period is long, as is the case in the selected scenarios for the Bull Arm spill site (30 days). **C)** In addition, working with a constant (average or statistical dominant) wind direction for the entire domain and the simulation period is inacceptable. Results obtained from these simulations cannot be considered as representative when assessing shoreline oiling for instance. **D)** Real wind data (time- and space-dependent), as collected in this study and the previous one, should be used in all simulations. As it is recognised in the first paragraph in page 7 of Document 4, the wind effects dominate the hydrodynamic circulation in Bull Arm and Trinity Bay.	A. The currents were developed using changes in water level due to tides in Trinity Bay and Bull Arm to capture the tidal currents. In order to also capture the component of the current driven by wind, a constant 8 m/s wind was blown over the area from 8 directions and the resulting currents, which capture both tides and wind driven circulation, were generated. This is done to obtain the combined tide and wind driven currents for the range of possible wind directions. B. The oil spill model is run using the actual wind time series (variable in space and time) and the current data are scaled using the average wind speed from the wind time series to scale the current generated using one of the 8 pre-defined wind directions. C. The currents are forced with a constant wind initially, and then when the oil spill model runs, it scales the currents based on the wind it reads from the wind time series. The oil spill model uses a spatially and temporally varying wind time series to move the oil. D. The data collected in prior studies is not sufficient to run the simulations defined for this study because they do not have adequate spatial or temporal coverage. The MSC50 wind data are the best available for the purpose of determining the probabilities of oil trajectories from spills for this kind of risk assessment.
6. Two seasons, summer and winter, were	Selection of the summer and winter seasons was

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selected to conduct the modelling work without any scientific justification. Wind data at Bull Arm spill site should be presented using monthly, or at least seasonal (four), wind rose. Presentation such as the one shown on Figure 2.4-2 for annual wind rose cannot be used to select the wind scenarios in this study. To determine risks of various resources being oiled, modelling scenarios should be based on at least the seasonal wind rose.	based on the analysis of the wind data completed in the previous modeling study (Spill Trajectory Modeling for the Hebron Project, AMEC Earth & Environmental). Summer and winter seasons were selected for modeling oil spills because they exhibit winds with distinct patterns. Summer winds are predominately from the southwest while winter winds are of higher speed and come most frequently from the west. These two wind regimes represent end members of speed and direction while the spring and fall winds represent transitions between them. It is not necessary to simulate spills occurring spring and fall because those results would be contained within the summer and winter predictions for oil trajectory and fate. (see additional information provided in response to Summary Comment 5, above) • Wind rose plots from the four seasons and a discussion of the reason for using summer and winter seasons for oil spill simulations have been included in the final report. • The modeling sampled wind and current from all months of the year, as discussed in response to Summary Comment 5 above.
7. Evaporated oil volume shown in Table 14.1 in Document 1 (Table 4.2-1 in Document 4) for IFO 180 is overestimated (15.5 to 18%), according the actual state-of-knowledge. The fact that the results showed that oil evaporation under ice conditions is equal or higher that the one obtained without ice in winter is not realistic. This is further evidence that the algorithm used to model oil-ice interaction is not appropriate. Revisions of the evaporation model used for the IFO 180 and the algorithm used for oil-ice interaction are necessary.	Not sure what "actual state-of-knowledge" refers to. The IFO 180 specifications were taken from the Environment Canada database of oil properties. This database reports percent aromatics for this fuel oil ranges from 39 to 51 percent. It is not understood how modeled predicted evaporation rates of 15.5 to 18 percent would be considered an overestimation. See response to Comment 13 (below) for additional information.
8. Results obtained under ice conditions are missing in Table 4.1-1 in Document 4.	We did not model ice conditions with the stochastic model, only the deterministic model.
9. Were the ice condition kept constant for the entire modelling period (30 days)? If yes, this not realistic. The simulations should be re-run time-dependent ice conditions as show in the data. If not, this should be mentioned in the report.	Yes. The ice data available for this area are not sufficient to define ice coverage over space and time in periods shorter than 30 days. The decision was made to use 65% ice coverage because it is the maximum under which operations can occur.
10. Table 4.1-1 in Document 4 should be added to Document 1, just before Table 14-1.	Noted. The table will be included in Section 14.2 of the CSR.

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11. A column showing the length of oiled shorelines should be added in Table 14-1 in Document 1 and Table 4.2-1 in Document 4.	This data will be included in the appropriate reports..
12. Results on time for shoreline oiling (Figures B5-B8 in Document 4) should be included in Document 1.	Summary statements regarding shoreline oiling probability will be included in Section 14.2.
13. How possible entrainment of IFO 180 into the water column under ice condition is higher than without ice during the winter (10 to 25 m3 compared to zero in Table 4.2-1/Document 4 and Table 14-1/Document 1)? This is one more evidence that the algorithm used to model oil-ice interaction in the SIMAP software is adequate.	The numbers reported for water column oil in the summary tables were in error for these spill scenarios. This will be corrected in the revised report.
14. Estimation of the volume of oil that contaminates the shorelines is strongly controlled by the type of shorelines. Where proper data on the types of shorelines in Bull Arm and Trinity Bay gathered and used in the model? If yes, the information should be discussed and presented in the report. If not, the results shown in Tables 14.1 and 4.2-1 about shoreline oiling are questionable and require revision. New simulations using proper information on shoreline types are required.	Shoreline types were defined using data provided by ExxonMobil Canada for Bull Arm (refer to Section 12 of the CSR) and the southwestern corner of Trinity Bay. Shorelines were defined as gravel beach or rocky. Shoreline types for the remainder of Trinity Bay were defined as rocky (see Figure 2.7-1 in the Nearshore Modeling Report.
15. Information on how the "Decayed Oil" is calculated is missing in the report and the Annexes describing the SIMAP software. This information is needed and should be presented in details in the report. Explanations should be presented also to clarify how ice effect is modelled in the calculations of the decayed oil. Modelling results presented in Tables 14-1 and 14-3 showed that the volume of decayed oil is significant.	**Oil Degradation** Degradation may occur as the result of photolysis, which is a chemical process energized by ultraviolet light from the sun, and by biological breakdown, termed biodegradation. Many types of marine organisms ingest, metabolize and use oil as a carbon source, producing carbon dioxide and water as by-products. The biodegradable fraction of various crude oils ranges from 11 to 90% (NRC, 1985, 1989). Most studies of microbe-hydrocarbon interactions have been carried out under controlled laboratory conditions and results are not always applicable to the marine environment. Several parameters can limit biodegradation including the microbial population, temperature, oil composition, toxicity and state of weathering; and availability of nutrients and dissolved oxygen. In the SIMAP model, degradation occurs on the surface slick, oil on the shore and the entrained oil and aromatics in the water column. A first order decay algorithm is used.

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<tr><td></td><td>
The degradation rate, $\overset{o}{M}_b$ (g/sec), can be defined as:

$$\overset{o}{M}_b = \frac{dM_{b,i}}{dt} = -K_i M_i$$

<table>
<tr><td>i</td><td>Environmental compartment (water, or shoreline surface, water column, and sediments)</td></tr>
<tr><td>$M_{b,I}$</td><td>Mass of oil lost by degradation from i(g)</td></tr>
<tr><td>M_i</td><td>Mass of oil subjected to degradation from i(g)</td></tr>
<tr><td>K_i</td><td>Degradation constant from compartment i (1/day)</td></tr>
</table>

A typical degradation rate results in the loss of 1% of the available oil mass per day. A degrdation constant (K_i) of 0.01 was used in the spill model simulations.

NRC (National Research Council). 1985. *Oil in the Sea: Inputs, Fates and Effects*. National Academy Press, Washington, DC. 601 pp.

NRC (National Research Council). 1989. *Review of the State-of-Knowledge Regarding Dispersant Usage in Open-Ocean Spill Responses*. NRC Marine Board, Washington, DC. 306 pp.
</td></tr>
<tr><td>16. A)The Summary Table in the Executive Summary in Document 4 should be revised. The data presented should be consistent with those presented in similar Table in Document 3. The percentage should be used and proper caption should be added to explain what the data in the Table represent.

B) All process affecting the mass balance calculation should be listed. Information about the percentage of the spilled oil that remains on the surface should be mentioned.

C) As discussed above, this percentage should be ZERO when the simulations in this study are re-run until the oil disappears from the surface.</td><td>A) The executive summaries will be revised to ensure that data presentation is consistent.

B) The executive summary provides a concise overview of the results of the modeling and should not include the detailed information, as presented in the main report.

C) All diesel spills show zero oil on the surface at the end of thirty days. IFO-180 shows ranges from 0 to 2.8 percent surface oiling at the end of 30 days.</td></tr>
</table>

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17. A) The Summary Table in the Executive Summary in Document 3 should be revised. A proper caption should be added to explain what the data in the Table represent. B) All process affecting the mass balance calculation should be listed. Information about oil on shorelines and the length of oiled shorelines is missing. The percentage of the spilled oil that remains on the surface should be mentioned. C) As discussed above, this percentage should be ZERO when the simulations in this study are re-run until the oil disappears from the surface.	A) The executive summaries will be revised to ensure that data presentation is consistent. B) The executive summary provides a concise overview of the results of the modeling and should not include the detailed information, as presented in the main report. C) See response to Summary Comment 4 (above).
18. Selection of the spill scenarios is crucial in this study. It is not clear how the 35K bpd for the platform blowout and the 20K bpd for the subsea blowout were estimated. Considering recent event of well blowout, these rates are underestimated by two to three orders of magnitude. Details about scientific estimation of the release rate should be provided. The estimate should provide a range of values. The spill scenarios include extreme and average values in this range.	**The following text will be added to the Offshore Spill Trajectory Modeling report to provide additional rationale for the chosen scenarios:** Two blow-out scenarios were included in the spill trajectory modelling: a platform case and a subsea case. The scenarios presented consider the rate at which oil could flow under a blow-out scenario for the Hebron Field. This rate was derived based on existing knowledge of Hebron crude properties, known reservoir properties for the Hebron field and assumptions made for specific well conditions at the time of the blowout. Reservoirs differ greatly from one to another and thier properties (pressure, volume, oil/gas ratio, etc.) are unique to each reservoir. Therefore, the flow rates described below reflect the properties of the Hebron Field. Historical flow rates from other spill events are not predictive of what would happen in other reservoirs, however they can be used to put specific events into perspective. Flow rates for Hebron Platform wells were estimated at 5,600 m^3/d (approximately 35,000 bbl/d) based on the reservoir properties, assuming a blowout to atmosphere (*e.g.*, approximately 70 m above mean sea level) and accounting for the viscous (thick - difficult to flow) nature of the oil from this reservoir. Flow rates for MODU wells were estimated at 3,200 m^3/d (approximately 20,000 bbl/d) based

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	upon the properties of its reservoir, a subsea blowout (approximately 90 m below sea level) and a lighter, less viscous oil. ExxonMobil's well control philosophy is focused on prevention using safety / risk management systems, management of change procedures, and global standards. ExxonMobil has a mature Operations Integrity Management System (OIMS) that emphasizes relentless attention to Safety, Well Control, and Environmental Protection. This includes proper preparation for wells (well control equipment inspections / tests), detecting the influx early, closing-in the well efficiently (personnel training / drills), and circulating out the kick with kill weight mud in a controlled manner. In the event of a blow-out, ExxonMobil's primary objective would be to stop the flow as quickly as possible. For both surface and subsea wells, this would involve shutting in at the wellhead and killing the well through the wellhead. Relief well drilling, and the subsequent dynamic kill, is considered a back-up strategy in the event shut-in and/or killing through the wellhead is not possible or is unsuccessful.
19. Statistical presentation of wind is not adequate for this study (Figures 2.4-2 to 2.44 in Document 3). As for the Bull Arm study, wind rose should be presented for each month of the year, or at least for the four seasons. Definition of the wind conditions to consider in the study should be based on such analysis, instead of considering two seasons only (summer and winter).	ASA analyzed the monthly wind roses presented in the previous modeling report (*Spill Trajectory Modelling for the Hebron Project*, AMEC Earth & Environmental 2009) and agreed that the summer and winter months were best representative of wind conditions in the offshore. Selection of the summer and winter seasons were based on the plots of monthly wind roses from the previous modeling study. Seasonal wind roses have been included in the revised report. Wind climatology in the summer and winter are substantially different and warrant two sets of spill scenarios. The spring and fall seasons in this region are transitional months, where wind speed is generally less and direction is widely variable. Spill simulations using the wind data from these transitional periods result in spills that travel less distance and remain clustered near the spill source. Spills modeled during the winter and summer months, when winds are stronger and persist in direction, result in spills that travel greater distances from the release point and therefore present a more plausible scenario. The oil spill modeling for Hebron sampled wind and current from all months of the year, even the spring and fall transitional seasons. In order to demonstrate this, plots of the wind data from the

<table>
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<tr><td></td><td>entire 30 year wind record are compared with plots of the wind data sampled by the stochastic model for each of the four seasons. These wind plots clearly show that the 100 stochastic model simulations performed for each spill scenario adequately sampled the relevant environmental data. The comparison plots and a discussion of the results have been included in the revised report.</td></tr>
<tr><td>20. Why wind data observed from the nearby platforms were not considered in this study? A complete comparison of the MSC50 wind data and the observed data for several years should be performed to show the accuracy of the wind data used in the simulations.</td><td>EMCP's contractor, ASA, approach is to use the best data available and the MSC50 wind data are generally considered the best. The oil spill modeling requires wind data covering a large area of the ocean over multiple decades and the MSC50 data are the best available for use in a risk assessment modeling study of this kind.

Although a comparison of the data was not done, the results of such a comparison will not necessarily "show the accuracy" of the wind data used in the modeling. The observed data from nearby platforms have gaps and are temporally and spatially limited. They are only useful to characterize the wind at the point of collection and for the limited time period over which they were collected (months to a few years).</td></tr>
<tr><td>21. Values of the variables used in the calculation of the oil droplet size distribution shown in Table 3.2-1 in Document 3 should be listed in the document. Selection of these values should be justified.</td><td>Oil droplet sizes are calculated using a method described in Rye, et al., 1998. Inputs to the droplet size calculation include the following:
<table>
<tr><td>GOR</td><td>110.6</td></tr>
<tr><td>Discharge Temperature</td><td>58° C</td></tr>
<tr><td>Well Diameter</td><td>15.9 cm</td></tr>
<tr><td>Temperature / Salinity Profile</td><td>From NODC, winter and summer</td></tr>
<tr><td>Oil Density (15° C)</td><td>0.9334</td></tr>
</table>
Rye, H., Ø. Johansen and H. Kolderup. 1998. Drop size formation from deep water blowouts. SINTEF Report, STF66 98090: 28 pp.</td></tr>
<tr><td>22. The oil droplet size distribution shown in Table 3.2-1 in Document 3 is valid for the dynamic zone of the jet close to the exit. It is not correct to use the droplet size distribution in the SIMAP to track the fate of the spilled oil in the far-field. The end results obtained using such assumption, as it is done in this study, may lead wrong estimation of the fate, especially estimation of oil entrainment into the water column. Above the dynamic zone of</td><td>The model calculates the initial oil droplet size distribution using the methods referenced above. This distribution applies to the initial stage of the blowout. As time passes, the spill model can recalculate droplet sizes as the oil coalesces into larger droplets. (There is no evidence that the initial droplet size distribution changes while the droplets are in suspension and rising to the surface during a blowout.) Once the oil reaches the surface and is transported by currents and</td></tr>
</table>

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the jet, the intensity of turbulence weakens and coalescence of oil droplets takes. This leads to formation of bigger droplets. In the far-field, oil droplet size distribution is controlled by local turbulence and the state of oil weathering. So, was the oil droplet size distribution shown in Table 3.2-1 used in the SIMPA model kept constant in the entire simulation period? If yes, results from such simulations are not correct and related simulation should be re-run. If not, details about the procedure used should be discussed in Document 3.	winds, it can be entrained by waves and the size distribution is recalculated based on the oil viscosity and surface wind/wave conditions. These dispersed droplets can then coalesce into larger droplets so it is a dynamic process throughout the spill simulation.
23. Estimation of the volume of oil that contaminates the shorelines is strongly controlled by the type of shorelines. Where proper data on the types of shorelines in the affected areas gathered and used in the model? If yes, the information should be discussed and presented in the report. If not, the results shown in Tables 14.3 and 4.2-1 about shoreline oiling are questionable and require revision. New simulations using proper information on shoreline types are required.	The shoreline type specified for the offshore spill simulation is exposed rocky shore which is the predominant shore type of the east coast of Newfoundland. In the SIMAP model, this shore type has a width of 3 m and an oil thickness of 2 mm. This results in a maximum oil mass holding capacity of 5.6 kg/m. Once the oil on the shoreline reaches this amount, oil is no longer able to accumulate on the shore and it either stays in the water or moves along shore if forced by wind and current where it may come ashore in areas where the threshold capacity has not been reached.
24. For simulations with 100 and 120 days of release, it is doubtful that the 100 simulations used in the stochastic model are sufficient to assess the probability of oiling. Selection of this number should be justified with a quantitative analysis, *i.e.*, consider different number to show convergence of the results.	The oil spill modeling sampled wind and current from all months of the year, even the spring and fall transitional seasons. In order to demonstrate this, plots of the wind data from the entire 30 year wind record are compared with plots of the wind data sampled by the stochastic model for each of the four seasons. These wind plots clearly show that the 100 stochastic model simulations performed for each spill scenario adequately sampled the relevant environmental data and that the probabilities calculated by the model accurately reflect the climate at the site.
25. Second paragraph in page 14.3 in Document 1. The justification proposed to focus on a 30-day platform blowout at a rate of 5,600 m^3/d, and a 100-day subsea blowout at 3,200 m^3/d is not acceptable. As discussed in this review, all simulations should be considered with longer simulations period (until the disappearance of oil from the sea surface).	See response to Summary Comment 4 above.
26. First paragraph in page 14-10 in Document 1. The statement "... represent a worse possible outcome" is not correct. The phrase should	The text “worst possible outcome” will be deleted.

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be removed from the report or revised according to the comments provided in this review. Oiling of Newfoundland shore becomes much worst if the For the 120 day simulation, results in Table 14.3 in Document 1 showed that 51% of the spilled oil remains on the surface at the end of the simulations!	
27. Figures 14.10 to 14.16 in Document 1 and the corresponding figures in Document 3 should be replaced to show details of the oiled shorelines, *i.e.,* zoom on the oiled areas, as shown in Figures 14.5 to 14.10 in Document 1.	Figures representing oiled shorelines are included in the final technical report.
28. One of the important outcomes from the simulations presented in this report is the need to extend the simulation domain to include the European shorelines on the Atlantic side, including Greenland and Iceland. Figures such as 14.8 and 14.9 in Document 1 (Figures 29 and 33 in Document 3) are clear illustration of the need to extend the modelling domain for proper assessment of the shoreline oiling. It should be noted that the oiled area shown in these figures is expected to extended significantly when the simulations are continued until the disappearance of the oil from the seas surface.	As discussed at the May 6, 2011 meeting with the regulatory agencies, EMCP has defined a model domain for oil spill trajectory simulations for the purposes of environmental assessment. This domain is defined as the area between 40 and 55 degrees north latitude, and 30 and 60 degrees west longitude. This area is sufficient to determine potential environmental impacts in the Newfoundland offshore area, including potential shoreline impacts in Newfoundland. Potential transboundary environmental effects are also discussed in the CSR. Within this domain, extended period spill simulations (see response to Summary Comment 4 above) clearly show surface oil approaching zero.
29. Results presented in Table and Figures in Document 3 should be reviewed once all simulations are re-run until oil disappears from the water surface, as recommended in this review.	The offshore modeling report has been revised to include responses addressed herein, as appropriate. As described above, within in this offshore modeling domain, extended period spill simulations (see response to comment 25 above) clearly show surface oil within the domain approaching zero.
Recommendations	
1. All simulations (using stochastic and deterministic approaches) should be re-run until the disappearance of oil from the sea surface. This may require extension of the simulation periods for few months. The result should be shown in the mass balance calculations. Stopping the simulations at the end of the spill duration, as it is done in most of the simulations conducted in this study, is not adequate for assessing the environmental impact, especially shoreline oiling. This has	This comment has been addressed in response to Summary Comment 4 (above).

Environment Canada Comment 19-Apr-11	EMCP Response 20-Jul-11
been validated by the observation from the Deepwater Horizon oil Spill in the Gulf of Mexico and from several other oil spills. It is also obvious from some of the results of this study when the simulation duration was extended from 30 to 60 days for a 30-days spill.	
2. The domain of the simulations should be extended to include the European shorelines on the Atlantic side, including Greenland and Iceland.	See Response to Specific Comment 28, above.
3. Additional scenarios should be studied for the platform and subsea blowouts considering a release period longer than 120 days. Based on past well blowout events, this is not an impossible event. In addition, the remote location of the Hebron site and the harsh weather in the area are additional justifications to increase the release during beyond the three months period.	Neither the CEAA nor the RAs have prescribed a blowout scenario in support of environmental assessment. For the purposes of the Hebron Project CSR, the Operator selected a plausible low-probability spill scenario for the spill trajectory modeling. The Proponent concedes that different scenarios could be theoretically contemplated. However, we are confident that the scenario described represents a reasonable basis for undertaking an environmental assessment. The selected scenario should not be interpreted as a commitment by the Operator to a specific response plan. The Operator intends to develop, in accordance with regulatory requirements, contingency plans to address offshore spill events.
4. Results from both the stochastic and deterministic simulations for the spill scenarios representing 50% shoreline oiling, surface oiling and oil entrained in the water column should be presented for the Bull Arm spill site, in addition to the 95% event for which the information was presented in the report.	50th percentile results would show less impact than the 95th percentile cases. Therefore, the report includes the 95th percentile cases.
5. The hydrodynamic model developed for the Bull Arm site should be validated using existing current and circulation data for Bull Arm and Trinity Bay water systems.	A comparison of the Bull Arm hydrodynamic model predictions with the current data collected by Seaconsult at the site of the Hibernia GBS in January and February 1991 has been carried out and is presented in the revised report. No current data from Trinity Bay have been identified for model comparison.
6. Wind data in both spill sites should be presented using monthly, or at least seasonal, wind roses. Seasonal wind (four) should be used in the simulations.	Winds in Bull Arm and at the well site show a typical pattern for locations at this latitude. The summer and winter seasons see a predominant wind direction with less variation than the spring and fall seasons when the wind is in transition. The transitional spring and fall months see winds fairly well distributed from all directions. Spills in the winter and summer will consequently travel a greater distance from the spill site and spills

Environment Canada Comment 19-Apr-11	EMCP Response 20-Jul-11
	during the transitional months will tend to remain closer to the source. For the well site spills the predominant wind direction is likely to result in the most impact because the oil is moved over longer distances, increasing the chances for contact with the shoreline. For the Bull Arm spills the transitional wind may result in the most impact because it potentially oils more shoreline. Since all of the Bull Arm shoreline is oiled this only applies to Trinity Bay. For additional detail regarding wind data see response to Summary Comment 5. Seasonal wind rose plots have been included in the revised report.

Environment Canada Response 16-Aug-11	
Comment	**EMCP Response 24-Aug-11**
Environment Canada contingently accepts the oil spill trajectory modeling in order to complete the Comprehensive Study Report. This contingent acceptance is based upon Environment Canada having the opportunity to participate in the Oil Spill Contingency Planning exercise once the environmental assessment is completed.	Acknowledged.

Fisheries and Oceans Review Comments - Nearshore and Offshore Spill Trajectory Modelling Reports

DFO Review Comment 19-Apr-11	EMCP Response 20-Jul-11
General Comments	
The assumptions used during the modeling of ocean circulation in the area causes concern regarding validity of the results for retention of an oil spill in Trinity Bay. For instance, there is no reference to any *in situ* oceanographic measurements taken to validate or justify the modeling approach in HYDROMAP. Furthermore, there are numerous important features regarding regional oceanographic circulation that are not mentioned in the document, and therefore it is assumed that they were not incorporated in the circulation modeling. These features include: • Realistic water column temperature and	A comparison of the Bull Arm hydrodynamic model predictions with the current data collected by Seaconsult at the site of the Hibernia GBS in January and February 1991 has been undertaken and is presented in the final ASA technical report. No current data from Trinity Bay have been identified for model comparison. Lack of major river flow in the region means that stratification is mainly from solar heating. Such stratification may develop in summer, yet the effect is not significant for accurately simulating the trajectory and fate of surface oil spills. Non-linear effects are due to bottom stress or

DFO Review Comment 19-Apr-11	EMCP Response 20-Jul-11
salinity stratifications in Trinity Bay and Conception Bay during winter and summer. (This affects the strength of circulation at the surface of the water column); • Non-linear terms in the equations of motion, specifically advection of momentum. (This can create gyre circulation features in Trinity Bay that would affect residency times of oil within the bay. They also enhance upwelling and downwelling effects due to wind forcing by displacing surface water); • Surface wind generated waves that induce Stokes drift. (This could move oil particles to shorelines quickly); • Realistic wind scenarios, including strong summer southwesterly wind events; and • Inertial oscillations caused by variable winds. Inclusion of these features may alter the modeling results. Please provide a rationale as to why these features were not incorporated and why the modeling approach was not validated with observations.	advection term. These terms are only significant in shallow water. Trinity Bay is generally too deep for these terms to become a dominant feature except near shore, where spatial scales are too small to consider. The SIMAP model calculates Stokes drift using the wind field specified for the spill simulation. In this case, the winds come from the MSC50 time series. Spill simulations were not performed using storm event winds; however, the MSC50 wind hindcast includes storm generated winds in its hindcast data. Bay-wide oscillations in the circulation would have too high a frequency for the time scales considered in the oil trajectory modelling. The revised report will provide more information regarding hydrodynamic model validation.
Specific Comments	
Section 2.4: Wind Data Although downscaling methodology for wind from MSC50 grids to the Bull Arm location is reasonable, there is no mention of the MSC50 winds being used in model simulations. Please provide clarification.	The MSC50 winds were used in the spill modelling. This has been clarified in the report.
Figure 2.4-2 Please provide the location of M6012874 on a map.	This location is shown in the Bull Arm modelling report, Figure 2.4-1.
Appendix C: Figure C5 The main figure and the accompanying inset map do not appear to match up. Please correct this error.	The wrong inset map was included. The correct map is included in the revised report.
Offshore Spill trajectory Modelling Report	
Although the Spill Trajectory Model used in the offshore may have been validated in other regions, it has not been validated for the Newfoundland Shelf and adjacent deep ocean. The report does not provide any validation of the model ocean currents for the study area or how winter ice was dealt with in the circulation model.	The SIMAP model has been validated against actual spill events. Reports describing that validation can be provided. The purpose of a model is to be able to make predictions where spills have not occurred. Every reasonable effort is made to use the best available environmental data to drive the model and to validate those data

DFO Review Comment 19-Apr-11	EMCP Response 20-Jul-11
Furthermore, insufficient detail is provided on how the model output was used and which HYCOM model data was used.	where possible. A more complete description of the HYCOM model ocean currents, current and sea ice interactions and how the HYCOM model data were implemented in the oil spill model have been included in the revised modeling report.
DFO would like to request the following information: • The frequency and resolution of the HYCOM ocean model run output used, (i.e. full model resolution and daily averaged output or hourly output).	The study employed the full resolution of the HYCOM model (1/12th degree spacing) with daily averaged currents. These details are included in the final technical report.
• More detail regarding how the runs were implemented. This is needed before DFO is able to comment on the acceptability of the approach used for these oil spill fate models	It is not clear what is specifically being asked; however, more details on the selection of the input data, specification of the spill scenarios and important assumptions have been included in the revised oil spill trajectory modelling report.
• Justification as to why MSC50 winds were used as opposed to the original HYCOM wind forcing. Using the original HYCOM wind forcing would have made for a more consistent approach	ASA's approach is to use the best data available and the MSC50 wind data are the best for the purposes of spill risk assessment in eastern Canadian waters. They have superior coverage to the HYCOM data, especially near shore and have better temporal and spatial resolution within the Canadian east coast region. There is nothing inconsistent with the approach taken.
• More detail on the model drift runs, specifically with regards to: The number of simulations run; How the HYCOM system was used, (i.e. static currents or variable currents); If a wind driven ocean component of drift was added to the HYCOM model output; What defines the characteristics of a SIMAP model run in winter and summer; Define how runs were set up in detail; and How ice was incorporated in the SIMAP model runs.	• The stochastic model simulations consisted of 100 runs for each spill scenario. A comparison of the wind data obtained from the MSC50 database with the data sampled in the stochastic model runs have been provided in order to demonstrate that wind data were adequately sampled by the oil spill model. • The HYCOM currents employed were spatially and temporally variable and consisted of daily mean current values on the full resolution HYCOM grid with 1/12th degree spacing. • The SIMAP model incorporates forcing from a spatially and temporally varying wind and current field to advect surface oil. The winds are from the MSC50 database and cover a 30-year period. • Additional details on the spill scenarios and the various model input parameters have been provided in the final technical report.
Figure 2.6.1	This figure shows ice coverage for eastern mainland Canada but excludes the eastern

DFO Review Comment 19-Apr-11	EMCP Response 20-Jul-11
It appears that this figure includes information for the Gulf of St. Lawrence, a portion of SW Newfoundland Shelf, Scotian Shelf and Gulf of Maine only, therefore it cannot represent the situation for the entire east coast.	Newfoundland coast. The appropriate figures have been provided in a revised report showing the same trend in ice coverage.

