**Hebron Development Project**
**Draft CSR Review**
**Environment Canada**

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| **No. EC_01** | **Reference**: | Section 2.6.4.2, of the CSR |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied** | Scope not satisfied |
| | **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:** | What was the outcome of the investigation into the use of pilotless flares? |
| **No. EC_02** | **Reference**: | Section 2.6.4.2, P. 2-17 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | The proponent is asked to comment on the composition, magnitude and significance of the gases being released through these vents. |

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| **EC -03** | **Reference**: | Section 2.8.2 – Gravity Base Structure Construction at Drydock |
| | **Scoping Document Cross Reference**: | Section 3.1.1 – Bull Arm – Great Mosquito Cove and Bull Arm (activities within or affecting the marine environment) |
| | **Scoping Document Satisfied:** | Section 3.1.1 of Scope not satisfied |
| | **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:** | The proponents should indicate a potential disposal site location or locations in order to properly assess the associated environmental effects. |
| **No. EC_04** | **Reference**: | Section 2.9.2, Hebron Project Operations, Table 2-9 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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, |

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| | | but does not provide any specifics. Air emissions from an incinerator are not mentioned in the CSR. |
| | **Request:** | 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. |
| **No. EC_05** | **Reference**: | Sections 3.1.1.1 Wind Climatology & 3.1.2.1 Waves |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **Preamble:** | The data sources in these sections for the nearshore were incompletely described (and in Oceans 1.1.1 and 1.1.3). |
| | **Request:** | 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.<br><br>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)?<br><br>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? |

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| **No. EC_06** | **Reference**: | Section 3.1.1.3 Tropical Systems |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **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:** | a) Include Hurricane Michael in table 3-4<br><br>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. |
| **No. EC_07** | **Reference**: | Section 3.1.1.3 Tropical Systems and 3.1.2.2 Waves |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **Preamble:** | In 3.1.1.3, the description of peak measurements in Hurricane Luis, which made landfall near Argentia on 11 Sept 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. |

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| | **Request:** | Include the peak wind and wave measurements from the local weather stations and buoy. |
| **No. EC_08** | **Reference**: | 3.1.2.2 Waves and 3.1.3 Wind and Wave Extremes |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **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:** | 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.<br><br>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 |
| **No. EC_09** | **Reference**: | 3.1.3 Wind and Wave Extremes, 3.1.3.1 Wind |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |

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| | **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:** | 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. |
| **No. EC_10** | **Reference**: | Section 3.1.4 Sea Ice and Icebergs (nearshore)<br><br>Section 3.2.3 Sea Ice and Icebergs (offshore)<br>Section 13.3.6 Effects of the Environment on the Project: Sea Ice and Icebergs (nearshore)<br><br>Section 13.4.6 Effects of the Environment on the Project: Sea Ice and Icebergs (offshore) |
| | **Scoping Document Cross Reference**: | Section 5.3.1 Physical Environment |
| | **Scoping Document Satisfied:** | Scope not met |
| | **Preamble:** | Errors and inconsistencies are noted throughout the text. |
| | **Request:** | Revise the text, figures and charts in accordance with the guidance provided in Appendix A. |
| **No. EC_11** | **Reference**: | 3.2.1.2 Wind Climatology |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |

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| | **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:** | a) To improve the utility of Table 3-23, maximum wind speeds, it would be appropriate to adjust the MSCS50 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.<br><br>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. |
| **No. EC_12** | **Reference**: | 3.2.1.2 Wind Climatology and 3.2.2.6 Wind and Wave Extremes |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **Preamble:** | When using winds from different sources, it is advisable to adjust winds for height, in |

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| | | order to reduce (although not eliminate) uncertainty when interpreting the data. |
| | **Request:** | 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 ).<br><br>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.<br><br>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/] |
| **No. EC_13** | **Reference**: | 3.2.1.7 Tropical Systems |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| | **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. |

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| | **Request:** | a) It would be useful to give an example of a severe event when platform wind and wave measurements are available.<br><br>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.<br><br>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.<br><br>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.<br><br>Reference: Hart and Evans, 2001: A Climatology of the extratropical transition of Atlantic tropical cyclones. J. of Climate, 14, 546-564. |
| **No. EC_14** | **Reference**: | Section 3.2.2.1 Waves (and 3.2.2.6 Wind and Wave Extremes) |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |

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| **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |
| **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:** | 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.<br><br>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.<br><br>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.<br><br>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.

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| **No. EC_15** | **Reference**: | 3.2.6 Climate Change, 3.2.6.2 Waves |
| | **Scoping Document Cross Reference**: | 5.3.1 Description of the Physical Environment |
| | **Scoping Document Satisfied:** | Scope largely met, comments relate to improving clarity or use of existing data. |

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| | **Preamble:** | The reference for Swail et al. (2006), mentioned in Section 3.2.6 is incorrect. |
| | **Request:** | Please give the correct reference for Swail et al. (2006). |
| **No. EC_16** | **Reference**: | Section 3.2.6 – Climate Change |
| | **Scoping Document Cross Reference**: | Section 5.3.1 Physical Environment |
| | **Scoping Document Satisfied:** | Section 5.3.1 of Scope not satisfied. |
| | **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:** | 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. |
| **No. EC_17** | **Reference**: | Section 3.2.6.1 – Sea Level Rise (Climate Change) |
| | **Scoping Document Cross Reference**: | Section 5.3.1 – Physical Environment |
| | **Scoping Document Satisfied:** | Section 5.3.1 of Scope not satisfied |

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| | **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:** | The proponents should apply more recent research regarding sea level rise projections. Proponents can see latest research in article at this website:<br><br>**http://www.nature.com/climate/2010/1004/pdf/climate.2010.29.pdf**<br><br>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. |
| **No. EC_18** | **Reference**: | Section 3.2.6.4 – Summary (Climate Change). |
| | **Scoping Document Cross Reference**: | Section 5.3.1 Physical Environment |
| | **Scoping Document Satisfied:** | Section 5.3.1 of Scope not satisfied. |
| | **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 |

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| | | 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:** | 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. |
| **No. EC_19** | **Reference**: | Sec 6.2.2, P. 6-7 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Implications for health and safety of workers |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **Preamble:** | Indication given in the introductory paragraph that each platform would be downwind of each other less than 15 percent of the time. |
| | **Request:** | The proponent is asked to provide a reference or to substantiate this statement. |
| **No. EC_20** | **Reference**: | P. 6-35; Table 6-20 |
| | **Scoping Document Cross Reference :** | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **Preamble:** | Air dispersion Modelling Emission Rates are indicated in the table header without an indication of units. |

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| | **Request:** | The proponent is asked to provide units for this table. |
| **No. EC_21** | **Reference**: | Table 6.26; P 6.45 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of annual estimates. |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **Preamble:** | Total of the four platform's CH4 CO2eq is greater than the provincial total after the inclusion of Hebron. |
| | **Request:** | The proponent is asked to reconcile this difference. |
| **No. EC_22** | **Reference**: | Table 6-2, P. 6-4, Table 2.1 Dispersion Modelling Study |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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 ug/m3. |

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| | **Request:** | This table should be corrected. |
| **No. EC_23** | **Reference**: | Table 6-3, P. 6-6 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality Assessment of fate and effects, including cumulative |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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, $4^{th}$ highest). |
| | **Request:** | The proponent is asked to confirm exactly what the values in the table represent and the time frame from which the data was selected. |
| **No. EC_24** | **Reference**: | P. 6-11, 6-13 CSR; Table 6-2, P. 15 Air Emissions and Dispersion Modelling Study. |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities<br>5.3.4.2 Air Quality. Description of means for reduction, management and reporting of air emissions, taking into account best industry practices. |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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 |

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| | | 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:** | 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. |
| **No. EC_25** | **Reference**: | Section 6.1.3, P. 6-4; Section 6.4.1, P6-16 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | 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. |
| **No. EC_26** | **Reference**: | Section 6.3.2, P. 6-11; Section 6.5.1.2, Table 6-9, P. 6-18 |

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| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | The proponent is asked to confirm these emissions estimates and the reference. |
| **No. EC_27** | **Reference**: | Section 6.3.2, P. 6-11; Section 6.5.1.2, Table 6-10, P. 6-19 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **Preamble:** | P. 6-11 states that natural gas use will release lower quantities of CO2 than diesel use, however, Table 6-10 lists the CO2 emissions from natural gas as being far greater than from the use of diesel fuel. |
| | **Request:** | The discrepancy between the text and the table should be addressed. |
| **No. EC_28** | **Reference**: | Section 6.5.1.1, P. 6-18 CSR; P. 7 of the Dispersion Modelling Study |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality. Description of emissions from all project activities |

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| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | 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. |
| **No. EC_29** | **Reference**: | Table 6-18, P. 6-32 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality Description of potential means for reduction, management and reporting of air emissions |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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 |

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| | | detection and repair) as well as technologies and these should be identified as well. |
| | **Request:** | 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. |
| **No. EC_30** | **Reference**: | Section 6.5.4.1, P. 6-34; Table 6-22, P. 6-38 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality – Description of emissions and emission rates from upset conditions, |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | 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. |
| **No. EC_31** | **Reference**: | Table 6-15, P. 6-27; Table 6-25, P. 6-43 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality - Assessment of Fate and effects including cumulative effects |
| | **Scoping Document Satisfied:** | Scope not satisfied |

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| | **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:** | The proponent is asked to confirm that these numbers are actually identical and not a transcription error. |
| **No. EC_32** | **Reference**: | Section 6.7, P. 6-47 |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality Method for measuring or validating initial emission estimates.<br>5.3.4.2 Air Quality – Mitigation and Monitoring |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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. |

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| | **Request:** | The proponent is asked to describe the methodology that will be used to validate the emissions |
| **No. EC_33** | **Reference**: | Table 6.2, P. 15 Dispersion Modelling Study |
| | **Scoping Document Cross Reference**: | 5.3.4.2 Air Quality |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **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:** | Please confirm the modelling scenarios in table 6.2. |
| **No. EC_34** | **Reference**: | Section 7.3.2.2, Page 7-17, paragraph 3. |
| | **Scoping Document Cross Reference**: | Environment Canada Report EPS 1/RM/42, April 2002, Biological Test Method: Reference Method for Determining the Toxicity of Sediment Using Luminescent Bacteria in a Solid-Phase Test |
| | **Scoping Document Satisfied:** | Information and analysis provided are not. complete and seem to be worded incorrectly |
| | **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 |

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| | | percent fines, which is the case in the Hebron Project Area (Chevron 2003)." |
| | **Request:** | (1) The text should state what is he criterion being used to judge a sediment sample being declared toxic.<br>(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 referred to.<br>(3) The proponent should reword and clarify the meaning of the last sentence. |
| **No. EC -35** | **Reference**: | Table 7-11 – Environmental Effects Assessment: Construction and Installation |
| | **Scoping Document Cross Reference**: | Section 4 (e) – Factors to be Considered |
| | **Scoping Document Satisfied:** | Section 4 (e) of Scope not satisfied |
| | **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:** | 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”. |
| | **Typos:** | Table 2-2: Page 2-1 Well Treatment Fluids – under Attributes “fluids” is misspelled. |

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| | | 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 Chapter 10 is 10.5.1.4. |
| | **References** | |
| | Page 18-2 | The citation is incorrect for AMEC Earth and Environmental Limited (2005a). The study was prepared for Environment Canada. |
| **No. EC_36** | **Reference**: | Section 7.5.1.2 Page 7 - 52 last line to Page 7 - 53, line 3. |
| | **Scoping Document Cross Reference**: | 5.3.2.3 Marine Fish and Shellfish |
| | **Scoping Document Satisfied:** | Information and analysis provided are not complete. |
| | **Preamble:** | (1) 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."<br>(2) 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.". |

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| | **Request:** | (1) 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. (2) 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.<br><br>Reference: Canadian Council of Ministers of the Environment (CCME). 1999. *Canadian Environmental Quality Guidelines*. Canadian Council of Ministers of the Environment, Winnipeg. |
| **No. EC_37** | **Reference**: | Project Overview, and Section 7.5.2.2 |
| | **Scoping Document Cross Reference**: | Section 5.3.4.1, bullet 3 (Operational Discharges, in particular SBM drill cuttings) |
| | **Scoping Document Satisfied:** | Not satisfied |
| | **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 |

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| | | "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:** | 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. |
| **No. EC_38** | **Reference**: | Section 9.3.2.1 (Pg 9-6) Data sources and survey effort for marine birds in the study area |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **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:** | 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.<br><br>Page 9-6 states “*Systematic marine bird observations (Tasker surveys; Tasker et al. 1984) were conducted on the northern* |

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| | | *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.<br><br>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. |
| **No. EC_39** | **Reference**: | Table 9-3 |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **Preamble:** | Not clear from previous text section 9.3.2.1 which data this table is summarizing. |
| | **Request:** | Recommend adding a sentence in the Table heading to indicate sources of the data. |
| **No. EC_40** | **Reference**: | Section 9.3.2.2 (Pg 9-10) and Table 9-4 |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |

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| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **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:** | Sources of data listed at end of table do not cite CWS 2009, although this was discussed in section 9.3.2.1 as a data source. This source should be added.<br><br>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. |
| **No. EC_41** | **Reference**: | Table 9-6 |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |

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| | **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:** | Please correct the number. |
| **No. EC_42** | **Reference**: | Section 9.3.2.4 (Pg 9-23) Pomarine Jaeger, Parasitic Jaeger and Long-tailed Jaeger |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **Preamble:** | This section states : "…Like skuas, they are kleptoparasites, preying chiefly on Black-legged Kittiwakes and Arctic Terns." |
| | **Request:** | 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. |
| **No. EC_43** | **Reference**: | Section 9.5.1.2 (Pg 9-34) Lighting |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Birds Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **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:** Data regarding meteorological and operational conditions (lighting flares, etc.) should be collected and submitted to CWS along with all reports of strandings.

**No. EC_44**

**Reference**: Table 9-13

**Scoping Document Cross Reference**: Section 5.3.2.2 Marine and/or Migratory Using the Study Area(s)

**Scoping Document Satisfied:** Not a deficiency, but clarification is needed.

**Preamble:** The numbers in the table need to be updated.

**Request:** 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.

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| **No. EC_45** | **Reference**: | Section 9.5.2.4 (Pg 9-48) |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 Marine and/or Migratory Using the Study Area(s) |
| | **Scoping Document Satisfied:** | Not a deficiency, but clarification is needed. |
| | **Preamble:** | The ESRF study on the effects of sheens on marine birds has been published. |
| | **Request:** | The information from the results of this study should be included in the CSR. |
| **No. EC_47** | **Reference**: | Section 9.5.4.3 – Potential Mortality - Offshore |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 – Marine Birds – environmental effects of the project |
| | **Scoping Document Satisfied:** | Section 5.3.2.2 of Scope not satisfied |
| | **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:** | (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. |

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| **No. EC_48** | **Reference**: | Table 9-13 – Environmental Effects Assessment: Accidental Events |
| | **Scoping Document Cross Reference**: | Section 5.3.2.2 – Marine Birds – environmental effects of the project |
| | **Scoping Document Satisfied:** | Section 5.3.2.2 of Scope not satisfied |
| | **Preamble:** | The table indicates that environmental effects from an OLS spill, subsea blowout 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:** | (a) 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. |
| **No. EC 49** | **Reference**: | Section 14 - Accidental Hydrocarbon Spill Events |
| | **Scoping Document Cross Reference**: | Section 5.3.4.3 – Accidental Events |
| | **Scoping Document Satisfied:** | Section 5.3.4.3 of Scope not satisfied |
| | **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. |

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| | | Section 14 highlights the potential for discharges from the OLS but none are discussed. |
| | **Request:** | 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. |
| **No. EC 50** | **Reference**: | Section 14 - Accidental Hydrocarbon Spill Events |
| | **Scoping Document Cross Reference**: | Section 5.3.4.3 – Accidental Events |
| | **Scoping Document Satisfied:** | Section 5.3.4.3 of Scope not satisfied |
| | **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:** | 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. |
| **No. EC 51** | **Reference**: | Section 14.6.4.1 – Response Options |

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| | **Scoping Document Cross Reference**: | Section 5.3.6.5 – Emergency Response Plan |
| | **Scoping Document Satisfied:** | Section 5.3.6.5 of Scope not satisfied |
| | **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:** | 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. |
| **No. EC 52** | **Reference**: | Section 14.6.4.1 – Response Options |
| | **Scoping Document Cross Reference**: | Section 5.3.4.3 – Accidental Events |
| | **Scoping Document** | Section 5.3.4.3 of Scope not satisfied |

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| | **Satisfied:** | |
| | **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:** | 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. |
| **No. EC 53** | **Reference**: | Section 14.6.4.3 – Response Methods |
| | **Scoping Document Cross Reference**: | Section 5.3.4.3 – Accidental Events |
| | **Scoping Document Satisfied:** | Section 5.3.4.3 of Scope not satisfied |
| | **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:** | 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 |

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| | | Characteristics of Spilled Crude Oil at Hebron suggest Hebron crude may not be suitable for chemical dispersion, more information is required on the physical and chemical properties of Hebron crude. |
| **No. EC 54** | **Reference**: | Section 14.6.4.4 – Availability of Containment and Recovery Equipment |
| | **Scoping Document Cross Reference**: | Section 5.3.6.5 – Emergency Response Plan |
| | **Scoping Document Satisfied:** | Section 5.3.6.5 of Scope not satisfied |
| | **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 time table 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:** | 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. |
| **No. EC_55** | **Reference**: | Spill Trajectory Modelling for the Hebron Project |
| | **Scoping Document Cross Reference**: | 5.3.4.3 Accidental Events |
| | **Scoping Document Satisfied:** | Scope not satisfied |
| | **Preamble:** | The study considered two spill sites: a nearshore 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 Oilmap model developed by Applied Science Associates. ADIOS was used to address the oil weathering, AMEC model was used for stochastic modelling, and Oilmap was used for trajectory modelling at the offshore spill site using deterministic approach, three blowout 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 Oilmap 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 Oilmap 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. Also, 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 Oilmap 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's 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 blowout (including the recent Gulf of Mexico spill) that the spill may 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:** Redo the oil spill trajectory modelling taking in to account the comments offered above.

# Appendix A
# Environment Canada Comments

# Hebron Project
# Comprehensive Study Report
# June 2010

## Comments on Sea Ice and Iceberg sections

***Canadian Ice Service, Environment Canada***

*Trudy Wohlleben, Luc Desjardins and Gilles Langis*
*(Senior Ice Forecasters)*

3 PHYSICAL ENVIRONMENT SETTING

3.1 Nearshore Environment (Bull Arm Area)

3.1.4 Sea Ice and Icebergs

*Para 1, sentence 1*: change “cyclical” to “variable”.

*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).**”**

*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.**

**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.** 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.

****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.**

3.1.4.1 Ice Type

*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.

*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.**

3.1.4.2 Iceberg Conditions in Trinity Bay

*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.

3.1.4.3 Iceberg Distribution by Year

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.