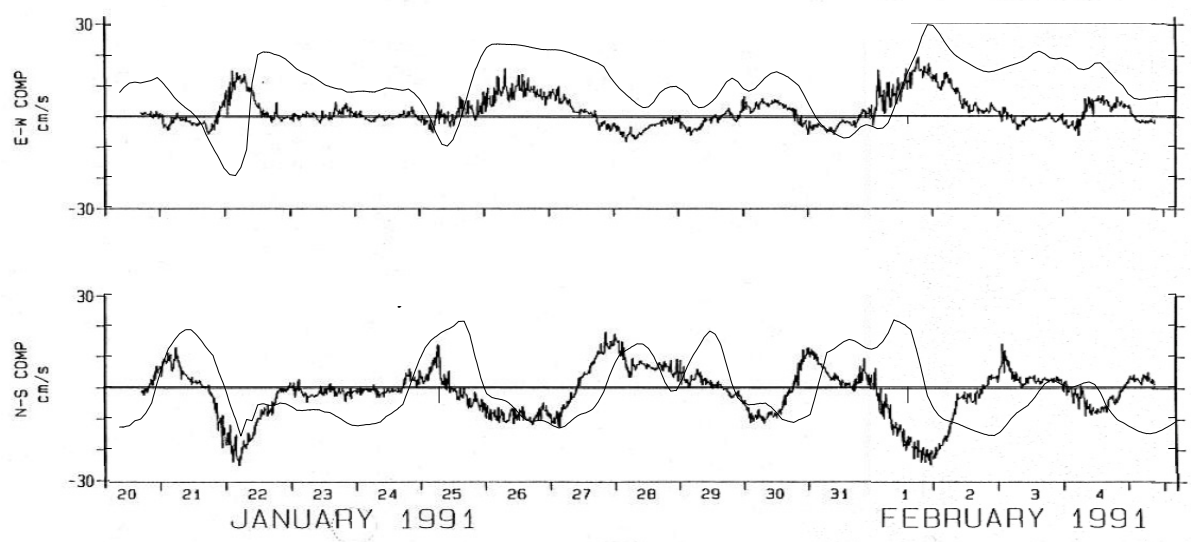
Responses from DFO 16-Aug-11

DFO Review Comment 16-Aug-11	EMCP Response 24-Aug-11
General Comments	
(1) With regards to the statement: "Non-linear effects are due to bottom stress or advection term. These terms are only significant in shallow water. Trinity Bay is generally too deep for these terms to become a dominant feature except near shore, where spatial scales are too small to consider." Despite the fact that Trinity Bay is deep, non-linear terms are important in strong horizontal gradients and strong currents. This occurs where there is upwelling along the northwest shore of Trinity Bay (for a southwesterly wind direction). Upwelling creates cold surface water (0°C) which contrasts starkly with summer surface temperatures of 10-14°C.	Non-linear terms are typically not necessary to capture the overall flow appropriate for modeling small volume surface spills using a stochastic approach. The goal in these studies is to determine the potential pathways for oil spills under the range of possible environmental conditions that account for the predominant forcings. The model simulations of IFO and marine diesel fuel spills within Bull Arm provide an overall prediction of the flow of hydrocarbons within Trinity Bay. We consider the results of the oil spill trajectory model to be acceptable for the purpose of the environmental assessment. It is not clear how the use of a more sophisticated hydrodynamic model application that includes non-linear features of flow in these water bodies would provide a significantly different result.
(2) In EMCP's response, the statement is made that: "Spill simulations were not performed using storm event winds; however, the MSC50 wind hindcast includes storm generated winds in its hindcast data". This is a short coming of the report. As the report does not cover oil spill scenarios under strong winds, there is potential to under predict maximum drift scenarios in Trinity Bay.	The modeling study performed by ASA sampled wind data from throughout the year from a 30-year dataset for the Bull Arm, Trinity Bay region. These data include a range of possible wind speeds and directions occurring in the region. Wind data obtained from wind model hindcasts, in this case the MSC50 model hindcast, typically do not fully represent the effects of localized low pressure systems and tend to underestimate wind speeds for these events. In the Bull Arm-Trinity Bay area this means that oil on the sea surface will be transported in all possible directions based on wind forcing but may not be moved as quickly as it might under the actual storm winds. This suggests that surface oil may travel greater distances with the higher wind speeds, but this is only a consideration in open water away from the coastline where oil can travel unimpeded. In this particular setting, oil reaches the shoreline rapidly, and in fact the results from the modeling show that any shoreline within Bull Arm and Trinity Bay is subject to oiling from IFO spills at the Bull Arm site. Spills of 100 m3 of marine diesel fuel will

DFO Review Comment 16-Aug-11	EMCP Response 24-Aug-11
	only travel so far before evaporation and dispersion into the water column account for a majority of the spill. Utilizing a higher wind speed will not change the overall results of surface oil spill simulations run for a 30-day period in this near shore location.
(3) With regards to the statement: "Bay-wide oscillations in the circulation would have too high a frequency for the time scales considered in the oil trajectory modelling", it is not a question of frequency, but a question of how far oil could be carried in one inertial oscillation period of roughly 16 hours. If this length scale is too small, it would be reassuring to see a quick calculation showing that inertial oscillations are not a factor.	We do not have data describing any potential inertial oscillations that may form within Trinity Bay so it is not possible to do such a calculation. The fact that model predictions indicate that spills of IFO in Bull Arm have the potential to reach any area within Trinity Bay suggest that additional hydrodynamic modeling is not necessary.
Nearshore Bull Arm Spill Trajectory Modelling Report July 2011 Revision with Track Change	
General Comments	
(1) Although a number of issues have been addressed thus improving the document, the main issue remains with the nearshore drift modelling from Bull Arm. The model applied is too simplistic and does not include coastal effects, even when the location in question is within the first baroclinic Rossby Radius of influence from shore (*i.e.,* 5-10 km depending on seasonal stratification). Non-linear terms are not included in the ocean model and are considered a significant absence in the modelling activity.	See response above regarding non-linear effects.
(2) The validation plots with the observed currents in Bull Arm are very informative and helpful. It does show however, that the model error with respect to observations can range from 10 - 50 cm/s, which would translate into an additional transport of oil drift of 10 to 50 km per day. This leads to the conclusion that model results should be treated cautiously and that in the absence of more accurate modelling for Trinity Bay, the oil from an oil spill could potentially land on shore anywhere within the bay.	It is unclear how 10 to 50 kilometers of additional oil drift in one day can result from 10 to 50 cm/s of current since a 10 cm/s current can travel only 8.6 km in a 24-hour period. In addition, any additional distance that surface oil may be transported is not straight-line distance since there is a small tidal component to the flow and wind is the predominant forcing in this area. As noted above, the model provides an overall prediction of the flow of hydrocarbons within Trinity Bay. As can be seen in the plot below, the agreement between the model predicted currents and the measured currents at the Bull Arm site show that the model under-predicts currents at times and over-predicts currents at other times. Taken as a whole over a period of 30 days (the time frame for the spill model simulations), the model predicted currents will do a reasonably good job of moving

DFO Review Comment 16-Aug-11	EMCP Response 24-Aug-11
	oil within Bull Arm and Trinity Bay.
DFO Response - Specific Comments	
Executive Summary (Page ii) The third paragraph in this section states that: "Wind driven current simulations were conducted for eight wind directions, each using a constant wind speed of 8 m/s. During simulations, the wind forced currents were scaled depending on the actual wind speed and direction for each simulation time step, these scaled wind forced currents were added to the tidal current simulation to create a combined current". This statement is confusing as the first sentence states that wind is constant at 8 m/s, however, the newly added second sentence indicates that actual wind speed was used, leading the reader to believe that the wind is variable. Please clarify.	The constant wind is used only in the hydrodynamic model simulations to determine circulation. An 8 cm/s wind from different directions is blown over the water surface and the corresponding circulation is determined. When the oil spill model is run it reads the wind speed and direction from the time series provided from the closest MSC50 node and the model selects the appropriate hydrodynamics for the wind direction and scales the current speed appropriately. For example, if the wind read by the oil spill model is 8cm/s then no scaling of the currents needs to occur because this wind is equal to the wind used to generate the current in the hydrodynamic model. If the wind speed read by the spill model is 15 cm/s then the currents need to be scaled up. Likewise, if the wind read by the spill model is 5 cm/s then the currents are scaled down. This way the oil spill model uses an appropriate flow for the spill model simulation while utilizing the variable winds contained in the model hindcast. This is done so that a multi-decade long wind time series can be used to drive the stochastic model without the onerous task of having to simulate a 30-year period in the hydrodynamic model.
Section 2.4 (Page 4) In the sentence, "Wind data for near shore model simulations were obtained from two sources, a model hindcast near the Study Area, and observations from a previous GBS construction program near the Study Area", it is suggested that "model hindcast" be replaced with "output from grid point located near the study area from a large scale model hindcast".	The text has been revised to read as "*Wind data for nearshore model simulations were obtained from two sources, an output from grid point located near the study area from a large scale model hindcast, and observations from a previous GBS construction near the Study Area.*"
Section 2.5 (Page 15) In the second paragraph on this page it is stated that: "Non-linear effects that may, for example, result in advection of momentum of other effects due to bottom stress are only significant in shallow water. Trinity Bay is generally too deep for these terms to become a dominant feature except near shore where spatial scales are too small to consider". Contrary to this statement, non-linear effects can be a factor in Trinity Bay. Non-linear effects such as the advection of tracers like salinity and temperature are important particularly where there are strong currents and strong horizontal temperature and salinity gradients. This	See response above regarding non-linear effects.

DFO Review Comment 16-Aug-11	EMCP Response 24-Aug-11
occurs in Trinity Bay during upwelling conditions on the northwest shore in the summer.	
Figure 2.5-7 (Page 18) Model currents very closely follow wind. This is indicative of a linear relationship to wind, and does not seem realistic in Bull Arm where coastal trapped waves under varying wind scenarios would be expected. Additionally, there appears to be no “land effect” in the resulting model predicted circulation; this seems unrealistic in a sheltered cove such as Bull Arm.	The Nearshore Oil Spill Trajectory Report clearly demonstrates that the SIMAP model does a reasonably good job of predicting potential oil flow through Bull Arm and Trinity Bay, an area for which a specific hydrodynamic model does not currently exist. We consider the results of the SIMAP oil spill trajectory model to be acceptable for the purpose of Environmental Assessment.
Figure 2.5-9 (Page 20) It would be valuable to have these two plots overlaid so it can be seen how the model fits the data. By superimposing the print out versions, one can see model-data differences up to 50 cm/s for an event near January 21st. Model-data discrepancies appear to be around 10-20 cm/s leading to drift errors of 10-20 km per day.	The plot below shows the model predicted currents (smooth line) overlain on the measured currents at the Bull Arm site for the period January 20 through February 5. This figure will be included in the Nearshore Spill Trajectory Report. As can be seen in the plot, the agreement between the model predicted currents and the measured currents at the Bull Arm site show that the model both under-predicts and over-predicts currents at times. Considering the data over a 30-day period (the time frame for the oil spill simulations), the model predicted currents are doing a good job of representing flow at the site.



Responses from DFO 9-Sep-11

DFO Review Comment 9-Sep-11	EMCP Response 12-Sep-11
General Comments	
In response to your request dated August 25th, 2011, Fisheries and Oceans Canada (DFO) has reviewed the "ExxonMobil Canada Properties Ltd. – Hebron Project Comprehensive Study report: EMCP Response to August 16, 2011 Review Comments (Part II)." The response is considered ***adequate***; however DFO would like to provide the following comment regarding the Nearshore Bull Arm Trajectory Model: The overall initial comment about viewing the results with high uncertainty is still valid. While it is agreed that there is no data to validate the various oceanic contributions such as inertial oscillations and non-linear effects, caution is advised in interpreting where an oil spill may drift from the results. Its should be noted that including more details into the simulation may change the net result. Therefore, it is agreed that although this is the best possible simulation the proponent can provided, it is possible that oil may drift onshore anywhere in Trinity Bay within a given time frame.	Acknowledged.

C-NLOPB Review Comments - Offshore Spill Trajectory Modelling Reports

Hebron Project Comprehensive Study Report: Offshore Spill Trajectory Modelling Report	
C-NLOPB Response	
1. Generally the subject report is a superior effort to that originally submitted with the CSR.	Noted.
2. Additional information should be provided to explain the well blowout rates chosen as input to the model simulations.	**The following text, will be included in the Oil Spill Trajectory Modelling Report.** Two blow-out scenarios were included in the spill trajectory modelling: a platform case; and a subsea case. The scenarios presented consider the rate at which oil could flow under a well blow-out scenario for the Hebron field. This rate was derived based on existing knowledge of Hebron crude properties, known reservoir properties for the Hebron field and assumptions made for specific well conditions at the time of the blowout. Reservoirs differ greatly from one to another and their properties (pressure, volume, oil / gas ratio, *etc.*) are unique to each reservoir. Therefore, the flow rates described below reflect the properties of the Hebron Field. Historical flow rates from other spill events are not predictive of what would happen in other reservoirs; however, they can be used to put specific events into perspective. Flow rates for Hebron platform wells were estimated at 5,600 m^3/d (approximately 35,000 bbl/d) based on the Hebron reservoir properties, assuming a blow-out to atmosphere (*e.g.*, approximately 70 m above mean sea level) and accounting for the viscous (thick - difficult to flow) nature of the oil from this reservoir. Flow rates for MODU wells were estimated at 3,200 m^3/d (approximately 20,000 bbl/d) based upon the properties of its reservoir, a subsea blow-out (approximately 90m below sea level) and a lighter, less viscous oil. ExxonMobil's well control philosophy is focused on prevention using safety / risk management systems, management of change procedures and global standards. ExxonMobil has a mature Operations Integrity Management System (OIMS) that emphasizes relentless attention to Safety, Well Control and Environmental Protection. This includes proper preparation for wells (well control equipment inspections / tests), detecting the influx early, closing-in the well efficiently (personnel training / drills) and circulating out the kick with kill weight mud in a controlled manner. In the event of a blow-out, ExxonMobil's primary objective would be to stop the flow as quickly as possible. For both surface and subsea wells, this

	would involve shutting in at the wellhead and killing the well through the wellhead. Relief well drilling, and the subsequent dynamic kill, is considered a back-up strategy in the event shut-in and/or killing through the wellhead is not possible or is unsuccessful.
3. Further information is required to explain the rationale for the number of stochastic model runs performed for each simulation.	Each simulation of the spill scenarios using the stochastic model consisted of 100 individual runs of the spill model, each with a randomly selected start time so that a different time slice of wind data was used for each model run. In order to demonstrate that 100 simulations is sufficient to obtain an adequate sample of the wind within each of the seasons, plots of the wind data from the entire 30 year wind record are compared with plots of the wind data sampled by the stochastic model for each season. These wind plots, shown in Figures 3.1-1 through 3.1-3, demonstrate that the 100 stochastic model simulations performed for each spill scenario adequately sampled the relevant environmental data within the season the spill began, but also within the subsequent season. For example, in Figure 3.1-3, the bottom two wind roses show good agreement between the entire wind record and the wind sampled by the spill model for the spring months for the 120 day spills started in the winter.
4. It is unclear why the stochastic model runs were not performed for a longer period to correspond with the predicted persistence of Hebron crude in the receiving environment. The rationale for this approach should be explained in detail	Extended period stochastic model simulations have been completed as follows: • 30 day blowout run for additional 200 days • 100 day blowout run for additional 200 days • 120 day blowout run for additional 200 days The results from these simulations provide a prediction of the fate of all oil remaining on the surface at the end of the blowout discharge. The attached document, "*Addendum – Results from Simulations of Oil Spills at the Hebron Well Site*" provides additional information regarding these extended run simulations. The results of these extended simulations (up to 10.5 months) demonstrate that: • Surface oil within the model domain decreases to zero within two to four months after flow stops • There is a low probability for a small amount of oil (up to 0.7 percent of total oil spilled) to reach the Newfoundland shoreline as a 0.01 mm sheen between 22 and 275 days following start of flow.

5. The rationale for choosing TAR Code G (0.01 mm thickness) for the thickness cut-off of the stochastic simulations requires considerable justification. This is considerably thicker than "sheen" thickness and potentially could considerably underestimate the area over which seabirds could be affected.	The 0.01 mm (10 micron) surface oil thickness was selected because it is sufficient to provide a lethal dose to seabirds provided they move through the slick a minimum distance (French-McCay 2009). Smaller surface oil thicknesses that may result in a sub-lethal dose to seabirds were not considered. French-McCay (2009) provides a good summary of recent work and discusses the details of wildlife oiling from surface slicks. French-McCay, D. 2009. State of the art research needs for oil spill impact assessment modeling. Pp. 601-653. In: *Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response*, Emergencies Science Division, Environment Canada.

7.0 APPENDIX A COMMENTS ON SEA ICE AND ICEBERG SECTIONS

3 PHYSICAL ENVIRONMENT SETTING

3.1 Near shore Environment (Bull Arm Area)

3.1.4 Sea Ice and Icebergs

Comment A-1: *Para 1, sentence 1*: change "cyclical" to "variable".

EMCP Response 30-Nov-10: The sentence will be revised as follows: Much like the offshore areas, pack ice presence in Trinity Bay from year to year is variable, based on a review of the weekly CIS charts from 1983 to 2008 inclusive.

Follow-up Comment 28-Jan-11	**unsatisfactory.** Although the requested change from "cyclical" to "variable" was made, a later comment (Comment A-3) asked that the error in the indicated data span "1983-2008" be corrected everywhere to "1971-2000" so that it is consistent with the cited data source, and this was not corrected here in the response to comment A-1.
EMCP Response 18-Mar-11	Years 1983 to 2008 are from CIS Ice Charts, not the Sea Ice Atlas. Figures 3-13 and 3-14 are derived from Canadian Ice Service 2001. The source for Figure 3-14 will be edited to: Source: Canadian Ice Service 2001. Section 3.1.4 does reference 1983 to 2008 from CIS Charts. **The first two paragraphs of Section 3.1.4 will be revised as follows:** "Much like the offshore areas, pack ice presence in Trinity Bay from year to year is variable, based on a review of the weekly Canadian Ice Service (CIS) charts from 1983 to 2008 inclusive (Environment Canada Canadian Ice Service Ice 2010). The frequency of presence of sea ice in Trinity Bay by week is shown in Figure 3-13, as from the Environment Canada Canadian Ice Service Sea Ice Climatic Atlas (2001). For this analysis, the frequency of sea ice in the mouth (most seaward point) of the bay and at the bottom (most landward point) of the bay over a 25-year period was reviewed.

Comment A-2: *Para 1, sentence 2*: Poor wording. Also, the type of ice most likely to be encountered should be specified: up until the middle of March mostly new ice (0-10cm) and grey ice (10-15cm) can be anticipated, however from mid-March to mid-May if any ice is in the vicinity it will likely be first-year ice (which can range from 30 cm to greater than 1.2 m). **Suggest the sentence be changed to: "**On average, pack ice is present in Trinity Bay every 1-in-3 years or 33% of the time, in the form of new or grey ice (<15cm) prior to mid-March and in the form of first-year ice from mid-March to mid-May (>30cm).**"**

EMCP Response 30-Nov-10: The sentence will be edited as follows: On average, pack ice is present in Trinity Bay every 1-in-3 years, or 33 percent of the time, in the form of new or grey ice (10 to 15 cm) prior to mid-March and in the form of first-year ice from mid-March to mid-May (>30 cm).

Comment A-3: *Figure 3-13*: **Inconsistencies/Errors in quoted Source:** in paragraph 1 of 3.1.4, you mention that ice charts from 1983-2008 were reviewed. For Figure 3-13, however, you quote the source as "Canadian Ice Service 2001", which would refer to the "Canadian Ice Service Sea Ice Climatic Atlas: East Coast of Canada 1971-2000". Further down, for Figure 3-14, you quote the source as "Canadian Ice Service weekly composite ice charts". After reviewing the data in your graphs (Figures 3-13 and 3-14), it appears that you used the Ice Atlas data from 1971-2000 and not

the 25-year 1983-2008 chart data that you mention in the text. **This needs to be corrected in the text and in the Sources listed under the Figures.**

EMCP Response 30-Nov-10: The Section will be revised as follows:

3.1.4 Sea Ice and Icebergs

Much like the offshore areas, pack ice presence in Trinity Bay from year to year is cyclical, based on a review of Environment Canada's Sea Ice Climatic Atlas (2001). Trinity Bay has pack ice in one form or another present on a ratio of 1-in-3 years.

The frequency of presence of sea ice in Trinity Bay by week is shown in Figure 3-13. For this analysis, the frequency of sea ice in the mouth (most seaward point) of the bay and at the bottom (most landward point) of the bay over a 25-year period was reviewed.

The source beneath Figure 3-13 will be revised as follows:

Source: Environment Canada Sea Ice Climatic Atlas (2001)

Follow-up Comment 28-Jan-11	**unsatisfactory.** While the text changes made to the indicated paragraph are satisfactory, the portion of the comment requesting that that the error in the indicated data span "1983-2008" be corrected everywhere to "1971-2000" so that it is consistent with the cited data source has not been addressed.
EMCP Response 18-Mar-11	See response to Comment A-1.

Comment A-4: Also, the reference to the East Coast Sea Ice Atlas is not listed in your references at the end of the CSR. The reference to the Atlas needs to be added.

EMCP Response 30-Nov-10: The reference list in Section 18.2 will be revised as follows:

Environment Canada Canadian Ice Service. 2001. *Sea Ice Climatic Atlas: East Coast Canada, 1971-2000.* Ottawa, ON.

Comment A-5: The only thing listed in the references is: "Canadian Ice Service, 2009. *Ice Archive. Latest, Past & Future Ice Conditions – East Coast.* Available at URL:

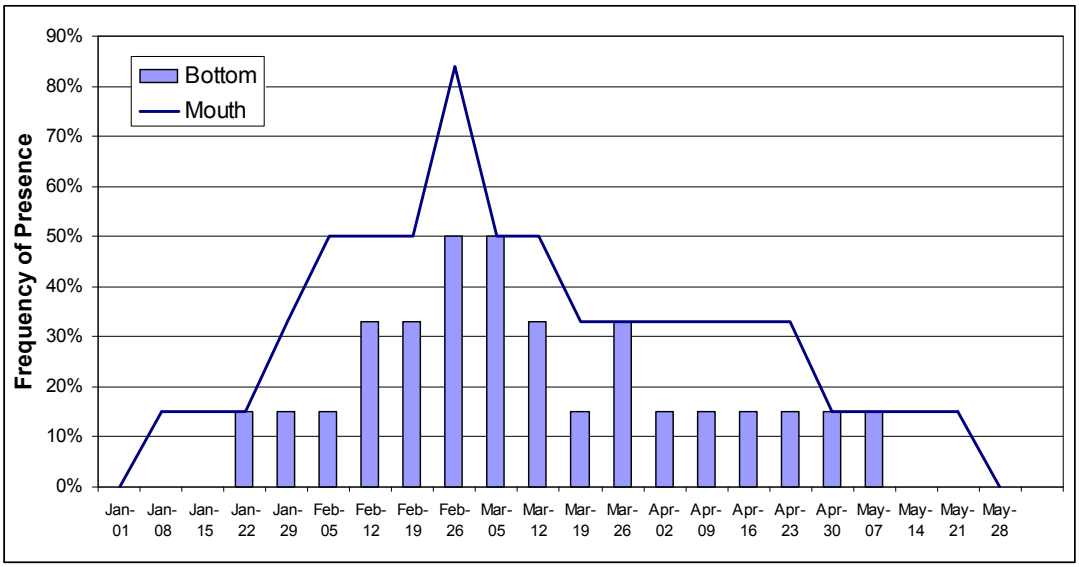
http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?Lang=eng&lnid=35&ScndLvl=no&ID=11889".

Note that CIS recently launched a new set of web pages, and referenced links may or may not work – all should be re-checked.

EMCP Response 30-Nov-10: Link to CIS Ice Archive, which is only CIS link cited, has been checked. This link is still functional and points to the correct address.