3.1.4.4 Iceberg Distribution by Month

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

3.1.4.5 Iceberg Size Distribution

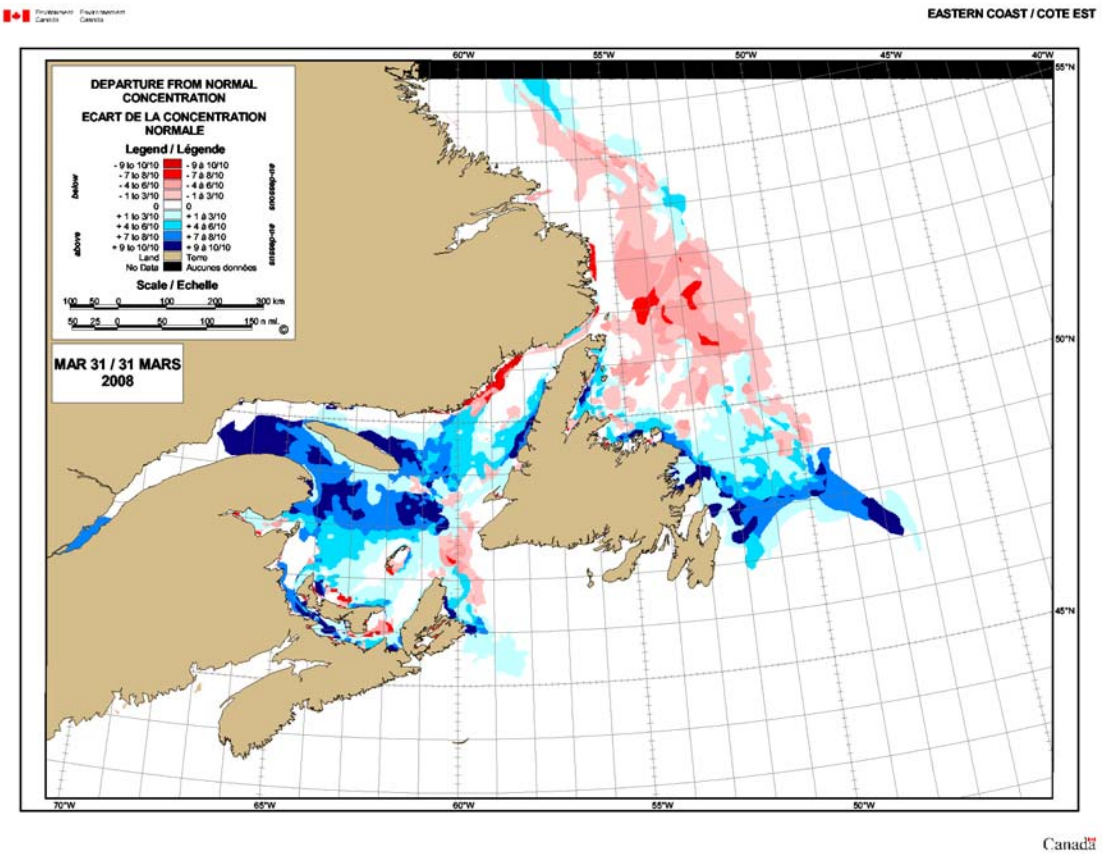
Table 3-20: Source … the most recent version of MANICE is dated 2005. This should be corrected in the Source and in the references at the end.

3.2 Offshore

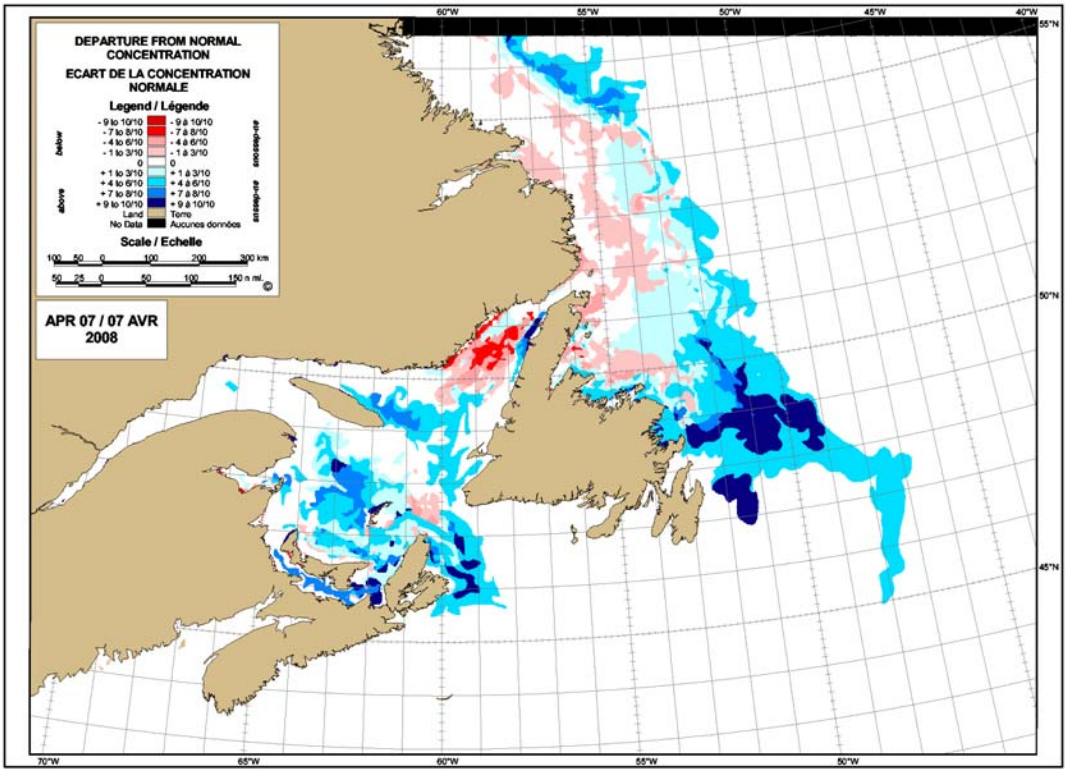
3.2.3 Sea Ice and Icebergs

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.

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:

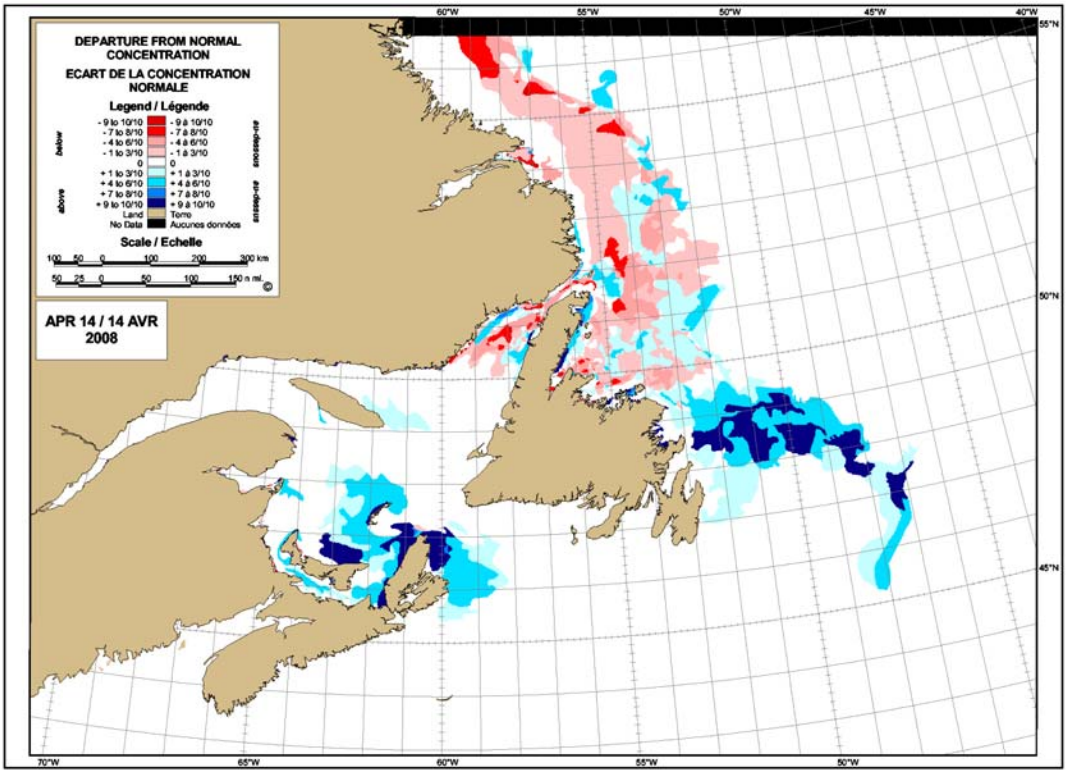


EASTERN COAST / COTE EST

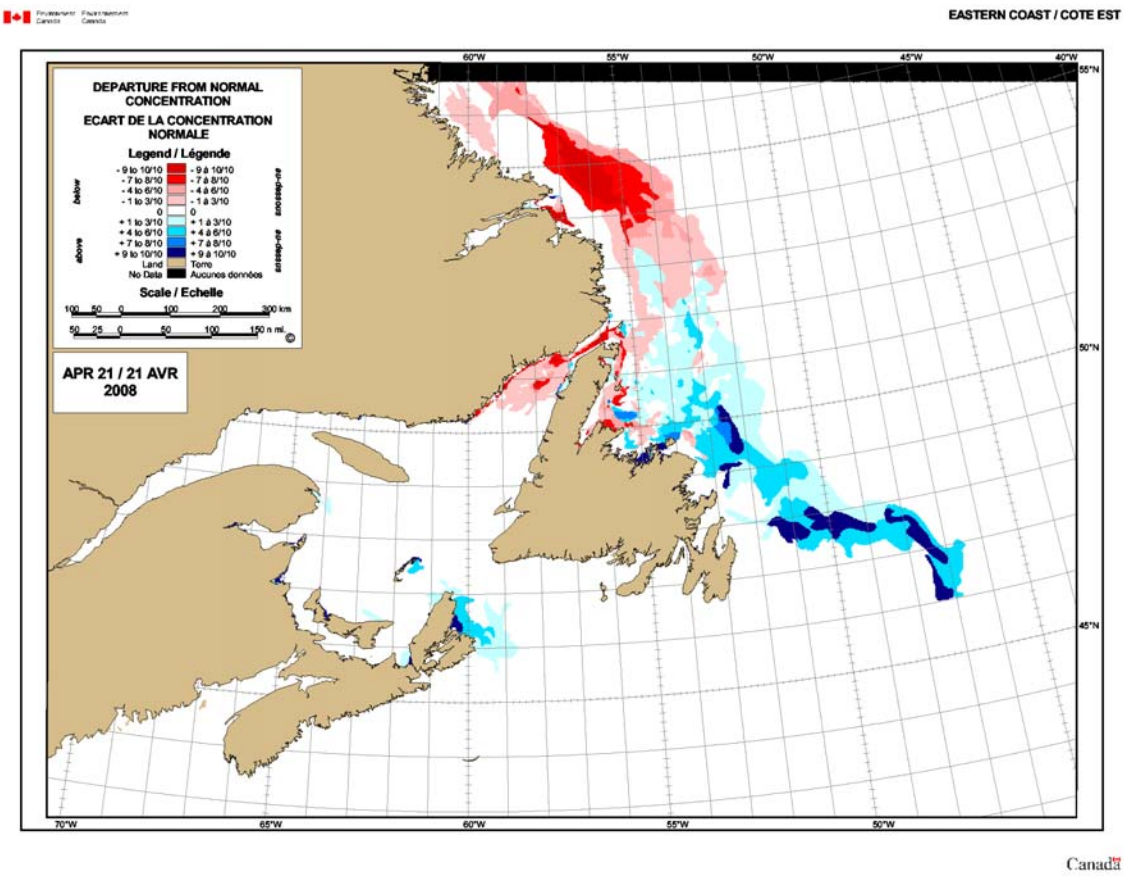



Canada

EASTERN COAST / COTE EST




Canada




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**.

3.2.3.1 Sea Ice

Formation, Growth and Thickness

*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.

*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; 3) The thickness range of first year ice

given in MANICE is any ice that is **>30cm**, and not 30-200cm. 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.

Spatial Distribution

*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 that "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."

*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**:

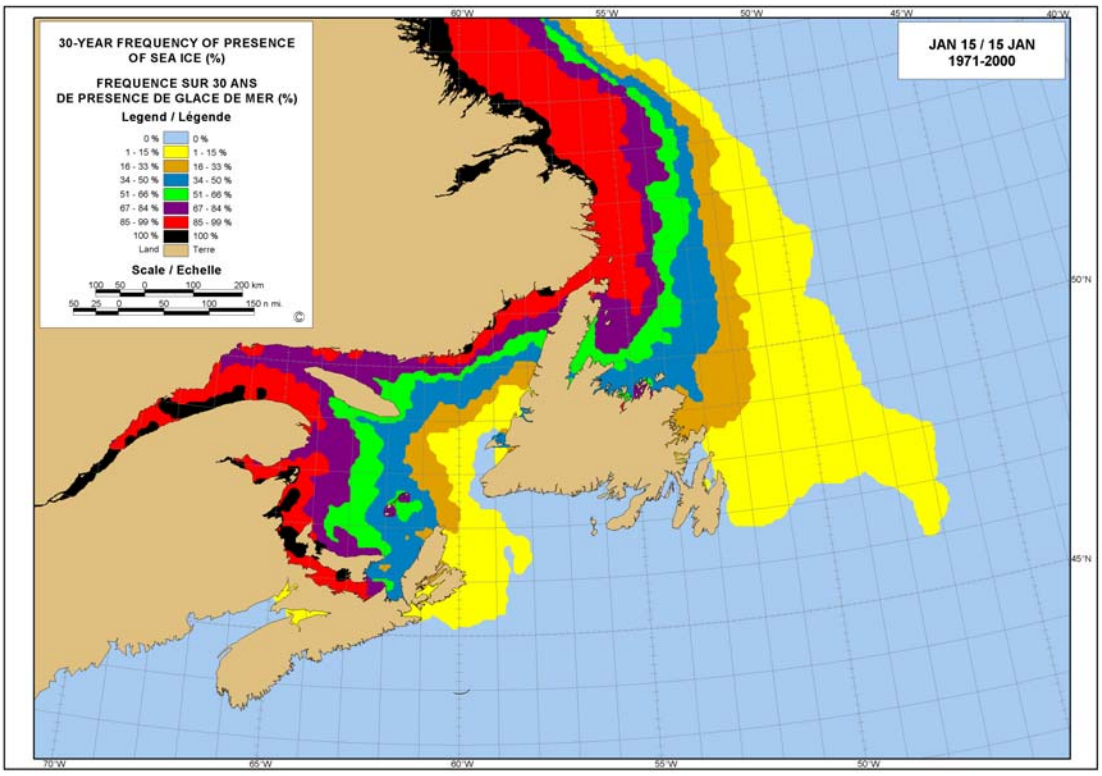
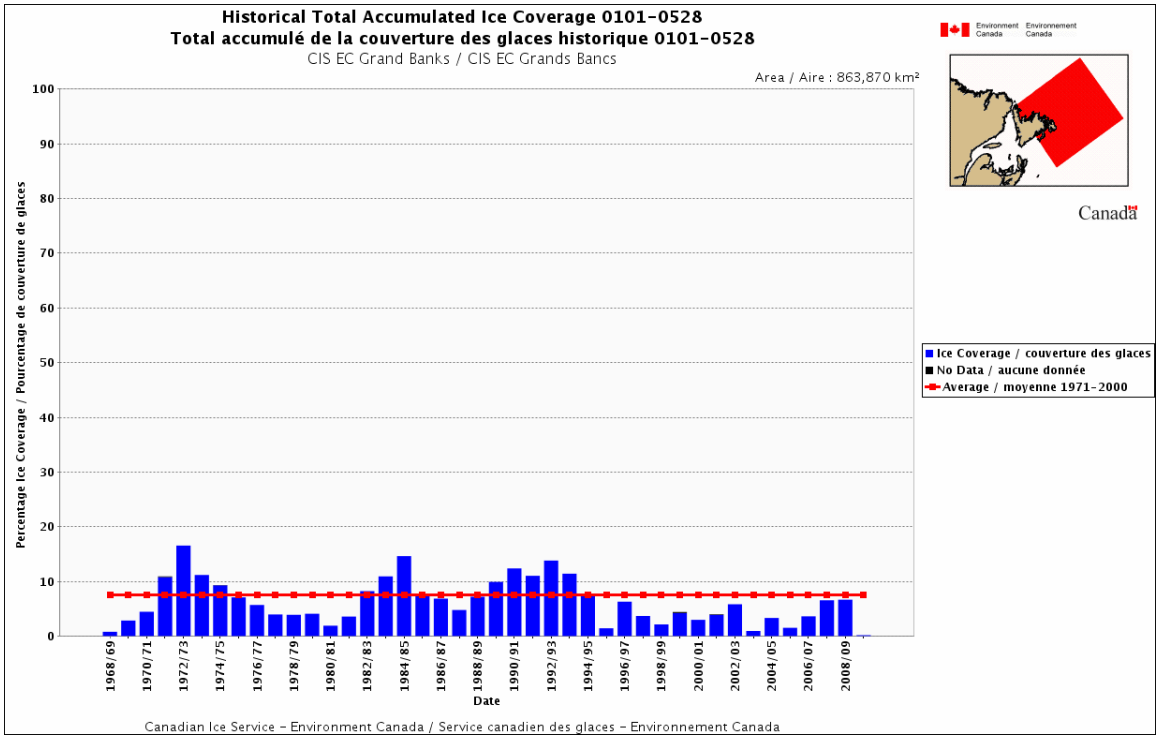
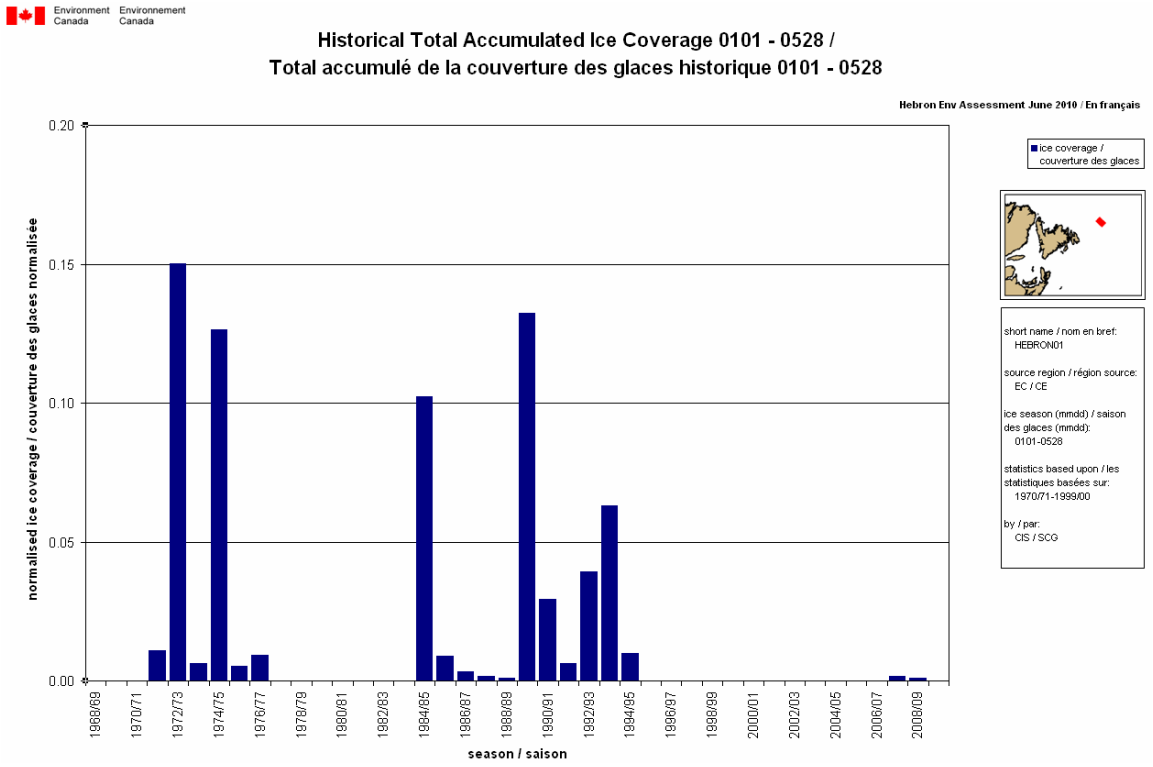