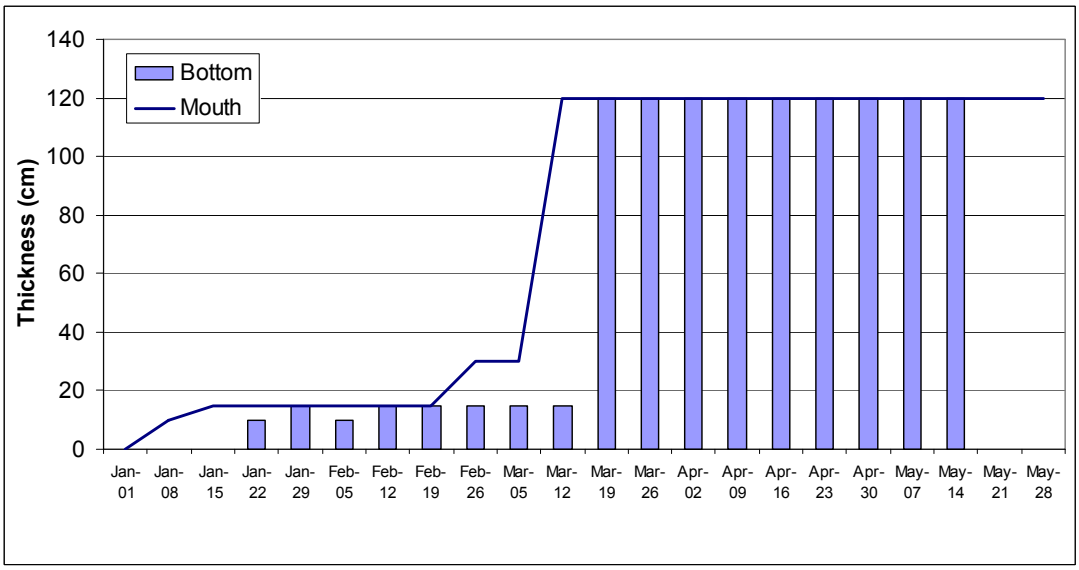
Comment A-6: **Also, on both Figures 3-13 and 3-14, the data for the week of Feb 19 was erroneously skipped and replaced with that for the week of Feb 26. As a result, all weeks after Feb 19 contain the data for the following week and the whole time series is out by one week. These graphs need to be corrected / re-done.

EMCP Response 30-Nov-10: The revised figures will be provided in the CSR as follows:



Source: Canadian Ice Service 2001

Figure 3-13 Frequency Presence of Sea Ice in Trinity Bay



Source: Canadian Ice Service 2001

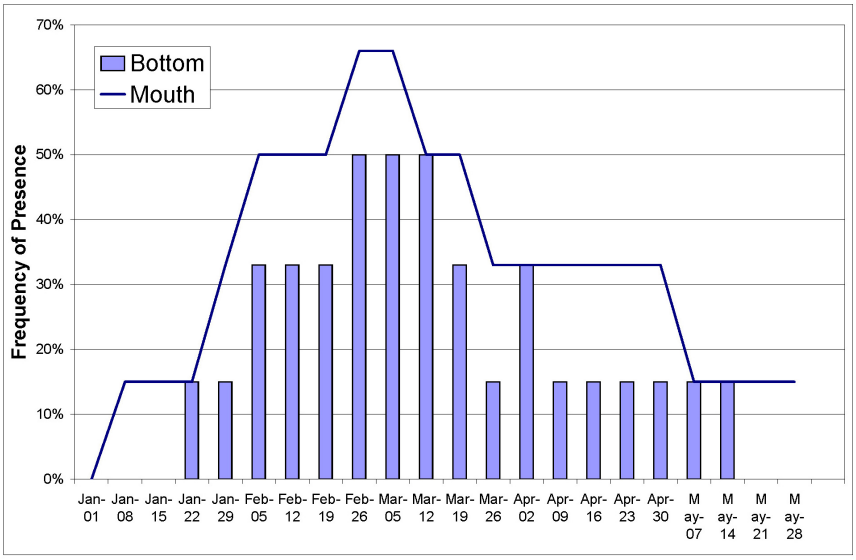
Figure 3-14 Derived Sea Ice Thickness at the Mouth and Bottom of Trinity Bay

Follow-up Comment 28-Jan-11	**partly satisfactory.** The graph 3-13 now contains even more errors than before. The ice chart data were not re-checked and the graph data were simply randomly shifted (in the wrong direction). The correct data are indicated in the table below. The graph 3-14 is correct. There are a couple of minor differences in interpretation with respect to the table of values given below, but these are acceptable given the ambiguity of the chart data in some cases.

	Frequency of presence of sea ice (max % for category)		Derived ice thickness (max cm for category)	
date	**bottom**	**mouth**	**bottom**	**mouth**
Jan 01	0	0	0	0
Jan 08	0	15	0	10
Jan 15	0	15	0	15
Jan 22	15	15	10	15
Jan 29	15	33	10-15	15
Feb 05	33	50	10	15
Feb 12	33	50	10	15
Feb 19	33	50	10	15
Feb 26	50	66	10	30
Mar 05	50	66	15	30
Mar 12	50	50	15	120
Mar 19	33	50	120	120
Mar 26	15	33	120	120
Apr 02	33	33	120	120
Apr 09	15	33	120	120
Apr 16	15	33	120	120
Apr 23	15	33	120	120
Apr 30	15	33	120	120
May 07	15	15	120	120
May 14	15	15	120	120
May 21	0	15	0	120
May 28	0	15	0	120
Jun 04	0	0	0	0

EMCP Response 18-Mar-11

Figure 3-13 will be revised as follows:



Source: Canadian Ice Service 2001

Figure 3-13 Frequency Presence of Sea Ice in Trinity Bay

3.1.4.1 Ice Type

Comment A-7: *Para 1, sentence 2*: Add the underlined for clarification… As a result, the analysis uses the upper limit for the standard thickness-ranges of the ice types present to derive sea ice thickness.

EMCP Response 30-Nov-10: The sentence will be revised as follows: As a result, the analysis uses the upper limit for the standard thickness-ranges of the ice types present to derive sea ice thickness.

Comment A-8: *Para 2*: **Several items are not clear here**. In the paragraph above, you say that you use the upper limit to derive the ice thickness in Figure 3-14. Then in Figure 3-14, you actually use the lower limit (70cm) for the first year ice range that you describe (70-120cm).

Note that there are different categories of first year ice (FYI) thickness (thin FYI = 30-70cm; medium FYI = 70-120cm; thick FYI > 120cm). In the text you are talking about medium FYI but neglect to mention this. However, since the Atlas (from which the graph data was derived) does not distinguish between FYI categories, categories should not be mentioned here. **All of section 3.1.4.1 as well as the data in Figure 3-14 (as described here and for the source error and missing week as described above) needs to be checked, re-plotted and the paragraph re-worded and clarified.**

EMCP Response 30-Nov-10: The figures are now using the Upper Limit (see Response to Comment A-6). **The following text will be inserted into Section 3.1.4.1:** There are few quantifiable data on the exact thickness of the sea ice in Trinity Bay. As a result, the analysis uses the upper limit for the standard ice types to derive sea ice thickness. As with the offshore area, most sea ice that occurs within the bay is formed off southern Labrador and drifts south to enter the bay around the mid-March timeframe. The derived sea ice thickness is shown in Figure 3-14 in centimetres (when ice is present) in Trinity Bay by week. This analysis includes the sea ice at the mouth and bottom of the bay over the same 25-year period.	
Follow-up Comment 28-Jan-11	**unsatisfactory.** Figure 3-14 has been modified to reflect the upper limit of the 70-120cm thickness range. However, the sentence in the text "The bay experiences first-year ice from mid-March through early May, which can range in thickness from 70 to 120 cm." has not been corrected to explain that the 70-120cm range represents medium first year ice, but that there is no way to determine from the CIS ice charts that medium first year ice prevails over the thin (30-70cm) or thick (>120cm) first year ice categories. The sentence "The bay experiences first-year ice from mid-March through early May, which can range in thickness from 70 to 120 cm." should be modified to something like: "The bay experiences first-year ice from mid-March through early May, **which can range in thickness from 30 cm to greater than 120 cm.**" **Additionally, based on the graphs, the sentence "As with the offshore area, most sea ice that occurs within the bay is formed off southern Labrador and drifts south to enter the bay around the mid-March timeframe." is incorrect. While the thickest ice occurs from mid-March to mid-May, the greatest frequency of sea ice begins near the end of February and lasts until mid-March, indicating that the ice enters the bay towards the end of February. **Additionally, the sentence "This analysis includes the sea ice at the mouth and bottom of the bay over the same 25-year period." has not been corrected according to comment A-3. The erroneous 1983-2008 period may represent 25 years, but the Atlas data is actually for 1971-2000 or **30 years**.
EMCP	**The CSR will be revised to include the changes noted above and will read as:**

Response 18-Mar-11	The bay experiences first-year ice from mid-March through early May, which can range in thickness from 30 cm to greater than 120 cm. As with the offshore area, most sea ice that occurs within the bay is formed off southern Labrador and drifts south to enter the bay near the end of February, with the thickest ice occurring from mid-March to mid-May. This analysis includes the sea ice at the mouth and bottom of the bay over the 25-year period of 1983 to 2008 inclusive.

3.1.4.2 Iceberg Conditions in Trinity Bay

Comment A-9: *Para 1, sentence 3*: **Typo** … According to Figure 3-15, the maximum number of icebergs (129) was sighted in **1997, not in 1979**. This typo needs to be corrected.

EMCP Response 30-Nov-10: The sentence will be revised as follows:

The maximum number of icebergs sighted in one year over the period of study was 129 in 1997, while the mean annual number for Trinity Bay is 32. In the area of Trinity Bay, the number of icebergs detected from year to year may be an underestimation of what is actually present as the Trinity Bay region does not lie on a primary route for aerial ice reconnaissance.

3.1.4.3 Iceberg Distribution by Year

Comment A-10: In the references, the PAL Iceberg Sighting Database is listed as spanning the years 1989 to 2008. Why is the data in Figure 3-15 only plotted from 1992 to 2007? Is the data from the earlier years not used because it is considered unreliable? Or is it because these years contained no data for Trinity Bay? Either way, it needs to be stated why the full range of years available in the database was not considered.

EMCP Response 30-Nov-10: The following text will be included in Section 3.1.4.3

Considerable fluctuations in the yearly iceberg distribution are evident in the PAL data. However, the same is true when considering any one-degree block off Canada's East Coast. The yearly iceberg distribution is shown in Figure 3-15, based on the PAL sighting database. Data from 1992 through to 2007 were used because data in the Trinity Bay region was variable as it does not lie on a regular flight route for iceberg surveillance. Data prior to 1992 are not well-documented and are not as of solid quality as those data logged from 1992 onwards.

3.1.4.4 Iceberg Distribution by Month

Comment A-11: Again, if the PAL database spans 1989-2008, why were only the years 1992-2007 considered in figure 3-16?

EMCP Response 30-Nov-10: Please refer to the response to Comment A-10.

3.1.4.5 Iceberg Size Distribution

Comment A-12: Table 3-20: Source … the most recent version of MANICE is dated 2005. This should be corrected in the Source and in the references at the end.

EMCP Response 30-Nov-10: Table 3-20 will be revised as follows:

Table 3-20 Iceberg Size

Category	Height (m)	Length (m)	Approx. Mass (T)
Very Large	>75	>200	<10 Million
Large	45 to 75	120 to 200	2 to 10 Million
Medium	15 to 45	60 to 120	100,000 to <2 Million
Small	5 to 15	15 to 60	100,000
Bergy Bit	1.0 to 5	5 to 15	10,000
Growler	<1.0	<5	1,000
Source: Meteorological Service of Canada Canadian Ice Service MANICE (2005)			

The list of references in Section 18.2 will be revised as follows:

Meteorological Service of Canada Canadian Ice Service. MANICE: Manual of Standard Procedures for Observing and Reporting Ice Conditions. Ottawa, Ontario: Meteorological Service of Canada, 2005.

3.2 Offshore

3.2.3 Sea Ice and Icebergs

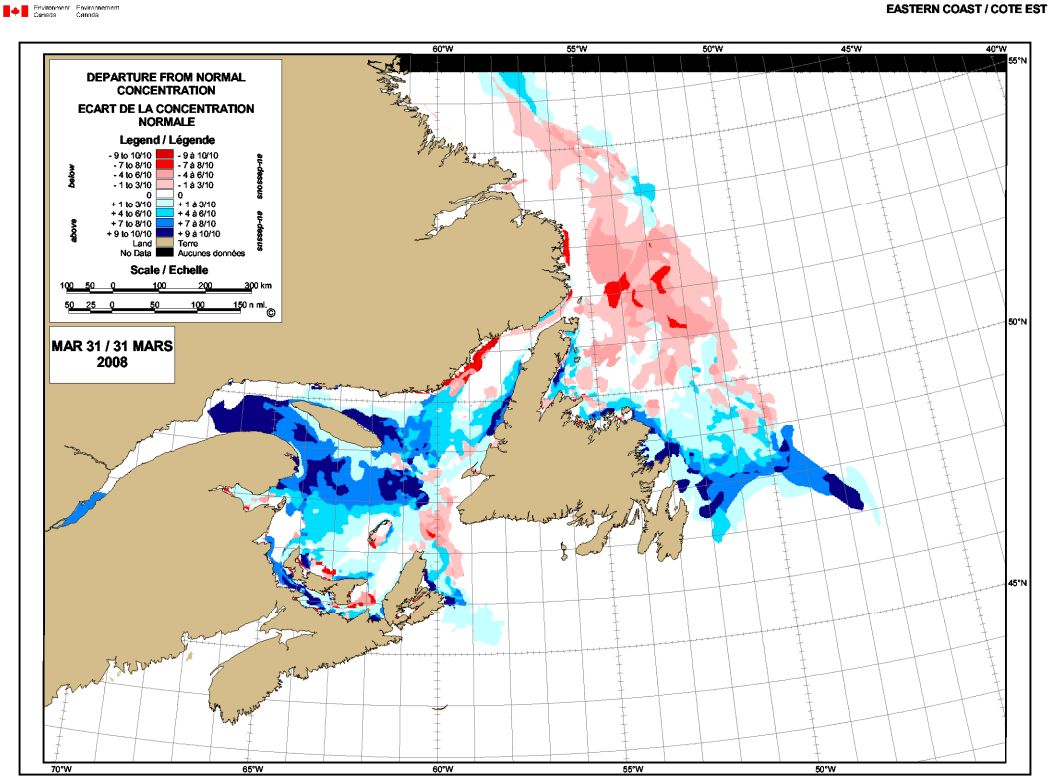
Comment A-13: The three paragraphs in this section are well written. However, the information presented in the second paragraph fails to emphasize that sea ice can also be a significant threat to platform operations in some years, and not only because it can mask icebergs (which pose the more common hazard). This is in spite of the fact that in the Hebron area sea ice, when present, is generally "loosely packed", "pressure-free", "with small floes" and "in the advanced stages of deterioration". For example, in April 2008, the White Rose oil platform was evacuated because of higher-than normal sea ice concentrations in the vicinity. The following article (see link below) about the incident contains many errors (e.g. it confuses sea ice floes and icebergs), but nevertheless records the fact that the platform was evacuated and production shut down because of encroaching sea ice in 2008:

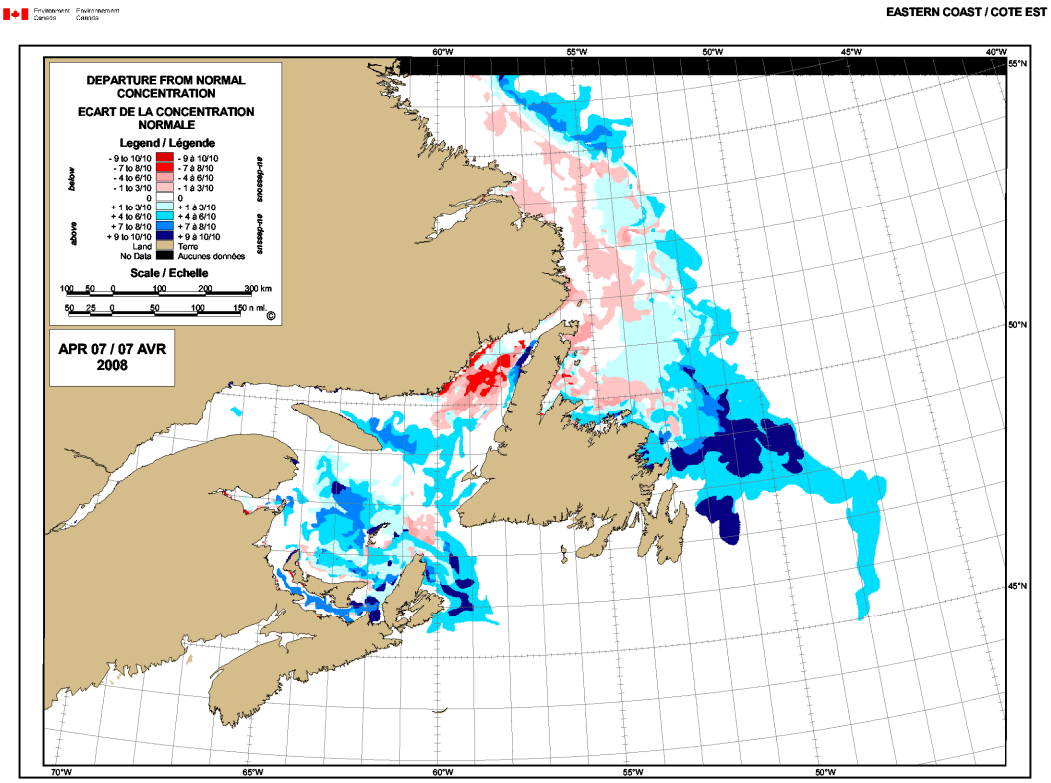
http://www.canada.com/calgaryherald/news/calgarybusiness/story.html?id=663b91ce-7090-4de1-9647-6948a5f10ef0.

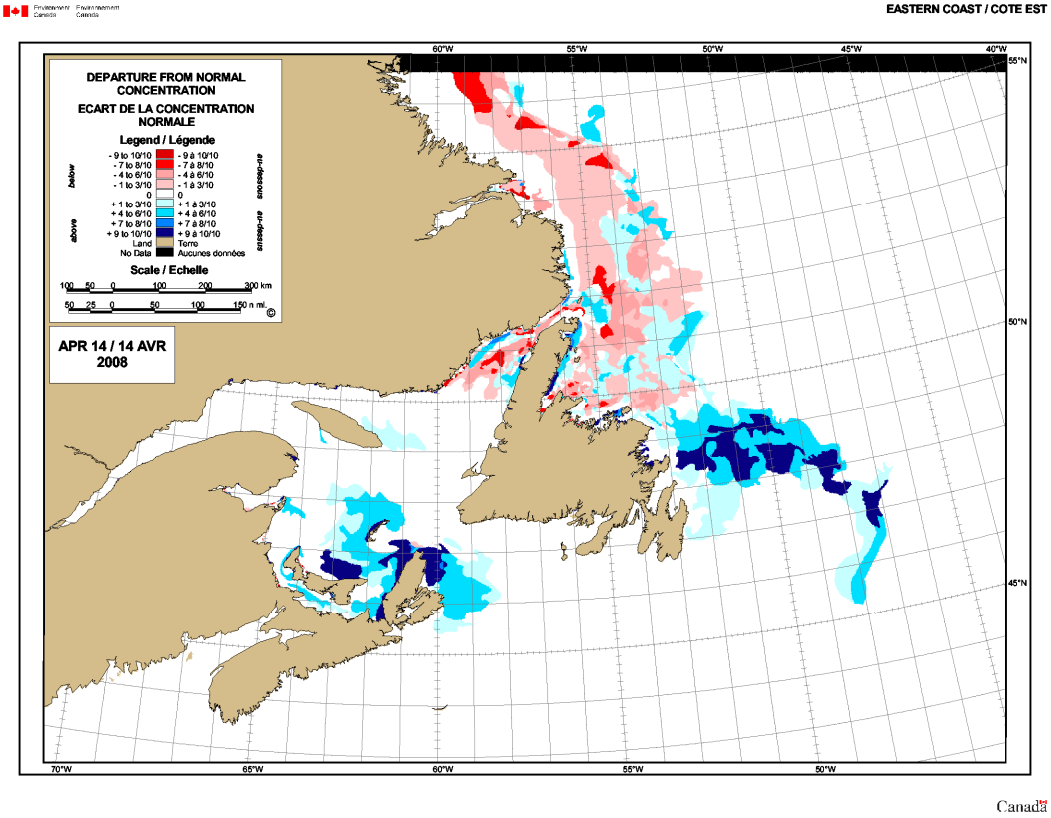
EMCP Response 30-Nov-10: The text will be revised as follows:

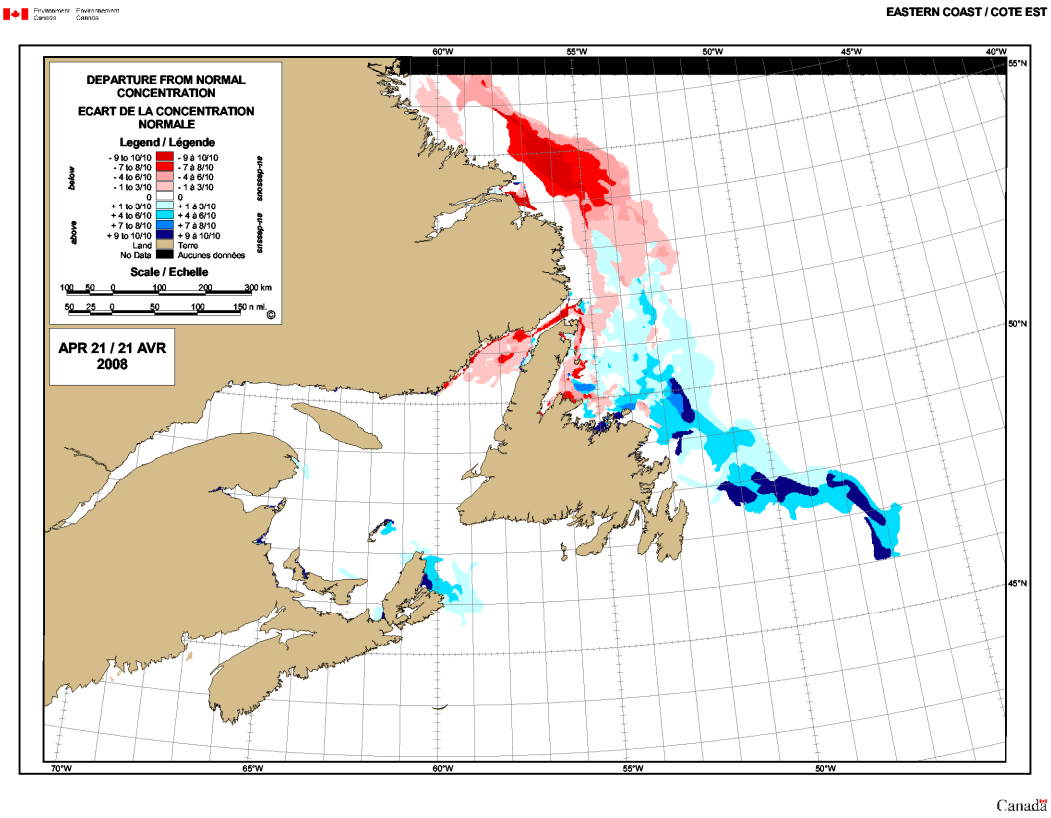
The Hebron Offshore Project Area is located on the eastern slope of the Continental Shelf, making it susceptible to seasonal incursions of ice. Two different forms of floating ice - sea ice and icebergs - are present in this marine environment. Sea ice is produced when the ocean's surface layer freezes. In the Hebron Project Area, sea ice is loosely packed and pressure-free. Floes are small and generally in advanced stages of deterioration permitting easy vessel movement. Despite this, sea ice can interfere with iceberg detection and management operations, and can force a facility to reduce operations if the quantity of pack ice near the facility exceeds the amounts in which evacuation equipment can be safely deployed and used. Sea ice is also known to carry embedded icebergs, and should these bergs start free drifting near a facility, implications may follow. Icebergs are freshwater ice made from snow compacted in a glacier. When the leading edge of a glacier reaches the sea, slabs of ice fall from it creating icebergs. Grand Banks icebergs originate primarily from the glaciers of West Greenland. Ice management efforts focus on icebergs as they can pose a hazard to offshore production facilities.

Comment A-14: Below is the series of departure-from-normal concentration sea ice charts showing the encroaching sea ice in the White Rose area over the period spanning end-of-March through April 2008:


EASTERN COAST / COTE EST
DEPARTURE FROM NORMAL CONCENTRATION
ECART DE LA CONCENTRATION NORMALE
Legend / Légende
below
above
- 9 to 10/10
- 7 to 8/10
- 4 to 6/10
- 1 to 3/10
0
+ 1 to 3/10
+ 4 to 6/10
+ 7 to 8/10
+ 9 to 10/10
Land
No Data
- 9 à 10/10
- 7 à 8/10
- 4 à 6/10
- 1 à 3/10
0
+ 1 à 3/10
+ 4 à 6/10
+ 7 à 8/10
+ 9 à 10/10
Terre
Aucunes données
Scale / Echelle
MAR 31 / 31 MARS 2008
60°W
55°W
50°W
45°W
40°W
55°N
50°N
45°N
70°W
65°W
Canada


EASTERN COAST / COTE EST
DEPARTURE FROM NORMAL CONCENTRATION
ECART DE LA CONCENTRATION NORMALE
Legend / Légende
below
above
- 9 to 10/10
- 7 to 8/10
- 4 to 6/10
- 1 to 3/10
0
+ 1 to 3/10
+ 4 to 6/10
+ 7 to 8/10
+ 9 to 10/10
Land
No Data
- 9 à 10/10
- 7 à 8/10
- 4 à 6/10
- 1 à 3/10
0
+ 1 à 3/10
+ 4 à 6/10
+ 7 à 8/10
+ 9 à 10/10
Terre
Aucunes données
Scale / Echelle
APR 07 / 07 AVR 2008
60°W
55°W
50°W
45°W
40°W
55°N
50°N
45°N
70°W
65°W
Canada





EMCP Response 30-Nov-10: The CSR will be revised to include the departure from normal charts.

Comment A-15: It is our understanding that, while the sea ice itself does not pose a direct serious hazard to the platform, concentrations greater than six tenths (>6/10) prevent the safe launch of emergency escape life-raft pods from the platform chutes into the water below. If there is the possibility that life rafts cannot be launched, preventing escape from the platform in the case of an emergency, then operations need to be shut down and personnel evacuated. **This should be verified and confirmed with those who coordinated the White Rose evacuation in 2008**.

EMCP Response 30-Nov-10: Operations practice is to reduce operational risk as ice conditions worsen. A matrix and ice response plan will be developed for the Hebron Project, including actions such as reducing staffing and discontinuing higher risk operations.