*Figure 3-34*: Why was this graph produced for the entire east coast and not specifically for the Grand Banks area (which is an option with CIS's online Ice Graph tool). Additionally, as indicated by the ice charts shown in Figures 3-29 to 3-33, the ice season for this area usually begins in January 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)**:



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).

*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**.

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**.

*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."

*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."

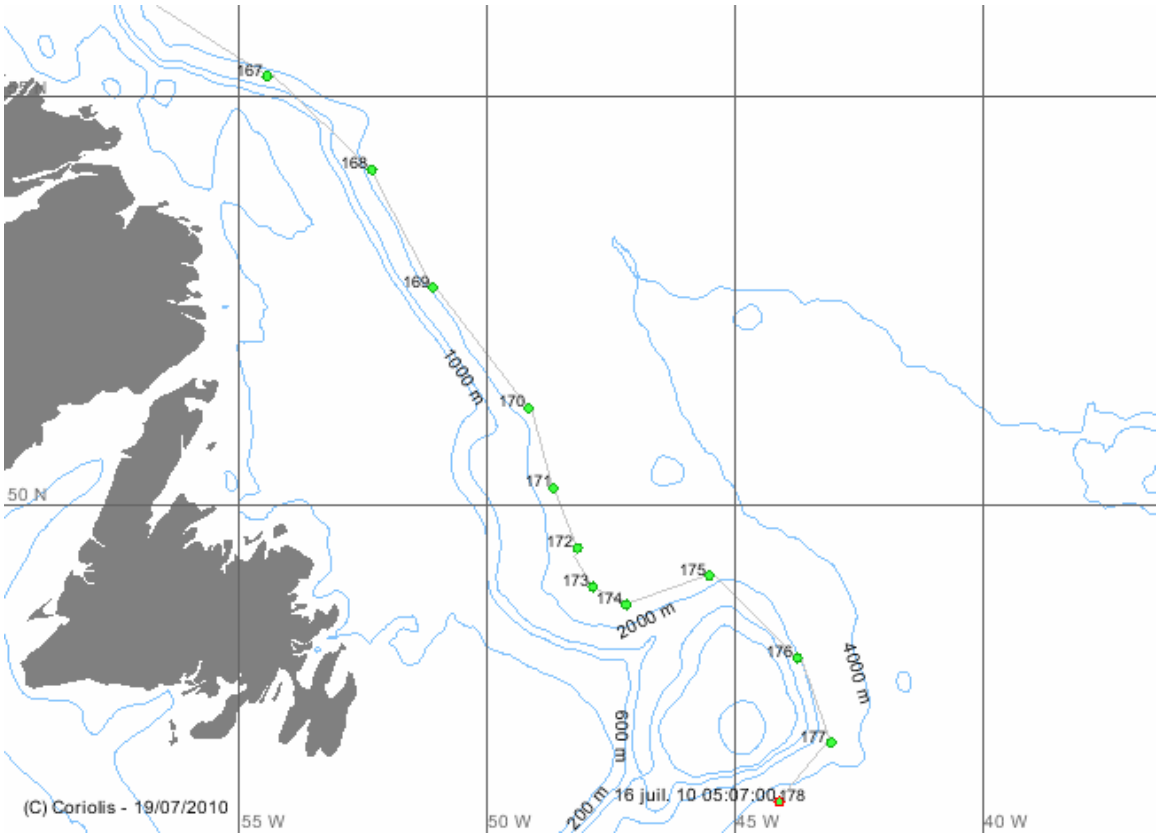
3.2.3.2 Sea Ice Movement

*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".

*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).




3.2.3.3 Concentrations

*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.

*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. So 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).

3.2.3.4 Floe Size

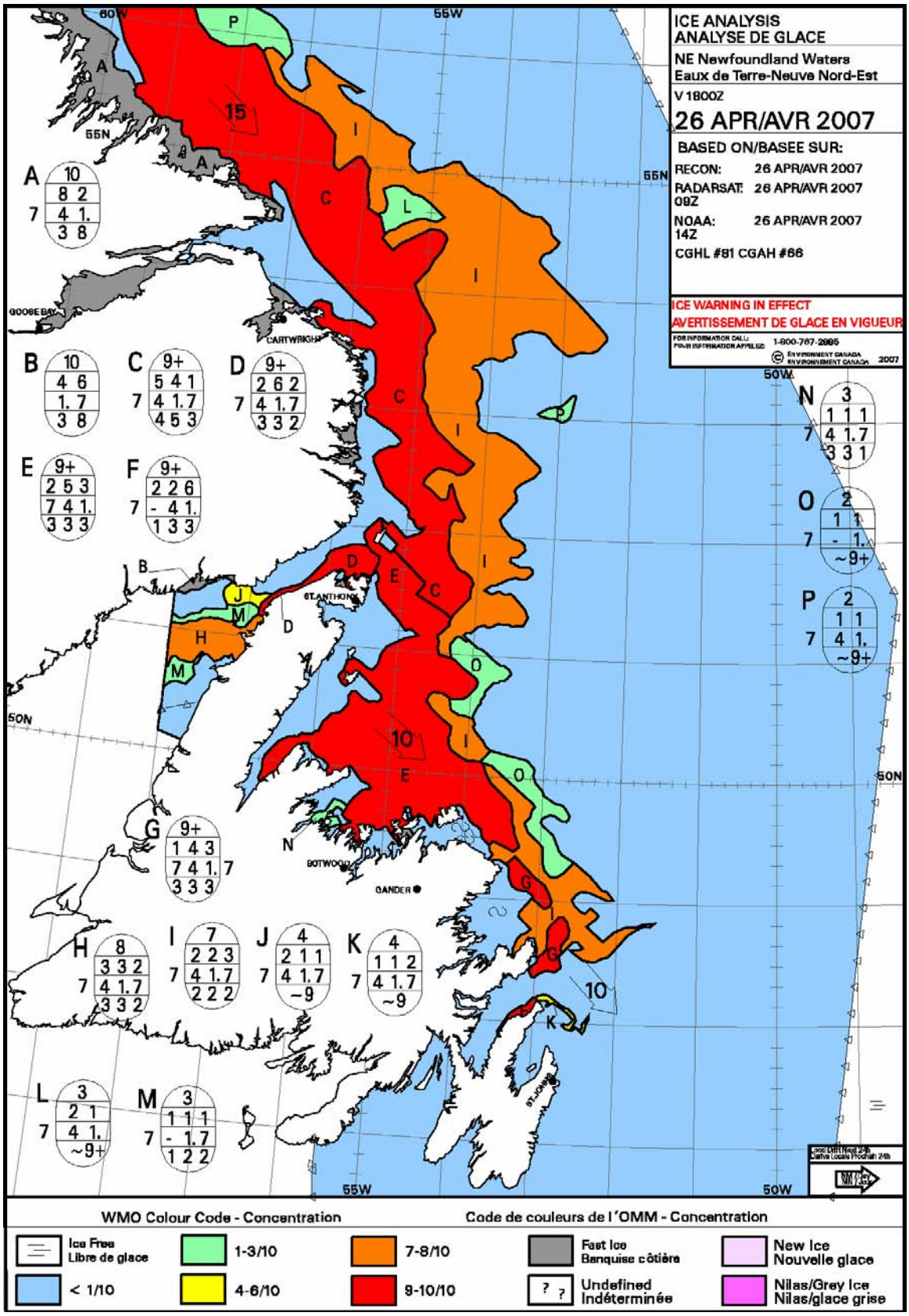
*Sentences 2 and 3, immediately under the bullets*: Poorly written and unclear. **Rephrase as**: "In Newfoundland waters, floe sizes tend to decrease from north to south and from west to east, towards the outer margins of the ice pack. Enhanced melt and disintegration of the ice floes occurs at the outer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