3.2.3.1 Sea Ice

Formation, Growth and Thickness

Comment A-16: *Para 1, sentence 2*: In this sentence you mention "young" ice, but this is not defined in Table 3.50. Young ice comprises Grey and Grey-white ice and ranges from 10 to 30 cm in thickness.

EMCP Response 30-Nov-10: The sentence will be revised as follows:

Almost all of the ice occurring near Hebron Platform location is either young (Grey and Grey-white ice between 10 and 30 cm in thickness) or first year ice between 30 and 100 cm thickness.

Comment A-17: *Table 3.50*: **Several corrections are required to this table, since MANICE is cited as the reference**. 1) In MANICE, new ice is defined as having a thickness **<10cm**, not 10cm; 2) The term "White Ice" is not an official MANICE term – the term "**First-Year**" ice should be used [White ice is a type of thin First-Year Ice as per MANICE (2005) page 1-3]; 3) The thickness range of first year ice given in MANICE is any ice that is **>30cm**, and not 30-200cm [White ice can be 30 – 70 cm thick as per MANICE (2005) page 1-3; first stage white ice is 30 – 50 cm thick while second stage white ice is 50 – 70 cm thick]; 4) The descriptions in the Age column are not exactly correct. The phrases "Early season first year" and "Mid-season first year" ice are misleading as these ice types can develop throughout the season at the fringes of and between floes within the main ice pack. Removing the "Age" column and changing the header of column 1 from "Description" to "Stage of Development" is suggested, in keeping with the term used in MANICE; and 5) the latest version of MANICE is dated 2005.

EMCP Response 30-Nov-10: Table 3-50 will be revised as follows:

Table 3-50 Characterization of Sea Ice by Type, Thickness and Age

Stage of Development	Thickness (cm)	Age (General Guideline)
New Ice	<10	Earliest stage of development
Young (Grey) Ice	10 to 15	First year; generally early season
Young (Grey-White) Ice	15 to 30	First year; generally mid-season
Young (White) Ice	30 to 70	First year
Old Ice	--	Second and multi-year ice
Source: Meteorological Service of Canada Canadian Ice Service MANICE (2005)		

Follow-up Comment 28-Jan-11

mostly satisfactory.

The table is much improved but there is still an error in the 4th row of the table. White ice is thin first year ice, not "young" ice as indicated in the first column of that row. Also, the table now omits any mention of medium and thick first year ice. The following changes (indicated in blue) are suggested:

Table 3-50 Characterization of Sea Ice by Type, Thickness and Age

Ice Type / Stage of Development	Thickness (cm)	Age / Period of Formation
New Ice	<10	Seasonal ice: Earliest stage of development
Young (Grey) Ice	10 to 15	Seasonal ice: generally early season
Young (Grey-White) Ice	15 to 30	Seasonal ice: generally early to mid-season
Thin First-year (White) Ice	30 to 70	Seasonal ice: generally mid- to late-season
Medium First-year Ice	70-120	Seasonal ice: generally late-season
Thick First-year Ice	>120	Seasonal ice: generally late-season
Second-year / Multi-year / Old Ice	>120	Perennial ice
Source: Meteorological Service of Canada Canadian Ice Service MANICE (2005)		

EMCP Response 18-Mar-11

Table 3-50 will be revised as follows:

Table 3-50 Characterization of Sea Ice by Type, Thickness and Age

Ice Type / Stage of Development	Thickness (cm)	Age / Period of Formation
New Ice	<10	Seasonal ice: Earliest stage of development
Young (Grey) Ice	10 to 15	Seasonal ice: Generally early season
Young (Grey-White) Ice	15 to 30	Seasonal ice: Generally early to mid-season
Thin First-Year (White) Ice	30 to 70	Seasonal ice: Generally mid- to late-season
Medium First-Year Ice	70 to 120	Seasonal ice: Generally late-season
Thick First-Year Ice	>120	Seasonal ice: Generally late-season
Second-Year / Multi-Year / Old Ice	>120	Perennial ice
Source: Meteorological Service of Canada Canadian Ice Service MANICE (2005)		

Spatial Distribution

Comment A-18: *Para 2, sentences 2, 3, and 4*: **The interpretation presented in this paragraph is not exactly correct and is written in a confusing way.** For example, on the charts, the exact 50% presence of sea ice line (equivalent to the median ice extent) lies between the blue and green areas on the charts, and is not represented by the blue area as indicated in sentence 3. Also, in sentence 2, the black area is discussed and then it goes on to say that this indicates, "in all months the region was ice-free in at least one year". Because the Hebron area (indicated by a star on the charts) is not specifically referred to in sentence 2, it makes it sound like the black area is still the region being discussed. This could be very confusing to someone who is not used to looking at these charts. If mentioning the black area at all, it should be referred to as the area where ice is present 100% of the time but which is significantly north of the drilling site.

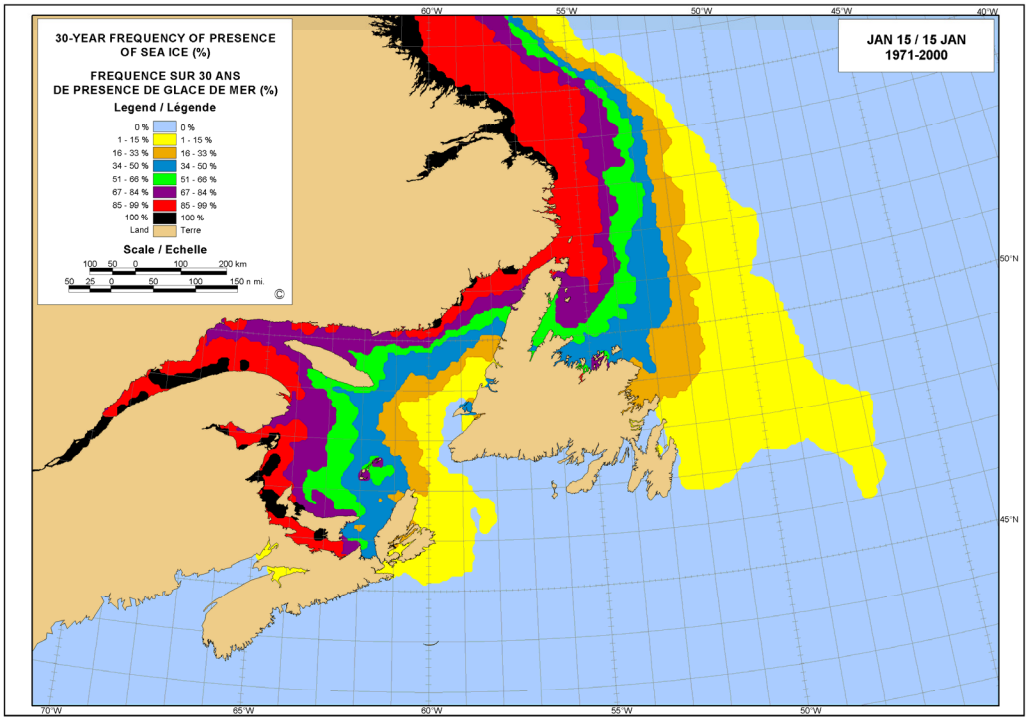
Suggest replacing Para 2, sentences 1-4 with: "The maximum mid-month ice extents for January through May, southeast of Newfoundland, are indicated by the yellow areas in Figures 3-29 to 3-33. These maximum extents are composites of the most advanced ice edges recorded over the 1971-2000 period. The Hebron platform location, indicated by a star on Figures 3-29 to 3-33, lies within the limit of the maximum recorded ice extent during the months of February, March and April. However, based on 1971-2000 data and as is indicated by the colours on the charts, the probability that this location will lie within the maximum limit is 1-15% in February and April, and 16-33% in March."

EMCP Response 30-Nov-10: Paragraph 2, sentences 1 to 4, will be replaced with the following:

The maximum mid-month ice extents for January through May, southeast of Newfoundland, are indicated by the yellow areas in Figures 3-29 to 3-33. These maximum extents are composites of the most advanced ice edges recorded over the 1971 to 2000 period. The Hebron Platform location, indicated by a star on Figures 3-29 to 3-33, lies within the limit of the maximum recorded ice extent during the months of February, March and April. However, based on 1971 to 2000 data and as is indicated by the colours on the charts, the probability that this location will lie within the maximum limit is 1 to 15 percent in February and April, and 16 to 33 percent in March."

Comment A-19: *Figure 3-29*: This is not the "mid-month" chart for January. The charts for all the other months are for close to the 15th of that month, and in the text it says the included charts are for "mid-month", so why not use the January 15th chart (below) as opposed to the January 8th chart (used in the study)? Replace Figure 3-29 with:

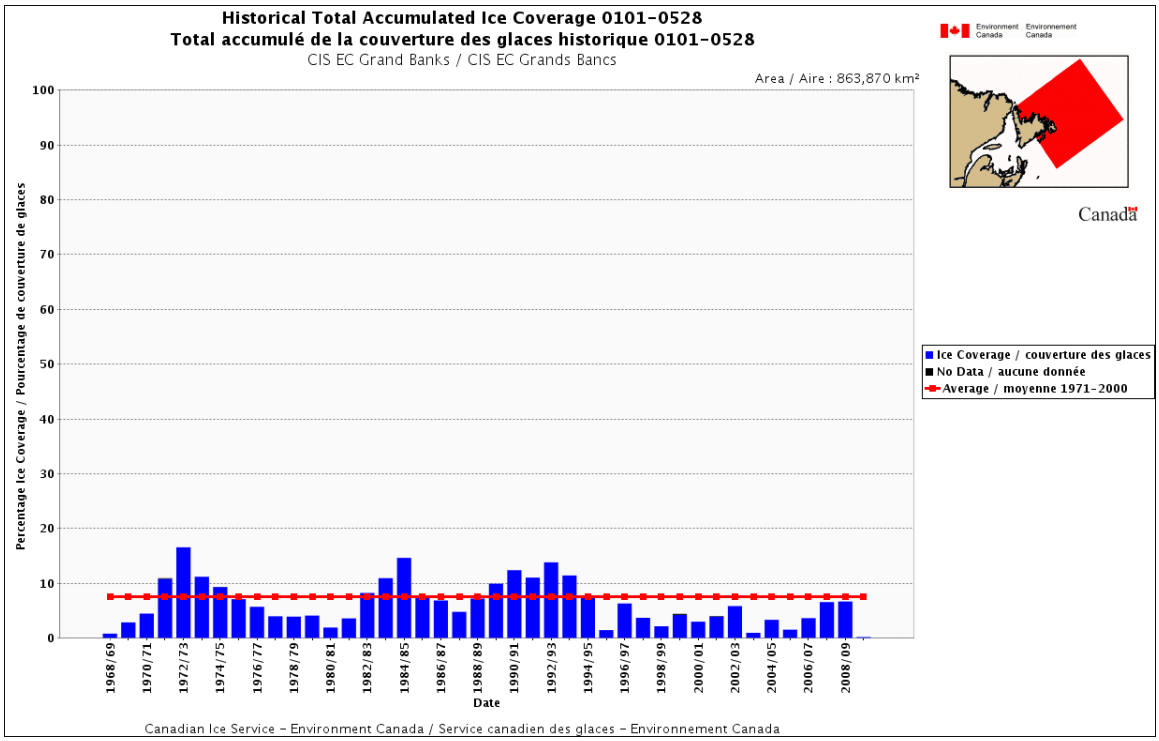
Environment Canada Environnement Canada



Canada

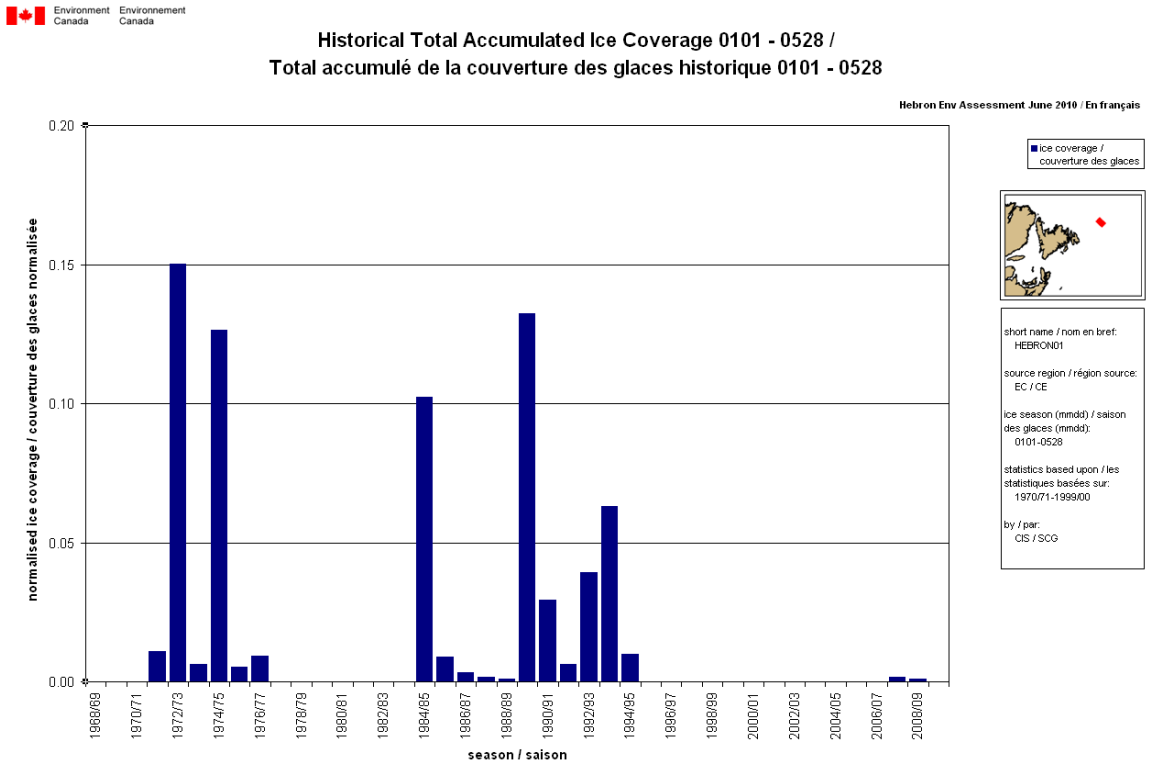
EMCP Response 30-Nov-10: Figure 3-29 will be replaced with above chart.

Comment A-20: *Figure 3-34*: Why was this graph produced for the entire east coast and not specifically for the Grand Banks area (which is an option with CIS's online Ice Graph tool). Additionally, as indicated by the ice charts shown in Figures 3-29 to 3-33, the ice season for this area usually begins in January and ends in May, so why choose a period from mid-November to mid-July to average over? **It would be better if this time series were replaced with one specific to the Grand Banks and representing the average for the January to May period (see below)**:



EMCP Response 30-Nov-10: Figure 3-34 will be replaced with the above and the text will be revised to reflect that it provides information specifically for the Grand Banks area.

Comment A-21: CIS also has the capability of generating such ice graphs for areas not included in the web tool, if requested. It might also be good to include the following ice graph, tailored specifically to the Hebron Platform area. This graph also emphasizes that, based on 1969-2010 data, ice is only present in the area in approximately 19 years out of every 42 years (or in ~45% of the years). Based on 1971-2000 data, ice was present in that area in 57% of the years. The springs of 2008 and 2009 represented the first time ice was seen in that area within the last 15 years. (Note that the ice graph below shows an "Accumulated Ice Coverage" for the entire January to May period. Naturally, the "frequency of presence of sea ice" for the January to May period is higher than that for any individual month as shown in Figures 3-29 to 3-33).



The above ice graph also makes a nice progression between the larger Grand Banks area (Figure 3-34) and the area within a 15km radius of the platform (Figure 3-35).

EMCP Response 30-Nov-10: The above figure will be added to the CSR (new Figure 3-X).

Comment A-22: *Figure 3-35:* In the text and in the caption, it says that this data is for within **15 km** of the platform location, but in the title of the top graph of Figure 3-35 it says within **28 km** of the platform. **Either the title or the Figure caption and text need to be corrected**.

EMCP Response 30-Nov-10: The figure caption will be revised as follows: Figure 3-X: Weekly Incursions of Sea Ice Within 28 km of Hebron Platform Location

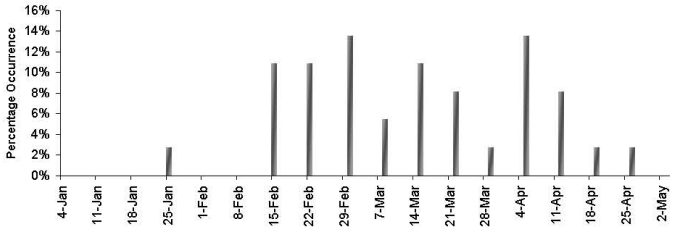
Follow-up Comment 28-Jan-11	**partly satisfactory.** While the figure caption has been corrected to say "within 28 km", the text on page 3-65 (second to last paragraph) needs to be corrected as well, as indicated in the comment.
EMCP Response 18-Mar-11	**The text in the CSR will be revised as follows:** The annual timings of all ice incursions within 28 km of the Hebron Platform location from 1972 to 2008 are shown in Figure 3-35. These data show the onset

	(approximately between 1983 and 1994) of higher incursion together with the ice incursions centered broadly in mid-March. This period was then followed by a time of no pack ice cover that lasted to 2008.

Comment A-23: Also, in the table for Figure 3-35 it is not clear what the values within the grey boxes represent. If they represent the average concentration of ice within 28 km of the Hebron platform, then the column containing the Mean Concentration in the table contains errors. For example, for year 1991, values of 1, 9 and 4 are indicated. The mean value should then be 4.67, but the corresponding Mean concentration given in column 7 is "9". On the other hand, if the values in the grey boxes represent "occurrence of ice within the 28km radius" as indicated in the column header, how can a value of 9 be obtained for a 7-day period? **The values in the table in Figure 3-35 need to be clearly defined and re-checked for errors**.

EMCP Response 30-Nov-10: Figure 3-35 will be revised as follows:

Percentage Occurrence of Sea Ice within 28 km of Hebron, by Week, 1972 - 2008

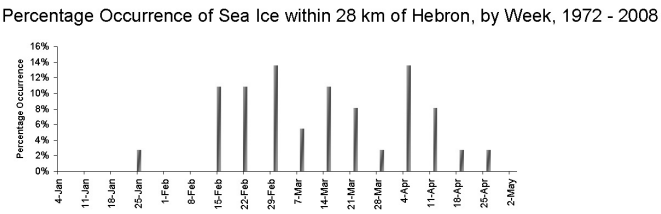


Year	Mean Concentrations of Sea Ice within 28 km of Hebron																			Mean Concentration	Weeks of Coverage
	4-Jan	11-Jan	18-Jan	25-Jan	1-Feb	8-Feb	15-Feb	22-Feb	1-Mar	8-Mar	15-Mar	22-Mar	29-Mar	5-Apr	12-Apr	19-Apr	26-Apr	3-May	10-May		
2008										4		1								3	2
2007																					
2006																					
2005																					
2004																					
2003																					
2002																					
2001																					
2000																					
1999																					
1998																					
1997																					
1996																					
1995																					
1994								8	9											9	2
1993							6							3	6					5	3
1992											9									9	1
1991							1		9			4								5	3
1990								1	9		8	9	6	6						7	6
1989																					
1988																					
1987																					
1986																					
1985								9		5	9			2	5					6	5
1984									3											3	1
1983														9						9	1
1982																					
1981																					
1980																					
1979																					
1978																					
1977																					
1976																					
1975																					
1974							3	9	5											6	3
1973				8			8				8			5	9	9	9			8	7
1972																					
																				6	3
% Occurrence	0%	0%	0%	3%	0%	0%	11%	11%	14%	5%	11%	8%	3%	14%	8%	3%	3%	0%	0%		

Years of Data 37

Source: CIS Ice Charts and Field Observations 2000 - 2008

Figure 3-35 Weekly Incursions of Sea Ice within 28 km of Hebron Platform Location

Follow-up Comment 28-Jan-11	**unsatisfactory**. While the noted error regarding the computed means of the data values was satisfactorily addressed, **several more errors were noticed.** 1) The Source of the data listed under the table is: CIS Ice Charts and Field Observations 2000-2008 and yet the table contains data for 1972-2008. 2) Also, going back and spot-checking the dates/concentrations in the table against the CIS online chart data indicates that the values in this table do not correspond very well or at all with the archived CIS chart data and must come either from somewhere else or the person going through the charts misinterpreted the dates and concentrations in many places. EC does not have time to re-do this entire table for the consulting company. Please re-check the source, the chart dates, the derived data, etc.
EMCP Response 18-Mar-11	**1.** The source of the data in Figure 3-35 will be revised as follows: Source: CIS Ice Charts (1978 - 2008) and Field Observations (1972 - 2008)  Year | Mean Concentrations of Sea Ice within 28 km of Hebron | Mean Concentration | Weeks of Coverage 2008: 4 1 — Mean Concentration 3, Weeks of Coverage 2 1994: 8 9 — 9, 2 1993: 6 3 6 — 5, 3 1992: 9 — 9, 1 1991: 1 9 4 — 5, 3 1990: 1 9 8 9 6 6 — 7, 6 1985: 9 5 9 2 5 — 6, 5 1984: 3 — 3, 1 1983: 9 — 9, 1 1974: 3 9 5 — 6, 3 1973: 8 8 8 5 9 9 9 — 8, 7 4-Jan 11-Jan 18-Jan 25-Jan 1-Feb 8-Feb 15-Feb 22-Feb 1-Mar 8-Mar 15-Mar 22-Mar 29-Mar 5-Apr 12-Apr 19-Apr 26-Apr 3-May 10-May — Mean Concentration 6, Weeks of Coverage 3 % Occurre: 0% 0% 0% 3% 0% 0% 11% 11% 14% 5% 11% 8% 3% 14% 8% 3% 3% 0% 0% Years of Data 37 Source: CIS Ice Charts (1978 - 2008) and Field Observations (1972 - 2008) **Figure 3-35 Weekly Incursions of Sea Ice within 28 km of Hebron Platform Location** **2**. With the corrected sources, those observations that may not agree with the CIS ice charts come from field observations, as indicated. As such, Figure 3-35 does not require any further updating.

Comment A-24: *Spatial Distribution section, para 4*: This paragraph is organized in a confusing way. **Please make the following edits**: "The time frame of the annual ice incursions within 15 km of the Hebron Platform location, based on data from 1972 to 2008, is shown in Figure 3-35. These data show the onset (roughly between 1983 and 1994) of a period of greater

incursions which was then followed by a period of no pack ice incursions (from 1997 to 2007). The data also show that ice incursions are centred broadly in mid-March."

EMCP Response 30-Nov-10: The text will be revised as follows:
The time frame of the annual ice incursions within 28 km of the Hebron Platform location, based on data from 1972 to 2008, is shown in Figure 3-35. These data show the onset (approximately between 1983 and 1994) of a period of greater incursions which was then followed by a period of no pack ice incursions (from 1997 to 2007). The data also show that ice incursions are centred broadly in mid-March.

Follow-up Comment 28-Jan-11	Again, as noted above for A-22, besides the changes already made, the text in this paragraph needs to be corrected from "15 km" to "28 km".
EMCP Response 18-Mar-11	See response to Comment A-22.

Comment A-25: *Spatial Distribution section, last para*: Again, the sentences in this paragraph are written in a very confusing way. For example, sentence 1 begins with rates in terms of years but then jumps to weekly periods with no logical transition from one phrase to the next. **Please edit this paragraph as follows**: "The Hebron Platform location experienced sea ice incursions in 11 of the 37 years examined in Figure 3-35. This is equivalent to a rate of one in every three to four years. Weekly probabilities, which peak at 14 percent, show two maxima: the first in the last week of February; and the second on the first week of April. The duration of the incursions vary from a minimum of one week to a maximum of seven weeks. Of the 11 years that ice was present, the average duration was three weeks."

EMCP Response 30-Nov-10: The text will be revised as follows:
The Hebron Platform location experienced sea ice incursions in 11 of the 37 years examined in Figure 3-35. This is equivalent to a rate of one in every three to four years. Weekly probabilities, which peak at 14 percent, show two maxima: the first in the last week of February; and the second on the first week of April. The duration of the incursions vary from a minimum of one week to a maximum of seven weeks. Of the 11 years that ice was present, the average duration was three weeks.

3.2.3.2 Sea Ice Movement

Comment A-26: *Para 1, sentence 1*: Make clearer … Suggest simplifying sentence 1 to: "Although the Hebron Platform location lies near the extreme southern limit of the regional ice pack, it is affected by the ice tongue that is formed by the loose pack ice being swept around the Grand Banks by the offshore branch of the Labrador Current".

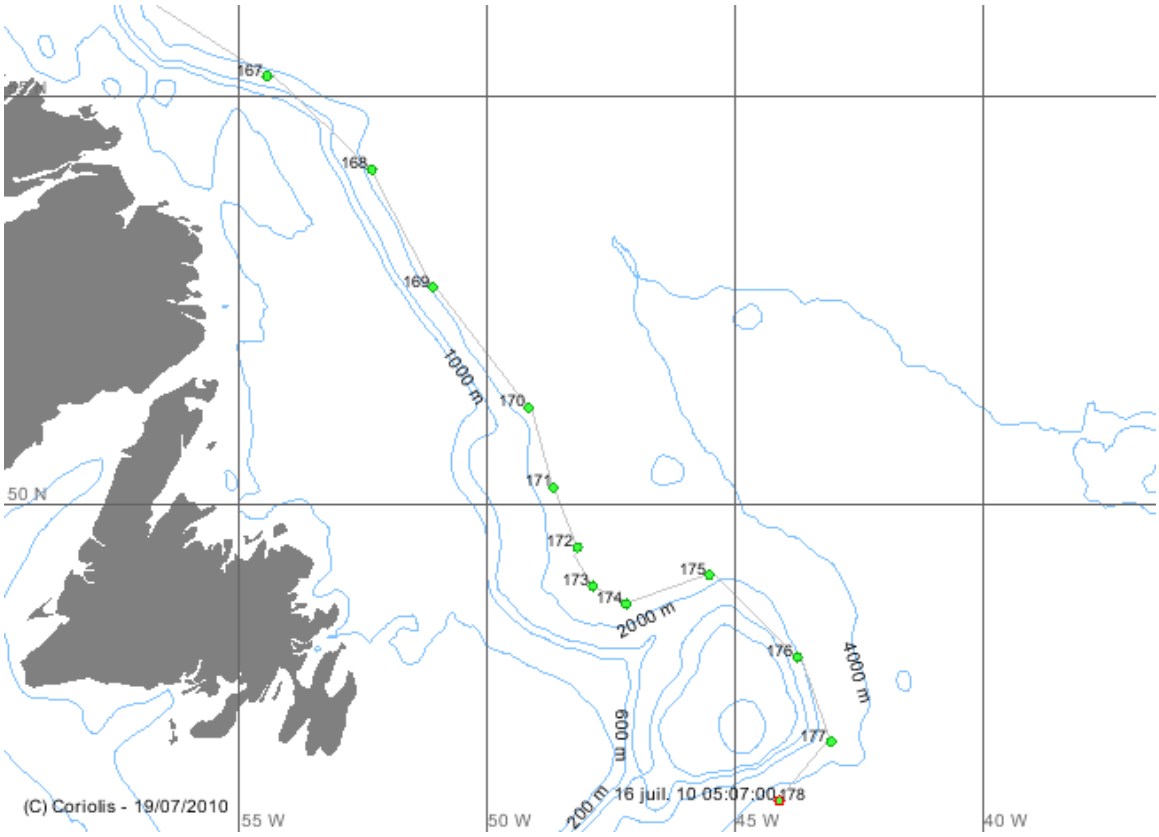
EMCP Response 30-Nov-10: The text will be revised as follows:
Although the Hebron Platform location lies near the extreme southern limit of the regional ice pack, it is affected by the ice tongue that is formed by the loose pack ice being swept around the Grand Banks by the offshore branch of the Labrador Current.