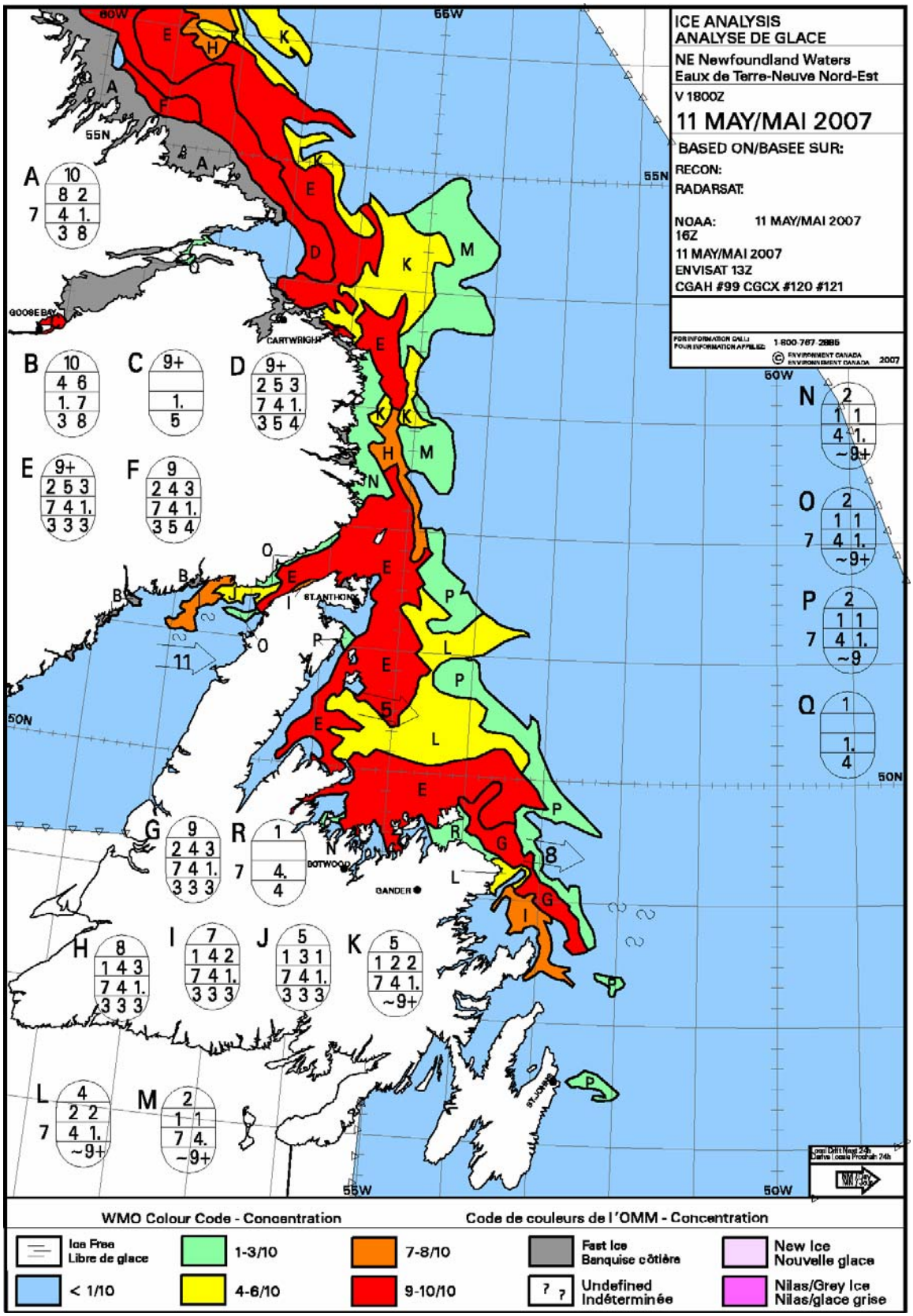
*Para 4, sentence 1*: It should be noted in the text that the Atmospheric Environment Service (AES) is now the Meteorological Service of Canada (MSC) and that the Canadian Ice Service (CIS) is a branch of the MSC.

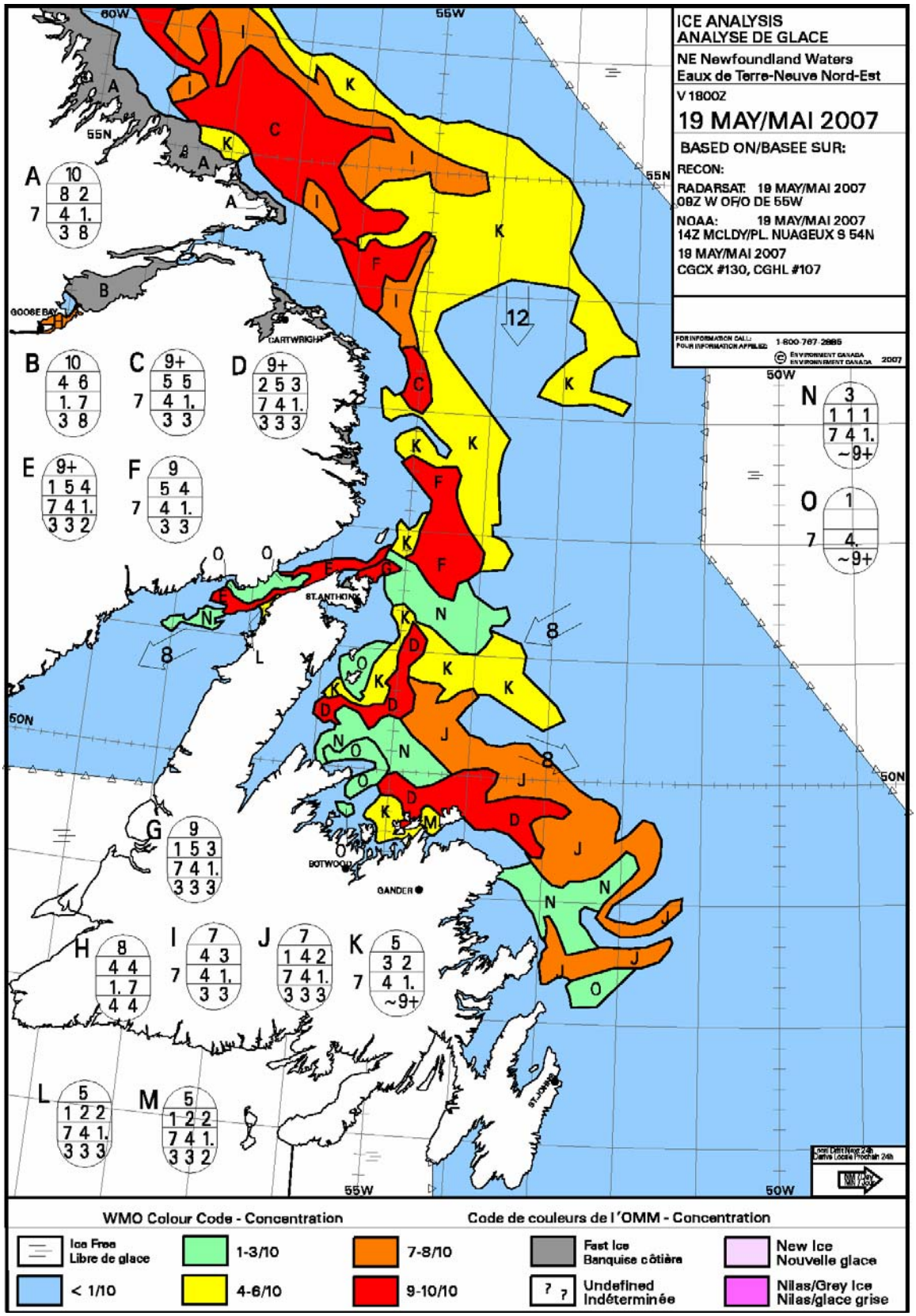
3.2.3.5 Thickness and Deformation

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.

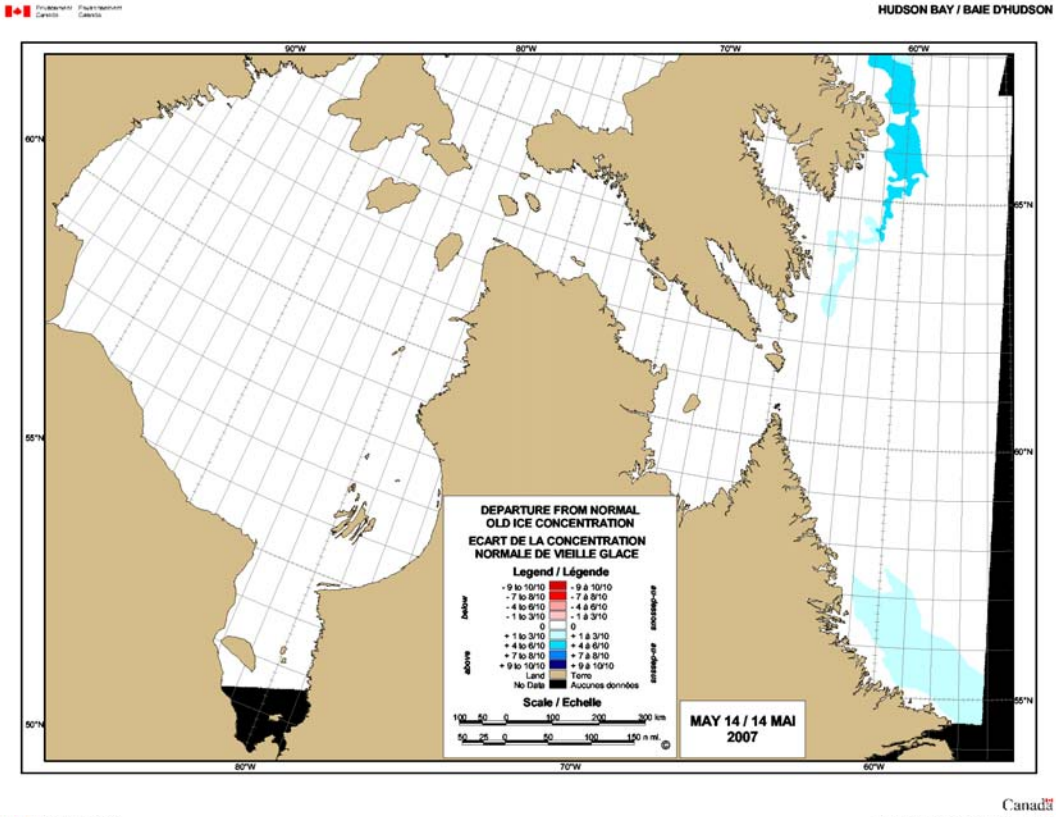
The sequence of daily ice charts below indicate a large area of 2/10 thick, old ice drifting south of 50N at the end of April, 2007.