Comment A-27: *Para 2 and Figure 3-36*: **Inconsistent reference**. In the text it says the study was conducted over the period 1984-87 by Seaconsult Ltd. (1988), but in the figure itself it says "Data: February through April 1985" and references "Fissel et al. (1985)".

Additional comment: the drift speed and direction study was conducted over a very limited period of 4 years (1984-87). Many factors can influence ice drift, including some that may not have been

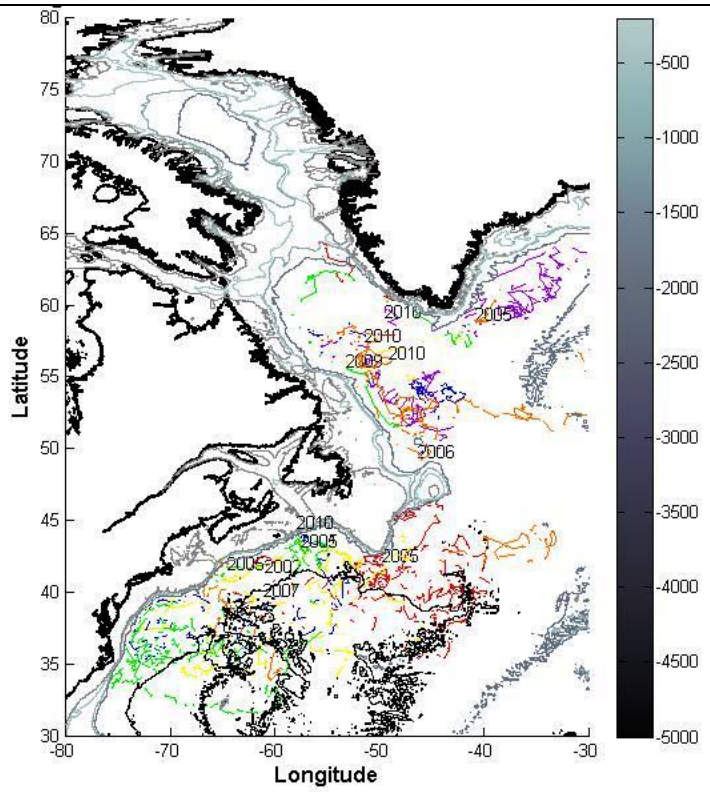
observed during this 4-year study. A new study should be conducted using new ARGO float data, freely available here: http://www.argodatamgt.org/Access-to-data/Argo-data-selection .

For example, the drift track of ARGO float 6900190, released in 2005 south of Iceland, could be followed down the east coast and along the slope of the Grand Banks in 2010 (green dots on figure below) over the period March 28 (float cycle 167) through July 16 (float cycle 178).



EMCP Response 30-Nov-10: The following text will be added to Section 3.2.3.2

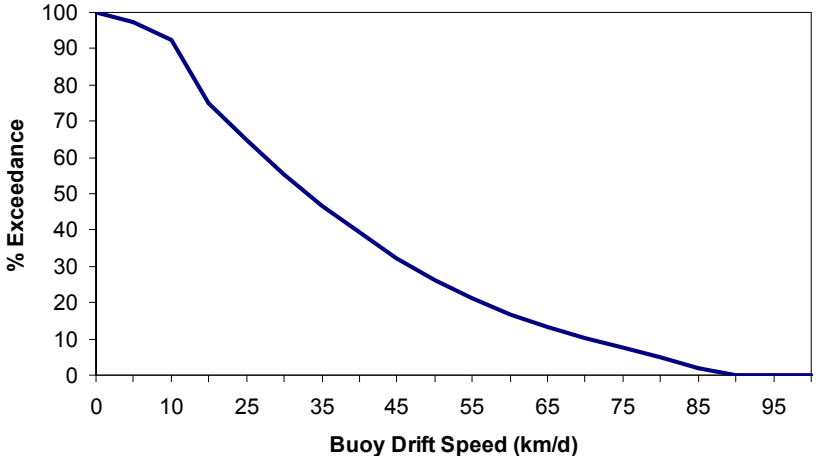
A verification study was carried out by Provincial Airlines Environmental Services Division with 18 Argo drifters from the years 2002 to 2010 in the North Atlantic Ocean, as obtained from the Integrated Science Data Management (ISDM) department of DFO. The spaghetti plot in Figure 3-X illustrates the tracks of these drifters. Each drift track is denoted by a different color line, with the year number indicating the point at which the drifter started transmitting data. Breaks in the lines indicate gaps in the data of five or more days, which may be a result of transmission errors or filtering of the data for quality control.



Source: ISDM 2010

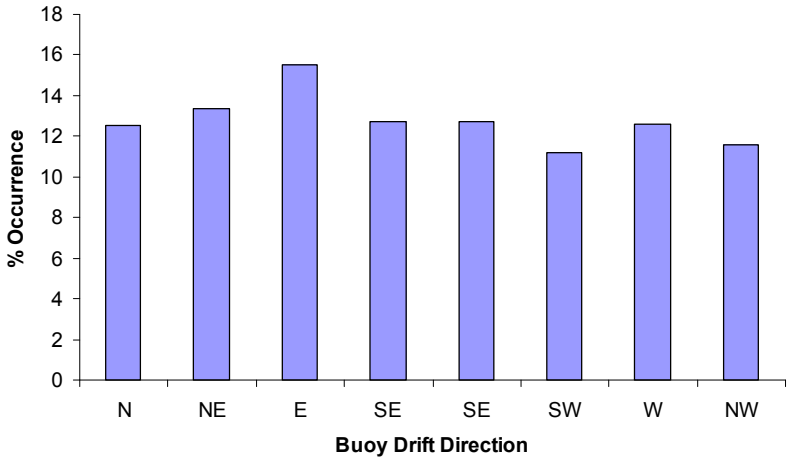
Figure 3-X Tracks of Argo Drifter, 2002 to 2010

Analysis of these tracks determined that similar drift speeds were encountered in the study by Fissel *et al.* (1985). The drift speed (Figure 3-X) was observed to be marginally higher overall, but this may be attributed to the fact that the 2002 to 2010 data were collected year-round while the 1985 study focussed on just one season (spring 1985). Similarly, there was no predominant direction of drift (Figure 3-X) in the PAL study, but the Fissel *et al.* (1985) study found that southeast drift was most common. This may be a result of both seasonal drift and geographic distribution of the drifters under study. The PAL study was widely distributed across the North Atlantic and undoubtedly captured less of the Labrador Current flow that Fissel *et al.* (1985) was focussed on, leading to the observation of multi-directional drift.



Source: ISDM 2010

Figure 3-X Buoy Drift Speed



Source: ISDM 2010

Figure 3-X Buoy Drift

The following reference will be added to Section 18.2:

ISDM (Integrated Science Data Management). 2010. Argo Canadian Tracked Data, 2002 - 2010. Available at URL: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/canada/data-donne-eng.html

Follow-up Comment 28-Jan-11	**partly satisfactory.** In the response, it is not indicated whether the issue of the inconsistent reference for Figure 3-36 was addressed. It is not clear if the figure was replaced or just supplemented with additional figures. If the figure and its related text were retained, then the comment "In the text it says the study was conducted over the period 1984-87 by Seaconsult Ltd. (1988), but in the figure itself it says "Data: February through April 1985" and references "Fissel et al. (1985)" needs to be addressed. The addition of the ARGO float data study is an improvement and addresses the second part of comment A-27. However, the proposed figures and accompanying text contain an error and also could be made clearer. For example, the first sentence says "A verification study was carried out by Provincial Airlines Environmental Services Division … ". A verification study of what – surface currents? To verify potential iceberg drift speeds and directions? This should be made clear up front. And note that it is now **Provincial Aerospace Ltd,** not Provincial Airlines. There is still a Provincial Airlines for commercial operations, but since the mid-2000's the part of the company that carries the Environmental Services is Provincial Aerospace. (Note: The term "Provincial Aerospace" was correctly used in the paragraph addressed in comment A-38 … why was it not referred to correctly here?). Also, when using an acronym like DFO, this needs to be spelled out somewhere so that people know it means Department of Fisheries and Oceans. In the second paragraph, the sentence "The drift speed (Figure 3-X) was observed to be marginally higher overall, …" is unclear. Do you mean the drift speeds determined by PAL were higher than those of Fissel?
EMCP Response 18-Mar-11	**A**. After retrieving both references, it has been found that the information from Figure 3-36 is summarized in Seaconsult (1988). In this document, there is reference to Fissel *et al.*'s 1985 work, but there is no reason to reference that document in the current report. Additionally, it was found that the buoy data were from February through April of 1985, and so the statement "between 1984 and 1987" will be changed.

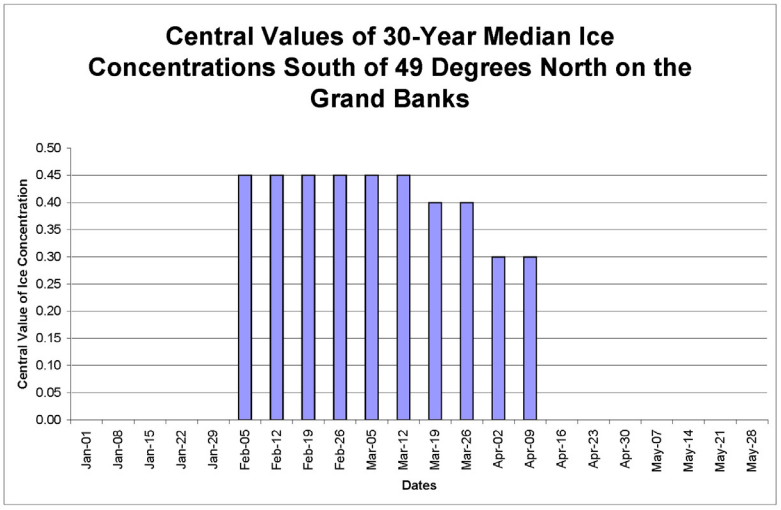
	B. **The CSR will be revised as follows**: A verification study of surface current drift speed and direction was carried out by Provincial Aerospace Environmental Services Division with 18 Argo drifters from the years 2002 to 2010 in the North Atlantic Ocean, as obtained from the Integrated Science Data Management (ISDM) department of the Fisheries and Oceans Canada (DFO). Argo drifters were chosen as they are representative of pack ice drift." **C. The CSR will be revised as follows**: The drift speeds (Figure 3-X) of the Argos drifters as studied by PAL was observed to be marginally higher overall than those observed by Fissel *et al.* (1985). This may be attributed to the fact that the 2002 to 2010 data were collected year-round while the 1985 study focussed on just one season (spring 1985). Similarly, there was no predominant direction of drift (Figure 3-X) in the PAL study, but the Fissel *et al.* (1985) study found that southeast drift was most common. This may be a result of both seasonal drift and geographic distribution of the drifters under study. The PAL study was widely distributed across the North Atlantic and undoubtedly captured less of the Labrador Current flow that Fissel *et al. (*1985) was focussed on, leading to the observation of multi-directional drift.

3.2.3.3 Concentrations

Comment A-28" *Para 1*: The statements made in this paragraph do not agree with CIS median ice concentration charts. It appears that the statements were derived from the "Frequency of Presence of Sea ice" charts shown in Figures 3-29 to 3-33, and that "frequency of presence of sea ice" has been confused with "mean sea ice concentrations". **This needs to be corrected.** Also, it is not clear how the information in this paragraph, which purports to describe the seasonal variation in sea ice concentrations over the Grand Banks, relates to Figure 3-37 (whose data is not divided into monthly periods) as indicated in the last sentence. This needs to be amended.

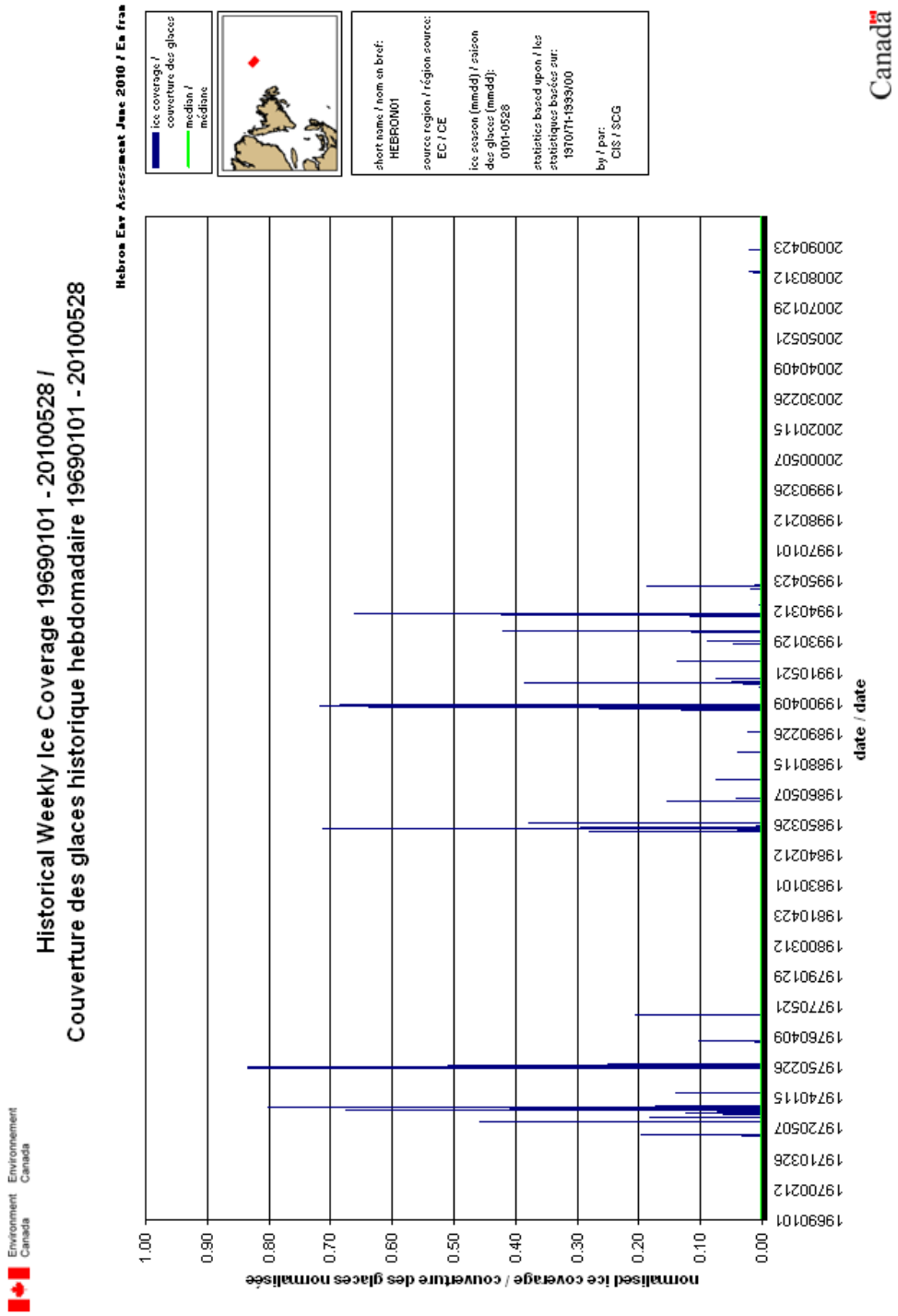
EMCP Response 30-Nov-10: The text will be revised as follows: Frequency of presence of sea ice concentrations for the Grand Banks south of 49°N are fairly consistent at approximately 6/10ths coverage. Ice concentrations of greater than 5/10ths are evident by early February and continue through to mid-April, after which they slowly decrease to 2/10ths coverage as per Figure 3-37.

Follow-up Comment 28-Jan-11	**unsatisfactory.** The response to this comment does not correct the problem at all. In fact, the paragraph: "Frequency of presence of sea ice concentrations for the Grand Banks south of 49°N are fairly consistent at approximately 6/10ths coverage. Ice concentrations of greater than 5/10ths are evident by early February and continue through to mid-April, after which they slowly decrease to 2/10ths coverage as per Figure 3-37." is just plain wrong and still confuses frequency with concentration in the second sentence. The section is called "Concentrations" not "Frequency of Presence". You cannot just change the text from concentrations to frequency because you used the frequency charts … you need to go back and look at the median concentration charts or the ice graphs of ice coverage. The ice graphs referred to in comments A-20 and A-21 show that for the Grand Banks as a whole and for the Hebron study area, seasonal averaged ice coverage is generally less than 10% or less than 1/10 concentration (this is also indicated by the actual median concentration charts in the CIS East Coast ice atlas). The ice graph referred to in comment A-29 indicates that when ice is present in the Hebron study area, sea ice coverage can reach greater than 6/10 during years with large incursions. Additionally, no attempt has been made to address the last part of comment A-28, which stated: "Also, it is not clear how the information in this paragraph, which

	purports to describe the seasonal variation in sea ice concentrations over the Grand Banks, relates to Figure 3-37 (whose data is not divided into monthly periods) as indicated in the last sentence. This needs to be amended."
EMCP Response 18-Mar-11	Figure 3-37 will be revised as follows:  **Figure 3-37** **The text in the CSR will be revised as follows:** The median sea ice concentrations for the Grand Banks south of 49°N are usually between 4 and 6/10ths by early February and continue to be present in the region through early-April, after which they slowly decrease to 1-3/10ths coverage and recede to above 49°N as per Figure 3-37. In this figure, the term "Central Value" is determined by averaging the minimum and maximum median concentrations of sea ice found below 49°N on each given week over the 30-year period between 1971 and 2000.

Comment A-29: *Figure 3-37 and Para 2*: √√ **Pie chart values were checked and are OK.** A spot-check was performed on several years during the 1979-2008 period during which ice was present in the Hebron area, using the CIS archived regional chart data. In 1985, ice affected the Hebron area between Feb03 and Apr07. Charts were produced every 3 days during this period, for a total of 17 charts. Ice concentrations greater than or equal to 8/10 affected Hebron on 8 (or 47%) of these charts and ice concentrations less than 8/10 affected Hebron on 9 (or 53%) of the charts. These numbers agree with the values presented in the pie chart, where concentrations of greater than or equal to 8/10s were determined to affect the area 46% of the time (during years when ice was present) and concentrations less that 8/10s were determined to affect the area 54% of the time. For 1993, ice affected the Hebron area on 3-4 charts from Feb08 to Apr19, and none of the charts indicated 8/10 or greater ice concentrations. Therefore, in this year, the proportions of 8/10 or more versus less than 8/10 is 0% and 100%. For 1994, a time when charts were done every week, ice affected the Hebron area from Feb14 to Mar07 (4 charts). Ice concentrations of 8/10 or greater impacted the Hebron area on ~3 of the charts, changing the proportions to 75% and 25%. For the 3 spot-check years, the average % of time with ice concentrations of 8/10 or greater is 40%, close enough to the pie-chart percentages given the limited number of years checked. The mean overall concentration, based on the data in the pie chart is ~7/10 as indicated.

****Another way to show the information above would be to include the following Ice Graph**, which shows weekly ice coverages for the Hebron-specific area (although the coverages average less than the concentrations in the pie chart in Figure 3-37 because the area considered is >15km radius. The area on the Ice Graph covers a 1°×1° or 111km N-S × 76.5km E-W box).



EMCP Response 30-Nov-10: The above figure will be included in the CSR.

3.2.3.4 Floe Size

Comment A-30: *Sentences 2 and 3, immediately under the bullets*: Poorly written and unclear. **Rephrase as**: "In Newfoundland waters, floe sizes tend to decrease from north to south and from west to east, towards the outer margins of the ice pack. Enhanced melt and disintegration of the ice floes occurs at the outer ice pack margins as a result of larger amplitude waves (not damped by the ice pack proper) and warmer sea surface temperatures."

EMCP Response 30-Nov-10: The text will be edited as follows: In Newfoundland waters, floe sizes tend to decrease from north to south and from west to east, towards the outer margins of the ice pack. Enhanced melt and disintegration of the ice floes occurs at the outer ice pack margins as a result of larger amplitude waves (not damped by the ice pack proper) and warmer sea surface temperatures.

Comment A-31: *Para 4, sentence 1*: It should be noted in the text that the Atmospheric Environment Service (AES) is now the Meteorological Service of Canada (MSC) and that the Canadian Ice Service (CIS) is a branch of the MSC.

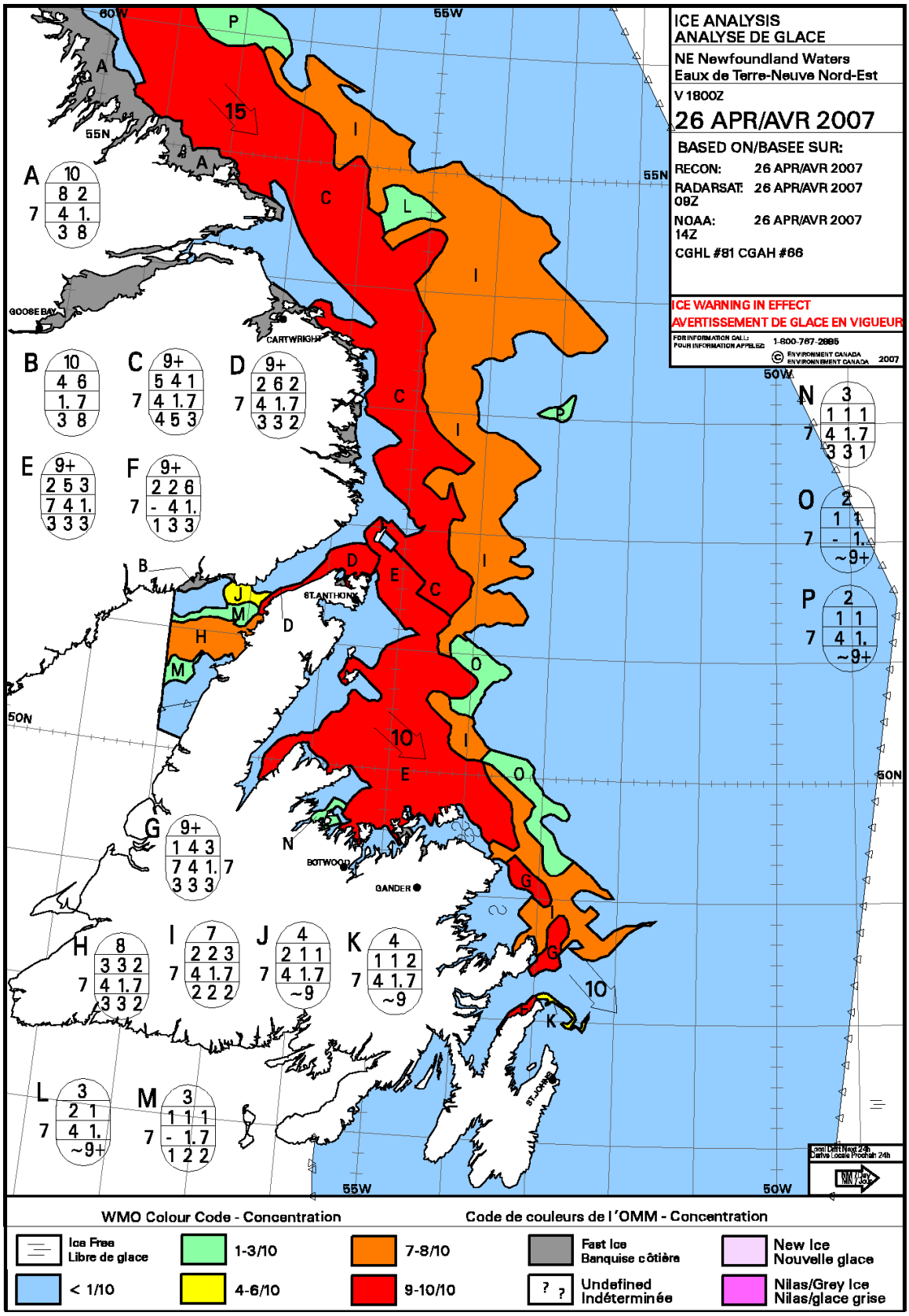
EMCP Response 30-Nov-10: The text will be revised as follows: Atmospheric Environment Service (AES), now called the Meteorological Service of Canada (MSC) supports a branch called the CIS who compiles composite ice chart data. For 1964 to 1987, these charts indicate that, within 50 km of the Hebron Platform location, floes larger than 100 m are present only 10 percent of the time.

Follow-up Comment 28-Jan-11	**partly satisfactory.** The revised sentence should spell out "… Canadian Ice Service (CIS) … " and not just use the acronym CIS on its own, unless it was recently described elsewhere. Also, ice charts from the Canadian Ice Service date back to 1968 at the very earliest. So where do the dates 1964-1987 in the second sentence come from?? This needs to be re-checked and corrected.
EMCP Response 18-Mar-11	CIS is defined in the first paragraph of Section 3.1.4, page 3-26. **The CSR will be revised as follows:** "Atmospheric Environment Service (AES), now called the Meteorological Service of Canada (MSC) supports a branch called the Canadian Ice Service (CIS), which compiles composite ice chart data. For 1968 to 1987, these charts indicate that, within 50 km of the Hebron Platform location, floes larger than 100 m are present only 10 percent of the time."

3.2.3.5 Thickness and Deformation

Comment A-32: General comment: Most of this section is devoted to a review of high ice thicknesses in the Grand Banks area as a result of ridging and deformation. Only a brief mention is made of thick ice floes drifting into the area from northern waters. In recent years, such as 2007 and 2010, Nares Strait has not always been consolidating in the winter as per normal, and as a result greater than normal amounts of thick, multi-year ice have been observed drifting south from the Arctic Ocean into Baffin Bay, down along the Labrador Coast and into Newfoundland waters. In spring 2007, pockets of 4/10 concentration of thick, old ice were observed by Coast Guard ships in some areas around Newfoundland.

The sequence of daily ice charts below indicate a large area of 2/10 thick, old ice drifting south of 50°N at the end of April, 2007.


ICE ANALYSIS
ANALYSE DE GLACE
NE Newfoundland Waters
Eaux de Terre-Neuve Nord-Est
V 1800Z
26 APR/AVR 2007
BASED ON/BASEE SUR:
RECON: 26 APR/AVR 2007
RADARSAT 09Z: 26 APR/AVR 2007
NOAA 14Z: 26 APR/AVR 2007
CGHL #81 CGAH #66
ICE WARNING IN EFFECT
AVERTISSEMENT DE GLACE EN VIGUEUR
FOR INFORMATION CALL: 1-800-767-2885
POUR INFORMATION APPELEZ:
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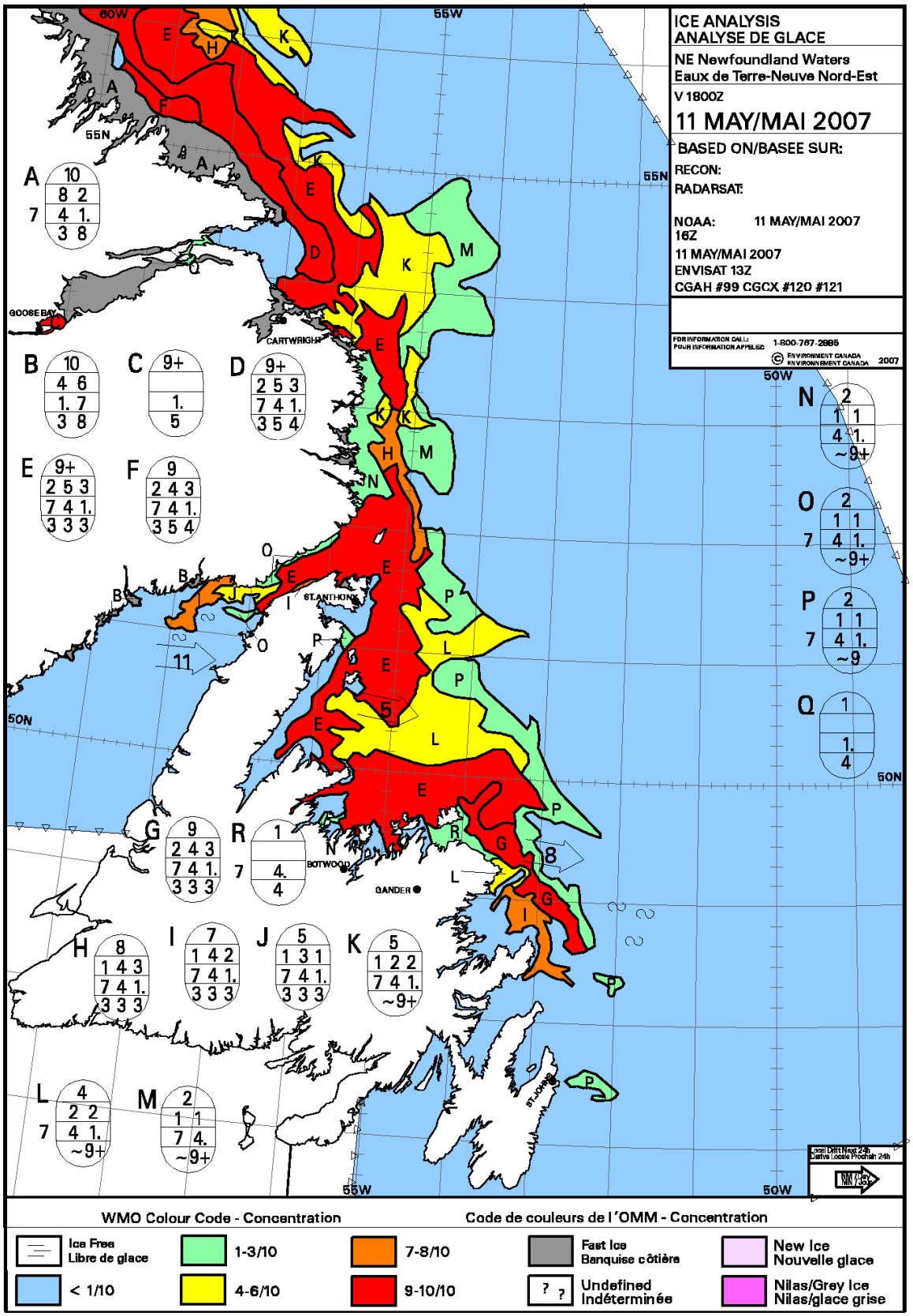
50N
GOOSE BAY
CARTWRIGHT
ST. ANTHONY
BOTWOOD
GANDER
ST. JOHN'S
WMO Colour Code - Concentration
Code de couleurs de l'OMM - Concentration
Ice Free
Libre de glace
< 1/10
1-3/10
4-6/10
7-8/10
9-10/10
Fast Ice
Banquise côtière
Undefined
Indéterminée
New Ice
Nouvelle glace
Nilas/Grey Ice
Nilas/glace grise


ICE ANALYSIS
ANALYSE DE GLACE
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Eaux de Terre-Neuve Nord-Est
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ENVISAT 13Z
CGAH #99 CGCX #120 #121
FOR INFORMATION CALL: 1-800-767-2885
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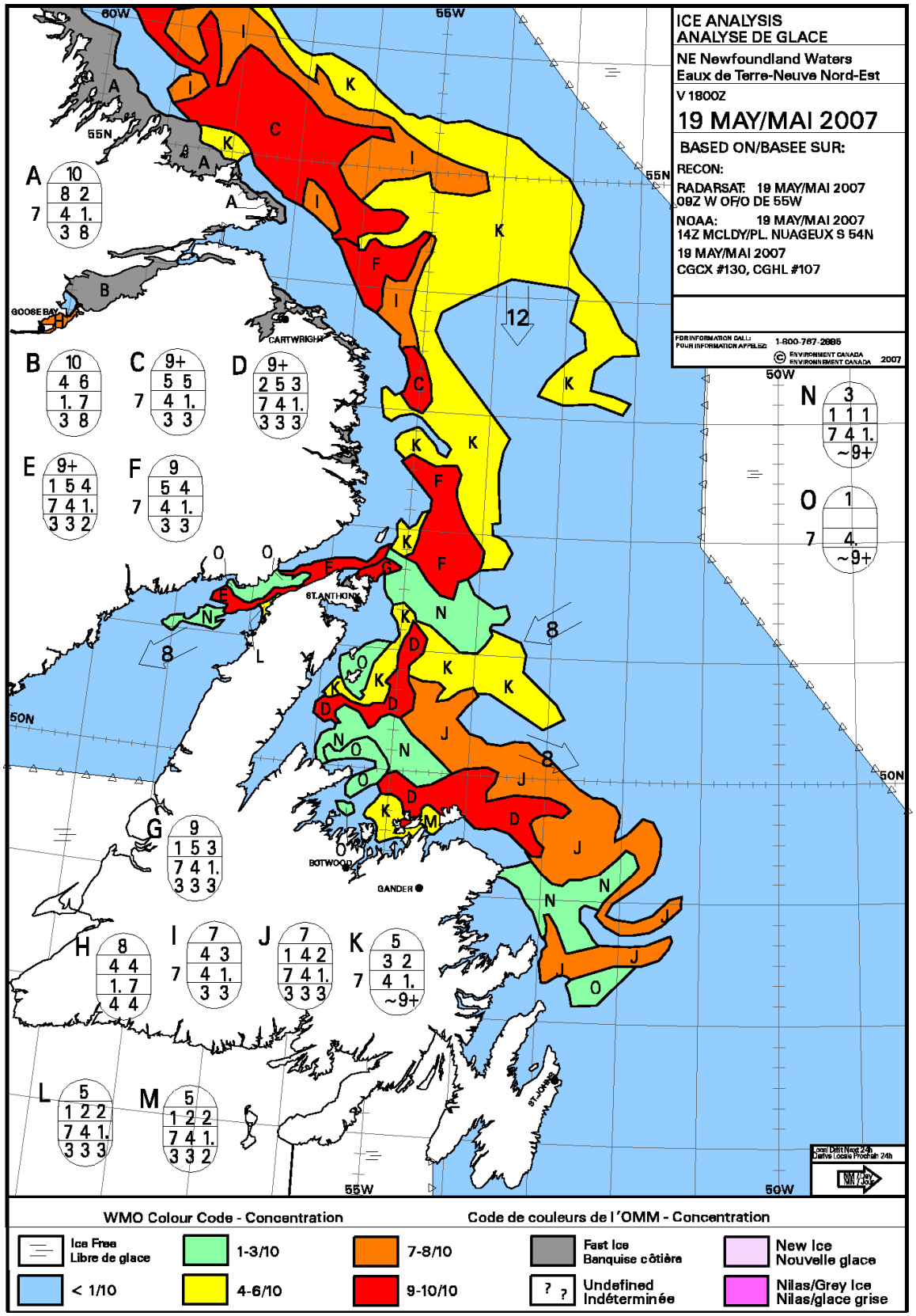
GOOSE BAY
CARTWRIGHT
ST. ANTHONY
BOTWOOD
GANDER
ST. JOHNS
WMO Colour Code - Concentration
Code de couleurs de l'OMM - Concentration
Ice Free
Libre de glace
< 1/10
1-3/10
4-6/10
7-8/10
9-10/10
Fast Ice
Banquise côtière
Undefined
Indéterminée
New Ice
Nouvelle glace
Nilas/Grey Ice
Nilas/glace grise


ICE ANALYSIS
ANALYSE DE GLACE
NE Newfoundland Waters
Eaux de Terre-Neuve Nord-Est
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19 MAY/MAI 2007
BASED ON/BASEE SUR:
RECON:
RADARSAT: 19 MAY/MAI 2007
09Z W OF/O DE 55W
NOAA: 19 MAY/MAI 2007
14Z MCLDY/PL. NUAGEUX S 54N
19 MAY/MAI 2007
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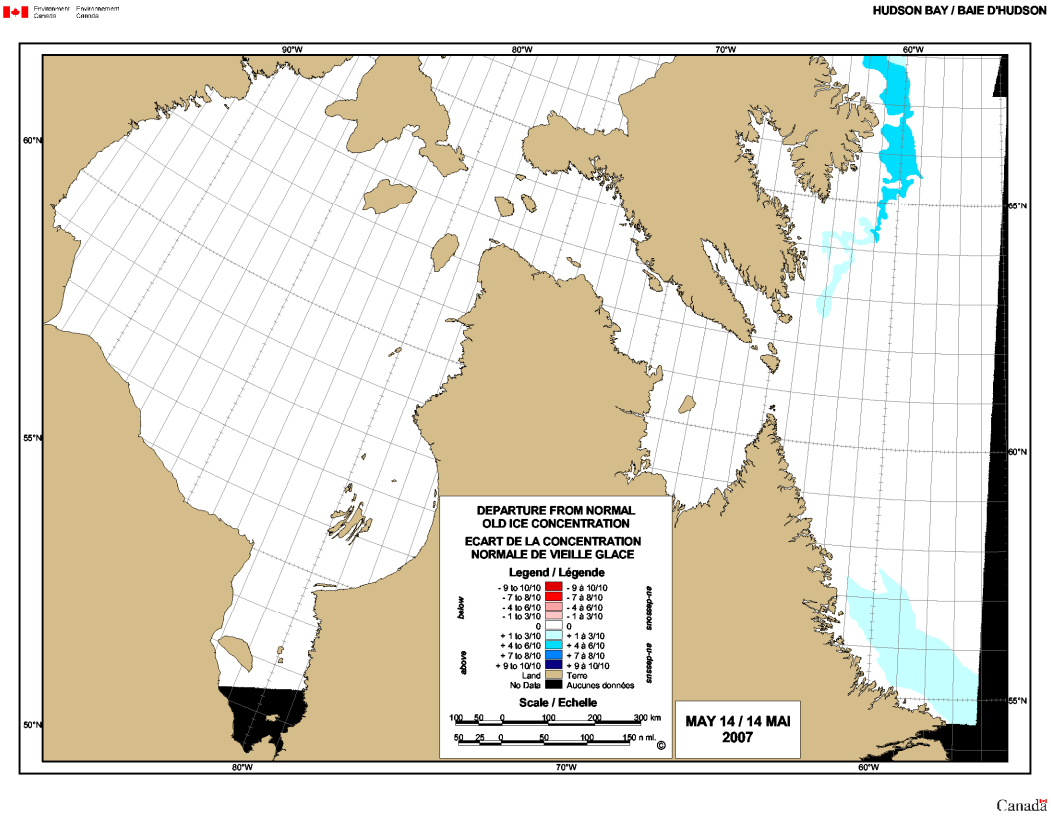
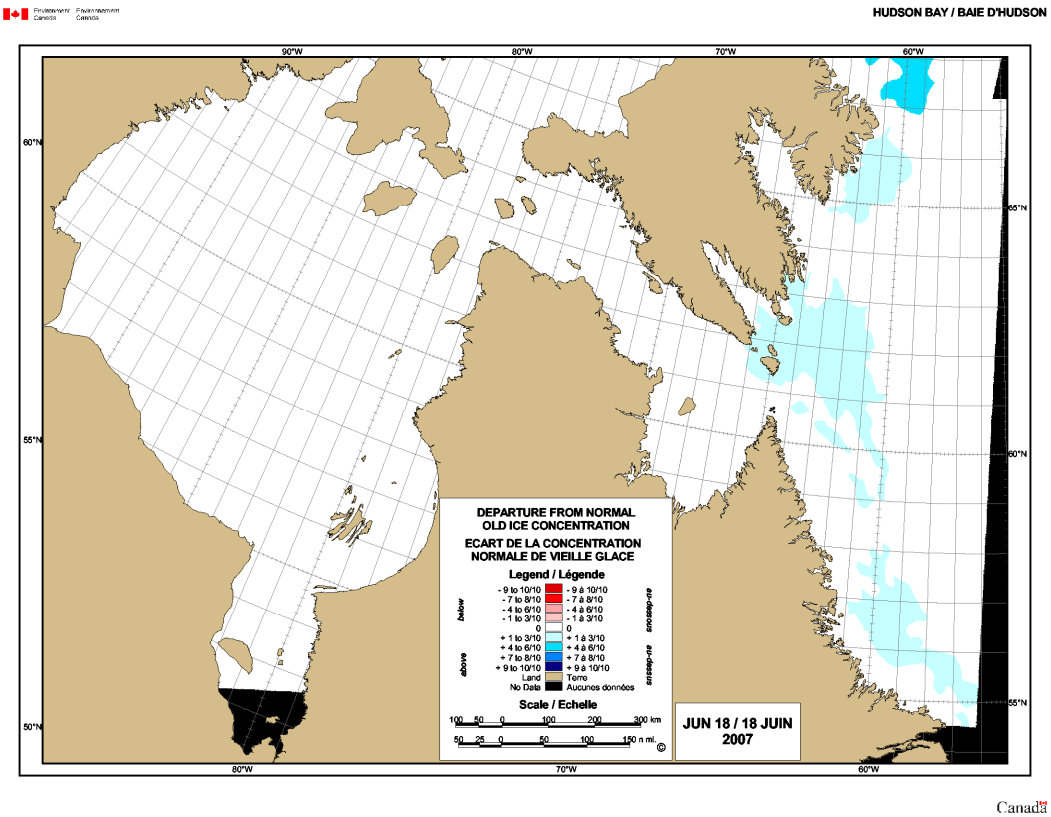
50N
GOOSE BAY
CARTWRIGHT
ST. ANTHONY
BOTWOOD
GANDER
ST. JOHN'S
WMO Colour Code - Concentration
Code de couleurs de l'OMM - Concentration
Ice Free
Libre de glace
< 1/10
1-3/10
4-6/10
7-8/10
9-10/10
Fast Ice
Banquise côtière
Undefined
Indéterminée
New Ice
Nouvelle glace
Nilas/Grey Ice
Nilas/glace grise

See also the departure from normal concentration of old ice charts for 2007 below. Unfortunately, these are not produced for Newfoundland waters.





It may be worth adding a line or two to this section indicating that in some years thick multi-year ice floes originating from the Arctic Ocean can drift southwards into Newfoundland waters. Because of their thickness and low-salinity (which makes the ice nearly as hard as glacier-derived ice), these ice floes can pose a significant danger to ships in the area – similar to the risks posed by icebergs. These ice floes are slow to melt because of their thickness and may or may not reach the Hebron area. Once individual multi-year floes are left behind by the main (melting and retreating first-year) pack as they drift south, they would be indistinguishable from bergy bits or growlers. Multi-year ice floes could also occasionally impact the ice conditions at the entrance to Trinity Bay (previous section of this study).

EMCP Response 30-Nov-10: The text will be revised as follows:

Ridge thicknesses for the Grand Banks have also been estimated from data gathered off southern Labrador during February and early March and extrapolated to the Grand Banks (Seaconsult Ltd. 1988). These estimates indicate that ridges or rubble fields with sails as large as 3.5 m could form on the Grand Banks (Bradford 1972; NORDCO Ltd. 1977). However, these estimates are offset by the fact that the farther south the ice deformations occur, the faster the rafted and upturned floes, as well as the thin binding ice between the floes, will melt. As the melting occurs, structural fragility and ice porosity increase. This reduces the operational hazards of any ridge or rubble field fragments surviving to well below those associated with smaller pieces of old or glacial ice.

In some years, thick multi-year ice floes originating from the Arctic Ocean can drift southwards into Newfoundland waters. Because of their thickness and low-salinity (which makes the ice nearly as hard as glacier-derived ice), these ice floes can pose considerable danger to ships in the area – similar to the risks posed by icebergs. These ice floes are slow to melt because of their thickness and may or may not reach the Hebron area. Once individual multi-year floes are left behind by the main (melting and retreating first-year) pack as they drift south, they would be indistinguishable from bergy bits or growlers. Multi-year ice floes could also occasionally impact the ice conditions at the entrance to Trinity Bay.

3.2.3.6 Icebergs

Comment A-33: *Para 2, general comment*: The text mentions that data up to 2008 was considered, but the PERD Iceberg Sighting Database is updated annually … data up to 2009 and perhaps even 2010 are available on the NRC website:

http://www.nrc-cnrc.gc.ca/eng/ibp/chc/reports/ice-engineering.html

PERD Iceberg Sighting Database: 2010

Iceberg_Sighting_10.pdf
PERD_Iceberg_Sighting_Database_10.mdb
PERD_Iceberg_Sighting_DatabaseXP_10.mdb
BMT Fleet Technology, Kanata, ON, Canada, 2010

Comprehensive Iceberg Management Database 2010
Iceberg_Management_10.pdf
PERD_Iceberg_Management_Database_10.zip
PAL Environmental Services, St. John's, NL, Canada, 2010

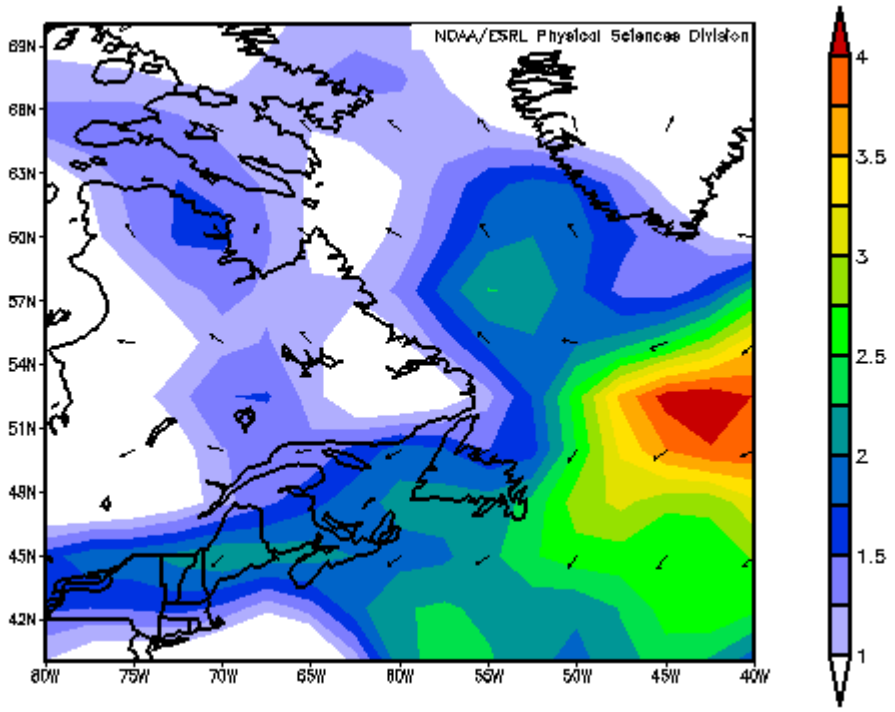
Grand Banks Iceberg Management
GB_Iceberg_Manage_Overview_07.pdf
AMEC and others
PERD/CHC Report 20-84, St. John's, NL, Canada, 2007.

EMCP Response 30-Nov-10: Thank you for the information. However, as the text notes that these numbers are from the PAL / IIP Databases.

Follow-up Comment 28-Jan-11	**partly satisfactory.** Yes, it is understood that PAL/IIP data were used, that is not the point of this comment. The point is that the data you present only goes up to 2008 when data up to 2009 are available. Why were the data from the last year not included in this study?
EMCP Response 18-Mar-11	As this report was originally submitted in June of 2009, the 2009 ice season had not yet concluded, and the 2010 ice season had not begun. As such, only the complete datasets available at the time of compilation were used in this work.

Comment A-34: Variations in Local and Regional Iceberg Numbers

Para 1, sentence 4: "These low numbers were attributed to a combination of very light sea ice coverage and higher than normal water temperatures on the Grand Banks" … Note that the low numbers in years such as 2005 were primarily the result of prolonged periods of onshore easterly winds during the spring months, which drove the bergs onto the Labrador Coast where they grounded. As a result, they were not free to drift south into Newfoundland waters. See the vector wind anomaly plots below for Mar-May (wind speeds in m/s), created from NCEP reanalysis data on the ESRL website: http://www.esrl.noaa.gov/psd/data/composites/day/ along with the CIS the daily iceberg charts from May of the years 2005 and 2010.


NOAA/ESRL Physical Sciences Division
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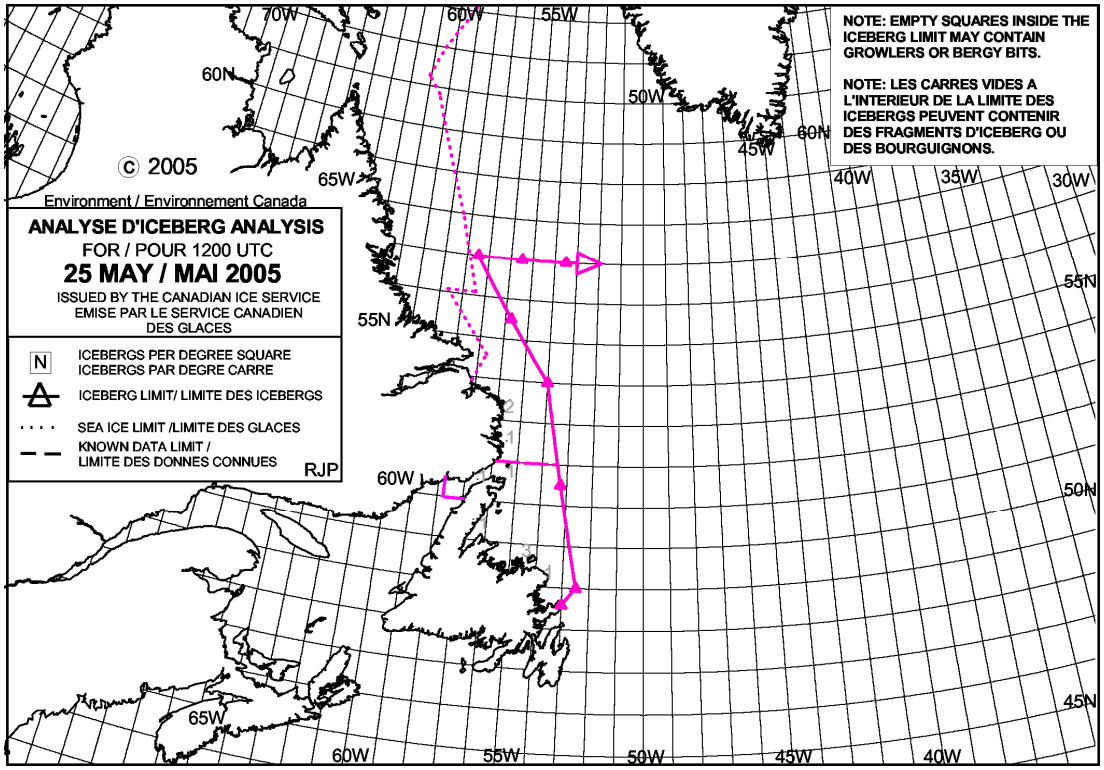
NOTE: EMPTY SQUARES INSIDE THE ICEBERG LIMIT MAY CONTAIN GROWLERS OR BERGY BITS.
NOTE: LES CARRES VIDES A L'INTERIEUR DE LA LIMITE DES ICEBERGS PEUVENT CONTENIR DES FRAGMENTS D'ICEBERG OU DES BOURGUIGNONS.
© 2005
Environment / Environnement Canada
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
25 MAY / MAI 2005
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
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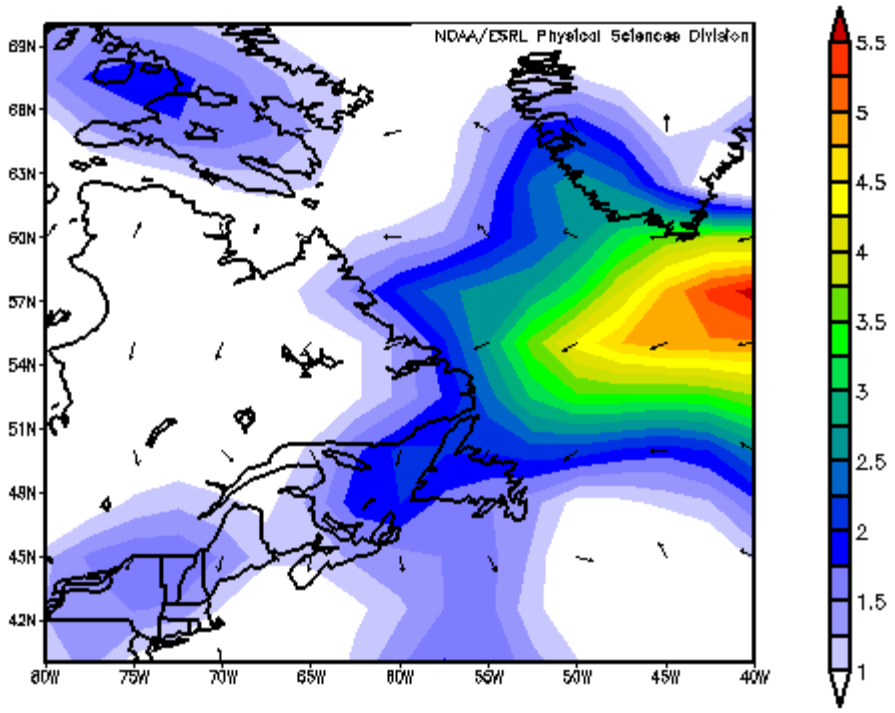
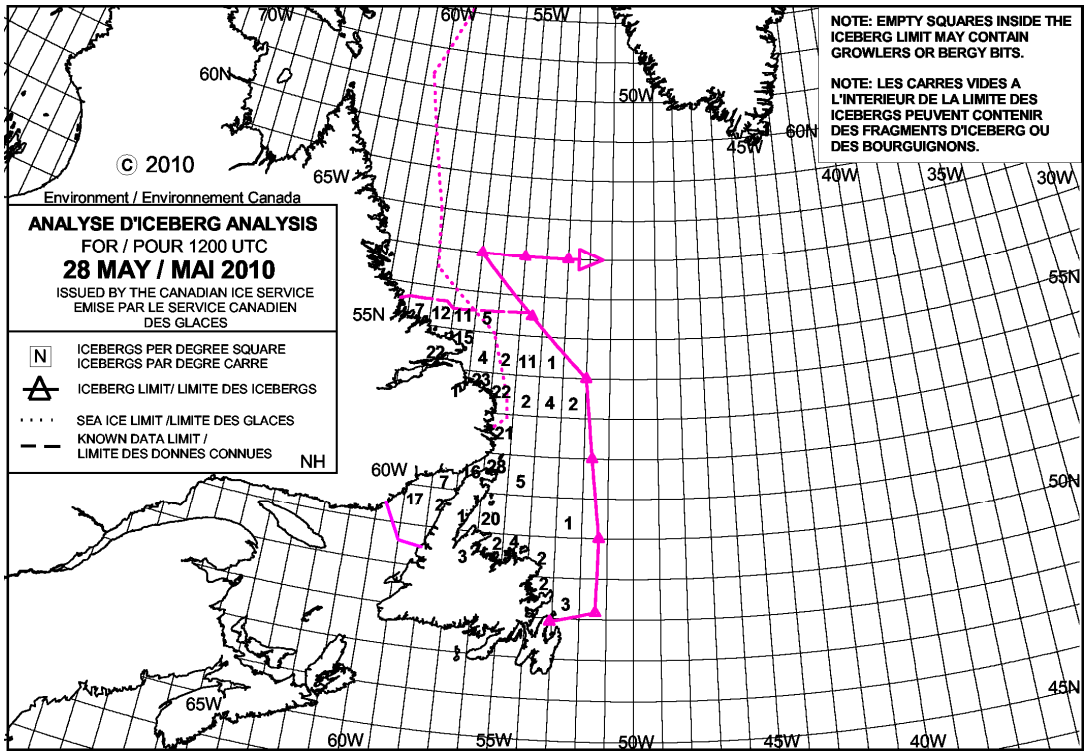