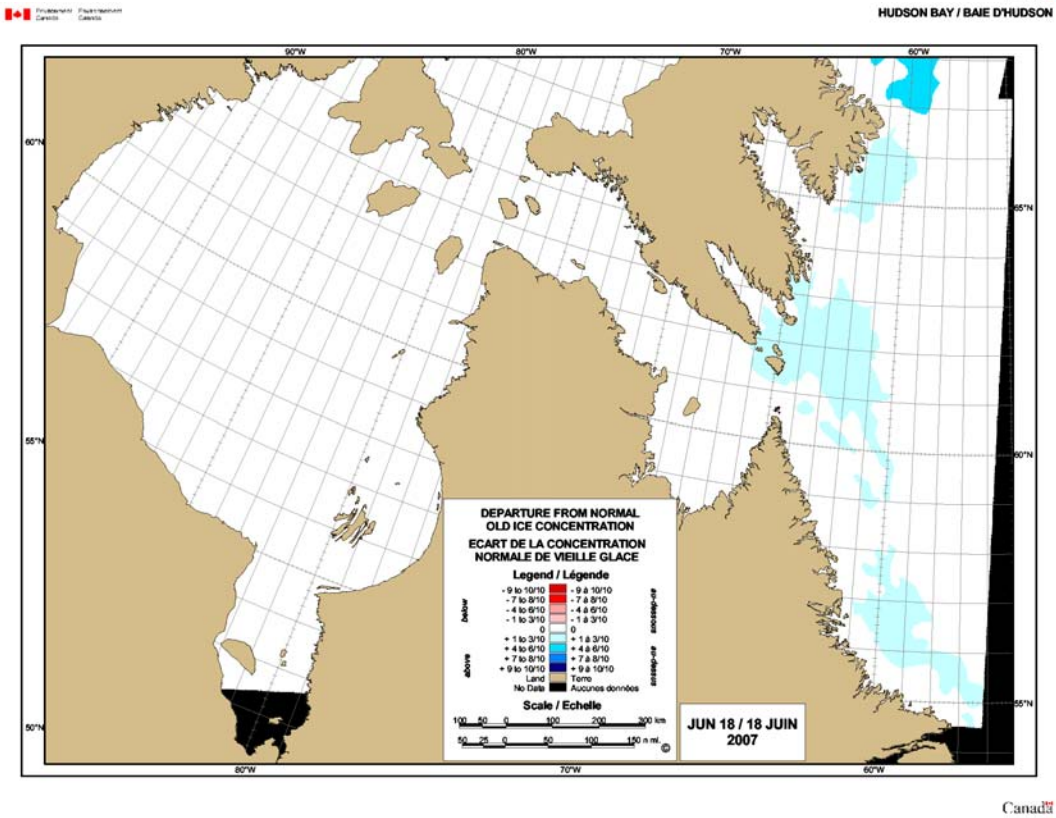

ICE ANALYSIS
ANALYSE DE GLACE
NE Newfoundland Waters
Eaux de Terre-Neuve Nord-Est
V 1800Z
26 APR/AVR 2007
BASED ON/BASEE SUR:
RECON: 26 APR/AVR 2007
RADARSAT: 26 APR/AVR 2007 09Z
NOAA: 26 APR/AVR 2007 14Z
CGHL #81 CGAH #88
ICE WARNING IN EFFECT
AVERTISSEMENT DE GLACE EN VIGUEUR
FOR INFORMATION CALL:
POUR INFORMATION APPELEZ: 1-800-767-2995
© ENVIRONMENT CANADA ENVIRONNEMENT CANADA 2007
60W
55W
50W
55N
50N
GOOSE BAY
CARTWRIGHT
ST. ANTHONY
BOTWOOD
GANDER
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
V 1800Z
11 MAY/MAI 2007
BASED ON/BASEE SUR:
RECON:
RADARSAT:
NOAA: 11 MAY/MAI 2007 16Z
11 MAY/MAI 2007 ENVISAT 13Z
CGAH #99 CGCX #120 #121
FOR INFORMATION CALL: 1-800-767-2885
POUR INFORMATION APPELEZ:
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60W
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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
NE Newfoundland Waters
Eaux de Terre-Neuve Nord-Est
V 1800Z
19 MAY/MAI 2007
BASED ON/BASEE SUR:
RECON:
RADARSAT: 19 MAY/MAI 2007
08Z W OF/O DE 55W
NOAA: 19 MAY/MAI 2007
14Z MCLDY/PL. NUAGEUX S 54N
19 MAY/MAI 2007
CGCX #130, CGHL #107
FOR INFORMATION CALL:
POUR INFORMATION APPELEZ: 1-800-767-2885
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ENVIRONNEMENT CANADA 2007
60W
55W
50W
55N
50N
GOOSE BAY
CARTWRIGHT
ST. ANTHONY
BOTWOOD
GANDER
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).

### 3.2.3.6 Icebergs

*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

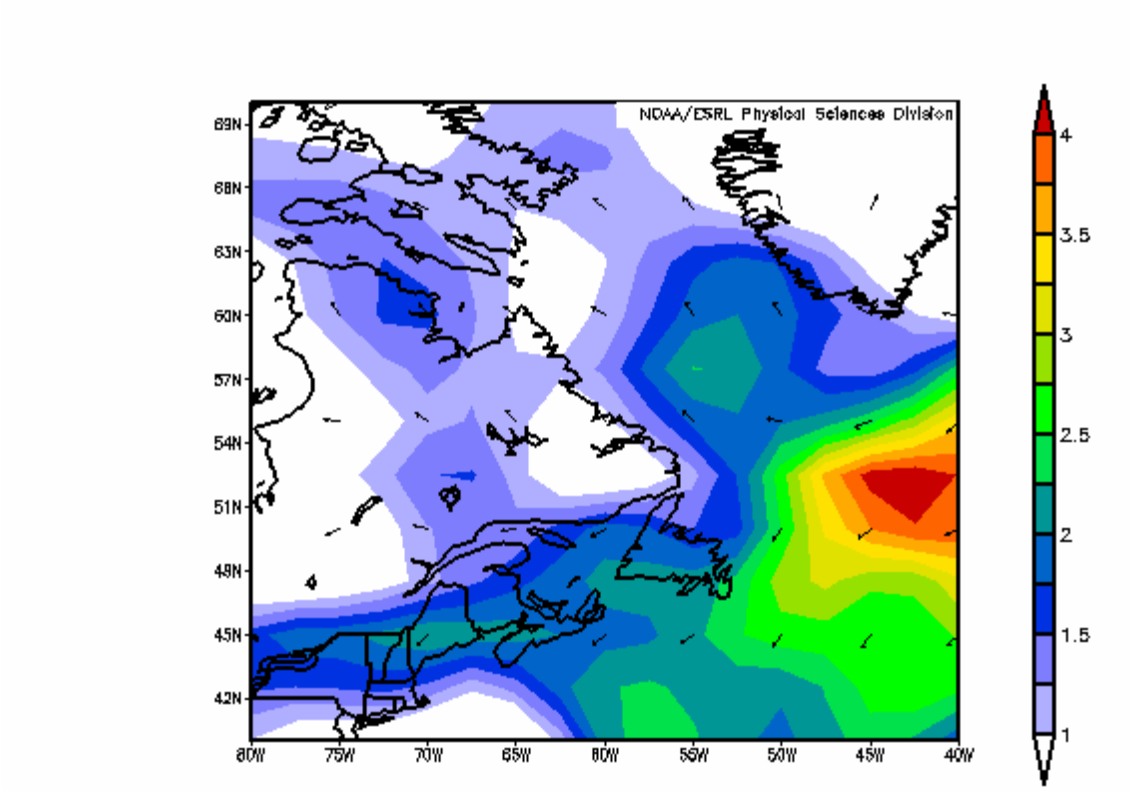
**PERD Iceberg Sighting Database: 2010**
**Iceberg_Sighting_10.pdf**
**PERD_Iceberg_Sighting_Database_10.mdb**
**PERD_Iceberg_Sighting_DatabaseXP_10.mdb**
BMT Fleet Technology, Kanata, ON, Canada, 2010