EMCP Response 30-Nov-10: The two figures will be included in the CSR. Paragraph 1, sentence 4 will be revised as follows:

These low numbers were attributed to a combination of higher than normal water temperatures on the Grand Banks, very light sea ice coverage and prolonged periods of onshore easterly winds during the spring months, which drove the bergs onto the Labrador Coast where they grounded. As a result, ice was not free to drift south into Newfoundland waters. This trend for light iceberg distribution…

Follow-up Comment 28-Jan-11	**partly satisfactory.** Most of this comment was addressed satisfactorily, however the sentence "This trend for light iceberg distribution …" also needs to be revised since 2010 was a very light iceberg year (as per the figure that is now being included) and so **the light iceberg conditions did not end with the 2008 season as indicated.**
EMCP Response 18-Mar-11	The 2010 data are not addressed in this report as the report was originally submitted in mid-2009 (July), the 2009 ice season had not yet concluded, and the 2010 ice season had not begun. As such, only the complete datasets available at the time of compilation were used in this work. For consistency, the 2010 figure will not be included in the CSR.

Comment A-35: *Para 5, sentence 1*: **Typo** … The sentence should read: "Variations in the timing of iceberg influxes reflect annual differences in southward ice ***drift rates,*** iceberg drift rates and wind fields".

EMCP Response 30-Nov-10: The text will be revised as follows:

Variations in the timing of iceberg influxes reflect annual differences in southward ice drift rates, iceberg drift rates and wind fields.

Comment A-37: *Para 6, sentence 1*: "It should be noted that very low (less than 12) to iceberg-free conditions appear over 6 percent of the 118-year record and 15 percent when looking at only the past 20-years" … **specify over what area**: just in the vicinity of the Hebron platform or over the entire area south of 48N?

EMCP Response 30-Nov-10: The text will be revised as follows:

It should be noted that very low (less than 12) to iceberg-free conditions appear over 6 percent of the 118-year record and 15 percent when looking at only the past 20-years south of 48°N. Sightings within the same region over the past two ice seasons (2008-2009) have returned to the levels seen in the early 1990s.

Drift

Comment A-38: *Para 2, general comment*: Although the study (Figure 3-40) indicates that less than 20% of icebergs have a speed >45 km/day, **it should be stressed in the text that even though they are few these fast-moving bergs can be problematic to a fixed platform**. Size and speed both figure in the damage that can result from a berg impact and it could be difficult for ships to manage **such fast moving bergs.**

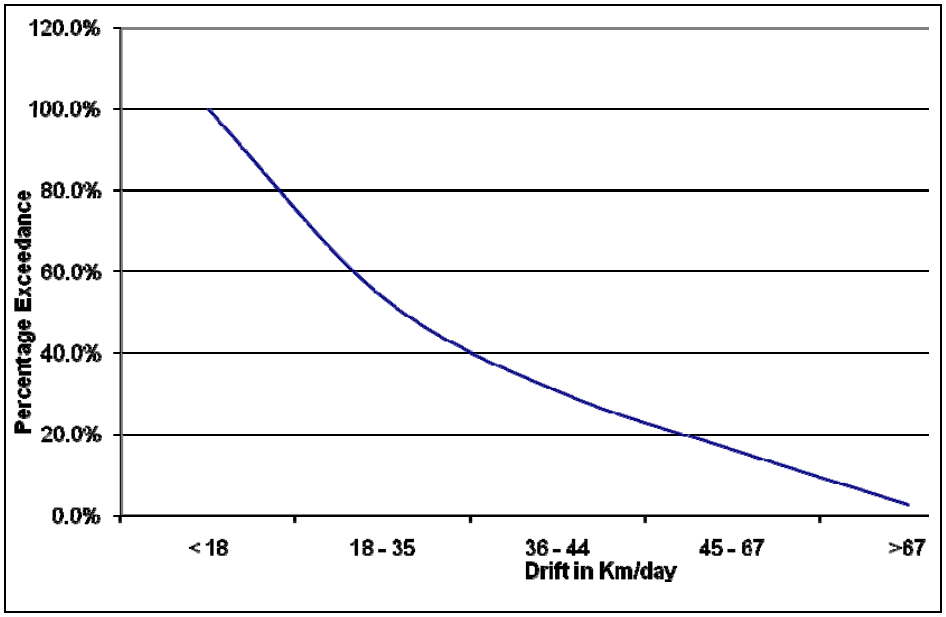
EMCP Response 30-Nov-10: The text will be revised as follows:

Iceberg speeds and drift directions on the Grand Banks (Figure 3-40) as measured over one- to three-hour time intervals in the years 2000 to 2008 (Provincial Aerospace Limited 2008), are qualitatively similar to mean sea ice velocity fields. Approximately 65 percent of the measured speeds were less than 30 km/day and most with a southerly component, with southeast drift being the most prevalent at 19.5 percent. Though there are few fast-moving bergs, these can still be problematic to a fixed platform as size and speed are both major factors in the impacts an iceberg can have, and management of such bergs may be more difficult.

Comment A-39: *Figure 3-40*: **Errors** …

1) The figure caption indicates that this figure shows data about both speed and direction. The text in paragraph 2 also refers the reader to Figure 3-40 for information on both of these factors. Yet the x-axes of both graphs shown in Figure 3-40 are identically labeled "Drift in km/day" and the ticks have speed values. Based on the similar Figure for ice drift (Figure 3-36) I suspect this is an error which needs to be corrected. **The second bar graph is supposed to show direction as opposed to speed, and its x-axis labels need to be corrected.**

EMCP Response 30-Nov-10: The figure will be edited as follows:



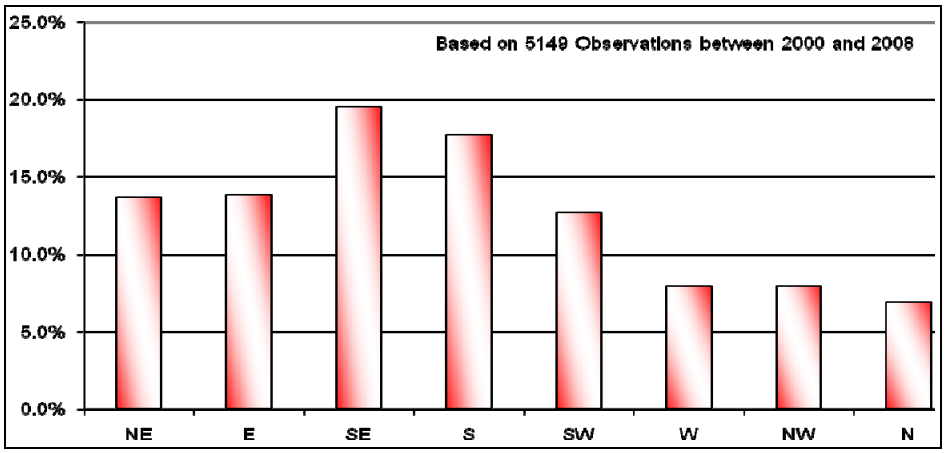


Figure 3-40 Speed Exceedance and Velocity Direction Distributions

2) The symbols > and < respectively denote "greater than" and "less than". They should not be used to show a range of values. On the x-axis of the speed graph, "18>35", "36>44", and "45>67" should be replaced with "18-35", "36-44", and "45-67".

EMCP Response 30-Nov-10: Information will be corrected in Figure in Response to Comment A-39-1)

Size Distributions

Comment A-40: *Para 1, sentence 1*: **Table 3-37, defining iceberg size categories, is referred to but is missing from the document**. This table needs to be added to the document.

EMCP Response 30-Nov-10: The CSR will be revised as follows:

Cross-reference will indicate Table 3-20.

Comment A-41: *Figure 3-41*: Source … Instead of citing the source reference here, the range of years considered is given. **The proper source reference needs to be added**.

EMCP Response 30-Nov-10: The following source will be added to Figure 3-41:

Source: PAL (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008)

The following references will be added to Section 18.2:

PAL (Provincial Aerospace Limited Environmental Services). 2000. *The 2000 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2001. *The 2001 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2002. *The 2002 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2003. *The 2003 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2004. *The 2004 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2005. *The 2005 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2006. *The 2006 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

PAL (Provincial Aerospace Limited Environmental Services). 2007. *The 2007 Ice Season Report for the Grand Banks of Newfoundland.* St. John's, Newfoundland and Labrador: The Grand Banks Joint Operators.

13 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

13.3 Nearshore Potential Marine Effects

13.3.6 Sea Ice and Icebergs

Comment A-42: *Para 1, sentence 1*: **replace the word "cyclical" (which incorrectly implies extremely regular cycles), with "variable".**

EMCP Response 30-Nov-10: The text will be revised as follows: Pack ice presence in Trinity Bay from year to year is variable, based on a review of the weekly CIS charts from 1983 to 2008, inclusive.

Follow-up Comment 28-Jan-11	**unsatisfactory.** Although the requested change from "cyclical" to "variable" was made, a previous comment (Comment A-3) asked that the error in the indicated data span "1983-2008" be corrected everywhere to "1971-2000" so that it is consistent with the cited data source, and (similar to the case of comment A-1 and elsewhere) this was not corrected here in the response to comment A-42.
EMCP Response 18-Mar-11	As per the response to Comment 53, this section referenced CIS charts from 1983 to 2008, and not the Sea Ice Atlas. **The CSR will be revised as follows:** Pack ice presence in Trinity Bay from year to year is cyclical, based on a review of the weekly Canadian Ice Service (CIS) charts from 1983 to 2008, inclusive (Environment Canada CIS 2010). Trinity Bay has pack ice in one form or another present on a ratio of 1-in-3 years. Most sea ice within the bay is formed off southern Labrador and drifts south to enter the bay around the mid-March timeframe. From mid-March through to early May, the bay experiences first year ice, which can range in thickness from 70 to 120 cm.

Comment A-43: *Para 1, last sentence*: **Error … First year ice is ice that is >30cm thick, NOT ice that ranges from 70 to 120cm thick.** First-year ice that ranges between 70 and 120 cm is termed "medium first-year ice". First-year ice that is 30-70cm thick is "thin first-year ice". First year ice that is >120cm thick is "thick first-year ice". But these-subtypes are not defined or referred to in the text. So the definition ">30cm" should be used here.

EMCP Response 30-Nov-10: The text will be revised as follows (as per Table 3-10): From mid-March through to early May, the bay experiences first year ice, which can range in thickness from 10 to 70 cm.

Follow-up Comment 28-Jan-11	**unsatisfactory.** The proposed correction to the sentence is incorrect (and I think table 3-50 not table 3-10 is what is being referred to). First, Ice that is less than 30cm thick is not called first year ice, it is called young ice. Also, your own graph (Figure 3-14) shows that mid-March to early May ice thicknesses can reach up to 120cm, not just 70cm. Also, it is noted that the ice thicknesses referred to in graph 3-14 represent the tops of the 30-70cm and 70-120cm thickness ranges for thin first year and medium first year ice respectively. Please rephrase the sentence to read: "From mid-March through to early May, the bay experiences first year ice which can range in thickness from 30 to 120 cm."
EMCP Response	**The CSR will be revised as follows:** From mid-March through to early May, the bay experiences first year ice which can

18-Mar-11	range in thickness from 30 to 120 cm.

Comment A-44: *Para 2, sentences 1 and 2*: **These sentences are speculation and the conclusions based on these speculations should be presented as tentative, not definite. Rephrase these sentences as**: "The Trinity Bay region does not lie on a primary aerial ice reconnaissance route; the low numbers of icebergs sighted each year, therefore, may be related to the low number of flights over that area. If this is true, the number of icebergs in the Trinity Bay area may be under-detected and under-reported."

EMCP Response 30-Nov-10: The text will be revised as follows:

The Trinity Bay region does not lie on a primary aerial ice reconnaissance route; the low numbers of icebergs sighted each year, therefore, may be related to the low number of flights over that area. If this is true, the number of icebergs in the Trinity Bay area may be under-detected and under-reported.

Comment A-45: Para 3: State where this "Ice Management Plan" plan can be found, if it already exists: either gives a page reference (if it is contained in this study) or a document reference. If it does not yet exist, state that it is under development.

EMCP Response 30-Nov-10: The ice management plan will be developed and submitted to the C-NLOPB as part of the Operations Authorization. The statement on the Ice Management Plan will be modified to state:

The ice management plan, which will be developed for offshore operations, will outline requirements for monitoring and managing sea ice conditions for the Hebron Platform.

13.4 Offshore Potential Marine Effects

13.4.6 Sea Ice and Icebergs

Comment A-46: *Para 1, sentence 1*: This sentence is written in a confusing way and is somewhat misleading. Stating that ice incursions occur in 1 out of every 4 years in the Hebron area is misleading. As seen in the Ice Graph for the Hebron area included on page 9 of this comment file, the incursions tend to occur in clusters or groups of years. **For clarity, rephrase this sentence as**: "The Hebron location experienced sea ice incursions in approximately 25% of the years spanning 1972 to 2008. These incursions are bi-modal and have peak probabilities centered on two periods: the first peak in the last week of February and the second in the first week of April."

EMCP Response 30-Nov-10: The text will be revised as follows:

The Hebron location experienced sea ice incursions in approximately 25 percent of the years spanning 1972 to 2008. These incursions are bi-modal and have peak probabilities centered on two periods: the first peak in the last week of February and the second in the first week of April.

8.0 NATURAL RESOURCES CANADA COMMENTS

NRCan Comment	EMCP Response
3.1.5 Geology of the Bull Arm (Mosquito Cove) Area	
The section references a 2005 exercise, but no background is provided. Some background on the 2005 effort would provide useful information.	The 2005 exercise, as reference in Section 3.1.5, should read **2005 monitoring study**. This study, undertaken by AMEC for Environment Canada, was a post-disposal monitoring study of the bund wall marine disposal location used during the construction of the Hibernia GBS. Further information regarding this report was provided in Section 7.1.3.2 of the CSR.
Dredging and Spoils Disposal	
Dredging and placement and removal of the bund wall are proposed for Mosquito Arm. For the dredging, given the thin cover of loose sediment above the till, this will presumably involve considerable volumes of till. Fine components, such as silts and clays may be abundant, and will be subject to dispersal in the removal from the seabed, the raising, and the dumping. Has water column turbidity and its transport been considered? Is there understanding of the local currents? GSC's (limited) experience is that local base of slope currents can be strong enough to remobilize muds and sands. The implication is that the "footprint" of such operations may be much larger than the immediate dump site.	The following information was provided in our December 2010 Response to Regulatory Comments regarding dredging and ocean disposal. Dredging and ocean disposal of the dredged spoils may be required in association with the partial removal of the bund wall and to ensure adequate depth for navigation and tow-out of the GBS to the deepwater site. Dredging of shallow areas near the Topsides pier identified by detailed bathymetry, may be required, depending on the vessels chartered for load-out of the Topsides. The CSR addresses dredging, ocean disposal, and any associated environmental effects in Sections 7.5.1, 8.5.1, 10.5.1, 11.4.2 and 11.5.2 of the CSR. The CSR outlines all mitigations to be employed during dredging, including *Fisheries Act* compensation. It is anticipated that a single ocean disposal location will be used for all Project dredging operations. A candidate site for ocean disposal will be discussed with DFO, Environment Canada and Transport Canada. The selection of a preferred site will consider fish habitat characteristics as well as its ability to accommodate the estimated volume of material for disposal without affecting navigation. Based on current estimates, the site will likely be in water depths ranging from 40 to 45 m and may be located near the mouth of Great Mosquito Cove. Additional information, regarding the disposal of the bund wall material was provided in our March 2011 Response to Regulatory Comments: As its preferred option for HADD compensation, EMCP is proposing to enhance fish habitat in GMC by re-locating bund wall material (*i.e.*, rock / cobble,

	100 to 210 mm) along with dredged native sediments to featureless sedimentary areas of the sea floor, which currently have low commercial fish productivity. The re-located rock material will be deposited in closely-spaced piles (to maximize 'edge' effects) with the intention of creating 'artificial reefs'. In addition, local fishers have recommended that the rock 'reefs' be placed in shallow, sub-tidal areas of Great Mosquito Cove (<30 m water depth), which are adjacent to areas with bedrock, boulder and medium to coarse gravel substrates, which will provide access corridors to allow for development of juvenile lobsters into later life stages and ultimately into mature, commercial-size adult lobsters and facilitate the growth of kelp species that provide food and/or cover for a variety of fish and invertebrate species.
The documents reviewed suggest that the dump site (for both bund wall and dredging, if we understand correctly) may be 40-45 m water depth in outer Mosquito Cove (pg 3 of review document). A bathymetric survey is proposed to further identify a dump site. What will be the scope and purpose of this survey? Given the highly variable nature of the seabed and sediment type and thickness in this type of nearshore and fjord environment, is part of the scope of such a survey to mitigate or anticipate issues with dumping? GSC has no survey data from the arm, only the mouth, outside the "nearshore Project Area"; nearby recent survey data (2010) in nearby SW Arm suggests much thicker (10s of m) loose sediments than are reported here. This is much more mud-rich than the 50-60 % sand reported in the 1991 document. However, SW Arm observations and samples are from the central portion of the fjord; Mosquito Cove may well be anomalous and the coastal boreholes indicate this. The dense dredged material (mainly till-derived) might end up being loaded onto much softer and thicker clays, for example, or being dumped in a location subject to later, natural redistribution of the sediment. Any purely bathymetric survey plans could be modified in terms of basic survey tools to provide basic background and baseline surficial geology (multibeam, high frequency sub-bottom acoustic profiler, grab samples). Bathymetric surveys would not likely be sensitive to "redeposited fine grained sediment.... from dredge spoils", if one purpose of the survey will be to address this	The bathymetric survey was undertaken in 2009. Its purpose was to define the bathymetry of Great Mosquito Cove, not to identify a potential marine sediment disposal zone. The CSR indicated that the data existing for this area was dated to the early 1990s and the Project required updated bathymetric data of the area for GBS construction and tow-out requirements. In addition, a geotechnical program was undertaken in 2009-2010 to provide information regarding soil properties in the proposed bund wall area. **The following text will be added to the end of Section 3.1.5 of the CSR:** The marine surficial geology of Bull Arm has been mapped with geophysical survey systems and geotechnical boreholes during pre-construction site investigations for the previous Hibernia and current Hebron projects (Newfoundland Geosciences Limited 1989a, 1989b, 1991; Fugro Jacques GeoSurveys Inc., 2010; Stantec, 2011 (see Section 3.1.5.2)). **The following text will be included in Section 3.1.5.1 of the CSR:** The bathymetry and seabed morphology in the nearshore area are characterized by both anthropogenic and naturally-occurring features. Within the drydock area, the seabed is predominantly flat, with average water depth of approximately 16 m. Seabed sediments in the drydock area are interpreted to range from silt to gravel. The bund wall area extends approximately 200 m southeast of the drydock area, with water depths on the order of 15 to 17 m. The seabed in this area has been reworked by the bund wall construction and demolition, and displays a rough seabed character with <1 m relief. Seabed

environmental affect as identified by the Environment Canada 2005 report. Generally individual natural or anthropogenic influences amount to dustings of sediment, not readily resolvable with sonar techniques. Is the goal to compare surficial geology findings from the NGL 1989 to 1991 surveys (referenced below) with present day (post Hibernia GBS construction)? If so, some short coring might be better suited to recognize the anthropogenic influences of the previous GBS construction.	sediments are mixed, consisting mainly of sand and gravel with cobble and boulders. Seaward of the bund wall area, water depths increase rapidly to >20 m, with occasional shoals formed by bedrock outcrops. Sediment thickness varies from 0 m in areas of locally exposed bedrock to <6 m in occasional sediment-filled depressions. Seabed sediments are interpreted to be mainly sand and gravel with minor silt in low-lying areas; with cobble-boulder occurrences noted on thinly covered bedrock highs. The bathymetry exhibits a general deepening trend progressing seaward through Great Mosquito Cove, with the exception of several knolls in the vicinity of the Topsides assembly pier, rising to approximately 20 m water depth. The bathymetry of the Bull Arm channel is characterized by a naturally-occurring trough running in a northwest / southeast direction and deepening to approximately 203 m. Water depth at the deep water mating site is approximately 145 m. **The following text will be included in Section 3.1.5.2 of the CSR:** Subsurface conditions at the Bull Arm Site were investigated in two phases (Stantec 2010a, 2011). The nearshore survey area of the Bull Arm Fabrication Site is characterized by varying thicknesses of fill in the areas of the north and south Hibernia bund wall abutments, which overlay glacial tills and occasional glaciomarine sediments. In areas where no fill was encountered (within tow channel), glacial till was generally observed at the seabed surface. The bund wall location, east of the original Hibernia bund wall alignment, is characterized by limited occurrences of fill in the areas of the north Hibernia bund wall abutment, which overlay glacial tills and occasional glaciomarine sediments. In areas where no fill was encountered (the majority of this area), glacial till was generally observed at the seabed surface. Thicknesses of overburden soils ranged from approximately 0.9 to 12 m. **The following references will be added:** Fugro Jacques GeoSurveys Inc. 2010. *Geophysical and Bathymetric Survey, Bull Arm Fabrication Site, Reconnaissance Report*. FJGI Report No. 10026SG-001-RPT-001 Rev 1, Contract Report to ExxonMobil Mobil Canada - Hebron Project and SNC-Lavalin Inc. Stantec Consulting Ltd. 2010a. *Bull Arm Marine Investigation - Geotechnical Report*. Report prepared for ExxonMobil Canada Properties, St. John's, NL.

	Stantec Consulting Ltd. 2011. *Bull Arm Marine Investigation Phase 2 - Geotechnical Report*. Report prepared for ExxonMobil Canada Properties, St. John's, NL.
Anchoring	
Figure 3 of the CSR document shows existing mooring points in Bull Arm. Are these on land or in the marine environment? Are they bedrock based? Are there plans for further mooring points? If they are in bedrock and in very shallow water or on land, likely little impact. Has this been addressed?	All mooring points are on land. They were established for the construction of the Hibernia GBS in the mid-1990s. As stated in our December 2010 Response to Regulatory Comments, the requirement for additional moorings will be determined at the FEED stage. If additional moorings are required at the deepwater site, they may be constructed on land. At the Topsides pier, temporary underwater moorings (or anchors) may be required to position the heavy lift vessel for Topsides tow-out. Details regarding the requirement for moorings, or the type of moorings that may be required are unknown at this time, as the Project is in the early stages of Project design.
Seabed beneath the GBS in mid-Bull Arm:	
No discussion of the impact on the seabed in mid-Bull Arm was seen in the document. Is this because none is anticipated? There are likely thick soft muds transitioning downwards to cohesive muds of glacial origin at this site (based only on assuming analogous conditions in other fjords). Is there any anchoring, risk of equipment or materials loss (dropping), including hazardous materials? Is the proponent aware of the geological conditions here? Presumably a soft or a hard seabed substrate might be impacted differently in the case of any seabed interaction at this site.	There are no anticipated impacts to the marine environment as a result of GBS construction activities in the mid-Bull Arm area.
Icebergs:	
Is it documented that iceberg trajectories into the nearshore site are of low enough probability to eliminate a mitigation plan?	Iceberg trajectory data within Bull Arm is not available. The probability of icebergs being present within Bull Arm is expected to be extremely low. Any icebergs entering Trinity Bay, would likely be grounded before reaching the upper reaches of Bull Arm. As stated in Chapter 13, sea ice conditions will be monitored and managed in accordance with an ice management plan.
3.1.2.3 Tsunamis	
The assessment is probably correct, given the short construction period. Nevertheless, Trinity	Noted.