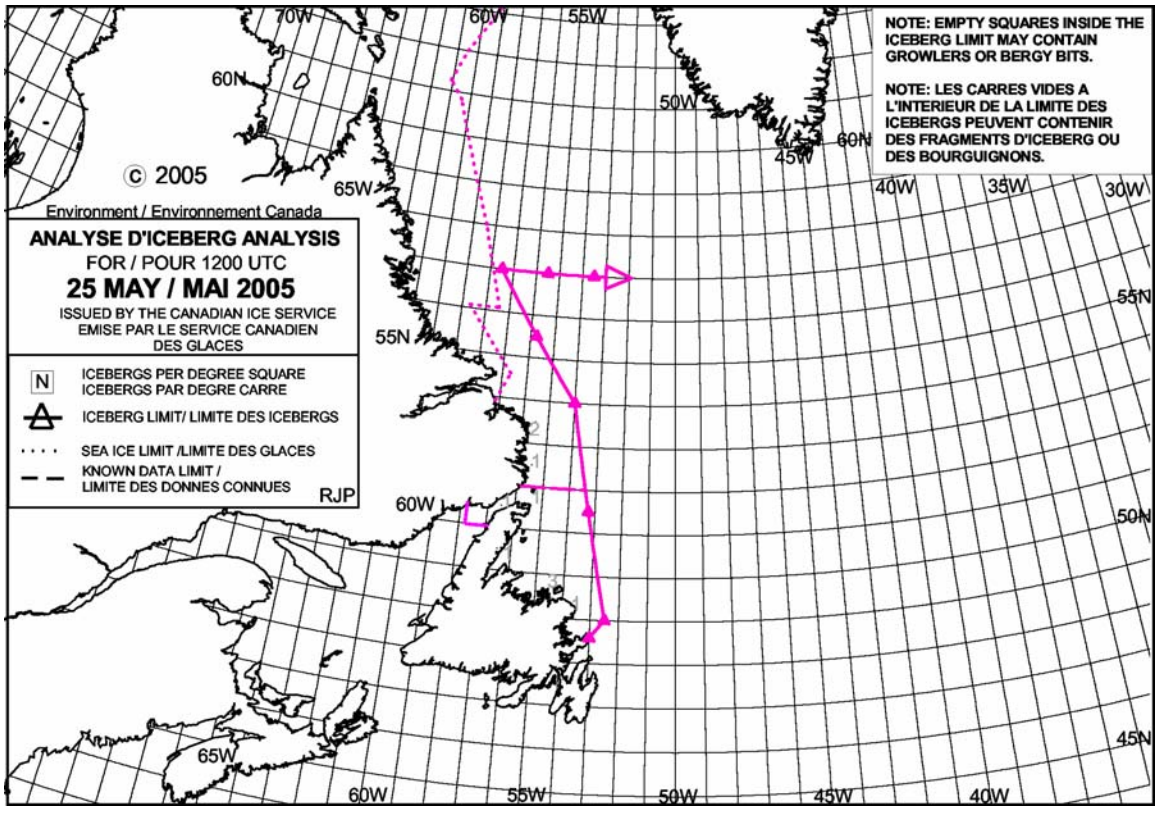
**Comprehensive Iceberg Management Database 2010**
**Iceberg_Management_10.pdf**
**PERD_Iceberg_Management_Database_10.zip**
PAL Environmental Services, St. John's, NL, Canada, 2010

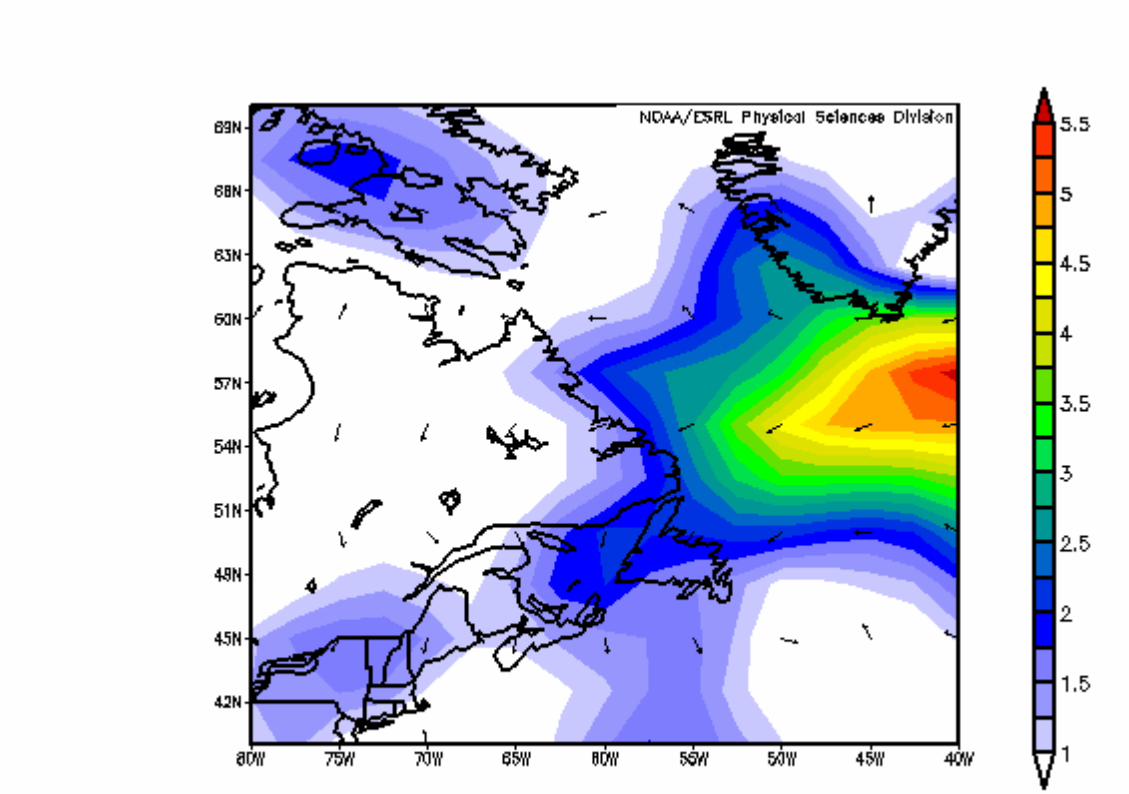
**Grand Banks Iceberg Management**
**GB_Iceberg_Manage_Overview_07.pdf**
AMEC and others
PERD/CHC Report 20-84, St. John's, NL, Canada, 2007.

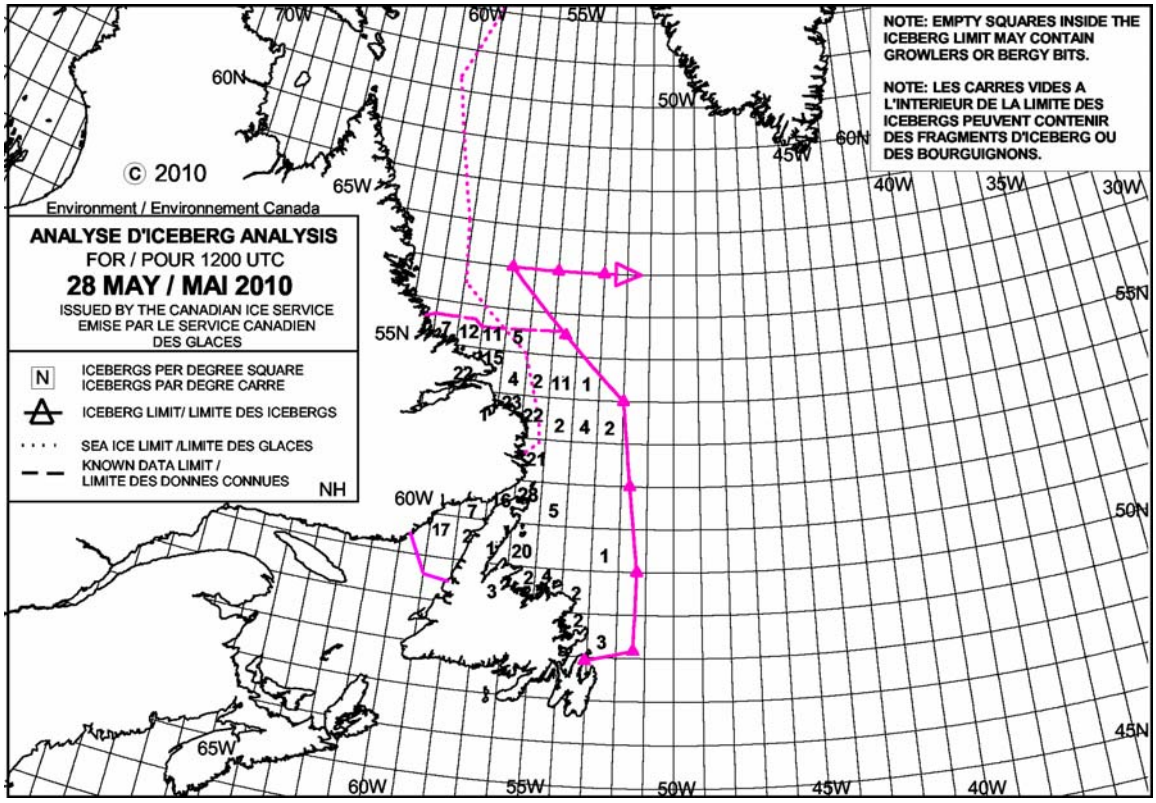
### Variations in Local and Regional Iceberg Numbers

*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
69N
66N
63N
60N
57N
54N
51N
48N
45N
42N
80W
75W
70W
65W
60W
55W
50W
45W
40W
4
3.5
3
2.5
2
1.5
1


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
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
KNOWN DATA LIMIT / LIMITE DES DONNES CONNUES
RJP
70W
60W
55W
60N
50W
45W
60N
40W
35W
30W
65W
55N
60W
50N
65W
45N
60W
55W
50W
45W
40W


NOAA/ESRL Physical Sciences Division
69N
66N
63N
60N
57N
54N
51N
48N
45N
42N
80W
75W
70W
65W
60W
55W
50W
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1.5
1


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.
© 2010
Environment / Environnement Canada
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
28 MAY / MAI 2010
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
KNOWN DATA LIMIT /
LIMITE DES DONNES CONNUES
NH
70W
60W
55W
50W
45W
40W
35W
30W
60N
55N
50N
45N
65W
60W
55W
50W
45W
40W

*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".

*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?

Drift

*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.

*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.**
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".

Size Distributions

*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.

*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**.

13 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

13.3 Nearshore Potential Marine Effects

13.3.6 Sea Ice and Icebergs

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

*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.

*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."

Para 3: State where this "Ice Management Plan" plan can be found, if it already exists: either give 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.

13.4 Offshore Potential Marine Effects

13.4.6 Sea Ice and Icebergs

*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."