Bay and Bull arm are exposed to tsunamis, especially those originating to the NE of Newfoundland. Any tsunami from this direction would be more severe than the 1929 tsunami in Trinity Bay (since the 1929 tsunami lost its energy wrapping around Newfoundland). A further consideration is that the long bays and arms would amplify the tsunami, so a moderate/small tsunami would become much larger in amplitude.	
Topic or Issue 2: Scope and adequacy of the documentation of Geotechnical properties towards safe GBS placement.	
3.2.4 Geotechnical and Geological Conditions (pp. 3-80 and 3-81)	
The proponent describes the regional near-surface geological conditions and then proceeds to the surficial (upper few metres) geology description. It is unclear what the purpose and scope of this section is. It provides a general setting but does not provide the specifics that are required of a GBS placement; these requirements must be considered elsewhere for the safe placement of a large structure on strata that are not well lithified. The question arises as to the purpose of this section of the document if it only describes the strata in geologic and genetic rather than in a geotechnical framework.	Section 5.3.2.1 of the Scoping Document (C-NLOPB et al. 2009) provides the following guidance on the information to be included in the CSR: "Characterization, including quantification to the degree possible, of the spatial area of seabed that is predicted to be affected by dredging, trenching, dredge spoil disposal; footprint of GBS, glory holes, flowlines (including OLS), berm (Bull Arm) moorings (Bull Arm), MODU moorings; discharge of drill cuttings and other discharges." Chapter 3 of the CSR, provides an overview of the physical environmental conditions, includes the geological characteristics of the Nearshore and Offshore study areas, as required by the Scoping Document. Soil stability considerations, either associated with bund wall construction or placement of the GBS offshore, are incorporated into the design of the bund wall and GBS during FEED and detail design stages.
Pg 3-18, uppermost paragraph:	
The pro-glacial outwash scenario is now considered incorrect. Still, from an environmental or geotechnical viewpoint, the character of the sediment, not its geologic genesis, is more important. The document presents rather vague descriptions of geologic units and their distribution but ignores whether the geology presents any hazards to the environment or safe installation and maintenance of a large GBS? These sections are not sufficient to demonstrate the safe placement of such a structure. Is the reader to assume that proper investigations have been or will be made? Where are the references to borehole studies? Even temporary seabed-places rigs require this. If this is beyond the scope of this CSR, then where will it appear?	See Response above under Section 3.2.4.
On page 3-83, under the sub-heading	See Response above. In addition, additional

"Comparison with Geotechnical Data", a caution is that presence of the Grand Banks Drift (diamict) is largely inferred; the stratigraphic zone is poorly imaged on all sonar, its thickness is generally not discernible and it may be patchy in its distribution. Limited groundtruth, almost all from industry engineering activities, confirms its local presence but in a very regional sense. Is the document suggesting that this level of understanding of the sub-seabed stratigraphy is sufficient for engineering assessment of foundation conditions? This is certainly not the intent nor within the scope of the material referenced by GSCA authors (eg. Sonnichsen and King, 2005). The document does not make it clear why the sub-surface stratigraphy is considered if not to characterize it for suitability for a GBS loading and if it is for this purpose, it remains wholly inadequate.	geotechnical studies will be undertaken to provide further data regarding soil strength integrity below the GBS. The data from these studies will be incorporated into the design requirements for the GBS.
3.2.4.3 Hebron Offshore Study Area Surficial Geology	
This section draws heavily on GSCA- authored studies of the sediment conditions within the upper few metres of the seabed. A caution from the main GSC-A-Author, that the map presented in this document (Fig 3-42) is regional in nature, generally conforming to industry findings (from publicly available wellsite surveys) and drawing upon widely-spaced survey lines. Details of surficial texture at the Hebron site are best revealed in industry gathered investigations which no doubt exist in greater detail than presented here. Still, even these types of "wellsite survey" reports do not commonly register precise thickness and distribution of the sands and even less-so, the lag gravels and the undulating, channel-like topography below the gravels. This is technically challenging information to obtain and the reporting is commonly vague with respect to geotechnical and thickness and distribution of strata and features. All can have some impact on a GBS structure, including foundation capabilities and current-induced sediment scour or mobility.	Noted.

3.2.4.4 Geotechnical Data from the Hebron Platform Location	
This section summarizes multiple boreholes conducted primarily with the purpose of assessing foundation conditions and its variability at the GBS footprint and mooring piles. The geotechnical section is surprisingly sparse. It very briefly summarizes results from boreholes and CPT tests conducted within the proposed Hebron Project Area and three sets of boreholes at potential mooring pile locations. The geotechnical information provided consists of a summary of the lithology and consistency of the surficial sediments. It is unclear if this summary was obtained from visual descriptions or from CPT data. This document states general semi-quantitative descriptions of the strata but fails to put them in any engineering application context. The geotechnical characterization which is required to access the foundation conditions of the GBS site would be much more comprehensive than is provided in this section. The engineering parameters would normally be obtained from a combination of in situ (CPT) and laboratory tests and include index properties, grain size, static and cyclic strength parameters, compressibility, permeability and bearing capacity. In addition a geotechnical program should be in place to monitor seabed response after the emplacement of the GBS. It is difficult to determine what is required for the CSR. The Scoping Document Table of Concordance (Section 5.3) suggests that the CSR should contain descriptions of the physical and biological environments. There is no mention of assessing foundation conditions. GSC is aware that geotechnical characterizations for the site have been completed so our presumption is that data is not required for the CSR. Is the reader to assume that full studies have been conducted? And that, yes, this is deemed a safe foundation for its intended use? If so, state this. If not, then certainly discuss the engineering design for mitigating any shortcomings. Otherwise, what is the purpose of this document section? A table or section outlying the geotechnical	See Response under Topic or Issue 2 (Section 3.2.4).

tests conducted, engineering parameters, possible data gaps and future geotechnical monitoring programs may be helpful.	
Topic or Issue 3: Seabed iceberg scour probability	
3.2.5 Ice Scour Data for the Hebron Offshore Study Area	
The CSR document describes the seabed iceberg scour phenomenon and some of the scour characteristic/metrics factors. The term bund wall for a scour side wall is not standard and not appropriate in the ice scour context. Suggest referring to it as a side wall rather than introduce terminology not used in the field of study. This should be changed throughout the section.	Noted. The term 'bund wall' when used in reference to an iceberg scour side wall, will be changed to 'side wall'.
Correction: Relict seabed iceberg scours have been observed to 650 m below sea level off Grand bank (Sonnichsen and King, 2005). Modern seabed scouring icebergs have been documented to 127 m (Sonnichsen et al, 2005), but based on measured iceberg keel drafts, iceberg scouring is predicted to occur to depths in excess of 200 m, possibly to 230 m.	**The following text will be inserted directly after Figure 3-53 (Figure 3-44 in June 2010 CSR):** The seabed of the Grand Banks, within the vicinity of the Hebron site, experiences regular contact with drifting icebergs. An average of 400 icebergs per year (albeit highly variable) reach Grand Bank (Sonnichsen and King 2005). Sidescan sonar and multibeam bathymetry data from the bank top display frequent linear ice scour (or furrows) from grounded icebergs (Figure 3-53). In addition, icebergs calving or rolling, or remaining in one location for an extended period, can produce large semicircular pits (Lewis and Blasco 1990; Parrott et al. 1990). **The following text will be inserted directly before Figure 3-54 (Figure 3-45 in June 2010 CSR):** Relict seabed iceberg scours have been observed to 650 m below sea level off Grand bank (Sonnichsen and King 2005). Modern seabed scouring icebergs have been documented to 127 m (Sonnichsen et al. 2005), but based on measured iceberg keel drafts, iceberg scouring is predicted to occur to depths in excess of 200 m, possibly to 230 m. However, bathymetry has an impact upon the size of icebergs that can reach a particular site, as draft cannot substantially exceed the water depth. Water depth at Hebron is approximately 90 to 95 m. Similarly, the presence of shallower regions "upstream" can result in bathymetric sheltering (Lewis and Blasco 1990; Sonnichsen and King 2005). In addition, the use of ice management techniques within a region (such as the Jeanne d'Arc basin) will result in a reduction of iceberg contacts. A location map of iceberg groundings in the Grand Banks of Newfoundland and areas is

	provided in Figure 3-54. **The following text will be inserted directly before Figure 3-55 (Figure 3-46 in June 2010 CSR):** As noted, surficial sediments in the Hebron region are composed of the Grand Banks Sand and Gravel (Fader and Miller 1986; Sonnichsen and King 2005). The gravels are a lag deposit, reflecting the removal of finer sediments by transgressive processes. Sands often form large-scale sand ridges and smaller-scale sand waves, ribbons and megaripples, reflecting both relict, and to a minor extent, modern sedimentary processes (Sonnichsen et. al. 1994). The hard "armoured" gravel / cobble surface, at or near the seabed, serves to limit the depth of ice scour through the bank top region. Linear furrows are most apparent in areas of sand, where they are generally deeper, or in areas of gravel substrate where there is infilling by sand (often only on the basis of the textural contrast). Scours mapped (with sidescan sonar) within the Hebron region are shown in Figure 3-55. **The following text will be inserted directly after Figure 3-55 (Figure 3-46 in June 2010 CSR):** Scour depth (from original seafloor to base of incision) for linear scour features was noted (C-CORE 2001) to be an average of 0.44 m (with a standard deviation of 0.43 m). As noted, this was based upon a reduced density of available information (492 scour crossings). Sonnichsen and King (2005) examined a different subset of data, and established an average (linear) scour depth of 0.4 m. Fugro Jacques GeoSurveys (2004) examined 1,557 scours mapped with multibeam, north of Hebron, and noted that typical scour depths were less than 0.5 m. Pit depth was noted by C-CORE (2001) to be 1.2 m (maximum depth noted was 7 m). Sonnichsen and King reported an average pit depth of 1.8 m. A pit of 9.3 m depth has been noted within the region (Fugro Jacques GeoSurveys 2004).
On pg. 3-88, "sedimentation rates" is presented as one factor to assess affecting the likelihood of an iceberg affecting oil production facilities. Strictly speaking, the process is not so much "sedimentation rate" as the redistribution of nearby sandy sediment, mainly under storm conditions. There is little or no net input of sediment in the area with the possible exception of small amounts of very fine and organic-derived material which would be ephemeral. This is more a question of	The author is correct in that risk assessments are incorporated into the overall design of the GBS, and other associated subsea infrastructure required for the Project.

semantics than substance. The study of iceberg scour has long been and remains one of ongoing research; abundant field study, documentation and sophisticated physical and numeric modeling exists, very specific to the Grand Bank hydrocarbon development area. The section appropriately references regional studies, but does not spend much time on actual risks to the project from iceberg scour. Perhaps that is appropriate for the CSR (GSCA authors fully anticipate that very specific ice scour risk assessments have been or will be done as part of eventual detailed engineering design) but presumably the purpose is to demonstrate that a new GBS will remain safe against impacts or that engineering will mitigate it effects. This is not stated.	
Topic or Issue 4: Tsunamis	
13.3.3 Tsunamis	
Although the arm is sheltered, this would not be a protection from tsunami; indeed long inlets magnify tsunami effects (e.g. Port Alberni for the 1964 tsunami). Nevertheless, the assessment that the risk is low due to the short (4 year) construction period is acceptable. In the text, there appear to be a few discrepancies. Document cites a 13 m high wave off the Burin...in fact it was the run-up that was 13 m high. They also quote from some anecdotal evidence that Bonavista Bay "drained" and damage was done to coastal buildings. Mr. Ruffman knows only of the fact that some boats swung at anchor in Bonavista Bay - at the correct time for the arrival of the tsunami (1:30 in the morning). It is hard to imagine that the wave refracted around the entire Avalon and "drained" Bonavista Bay, without impacting St. John's harbour or anywhere in between. Neither of these issues bears any relevance, however, to the risk assessment for the Bull Arm facility.	Noted.
13.4.3 Tides, Water Levels, and Storm Surge	
The reviewer found the assessment acceptable, but in terms of operations, the owner should ensure that they will receive any tsunami alerts, so as to adjust offshore operations accordingly.	Should the Government of Newfoundland and Labrador implement a tsunami / earthquake warning system, EMCP will ensure that we receive alert notifications.

Topic or issue 5: Seismic Hazard	
13.4.7 Geohazard	
"*A detailed geohazard assessment will have to be performed at any drilling locations selected, via a dedicated geohazard survey (or based on existing data) as per Canada-Newfoundland and Labrador offshore Petroleum Board (C-NLOPB) guidelines."* We are surprised that there is no statement of the proposed seismic design levels for the platform and its facilities in this CSR. "*The Operating and Safety Level Earthquake risk levels are usually determined by the facility owner (URS Corporation 2006)."* While this section lists the proposed return periods of design events like the "Abnormal Level Earthquake: 3,000 years" where is the assurance in this CSR that the seismic hazard has been correctly assessed and that the platform and the facility will be designed to accommodate appropriate levels of earthquakes shaking? *"…. there are not any focal mechanisms for earthquakes in the Jeanne d'Arc or other nearby basins."* Adams and Wahlstrom (1995)[3] published a focal mechanism for the 1971 M4.8 earthquake 100 km NNW from the Hebron site. Although of rather low quality, it indicates strike-slip faulting, which is consistent with the mechanisms of the large (M7.2, M7.3) earthquakes along the Atlantic margin. "While overall rates of seismicity are relatively low, there are zones of clustered higher rate seismicity" including one ~100 km from the Hebron site (see Adams and Wahlstrom, 1995).	Seismic hazard analysis for the Hebron area has been undertaken and the results have been considered in the design elements for the GBS.
Topic or Issue 6: Marine hydro-carbon spills and shoreline cleanup	
14.2-14.6	
For the Trinity Bay -Bull Arm region the proponent has provided a good overview of spill trajectory modeling and response activities and agencies identified in the event of a marine spill. Although much of the nearshore environment is steep sloping rocky shores that do not significantly change, there are unconsolidated shores present, e.g. Belledune Beach. Physical shoreline conditions do vary over time. There is no description of the level of shoreline information available for oil spill cleanup operations.	EMCP committed to developing an oil spill response plan for nearshore Project operations. This plan is under development. Shoreline sensitivity information, where available, will be incorporated into the Bull Arm oil spill response planning.

3 Adams, J., and Wahlstrom, R. Revised seismicity of the Grand Banks and offshore Newfoundland. Geological Survey of Canada Open File 3043, 58 pp., 1995.

Environment Canada as part of REET has a data base of shoreline conditions taken from select temporal data. The question is whether the shoreline in the Trinity bay -Bull Arm and approaches have been segmented into shore units and described in sufficient detail to allow rapid assessment of oiling impacts in the event of a spill and how the response agencies are updating their information so that appropriate physical and biological sensitivities are available in the event of a spill.	
Topic or Issue 7: Sea bed character and stability in the Bull Arm-Trinity Bay area and disposal of bund wall	
There is very useful information in the consolidated response regarding the impacts of previous activities on the nearshore sea bed and anticipated changes in future plans for the bund wall. Potential disposal sites are discussed and some implications for the fisheries and fish habitat are provided. Why were the suggested general sediment waste disposal sites selected, and what were the anticipated impacts on local sea bed sediment dynamics?	The CSR is an environmental assessment of the Hebron Project, which at the time of writing, was in the concept stage of development. The disposal sites, as referenced above, were indicated as potential sites and were the sites used during the construction of the Hibernia GBS. Since the submission of the CSR in June 2010, design work has progressed. As stated above, the Hebron Project is proposing to use the material from the bund wall to create fish habitat, as part of the requirement for fish habitat compensation pursuant to Section 35(2) of the Fisheries Act. Sites for this fish habitat creation have not been selected, but as described above, will likely be within the Great Mosquito Cove area, and site selection will be undertaken in consultation with DFO and Transport Canada, and other regulatory agencies as may be required.
Topic or Issue 8: Adaptation to Sea level change and changing environmental conditions	
3.2.6 Climate Change (pp 3-91)	
The proponent acknowledges that facility design and operations planning have considered the potential effects of climate change. Design has considered the potential rise in sea level and more frequent and more severe storms and wave heights. New information is being published in the scientific literature all the time projecting different rates of sea level. As construction plans proceed the proponent is encouraged to incorporate the best accepted sea level projections in final designs. There is no discussion if the present rates of projected sea level increases can be easily incorporated in design of the GBS or what levels of change substantially alter design costs or would cause delays in construction plans for the GBS.	Additional information regarding sea level rise was provided in our December 2010 Response to Regulatory Comments (see Response to EMCP Comment 37: EC 17). The basis of design for calculating loads due to increased water depth from sea level rise and wave motion are accounted for in the safety factors used to determine minimum deck height and wave crest heights. An evaluation of design loads on the Hebron Platform due to the metocean environment will be conducted during the next stage of design (FEED) and will account for metocean uncertainties.

9.0 REGULATORY AGENCY COMMENTS ON AUGUST 2011 TRACKED CHANGES COMPREHENSIVE STUDY REPORT

9.1 Environment Canada Comments (24-Aug-11)

1) Chapter 3 Physical Environment Setting
Note on Data Sources: Description of the nearshore and offshore environment used the MSC50 1954-2005 wind and wave dataset. The MSC50 now extends another 4 years, to 2009. For future analyses, it would be advisable to use the most up-to-date set available.

> **EMCP Response (26-Aug-11)**: Noted. If future analysis are required, the most recent MSC50 dataset will be used.

2) 3.1.1.1 Wind Climatology
a) Please clarify in the text use of the terms Mosquito Cove and Bull Arm as related to the Oceans wind measurements. While in the Revised Draft CSR, the Oceans Ltd. Weather Station is now referred to as the Oceans Bull Arm station, there is still text that refers to winds measured within Mosquito Cove (p3-2).

> **EMCP Response (26-Aug-11)**:The text has been revised as follows:
> *Wind roses of the annual wind speed from Grid Point M12874 (Figure 3-2) and the Bull Arm weather station (Figure 3-3) highlight the differences between the climatologically winds and those measured within Bull Arm.*

b) It was noted in the document "Spill Trajectory Modelling for the Hebron Project" by AMEC (2010), section 3.3.2 states that the Oceans Bull Arm (OBA) winds were from an RM Young anemometer on a floating dock at the Hibernia GBS deepwater site in Bull Arm. If applicable, it would be relevant to include this information here.

> **EMCP Response (26-Aug-11)**: The Report “Spill Trajectory Modelling for the Hebron Project” (AMEC 2010) was superceded by the following reports: Hebron Project Comprehensive Study Report – Offshore Spill Trajectory Modelling Report (ASA 2011) and Hebron Project Comprehensive Study Report – Nearshore Spill Trajectory Modelling Report (ASA 2011).

3) Figure 3-1 MSC Climatology Grid Point (M6012874)
It would be helpful to include on this map the locations of the other data sources listed in Table 3-1. If the map was shifted 0.1° longitude further to the west, it would include the locations of Argentia and Arnold's Cove, without losing the location of any data sources to the east.

> **EMCP Response (26-Aug-11)**: A change in the figure at this time will not alter the conslusions in the CSR. EMCP, for any future environmental assessments, will ensure that figures adequately represent the data being discussed.

4) Table 3-1 Data Sources for Grid Point M12874 and other Observation Points

a) Title could just be Data Sources.

> **EMCP Response (26-Aug-11)**: Noted. The title has been changed (see revised table below).

b) Suggest column header "Depth", could be "Water Depth" for clarity.

> **EMCP** Response **(26-Aug-11)**: The title in the column header has been changed to “Water Depth” (see revised table below).

Table 3-1 Data Sources

Source	Period	Location	Station Elevation (m ASL)	Anemometer Height (ASL)[A]	Water Depth (m)
M12874	January 01, 1954 to December 31, 2005	47.70°N; -53.80°W			140.89
Environment Canada Bull Arm	June 08, 1994 to May 28, 1997	47.82°N; -53.90°W	119.0	129.0	
Oceans Bull Arm (Wind)	January 26, 1995 to May 27, 1997	47.82°N; -53.86°W	1.0	11.0	
Oceans Bull Arm (Wave)	May 15, 1995 to January 31, 1996	47.82°N; -53.86°W			155.00
Argentia, NL	January 01, 1953 to May 25, 1970	47.30°N; -54.00°W	13.7	23.7	
	May 01, 1976 to October 31, 1986	47.30°N; -54.00°W	15.5	25.5	
	January 01, 1987 to July 26, 2006	47.30°N; -54.00°W	19.0	29.0	
Arnold's Cove, NL	July 01, 1971 to July 01, 1993	47.78°N; -54.00°W	15.2	25.2	

[A] Anemometer heights for the Environment Canada stations assume that the standard 10 m anemometer height was used

c) Request: Please clarify in the table/text the information concerning elevation - does this refer to station elevation ASL or instrument elevation? If instrument elevation, is this ASL or AGL? It would be useful to include both station elevation and anemometer height (above ground level). The elevation for the Bull Arm Environment Canada weather station (climate ID 8400755) was 119 m (ASL), but the table shows 13.7 m.

EMCP Response (26-Aug-11): Table 3-1 has been modified to clarify the elevation data presented. The following revised table will replace Table 3-1 in the CSR.

d) The longitudes for the Oceans Bull Arm wind and waves contain a typo: -51°, should that be -53°?

EMCP Response (26-Aug-11): Noted. The text has been corrected to read "-53°"

5) P 3-6: The highest wind speed of 27.8 m/s recorded at Bull Arm - need to specify that this is the Environment Canada station. The date was February 13, 1995, not the 14th as in the Revised Draft CSR.

EMCP Response (26-Aug-11): The text has been revised to read as :
The highest wind speed of 27.8 m/s recorded at the Envoronment Canada station in Bull Arm occurred on February 13, 1995. During this event, a mid-latitude low pressure system tracked eastward across Newfoundland, and deepened rapidly as it moved over the cold North Atlantic Ocean. During this same event, the Oceans Bull Arm weather station reported wind speeds of 15.9 m/s. Unfortunately, the waverider buoy at Bull Arm was not reporting during this event.

6) 3.1.1.2 Temperature
It should be clarified whether EC or Oceans was the source of the temperatures (text and table 3-4) (or add "s" to station).

EMCP Response (26-Aug-11): Table 3-4 already has a notation at the bottom of the table identifying the source of the data. It states "Source: Oceans Ltd. weather station in Bull Arm 01/95-04/97."

7) 3.1.1.3 Tropical Systems
The values in the text need to be updated (including the number of storms) to correspond to the updated values in Figure 3-5 and Table 3-5.

EMCP Response (26-Aug-11): The first paragraph in Section 3.1.1.3 has been revised as follows:
During the 59-year period from 1950 to 2009, 60 tropical systems have passed within 278 km of Bull Arm. The tracks over Trinity Bay are shown in Figure 3-5 and the names of each hurricane are listed in Table 3-5.

8) 3.1.3 Wind and Wave Extremes, 3.1.3.2 Waves
a) The text incorrectly says that the MSC50 grid point used was "outside of the nearshore environment". Although it was outside Bull Arm, it was still near shore, well inside Trinity Bay.

EMCP Response (26-Aug-11): The first paragraph in Section 3.1.3.2 has been revised as follows:
The annual and monthly extreme value estimates for Hs for return periods of 1 year, 10 years, 25 years, 50 years and 100 years are presented in Table 3-15. The annual 100-year extreme Hs was 1.9 m at Grid Point M12874 (located outside of Bull Arm (but well inside Trinity Bay) at 47.7°N 53.8°W). On a monthly basis, the highest extreme Hs of 1.8 m is predicted to occur during the months of December and January.

b) The text refers to results in Table 3-18 - should that be Table 3-13?

EMCP Response (26-Aug-11): The text is correct – the error in the table numbering is a result of inserting table captions in tracked changes. The Table captions have been corrected.

9) 3.2.1.2 Wind Climatology
a) P3-37: Table 3-20. The text or a note in the table could indicate that Glomar Grand Banks and GSF Grand Banks (not GFS as in the note) were the same platform, reporting at different periods under different names.

EMCP Response (26-Aug-11): A note will be included in Table 3-20, per the above request, to clarify the data sources. Note that with the correction of the Table captions, this is now Table 3-25.

b) The text refers to Table 3-25 twice (should it be 3-20?)

EMCP Response (26-Aug-11): With the correction of the Table captions, Table 20 is Table 25

c) Note: The text says that "methods to reduce wind speeds from anemometer level to 10 m have proven ineffective due to atmospheric stability issues". It is interesting to note that the report by AMEC (2010) with regard to winds input to the oil spill trajectory modeling (Section 4.3) does describe use of a height dependent scaling factor that is reasonable to use over the open ocean to adjust sustained winds from platforms to 10 m. In future analyses, it may be helpful to use platform air and sea temperature measurements to include stability in height adjustment of wind speeds.

EMCP Response (26-Aug-11): Noted.

d) Table 3-27. The wind speed units were changed from m/s to knots, but the values are in m/s.

EMCP Response (26-Aug-11): The table has been revised back to the unit 'm/s', as the values listed are in m/s.

10) 3.2.2.1 Waves and **3.2.2.6 Wind and Waves Extremes**

There are two different sections numbers 3.2.2.1: Bathymetry and Waves. 3.2.2.1 Waves includes results of an extremal wave analysis (Table 3-20 Extreme Wave Statistics, p. 3-57), which is separate from the results of a different extremal wave analysis presented in Section 3.2.2.6 Wind and Waves Extremes (Table 3-51 Extreme Significant Wave Estimates..., p 3-74). It is requested that the information on two different extremal wave analysis results for the offshore (part of 3.2.2.1 and 3.2.2.6) be adjacent and appropriately titled, rather than separated.

EMCP Response (26-Aug-11): The fourth-level heading numbering under Section 3.2.2 has been corrected. The section on Wind and Waves Extremes has moved to immediately follow Section 3.2.2.2 Waves.

9.2 Canada-Newfoundland Offshore Petroleum Board

Additional Comments on Section 14-1 Track Changes (09-Sep-11):

Page 14-8, last paragraph, the number 3.3 x 10^{-3} should be followed by the words "blow-outs / releases per well drilled".

EMCP Response (12-Sep-11): The text has been added to page 14-8.

Page 14-10, first paragraph following Table 14-7 the number 4.8 x 10^{-5} should be followed by the words “blow-outs per well drilled”.

EMCP Response (12-Sep-11): The text has been added to page 14-10.

Page 14-10, in the first paragraph of 14.1.2.2 the number of producing well-years from 1972 to 2005 in MMS jurisdiction is estimated as 235,000, but in the second paragraph the blowout count is divided by 250,000 (the estimated total number of producing well-years worldwide up to 2002). If the 235,000 producing well years is used, the result is 3.32 x 10^{-4} blowouts per well year rather than the 3.12 x 10^{-4}. Please verify/correct this.

EMCP Response (12-Sep-11): The value 250,000 is the correct value. The text “235,000” has been changed to “250,000”.

Page 14-11, first paragraph, the number 1.85 x 10^{-4} should be followed by “blow-outs per well year”.

EMCP Response (12-Sep-11): The text has been added to page 14-11.

Page 14-12, second paragraph following Table 14-9, replace the word “frequency” with “likely number”.

EMCP Response (12-Sep-11): The text has been replaced.